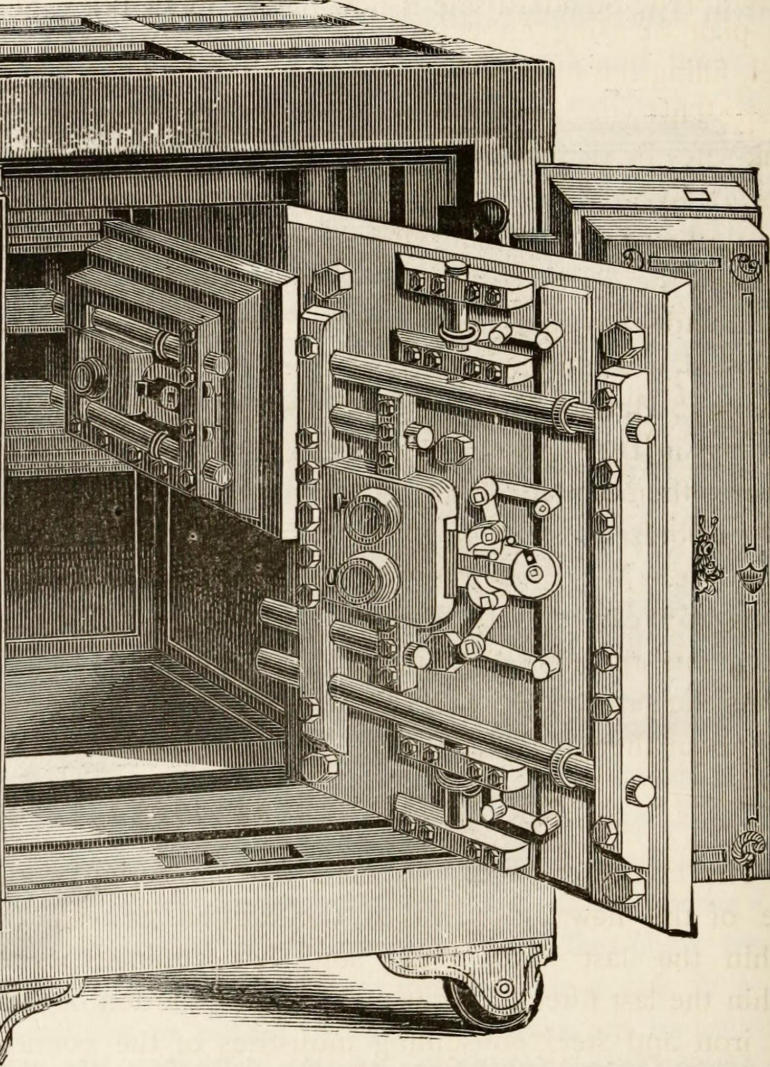


Cloud & Offline Secrets Management

Managing operational secrets with SOPS

Schlomo Schapiro, Associate Partner / Principal Engineer, Tektit Consulting
19.06.2024, DevOpsCon 2024, Berlin

DevOpsCon by  devmio



Agenda

1. Context: DevOps
2. Why Secrets?
3. Functional Requirements
4. Non-Functional Requirements
5. What Could Possibly Go Wrong?
6. SOPS – Secrets OPerationS
7. Backup & Disaster Recovery

Happy DevOps Campers



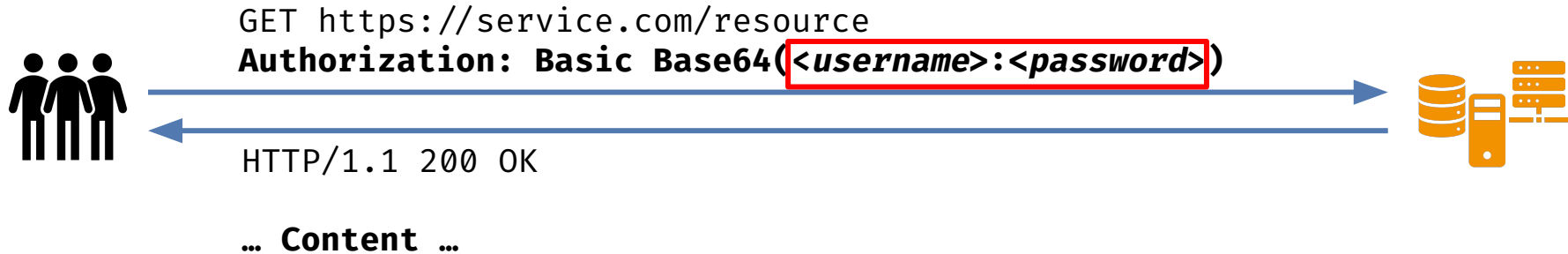
DevOps is

- ... if every person uses the same tool for the same job
- ... codified knowledge – everybody contributes his part to common automation
- ... if all people have the same privileges in their tooling
- ... if human error is equally possible for Dev and Ops
- ... replacing people interfaces by automated decisions and processes

