# VAULT

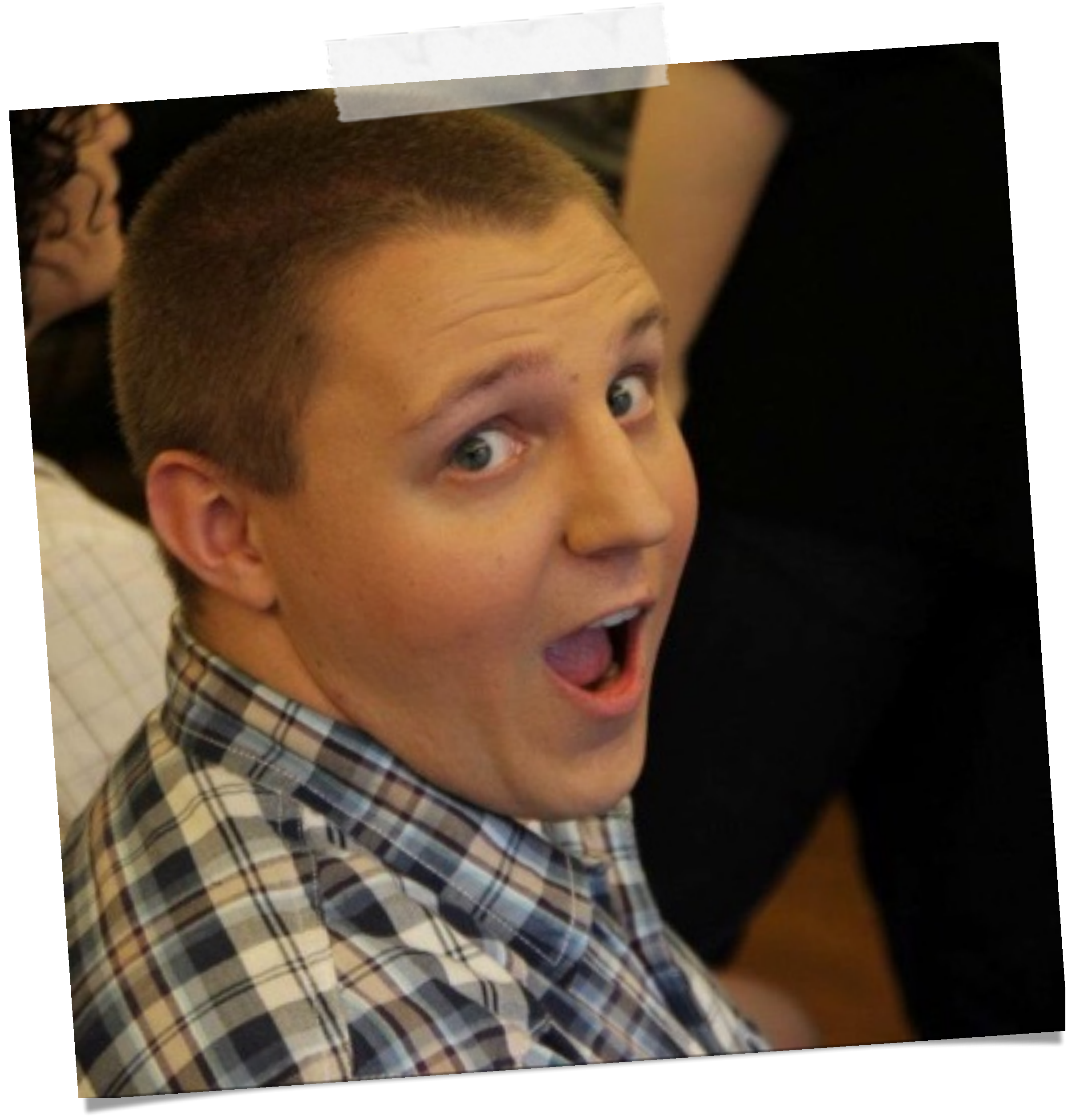
MODERN SECRETS MANAGEMENT

CLICK ENGAGE

TO RATE

LESSON

RATE 12 SESSIONS AND GET THE SUPER COOL GOTO PRIZE



SETH VARGO

@sethvargo

## SECRET MANAGEMENT

## WHAT IS "SECRET"?

## SECRET VS. SENSITIVE

## SECRET

## SENSITIVE

## SECRET

DB CREDENTIALS

SSL CA/CERTIFICATES

CLOUD ACCESS KEYS

ENCRYPTION KEYS

WIFI PASSWORDS

SOURCE CODE

## SENSITIVE

## SECRET

DB CREDENTIALS

SSL CA/CERTIFICATES

CLOUD ACCESS KEYS

ENCRYPTION KEYS

WIFI PASSWORDS

SOURCE CODE

## SENSITIVE

PHONE NUMBERS

MOTHER'S MAIDEN NAME

EMAIL ADDRESSES

DATACENTER LOCATIONS

CUSTOMER PII

EMAIL/CHAT

## SECRET

DB CREDENTIALS

SSL CA CERTIFICATES

CLOUD ACCESS KEYS

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DATACENTER LOCATIONS

CUSTOMER BIL

EMAIL/CHAT

## SECRET

## SENSITIVE

ANYTHING THAT MAKES THE NEWS

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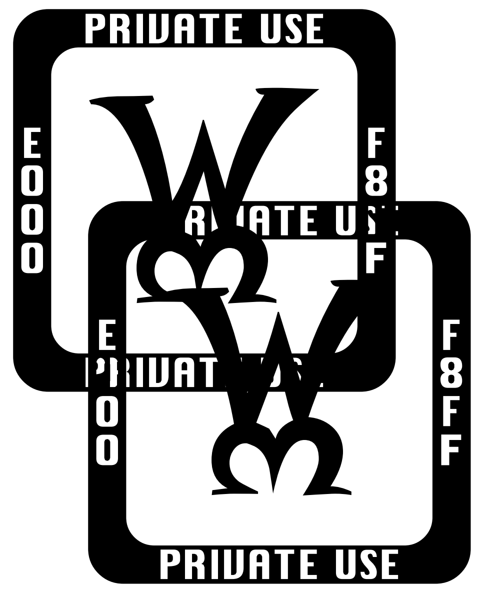
PRIVATE USE
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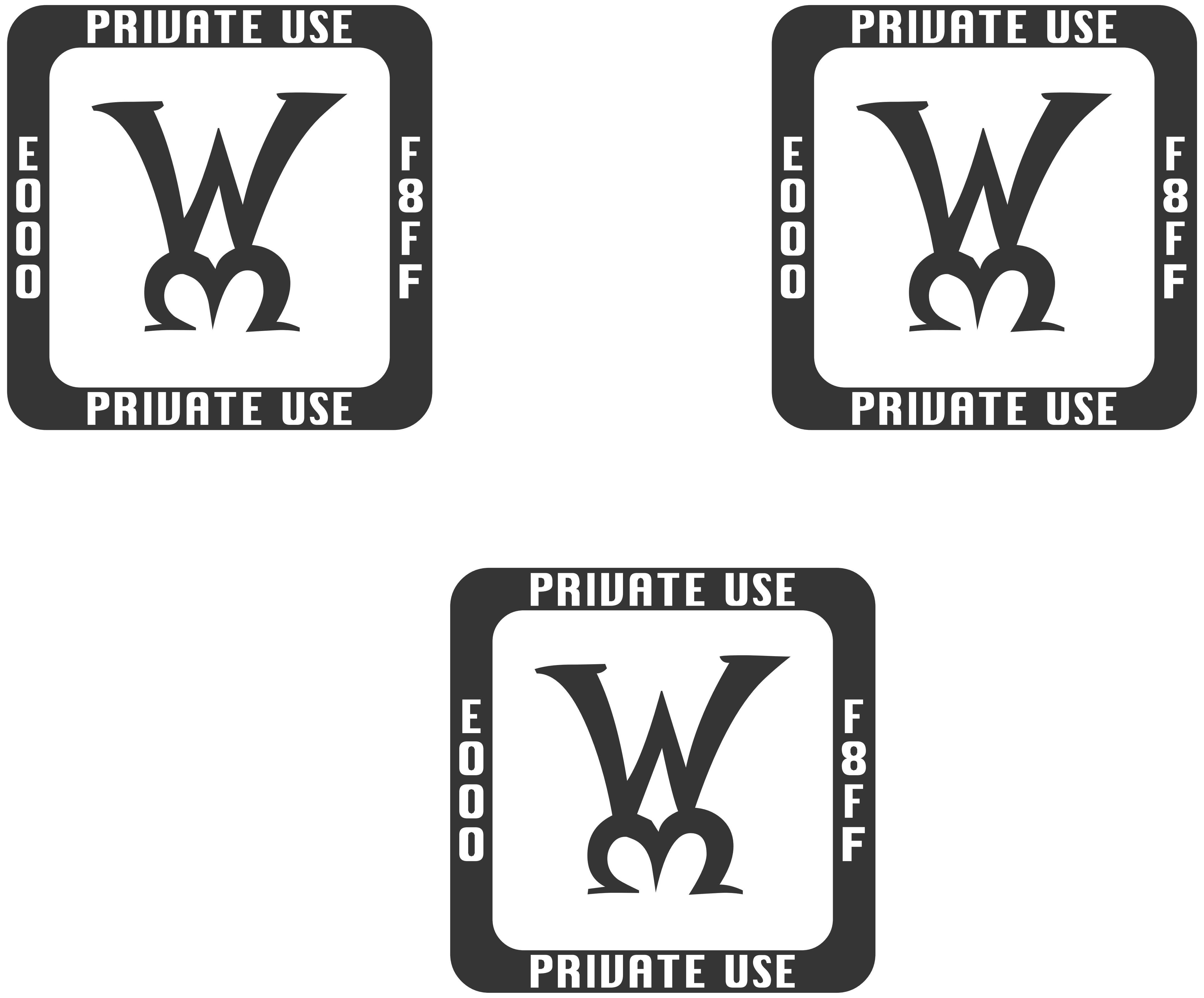