bit.ly/5devops

... a result

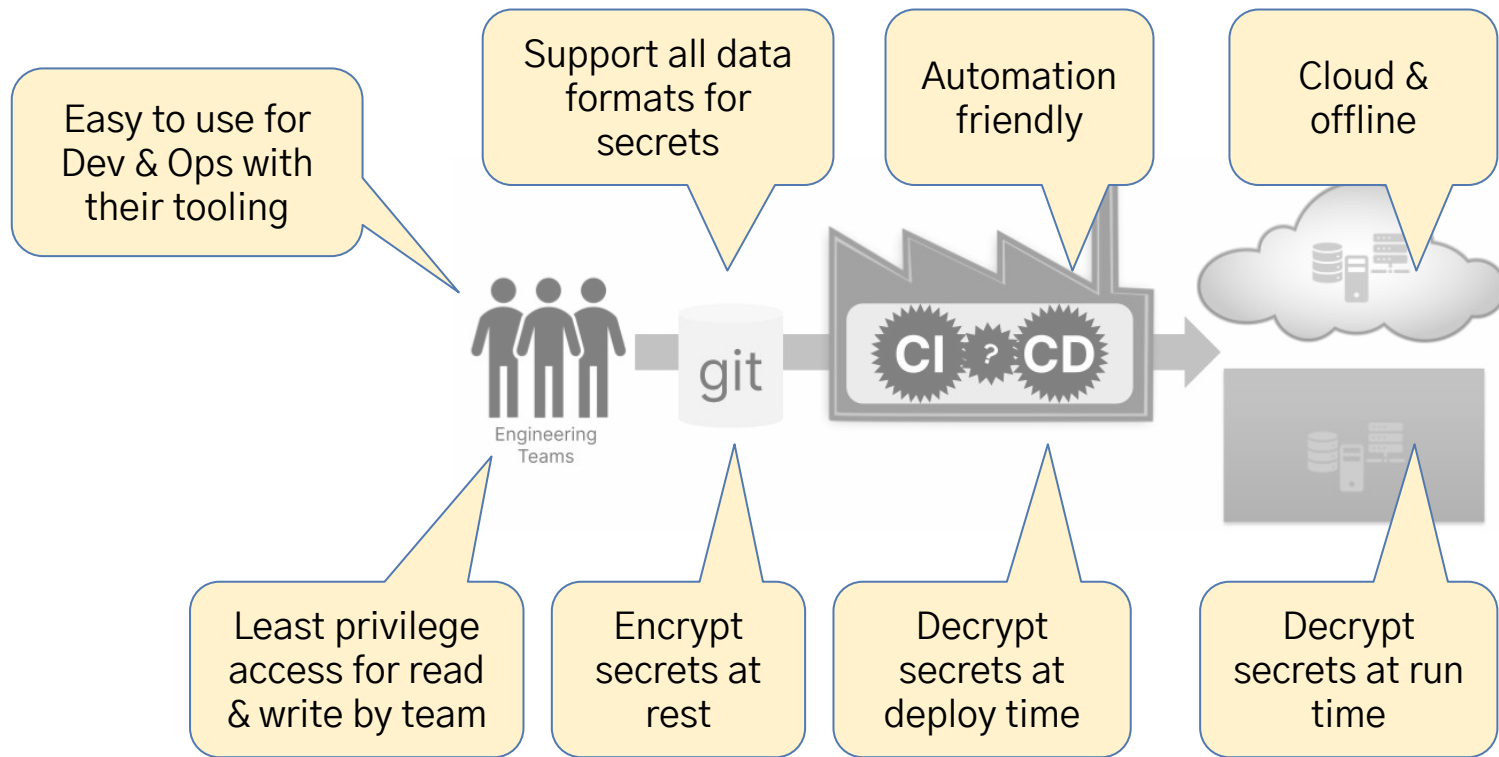
Why Secrets?



Read more in my blog at schlomo.schapiro.org

1. Lifting the Curse of Static Credentials
schlomo.schapiro.org/2016/05/lifting-curse-of-static-credentials.html
2. Eliminating the Password of Shared Accounts
schlomo.schapiro.org/2017/06/eliminating-password-of-shared-accounts.html
3. A Login Security Architecture Without Passwords
schlomo.schapiro.org/2022/02/login-security-architecture-without-passwords.html

Functional Requirements for Secrets Management

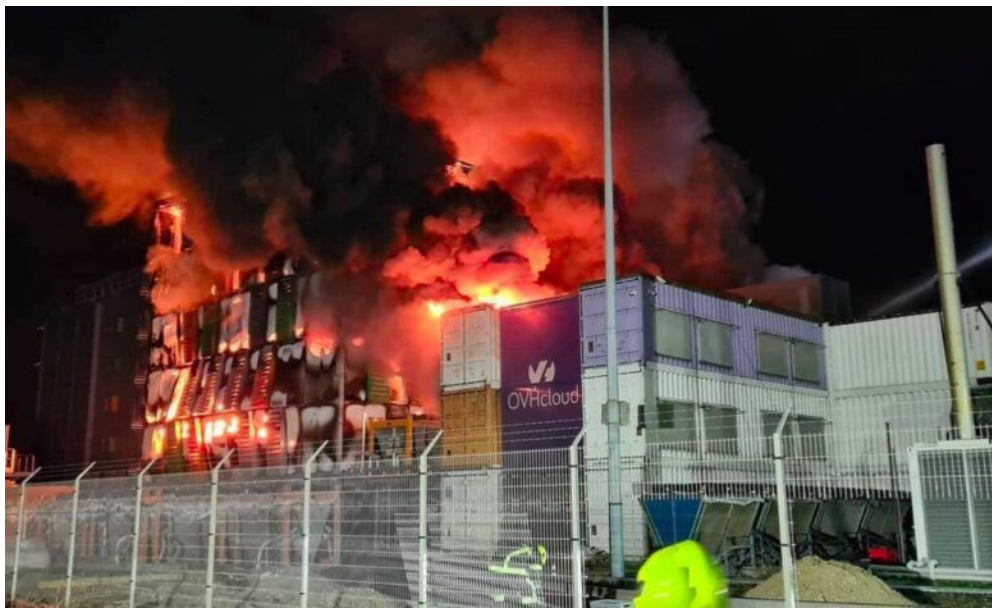


Non-Functional Requirements for Secrets Management

- Strong identity verification of users and deployment / runtime software
- Stolen or lost laptop doesn't pose a risk
- Immediate off-boarding of users if needed, cannot retain access to copied secret stores
- Reduce the exposure of secrets by segmenting secrets access per team, department or criticality / blast radius, as much as reasonably possible
- Prevent tampering with secrets by separating between decryption permissions used for software deployment and encryption permissions used by engineers
- Change management and traceability of changes at least as good as for software and configuration changes
- Secrets management should have no or only limited impact on operational ability to effect changes in production, e.g. perform a deployment or change configuration
- Retain access to secrets under all circumstances, even if we lose access to one or all Cloud accounts or services
- ...

What Could Possibly Go Wrong?

**All my Data is
in the Cloud!**



10.03.2021: [OVHcloud data centre destroyed in inferno](#)

**Where is my
Cloud Data?**



Google refuses to reinstate man's account after he took medical images of son's groin

Experts say case highlights dangers of automated detection of child sexual abuse images



📷 Tech companies like Google have access to a vast trove of data – but no context for it, says an ACLU technologist. Photograph: Avishek Das/Sopa Images/Rex/Shutterstock

22.08.2022: [Google account is lost for good \(The Guardian\)](#)



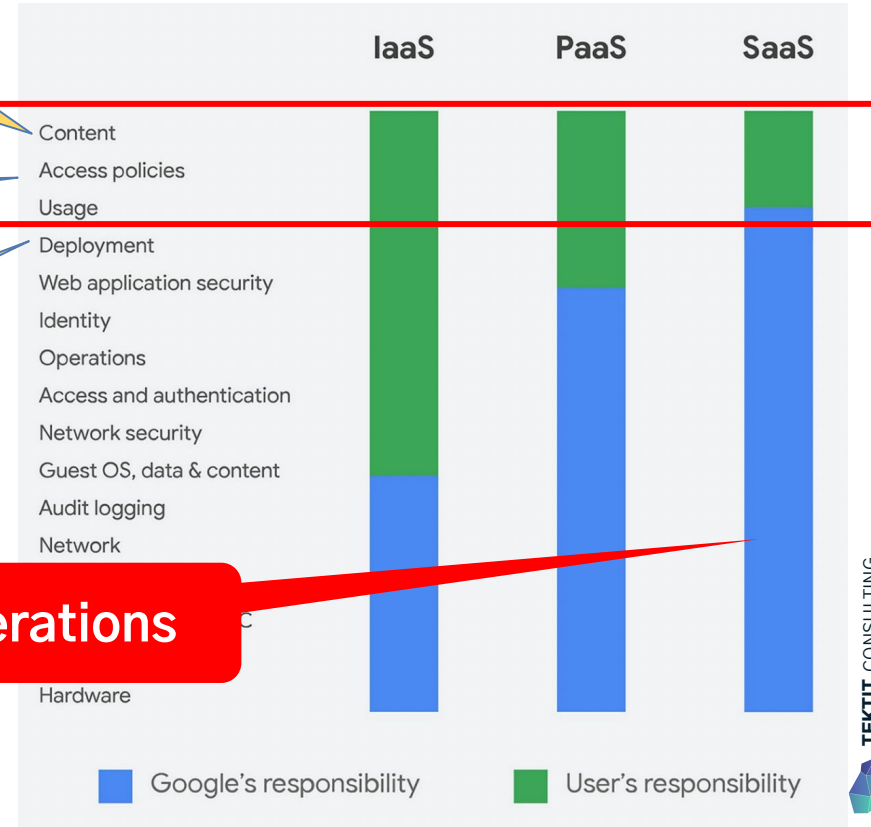
The Problem: Users are Responsible for Content

Accidentally or maliciously deleting data?

Granting access to malicious apps?

Deleting entire user account or Domain?

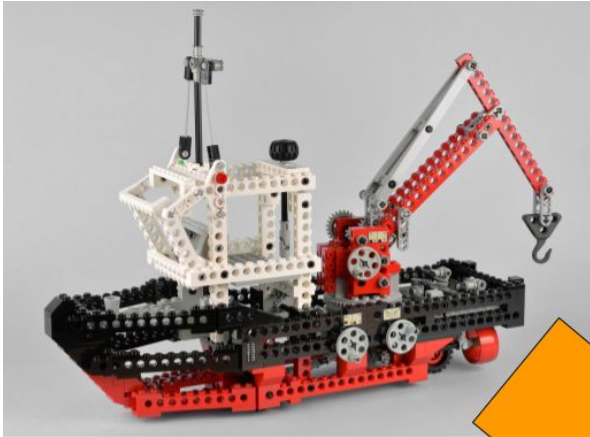
Vendor only guarantees technical operations



Example Source:

[Google Workspace data protection implementation guide](#)

Released 12/2020



Mission Impossible:

**Complete
Google Workspace
Disaster Recovery**



- Commonly used SaaS for collaboration, communication & office productivity
- **Data ownership**
≠ data possession
- **NO** complete backup possible!
- Only **partial** backups possible!
- Everybody accepts the risk!

See [Mission Impossible: Complete Disaster Recovery for Google Workspace](https://schlomo.schapiro.org/2022/04/mission-impossible-complete-google-workspace-disaster-recovery.html)

Secrets OPerationsS



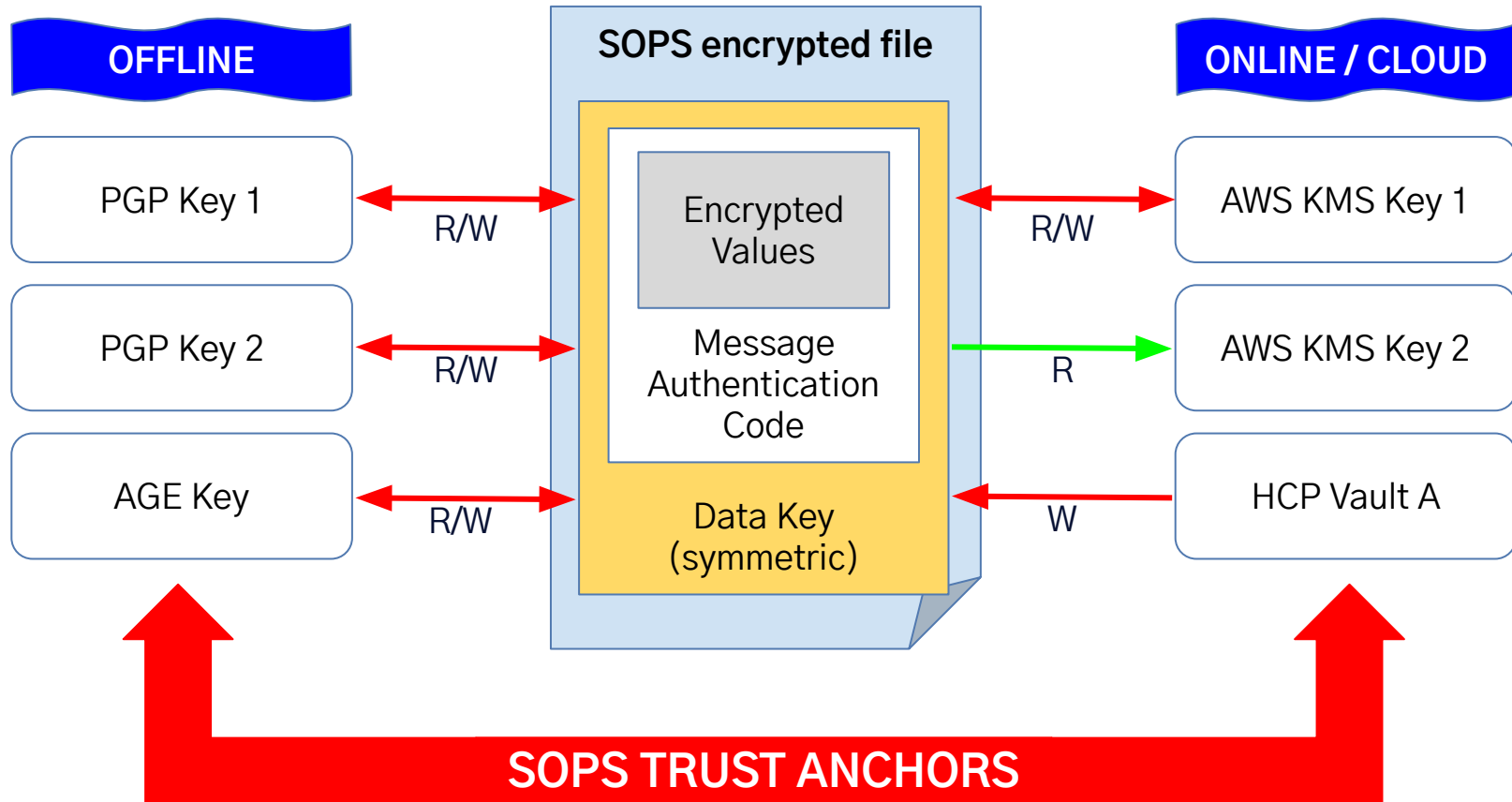
“SOPS (Secrets OPerationS) is an **editor** in the form of a **command-line** tool and **SDK** designed to help **manage encrypted files** in a variety of structured (YAML, JSON, ENV, INI) and BINARY formats using one of the supported **Key Management Systems** (KMS), **PGP**, or **age**.”