PRIVATE USE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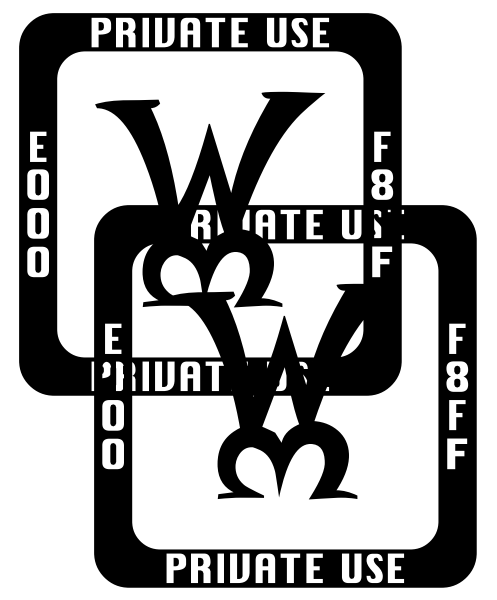
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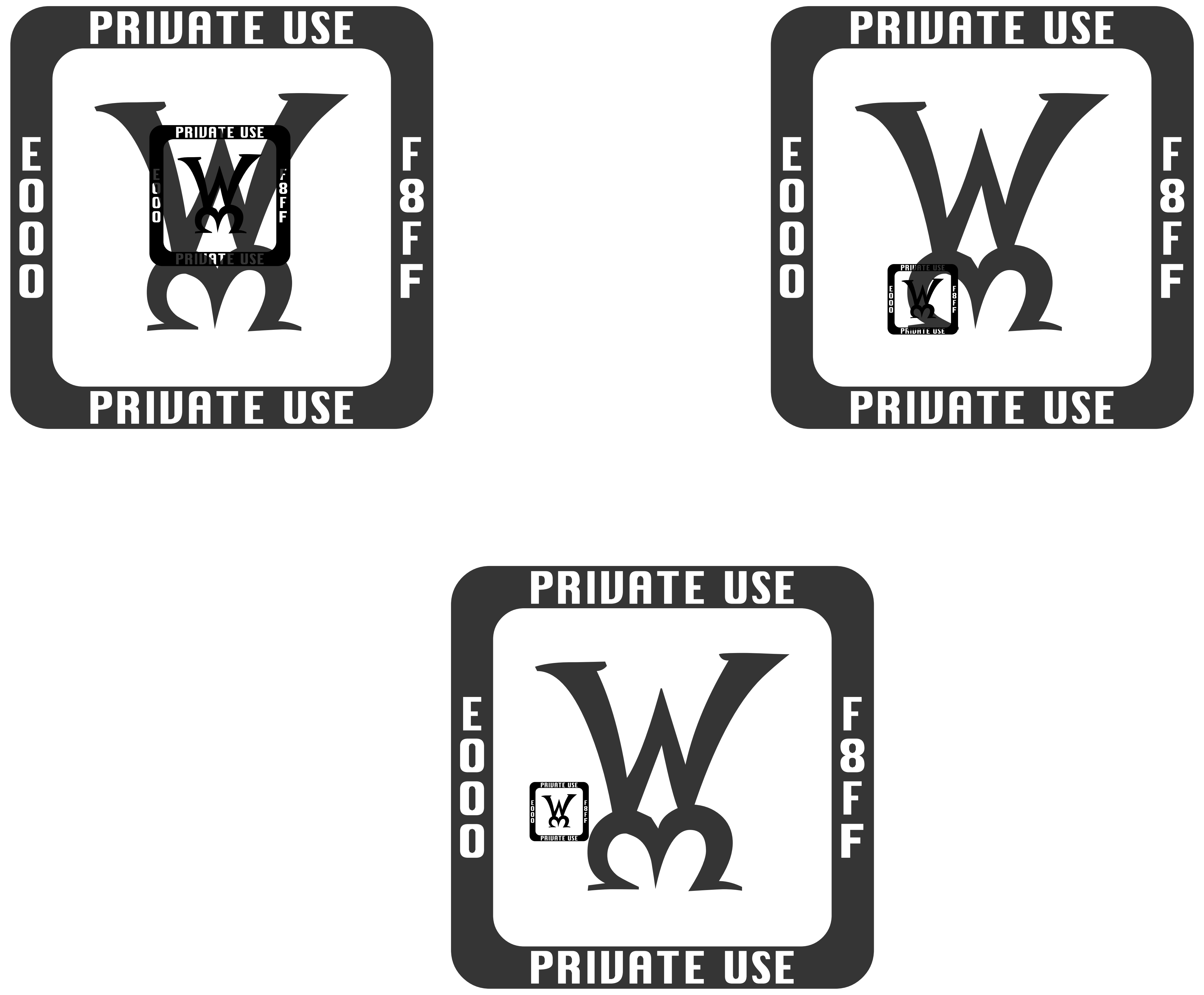
PRIVATE USE
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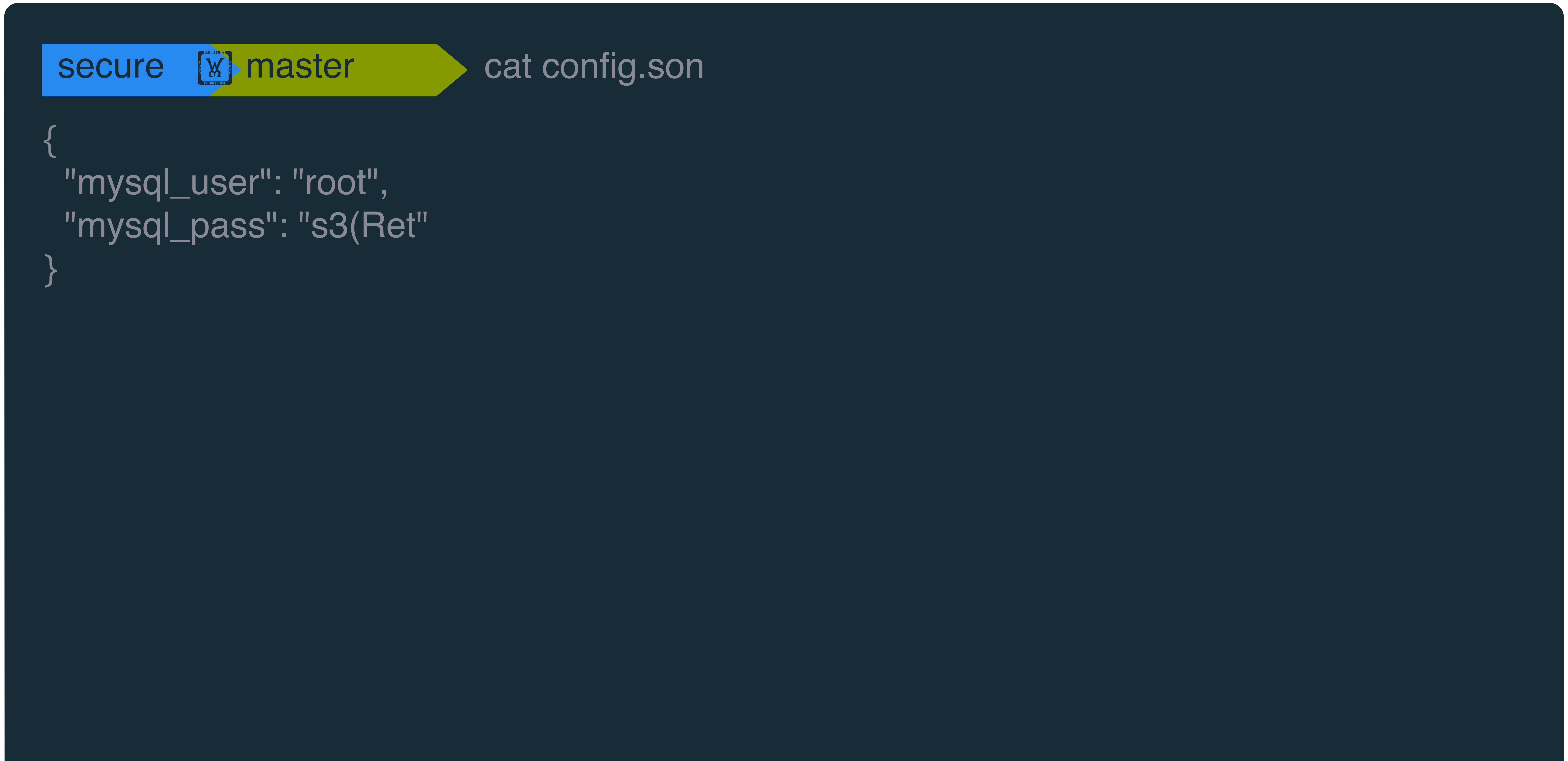
PRIVATE USE

## SECRET MANAGEMENT 1.0

## HOW DO I DISTRIBUTE SECRETS?

- How do applications get secrets?
- How do humans acquire secrets?
- How are secrets updated?
- How is a secret revoked?



```
secure  master  cat config.son
{
  "mysql_user": "root",
  "mysql_pass": "s3(Ret"
}
```

## WHY NOT CONFIG MANAGEMENT?

- Centrally stored
- Eventually consistent
- No access control
- No auditing
- No revocation

## WHY NOT (ONLINE) DATABASES?

- RDBMS, Consul, ZooKeeper, etc
- Not designed for secrets
- Limited access controls
- Typically plaintext storage
- No auditing or revocation abilities

## HOW TO HANDLE SECRET SPRAWL?

- Secret material is distributed
- Who has access?
- When were secrets used?
- What is the attack surface?
- What do we do in the event of a compromise?