Source: getsops.io

Method	Encrypt	Decrypt
Offline: PGP/GPG, age	Public Key	Private Key
Cloud: KMS (GCP KMS, AWS KMS, Azure Key Vault, Hashicorp Vault)	Encrypt Permission	Decrypt Permission

age - A simple, modern and secure encryption tool (and Go library) with small explicit keys, no config options, and UNIX-style composability.

Secrets Operations Architecture




```
-----BEGIN PGP MESSAGE-----
Version: GnuPG v1

Hs1N8nAuDHI1ncgAB+BA3yrjCxtE9RT2baI3uwaJ53/sjR556fmcjR3v0BhwZ
6x0K004BFI0C7ic3d+P7Csefug100thel.g4cJ1B4EGwe0Ww08IH00B8YhuiaW7F
18P4adpC4elrnp7Wu0W44n+J51wphmcJG7d4grjMps802m41r3yV5E.8Wpu3fng
Phg0046ypp+4C30Kerobauk7oc0w0B904p+54Qv4A+454665176+Kw0530894Jd
w0fwrTruakr0DagB021P8MA04w0w0Tud20fuz87b7v4T+6w4p109f4w07L07b8
j112p57v52yup4f05770495v0243v08gr527800P5.w044005A1q0221v012y04y
Aq0428A1P4c03v040p.A3v03w089jclw05d0c1w04p+9w0P6w05077pCv5L
0v0w0w04070w0290v0v0548027V.w0jpw0w0G271w0w0Q0p0c0t.R0728v0p049
112v04800T+4850v0c00C30570c04w0t527951v034d.C7A3v0v0w0w071v
-----END PGP MESSAGE-----
```

Secrets OPerationsS

info: Welcome to SOPS! Edit this file as you please!

example_key: example_value

Example comment

example_array:

- example_value1
- example_value2

example_number: 1234.56789

example_booleans:

- true
- false

Secrets OperationsS - encrypted file

```

info: ENC[AES256_GCM,data:HYGEJN0q3C6c4Id6d9CE40Va15mX/8uE+M2Dr05ONd2hDTpUKw5oNEJ
example_key: ENC[AES256_GCM,data:h4ZPZQVP3V3hVxt6Mw=,iv:x8mYCxxpzWBbN5sf0fr2V5IB
#ENC[AES256_GCM,data:6gX78q+XkdVTGYd1CHxXCw=,iv:ce5lH6voUQnea70Ksu1DWSAgKTgZ7m0h
example_array:
  - ENC[AES256_GCM,data:HC5zVU6LaVzehk77Hos=,iv:6C/pusncdpKGZFTX569+5lVRkoJHNhs1
  - ENC[AES256_GCM,data:r6DuIBIn+mbi70M2f2E=,iv:fNTW4iWd4rt98zqnw81D2fNBnARt+C7c
example_number: ENC[AES256_GCM,data:3xKjch9GJO6Zdw=,iv:ISJTxCs+ITs8+XUch45a/w5Mo
example_booleans:
  - ENC[AES256_GCM,data:mpAj/A=,iv:S+3cL9klQ/3D4Waa1kXz3RBF68nhZDV4CHuPF0Zc84I=
  - ENC[AES256_GCM,data:NGOxinc=,iv:Tj9bSL5d1HlX5yAZ07jpyNL3keVYAvUJi9VNDNcD0B4=
sops:
  kms: []
  gcp_kms: []
  azure_kv: []
  hc_vault: []
  age:
    - recipient: age12pewudxq53khcgm49flqq7t6l5na8jscsnn4lqyyla4nzzm4l92qsk7qq
      enc: |
        ———BEGIN AGE ENCRYPTED FILE———
        YWd1LWVubY3J5cHRpb24ub2JnL2VxGi0jTEgyNTUxOSBUN1NBzE+NT01pDVZxOzBK

```

Secrets Operations - encrypted file explained

example_array:

- ENC[AES256_GCM,data:HC5zVU6LaVzehk77Hos=,iv:6C/pusncdpKGZFTX569+5L
- ENC[AES256_GCM,data:r6DuIBIn+mbi70M2f2E=,iv:6C/pusncdpKGZFTX569+5L

sops:

```
kms: []
gcp_kms: []
azure_kv: []
hc_vault: []
```

age:

- recipient: age12pewudxq53khcgm49flqq7t6l5na8jscsnn4lqvyla4nzzm
- enc: |

——BEGIN AGE ENCRYPTED FILE——

YWdlLWVuY3J5cHRpb24ub3JnL3YxCi0+IFgyNTUxOSBUNlNPaEtNT01nRVZx

...

——END AGE ENCRYPTED FILE——

lastmodified: "2023-11-14T13:06:19Z"

mac: ENC[AES256_GCM,data:GcnG90R58Se0f06kukMUiBfB8MJ+SnB2RgXJKqBvMK1

Plaintext Keys

Encrypted Values

Trust Anchor ID


Encrypted Data Key

Tamper Proofing

More about SOPS → getsops.io

Excellent tooling support:

- VS Code plugin, IntelliJ plugin,
- Terraform provider, wrapper, ... and Ansible integration
- Lots of Kubernetes tooling supports SOPS
- Configure SOPS standard keys and behaviour via `.sops.yaml` file
- ...

The SOPS logo consists of a solid black square. Inside the square, the word "SOPS" is written in a white, bold, sans-serif typeface, centered both horizontally and vertically.

Advanced security features:

- Key rotation via `sops -r`
- Require multiple master keys (key groups) via `--shamir-secret-sharing-threshold`
- Unencrypted values via `--unencrypted-suffix` or `--unencrypted-regex`
- diff support for `git diff` ...
- Encrypt binary files
- Upload encrypted files to S3, GCS ...
- Audit trail

SOPS Usage

Configure: Create `.sops.yaml` with default settings and **trust anchors:**

```
creation_rules:  
  - path_regex: secret  
    age: age12pewudxq53khcgm49flqq7t6l5na8jscsnn4lqyxla4nzzm4l92qsk7qq4
```

Encrypt:

```
sops secrets.env
```

Decrypt:

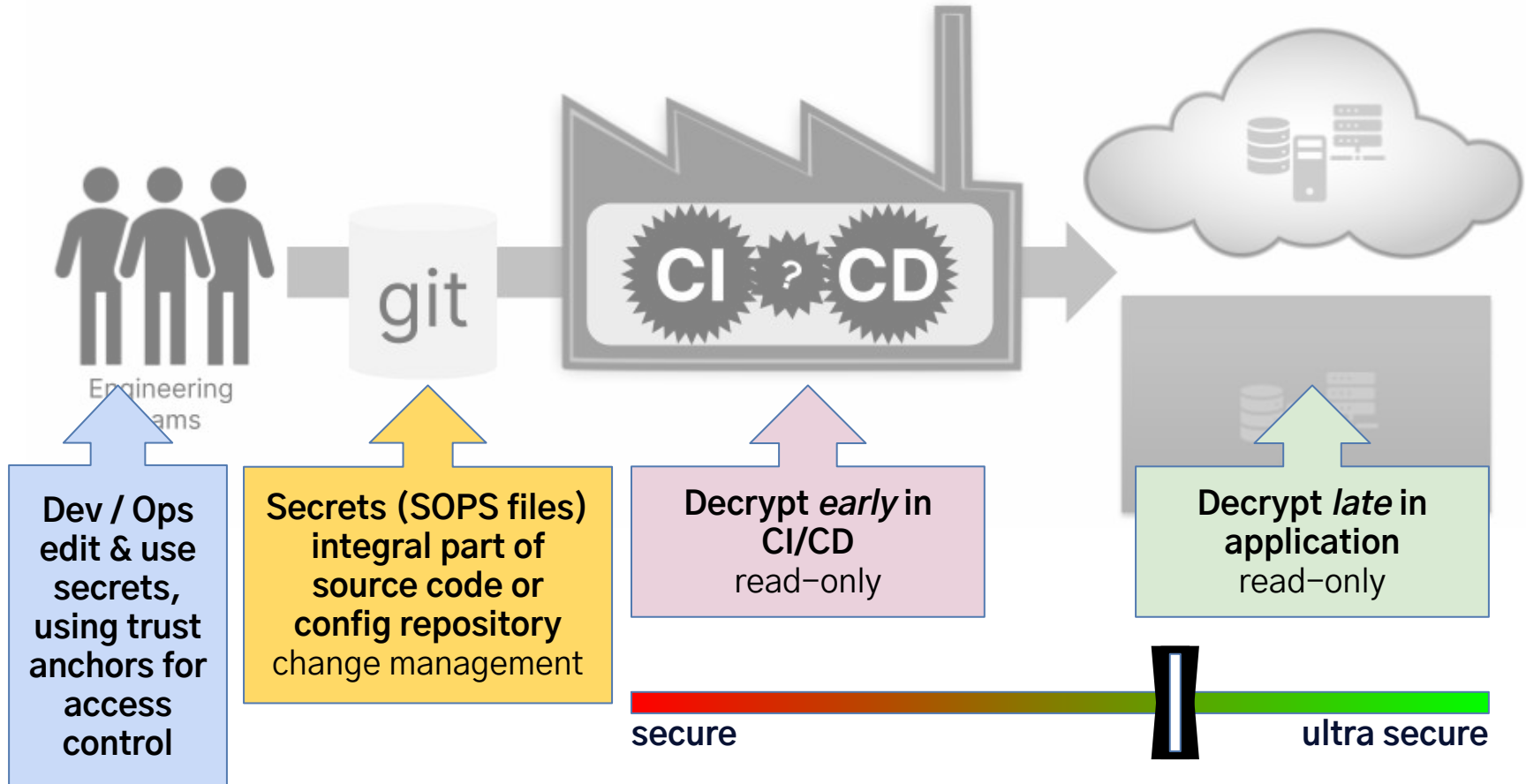
```
export SOPS_AGE_KEY=AGE-SECRET-KEY-165DJSTUXKL8WEUEJJ9H3M25YKQUQ3RDGTQJJ9YU72PK3F6NZ26NQRD6NRT
```

```
sops -d secrets.env
```