## STATE OF THE WORLD 1.0

- Secret sprawl
- Decentralized keys
- Limited visibility
- Poorly defined “break glass” procedures

## SECRET MANAGEMENT 2.0

## VAULT

MODERN SECRETS MANAGEMENT

## VAULT GOALS

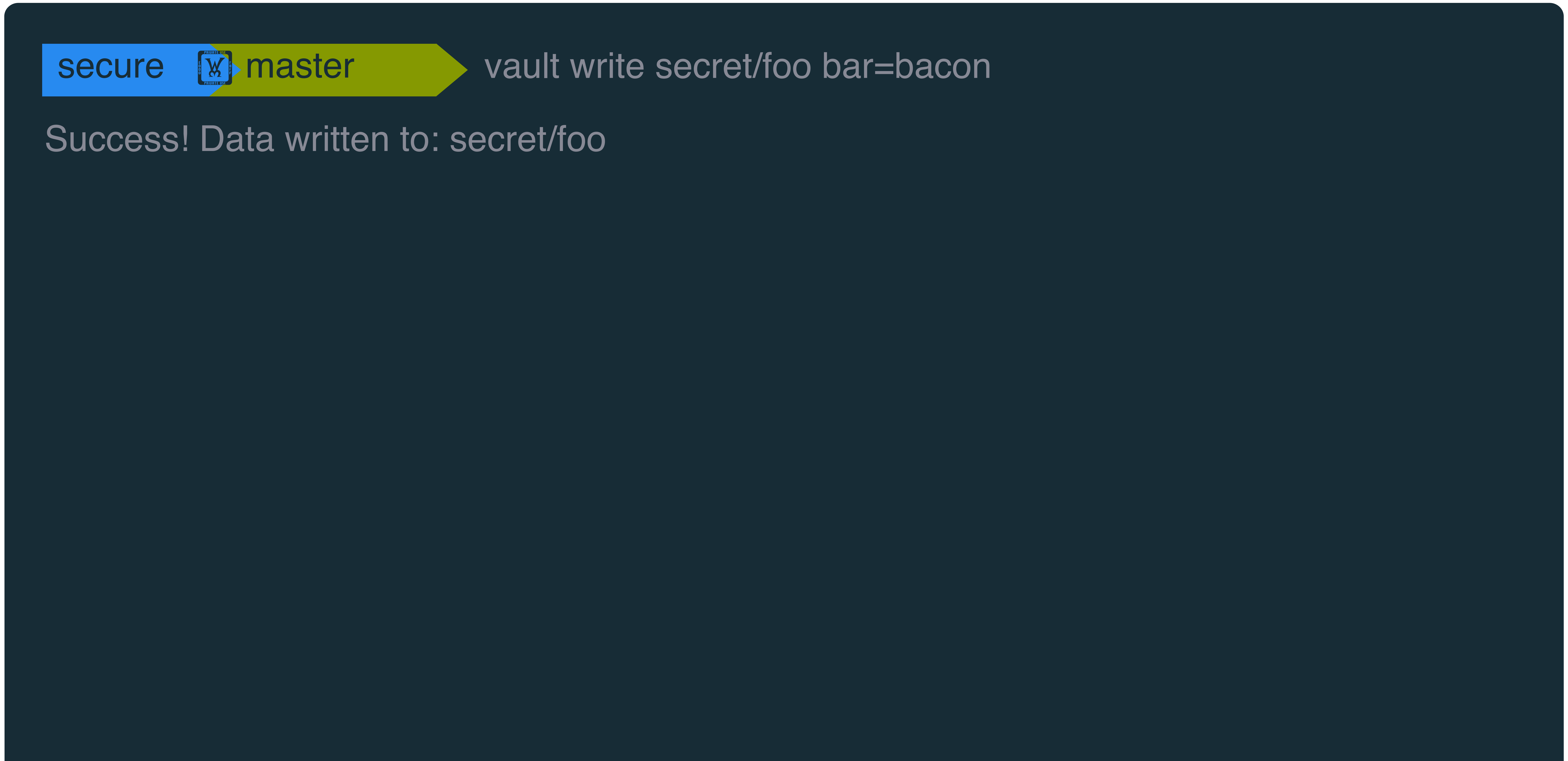
- Single source for secrets
- Programmatic application access (Automated)
- Operator access (Manual)
- Practical security
- Modern data center friendly

## VAULT FEATURES

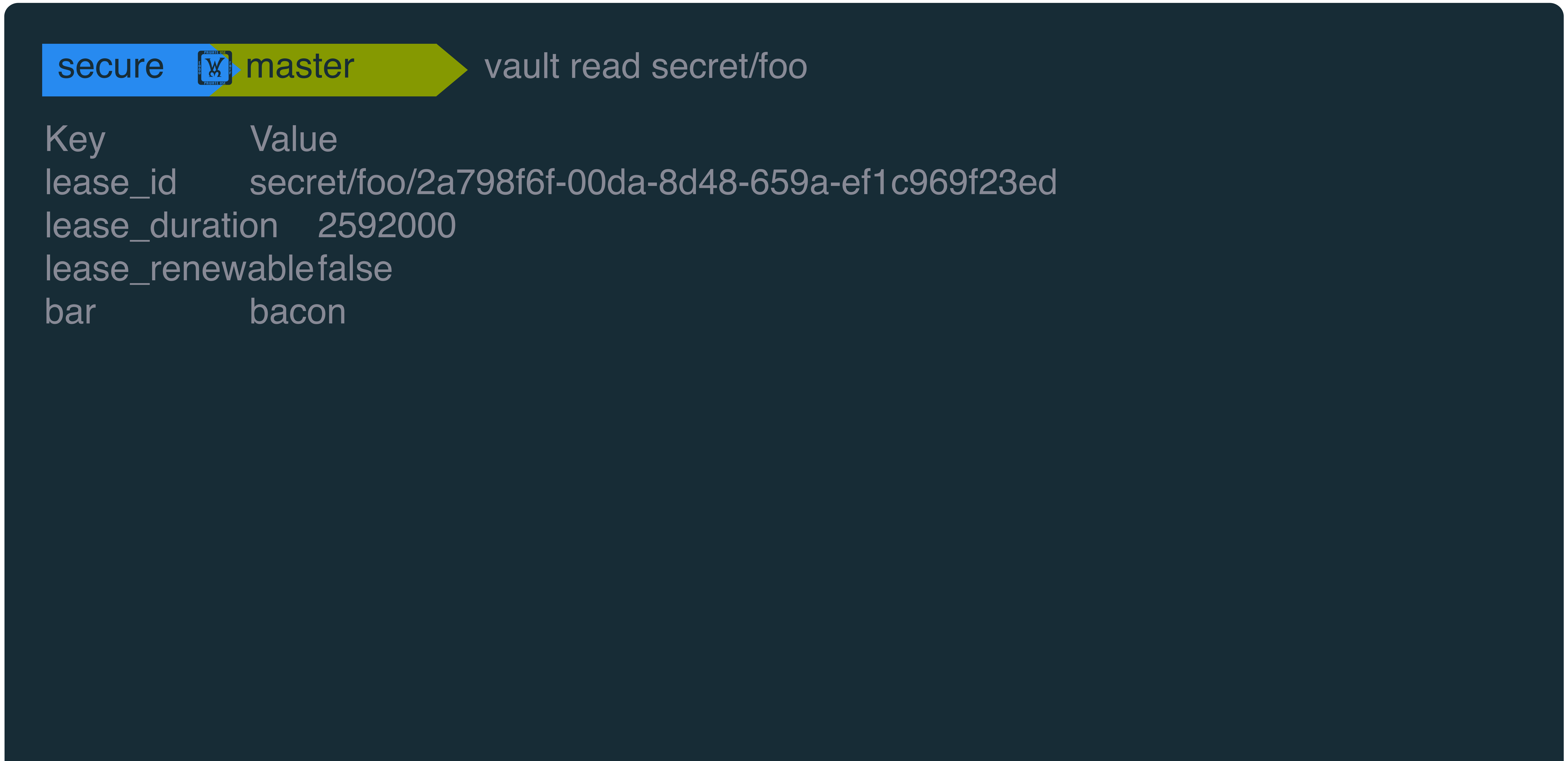
- Secure secret storage (in-memory, Consul, file, postgres, and more)
- Dynamic secrets
- Leasing, renewal, and revocation
- Auditing
- Rich ACLs
- Multiple client authentication methods

## SECURE SECRET STORAGE

- Data is encrypted in transit and at rest
- 256bit AES in GCM mode
- TLS 1.2 for clients
- No HSM required