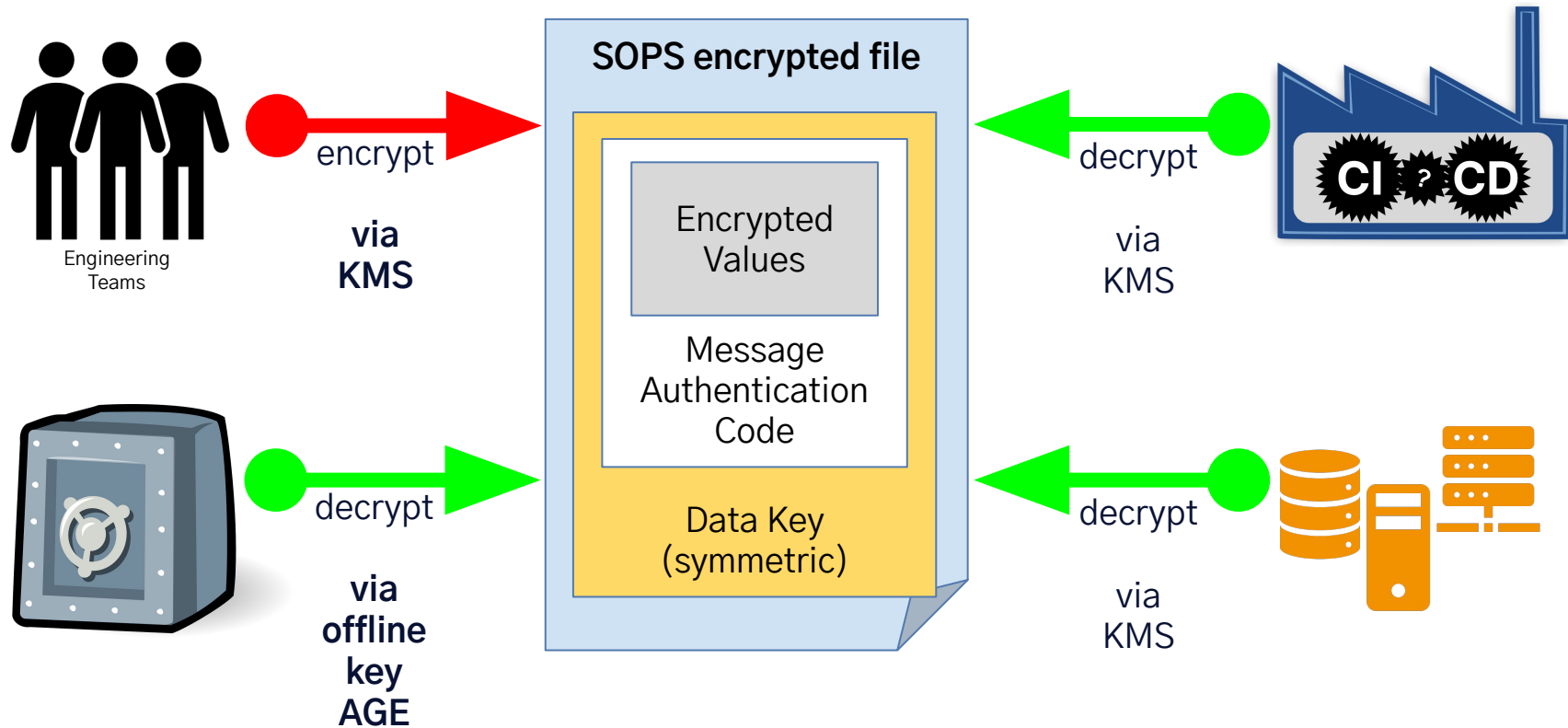
```
sops exec-env secrets.env ./run.sh
```

```
sops exec-file secrets.env './run.sh --secrets {}'
```