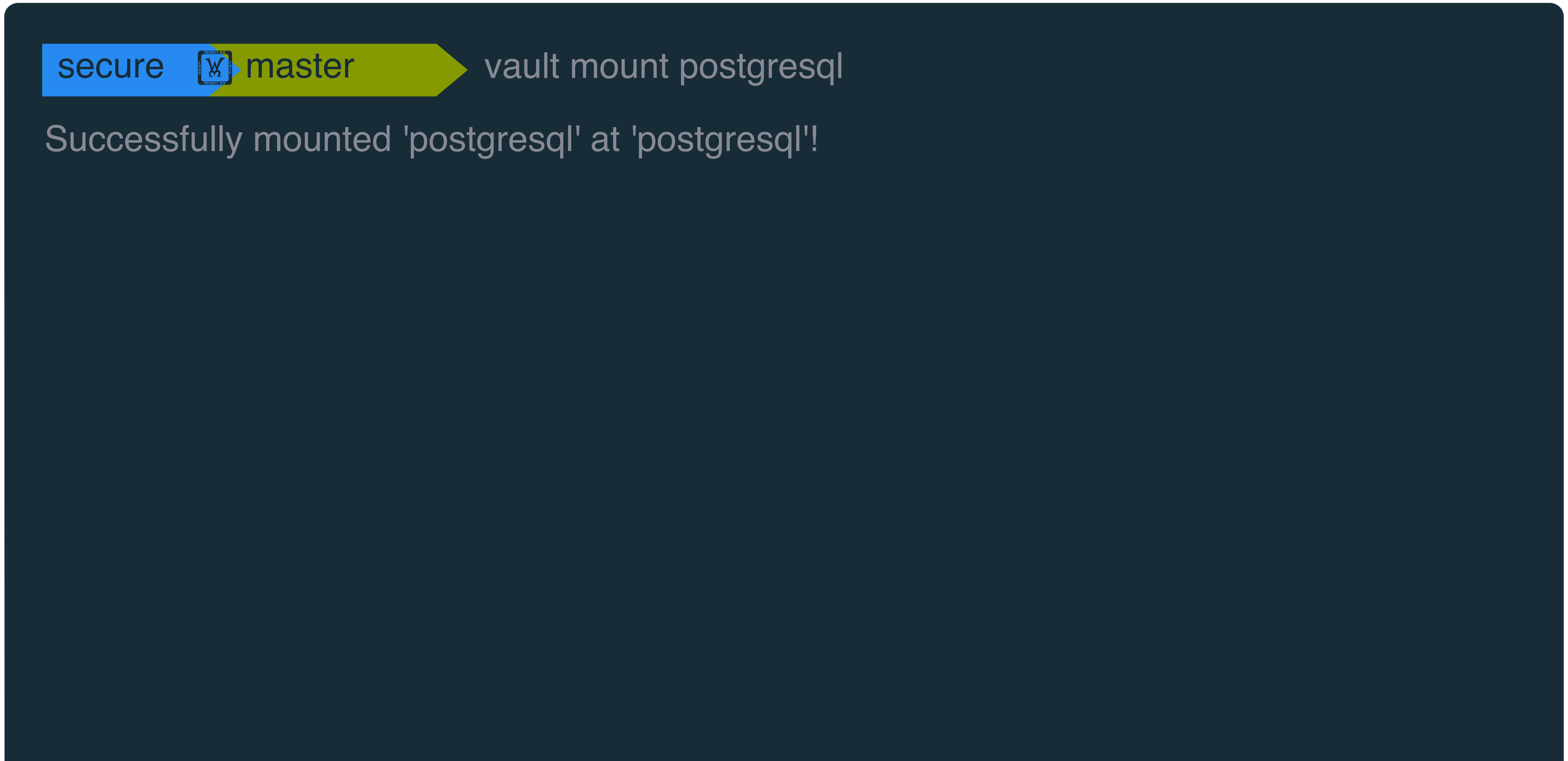
```
secure  master  vault write secret/foo bar=bacon
Success! Data written to: secret/foo
```



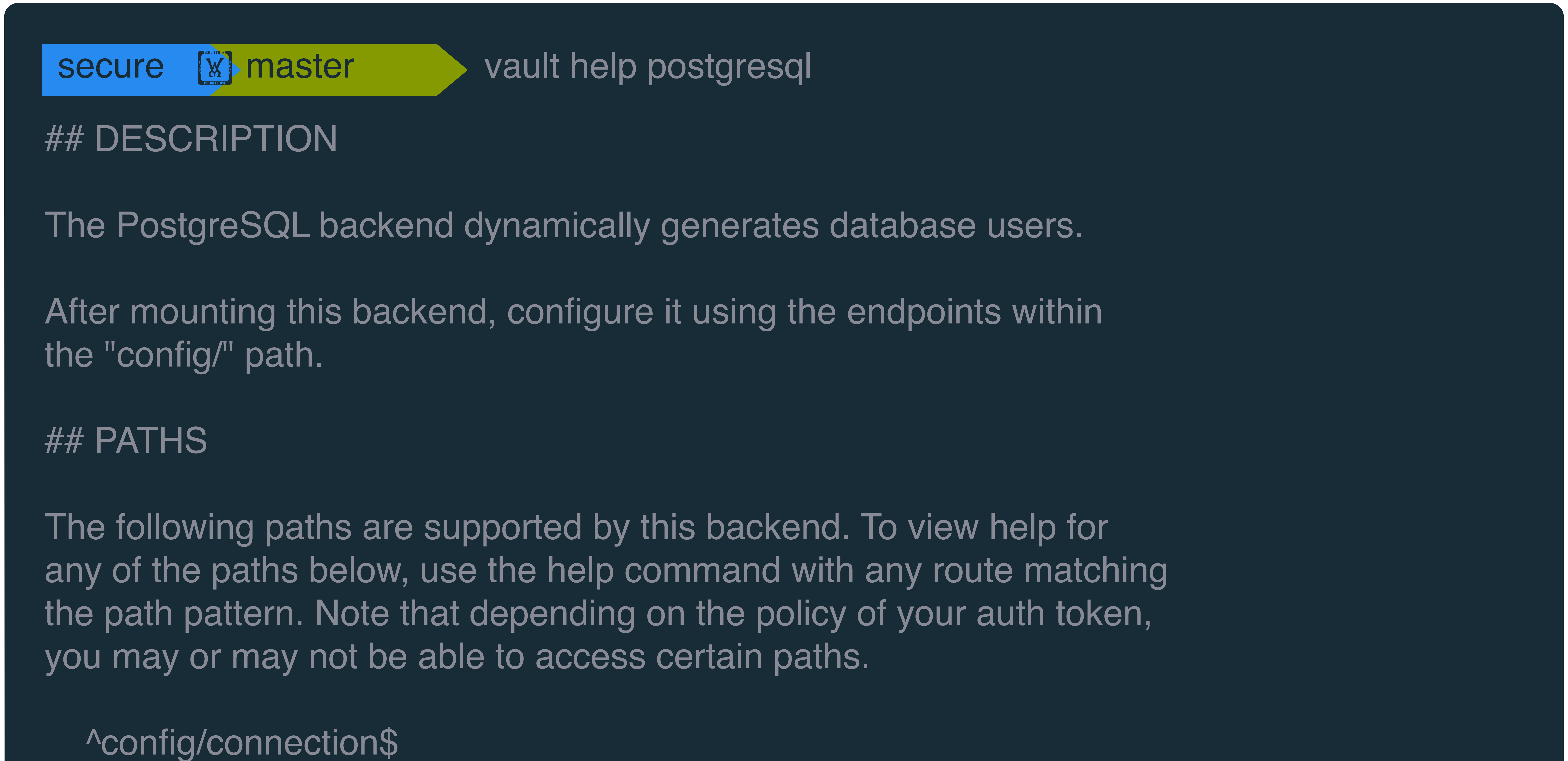
```
secure  master  vault read secret/foo

Key               Value
lease_id          secret/foo/2a798f6f-00da-8d48-659a-ef1c969f23ed
lease_duration    2592000
lease_renewable   false
bar               bacon
```

## DYNAMIC SECRETS

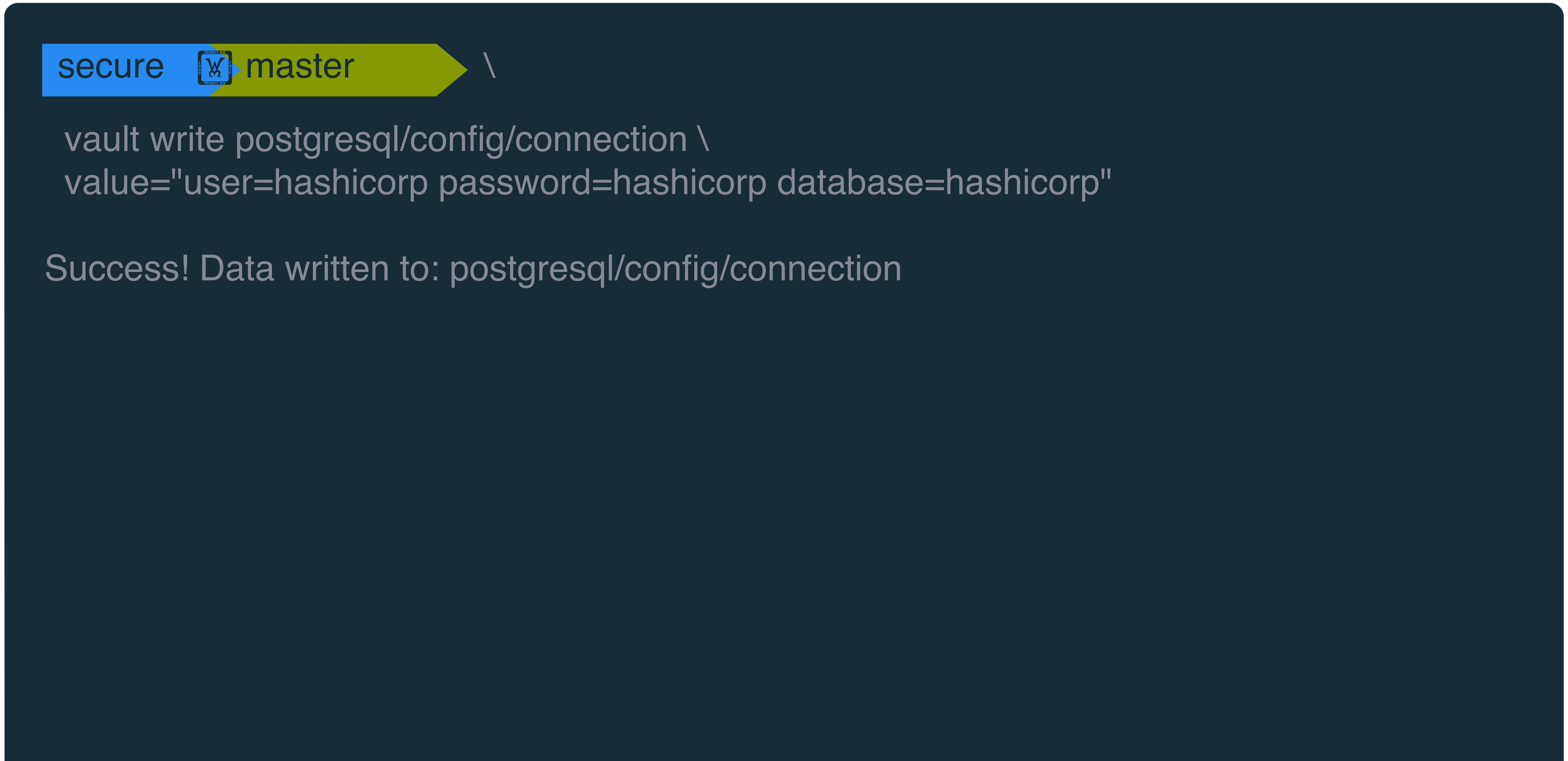
- Never provide “root” credentials to clients
- Provide limited access credentials based on role
- Generated **on demand** when requested
- Leases are enforceable via revocation
- Audit trail can identify point of compromise



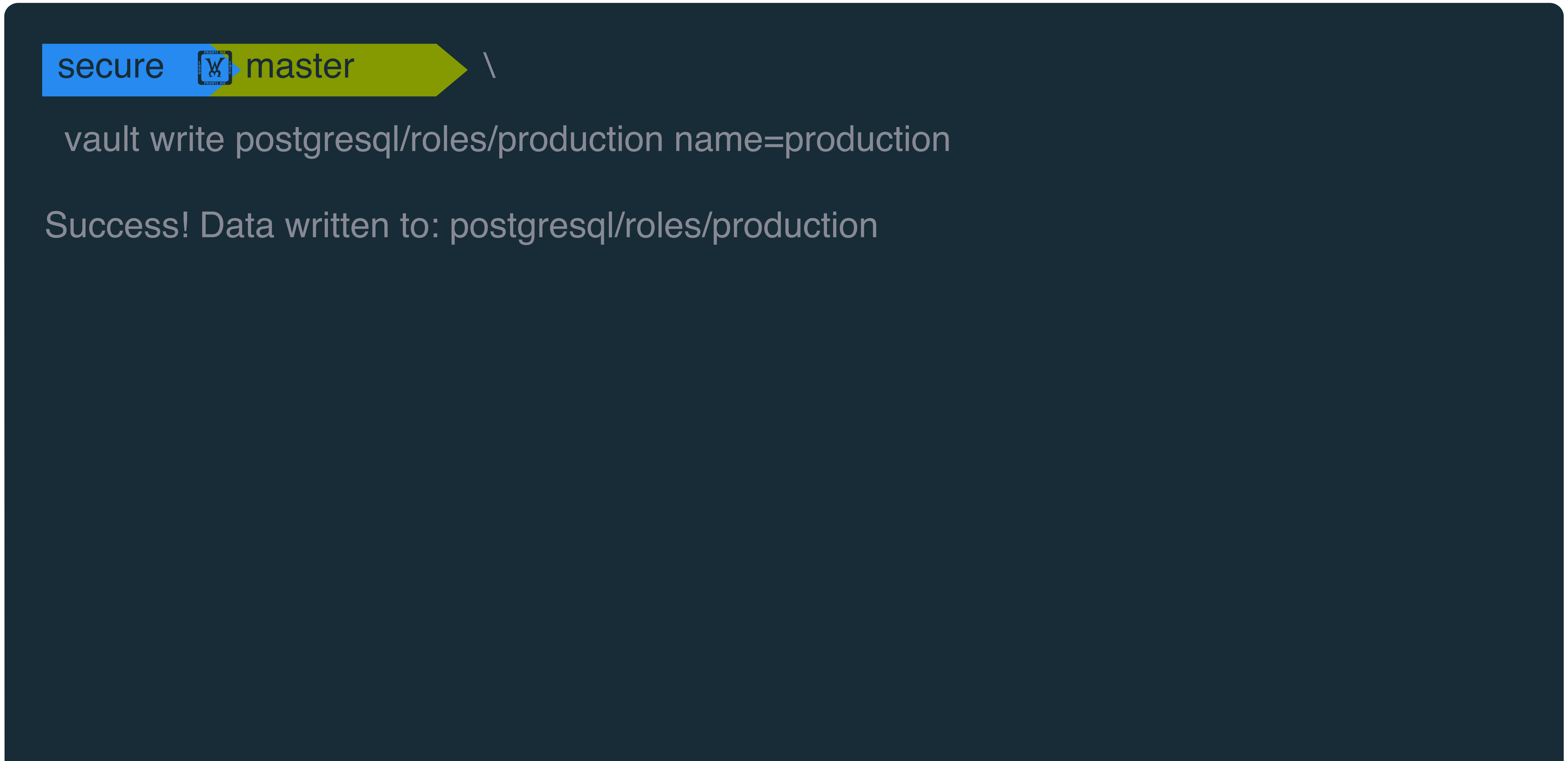
```
secure  master  vault mount postgresql

Successfully mounted 'postgresql' at 'postgresql'!
```



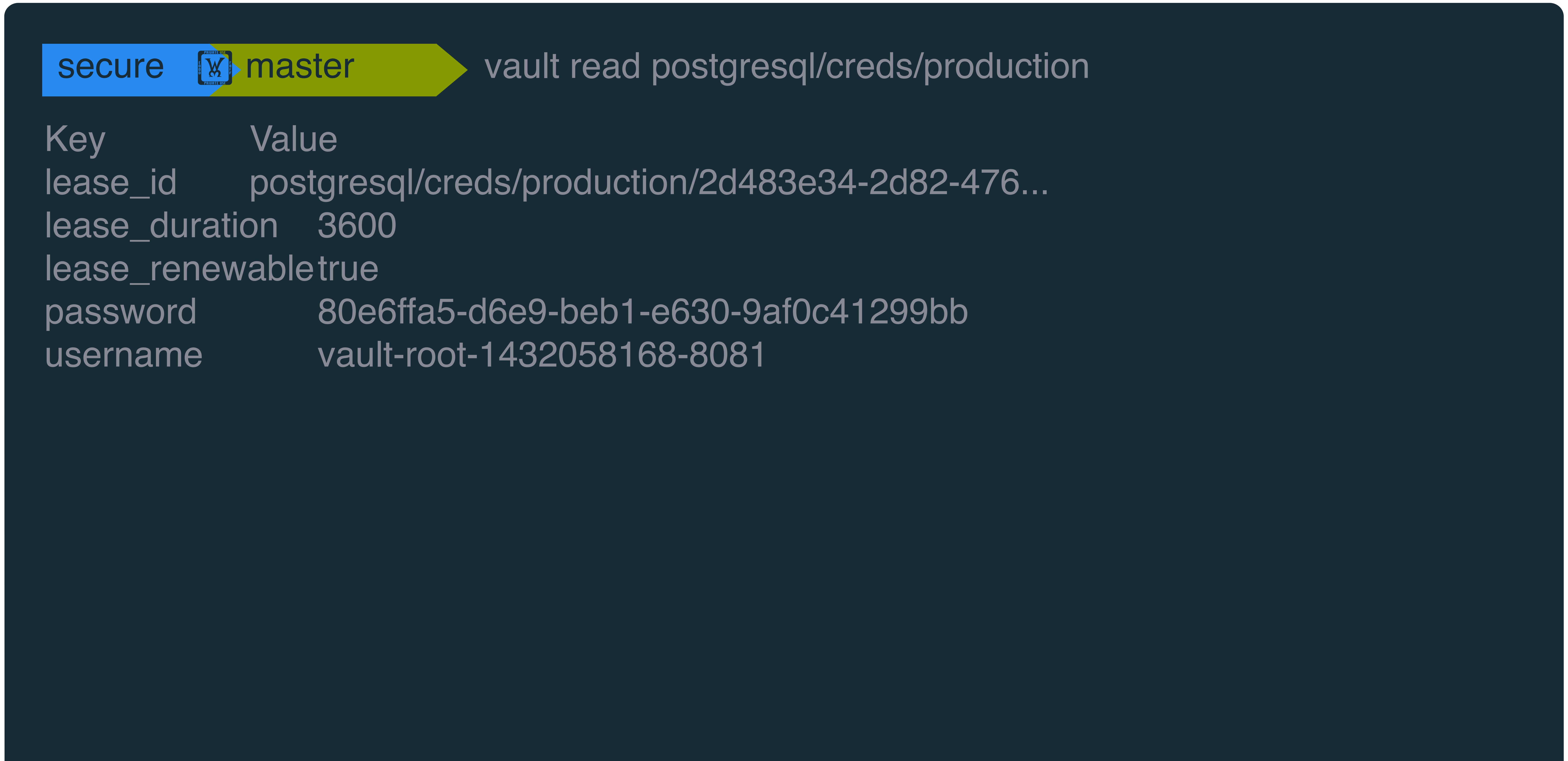
```
secure  master  vault help postgresql
## DESCRIPTION

The PostgreSQL backend dynamically generates database users.

After mounting this backend, configure it using the endpoints within
the "config/" path.

## PATHS

The following paths are supported by this backend. To view help for
any of the paths below, use the help command with any route matching
the path pattern. Note that depending on the policy of your auth token,
you may or may not be able to access certain paths.

    ^config/connection$
```