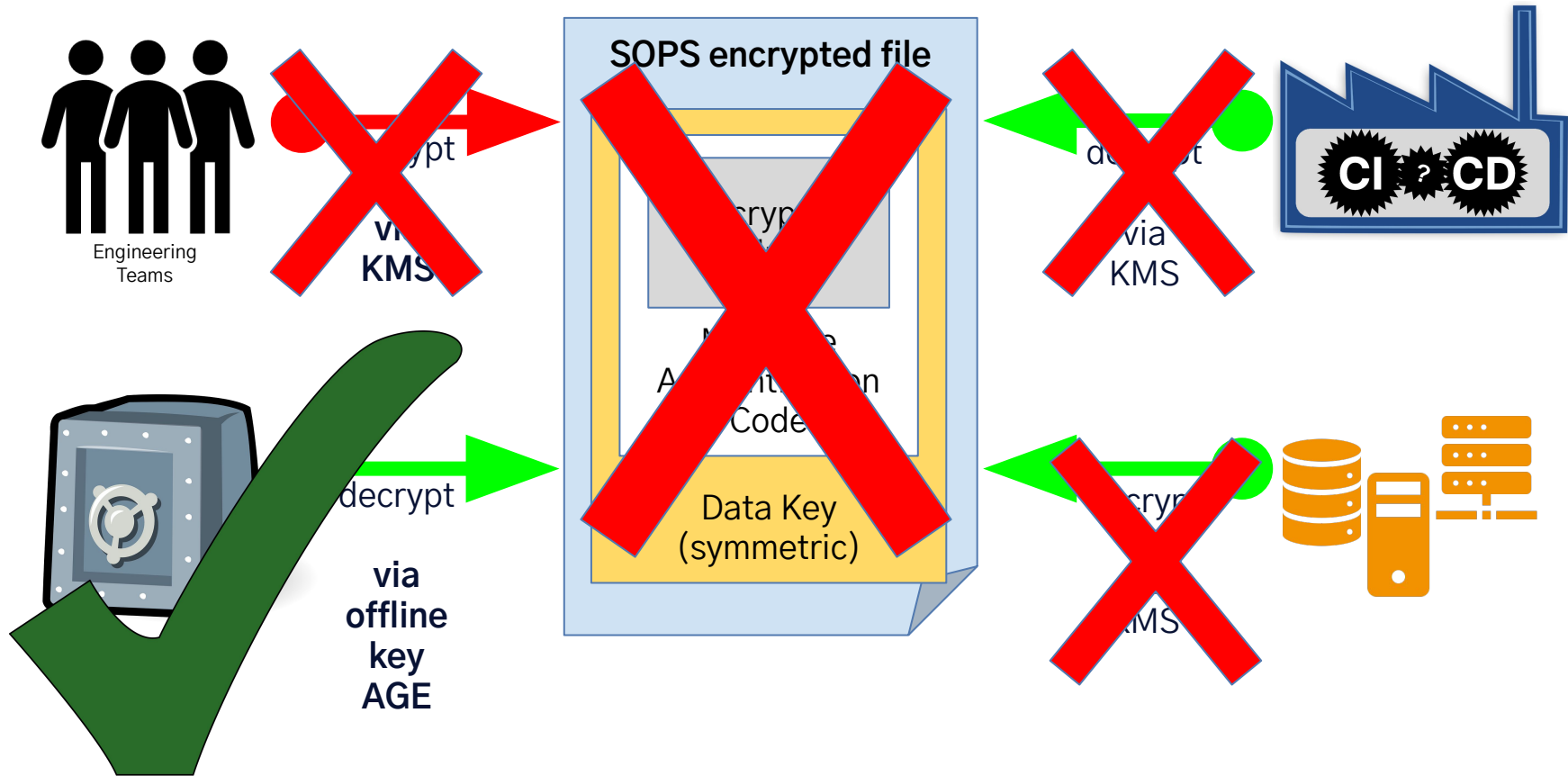

SOPS in the Software Delivery Life Cycle



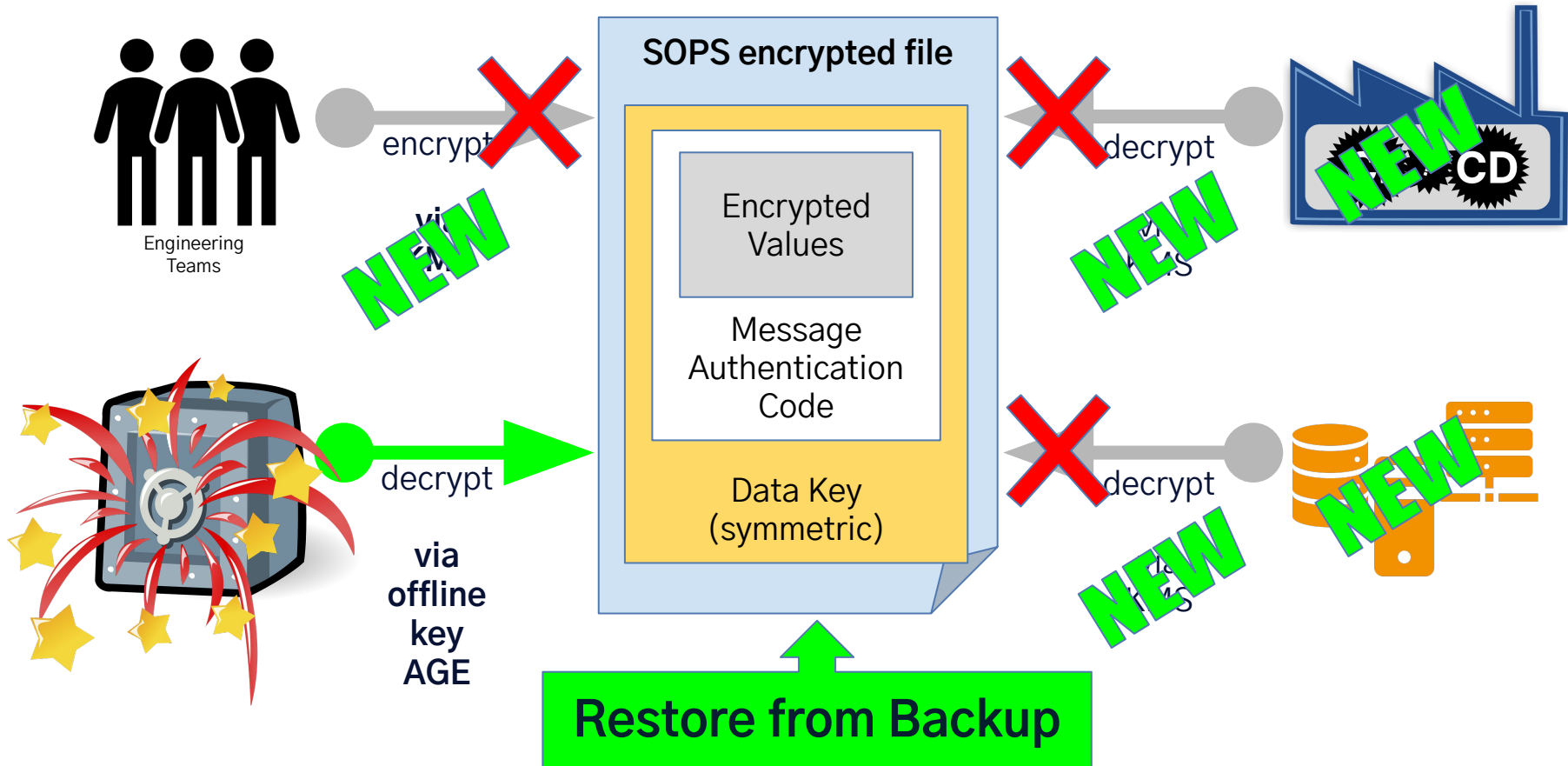
SOPS Trust Anchors → “Secrets Management”



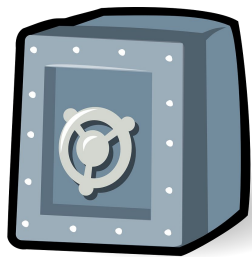
Disaster — All Cloud Data or Services are Gone!





Recovery — All Cloud Data and Services are New!



Recovery — Restore Access for New SOPS Trust Anchors



via
offline
key
AGE

1. Update `.sops.yaml` with **new** trust anchors
2. `sops updatekeys -y FILE`
3.  

```
> sops updatekeys demo.env -y
```

```
2023/11/15 17:01:09 Syncing keys for file /Users/schlomoschapiro/Downloads/demo.env
The following changes will be made to the file's groups:
```

```
Group 1
```

```
age12pewudxq53khcgm49flqq7t6l5na8jscsnn4lqyxla4nzzm4l92qsk7qq4
```

```
--- age1g45d2ymssutc3d3qvsk66qagtwvpejpf4tz9ve8uej4p7tcu5uq5c8qgn
```

```
2023/11/15 17:01:09 File /Users/schlomoschapiro/Downloads/demo.env synced with new keys
```

Offline Disaster Recovery Decryption Key for SOPS files

While we use AWS/GCP KMS keys to secure our SOPS files, that renders them inaccessible if we don't have access to the AWS/GCP KMS keys. To provide access to our SOPS files in such a case, we encrypt our SOPS files with an additional AGE key that can be used to decrypt the SOPS files offline.