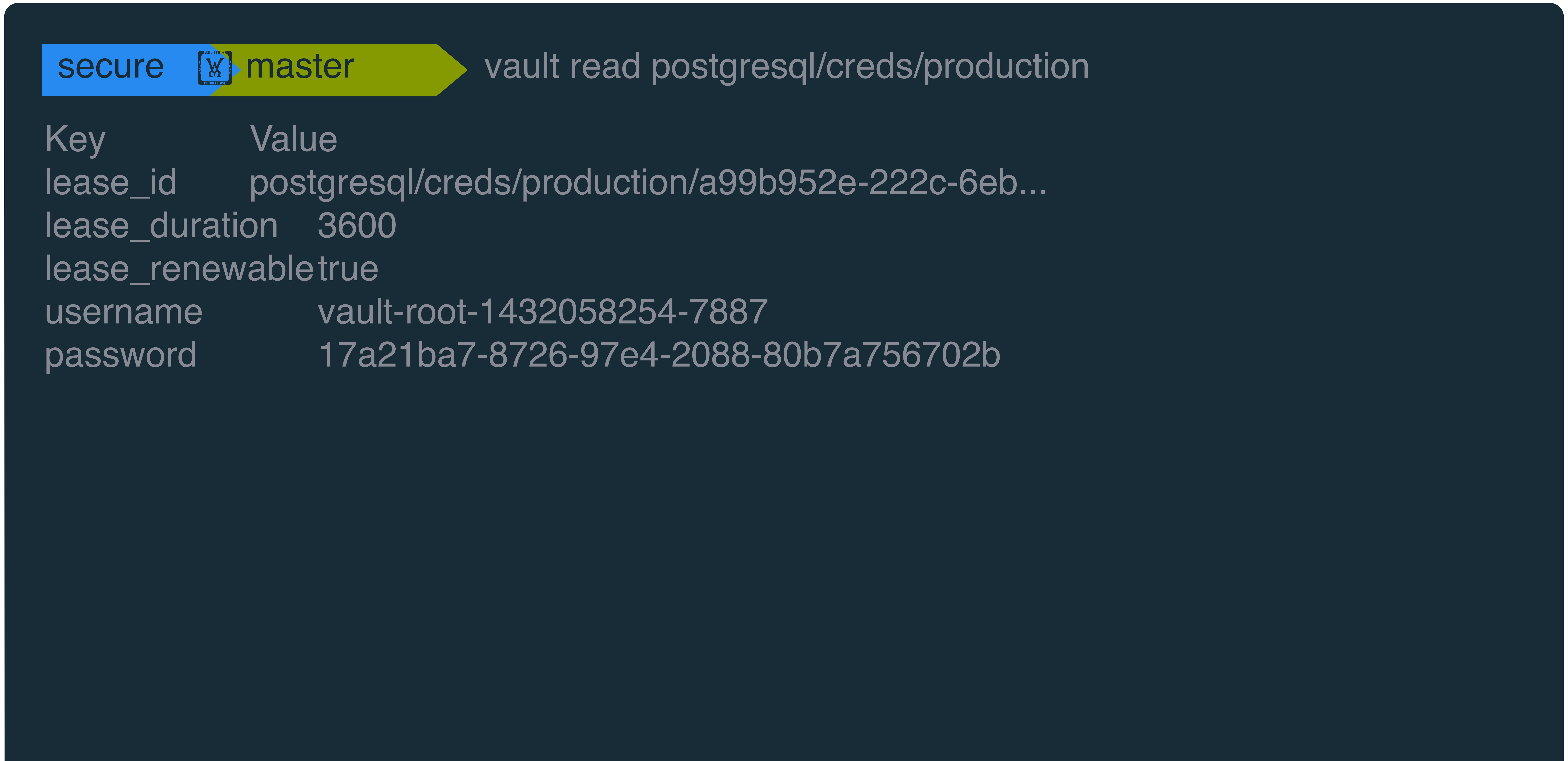
```
secure  master  \
  vault write postgresql/config/connection \
  value="user=hashicorp password=hashicorp database=hashicorp"

Success! Data written to: postgresql/config/connection
```



```
secure  master  \
 vault write postgresql/roles/production name=production

Success! Data written to: postgresql/roles/production
```



```
secure  master  vault read postgresql/creds/production

Key              Value
lease_id         postgresql/creds/production/2d483e34-2d82-476...
lease_duration   3600
lease_renewable  true
password         80e6ffa5-d6e9-beb1-e630-9af0c41299bb
username         vault-root-1432058168-8081
```



```
secure  master  vault read postgresql/creds/production

Key             Value
lease_id        postgresql/creds/production/a99b952e-222c-6eb...
lease_duration    3600
lease_renewable true
username          vault-root-1432058254-7887
password          17a21ba7-8726-97e4-2088-80b7a756702b
```

## DYNAMIC SECRETS

- Pluggable Backends
- AWS, Consul, PostgreSQL, MySQL, Transit, Generic
- Grow support over time

## LEASING, RENEWAL, AND REVOCATION

- Every Secret has a Lease*
- Secrets are revoked at the end of the lease unless renewed
- Secrets may be revoked early by operators
    - “Break Glass” procedure
- Dynamic Secrets make leases enforceable
    - Not possible for arbitrary secrets
    - Not possible for transit backend

## AUDITING

- Pluggable Audit Backends
- Request and Response Logging
- Prioritizes Safety over Availability
- Secrets Hashed in Audits
    - Searchable, but not reversible

## RICH ACLS

- Role Based Policies
- Restrict access to “need to know”
- Default Deny, must be explicitly allowed

## FLEXIBLE AUTH

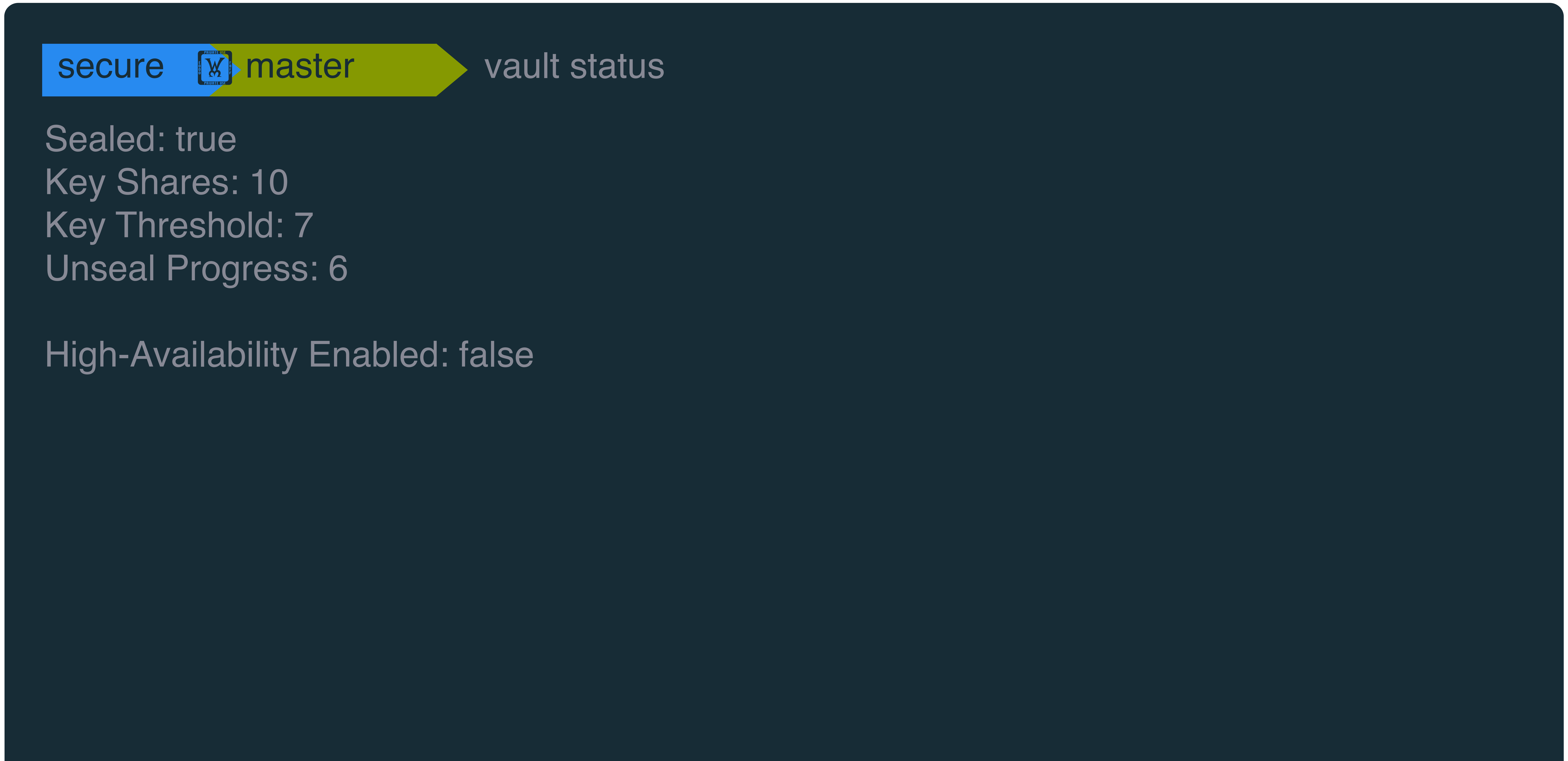
- Pluggable Backends
- Tokens, GitHub, AppID, User/Pass, TLS Certs
- Machine-Oriented vs Operator-Oriented

## HIGH AVAILABILITY

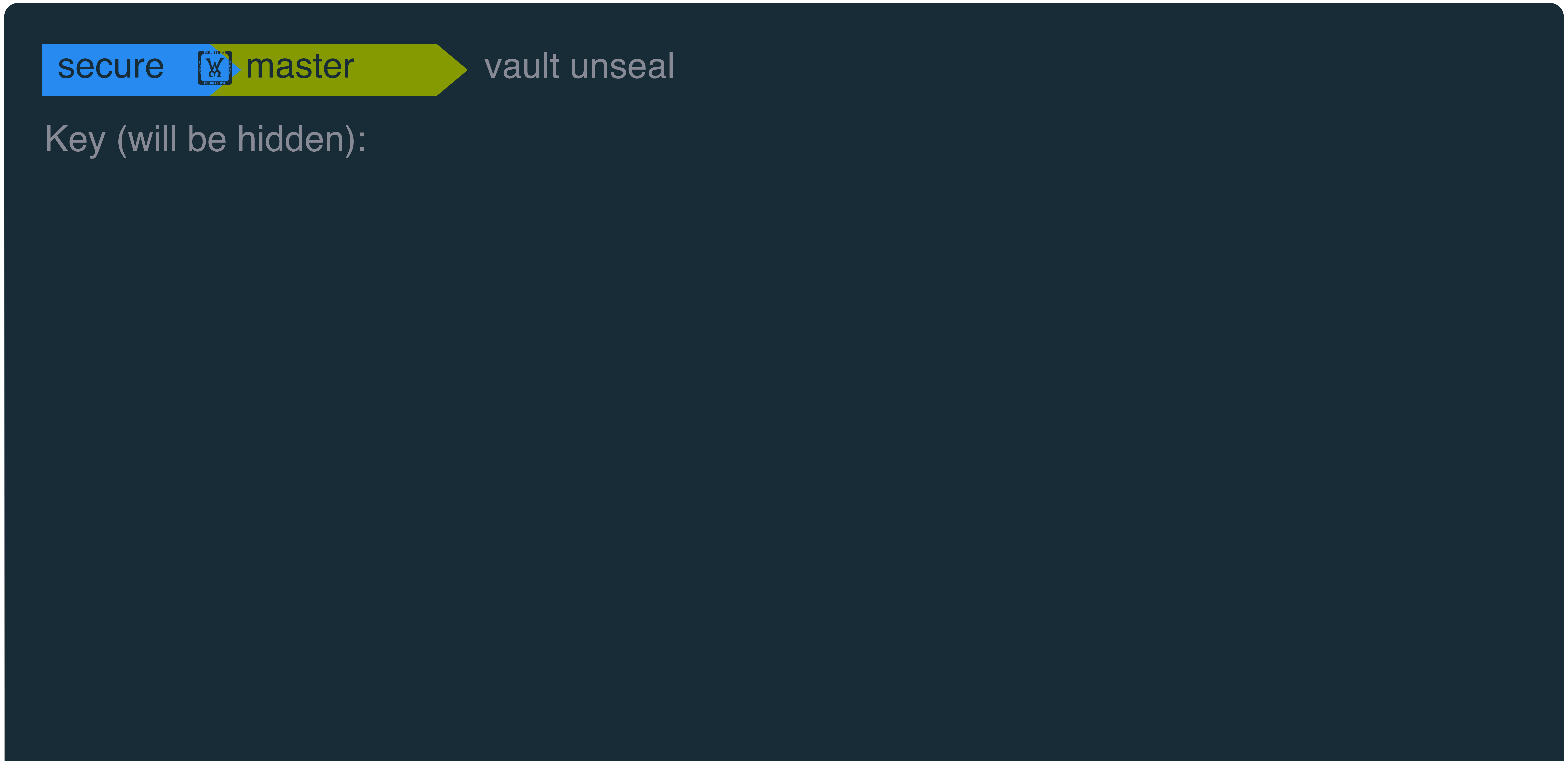
- Consul used for leader election
- Active/Standby
- Automatic failover

## UNSEALING THE VAULT

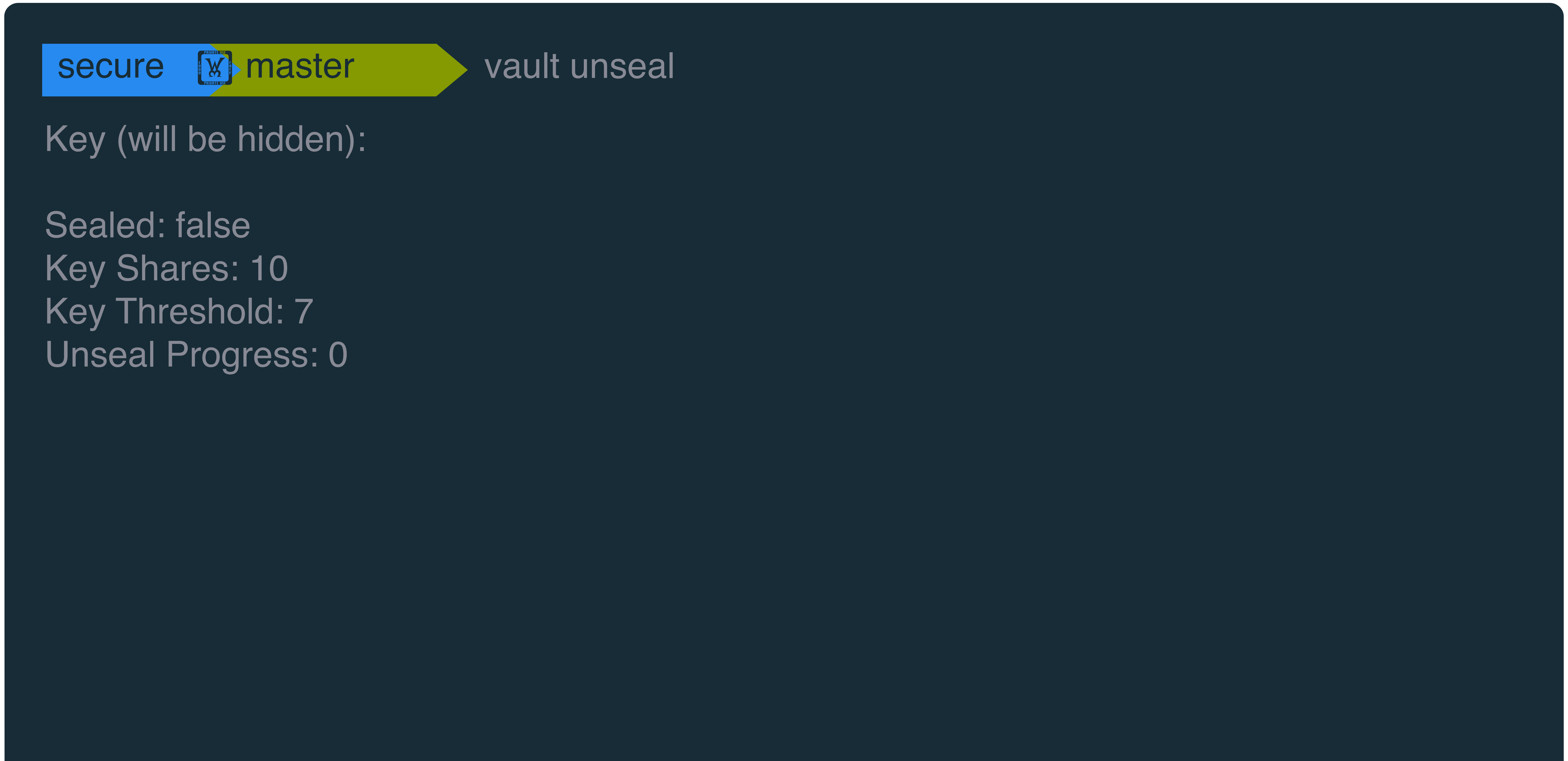
- Data in Vault encrypted
- Vault requires encryption key
- Must be provided *online*



```
secure  master  vault status

Sealed: true
Key Shares: 10
Key Threshold: 7
Unseal Progress: 6

High-Availability Enabled: false
```



```
secure  master  vault unseal
Key (will be hidden):
```