The following is this additional AGE key used in all our SOPS files. We store it in a sealed envelope and the security posture of our SOPS files relies on the fact that nobody has access to or a copy of this key. Opening this envelope gives access to the key and therefore **requires generating a new AGE key and re-encrypting all SOPS files with it, and storing the new key like this key here in a sealed envelope.**

		<p>AGE-SECRET-KEY-1URQG46XWU8 0J408HUDAXP3F QZQ5Z5DZWS2YZ CCKMQ76HLKGCM 65QTC9WK3FAKE</p>	
<p>Mozilla SOPS: github.com/mozilla/sops</p> 	<p>AGE: github.com/FiloSottile/age</p> 	<p>This document: Offline Disaster Recovery for SOPS</p> 	<p>The HOW-TO: Encrypted Files with SOPS</p> 

Usage Hints:

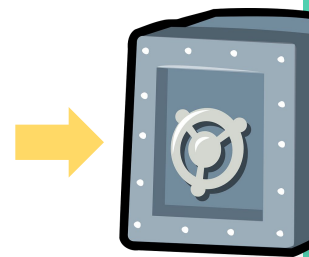
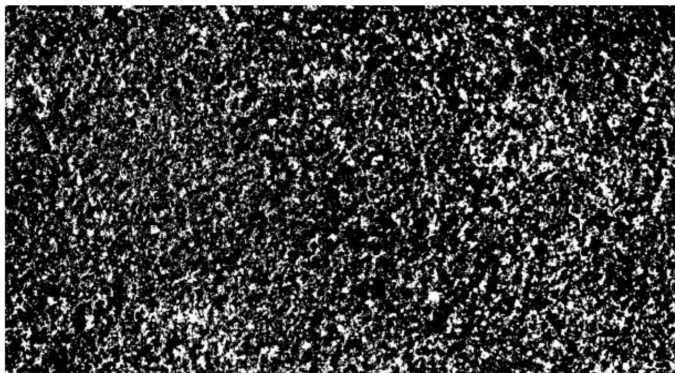
```
SOPS_AGE_KEY=AGE-SECRET-KEY-1URQG46XWU80J408HUDAXP3FQZQ5Z5DZWS2YZCCKMQ76HLKGCM65QTC9WK3FAKE sops -d secrets.yaml # decrypt
SOPS_AGE_KEY=AGE-SECRET-KEY-1URQG46XWU80J408HUDAXP3FQZQ5Z5DZWS2YZCCKMQ76HLKGCM65QTC9WK3FAKE sops -add-age age1... -r -i secrets.yaml # reencrypt
echo AGE-SECRET-KEY-1URQG46XWU80J408HUDAXP3FQZQ5Z5DZWS2YZCCKMQ76HLKGCM65QTC9WK3FAKE | qrencode -s 100 -o key.png # create QR code
```

Please export this file from Google Docs as ODT and replace the demo QR code and AGE key with the real data before printing.

Offline Disaster Recovery Decryption Key for SOPS files

CONFIDENTIAL! OPENING THIS REQUIRES RE-ENCRYPTING ALL SOPS FILES! TO BE OPENED BY SRE TEAM!

Key:age1rh03azryv1hmmgecw2v6afar7pvzucr767m9cvxp8s9vgzf394gq462kzk



Fully Automated SOPS Compliance Check


[repo nanny](#)
[code search](#)
[dependabot PRs](#)
[data exports](#)
[sign out](#)

▼ **SOPS Compliance** Found 5 SOPS configuration problems

Found 5 SOPS files with problems, see [Encrypted](#)

[Line 19](#) of [./deploy/repo-nanny/secrets.tooling.yaml](#):

```
sops:
```

No age trust anchors found, add age1n3l6c8ww3ayy6g7w9x75cn4aw0k4v5fxnpnnuymcwgh8euf764vqwruj44

[Line 24](#) of [./dev-settings.sops.yaml](#):

```
sops.yaml:24:1:sops:
```

No age trust anchors found, add age1n3l6c8ww3ayy6g7w9x75cn4aw0k4v5fxnpnnuymcwgh8euf764vqwruj44

[Line 12](#) of [./tests/fixtures/sops-compliance/2_old.secrets.yaml](#):

```
sops-compliance/2_old.secrets.yaml:12:1:sops:
```

No age trust anchors found, add age1n3l6c8ww3ayy6g7w9x75cn4aw0k4v5fxnpnnuymcwgh8euf764vqwruj44

[Line 14](#) of [./tests/fixtures/sops-compliance/3_bad.secrets.json](#):

```
"sops": {
```

Mandatory age trust anchors (age1n3l6c8ww3ayy6g7w9x75cn4aw0k4v5fxnpnnuymcwgh8euf764vqwruj44) not found



Managing operational secrets with SOPs

***No Backup?
No Mercy!***

Q&A — How may I help you?



schlomo.schapiro.org

We are not consultants. We are Partners, Coaches, Humans, Enablers, Catalysts, Sparring Partners, Experts ... and sometimes a little annoying.

I focus on IT strategy, IT governance, technology and architecture management, security and compliance automation, related organisational changes, business continuity, open source and cloud technologies – and I'm available as a Principal Engineer or Technical Product Owner for short-term / interim support.

Examples:

- **Business-IT alignment & leveraging**, developing required skills and abilities for 21st century IT, leverage AI
- **SaaS compliance & governance**, data possession vs. ownership, IAM, integrations, backup & DR, shadow IT
- **Compliance Automation**, finding the “golden path” to a “golden state”
- **Secrets Management** for Datacenter, Cloud Infrastructure, IaaS/PaaS/SaaS
- **Open Source**, from usage to contribution, writing policies, using SBOM, establishing Open Source Stewardship
- **Good Engineering Practices**, GitOps, test driven development, good architecture decisions, known tech strategy
- **Business Continuity and Disaster Recovery** for office, Cloud infrastructure, data center & SaaS, with quality assurance, emergency communication & collaboration, hot & cold standby, no-restore solution, ransomware protection, Linux Disaster Recovery / Bare Metal Restore with “Relax and Recover ([rear](#))” Open Source tooling

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We ask for
your feedback!

**PLEASE
VOTE
NOW!**