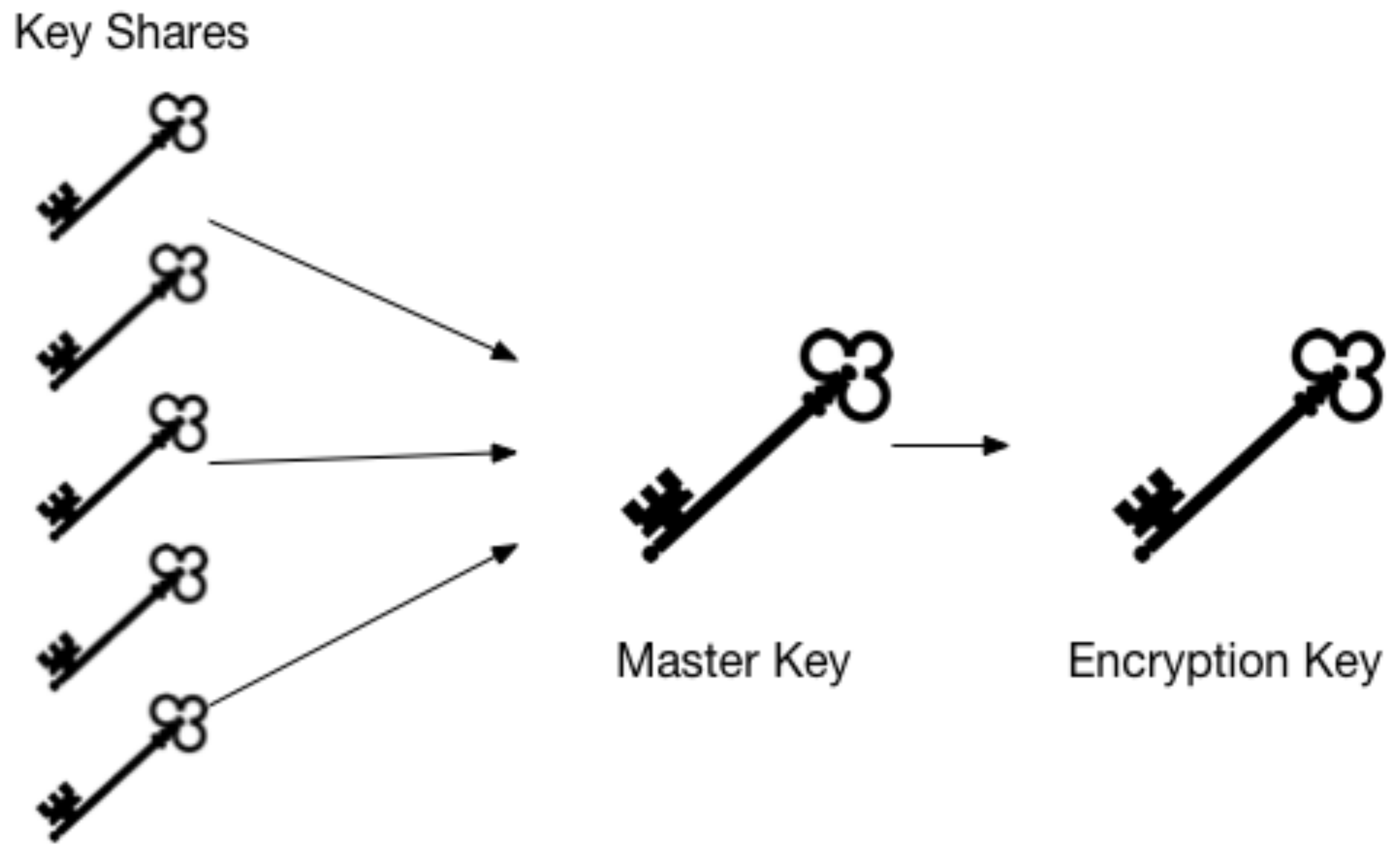
```
secure  master  vault unseal
Key (will be hidden):

Sealed: false
Key Shares: 10
Key Threshold: 7
Unseal Progress: 0
```

## WATCHING THE WATCHMEN

- Master Key is the “key to the kingdom”
- All data could be decrypted
- Protect against insider attack
- Two-Man Rule

# SHAMIR SECRET SHARING

- Protect Encrypt Key with Master Key
- Split Master Key into **N** shares
- **T** shares to recompute Master
- Quorum of key holders required to unseal
  - Default N:5, T:3



## SUMMARY

- Solves the “Secret Sprawl Problem”
- Protects against external threats (Cryptosystem)
- Protects against internal threads (ACLs and Secret Sharing)

## BUILDING ON VAULT

## SECURITY FOUNDATION

- Base of Trust
- Core Infrastructure
- Flexible Architecture
- Foundation for Security Infrastructure

# PERSONALLY IDENTIFIABLE INFORMATION

- PII information is everywhere
  - SSN, CC#, OAuth Tokens, etc.
  - Email? Physical address?
- Security of storage?
- Scalability of storage?
- Audibility of access?

## PII WITH VAULT

- “transit” backend in Vault
- Encrypt/Decrypt data in transit
- Avoid secret management in client applications
- Builds on Vault foundation

## TRANSIT BACKEND

- Web server has no encryption keys
- Requires two-factor compromise (Vault + Datastore)
- Decouples storage from encryption and access control

## CERTIFICATE AUTHORITY

- Vault acts as Internal CA
- Vault stores root CA keys
- Dynamic secrets - generates signed TLS keys
- No more tears

## MUTUAL TLS FOR SERVICES

- Dynamic CA allows all services to generate keys
- All internal service communication can use mutual TLS
- End-to-End encryption inside the datacenter

## VAULT IN PRACTIVE

## USING VAULT

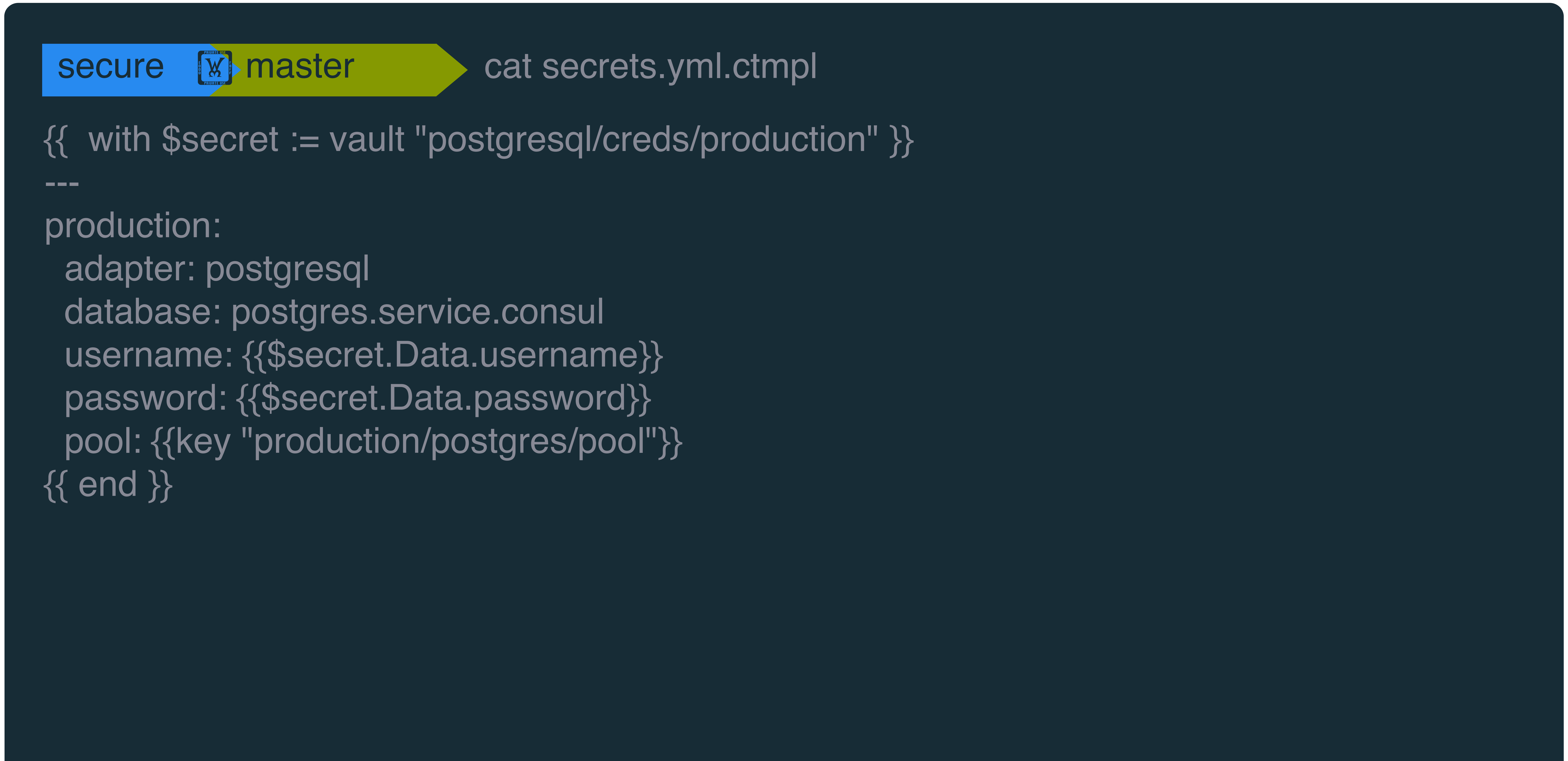
- API Driven
- JSON/HTTPS
- Rich CLI for humans and scripts
- Rich client libraries

# APPLICATION INTEGRATION

- Vault-aware
  - Native client libraries (go, ruby, rails, python, node, and more)
  - Secrets only in-memory
  - Safest but high-touch

## CONSUL TEMPLATE INTEGRATION

- Secrets templatized into application configuration
- Vault is transparent
- Lease management is automatic
- Non-secret configuration still via Consul



```
secure  master  cat secrets.yml.ctmpl
{{  with $secret := vault "postgresql/creds/production" }}
---
production:
  adapter: postgresql
  database: postgres.service.consul
  username: {{$secret.Data.username}}
  password: {{$secret.Data.password}}
  pool: {{key "production/postgres/pool"}}
{{ end }}
```

REMEMBER TO RATE THIS SESSION

TWEET @SETHVARGO FOR QUESTIONS TO

# THANK YOU!

QUESTIONS?

hashicorp/vault

https://vaultproject.io

security@hashicorp.com