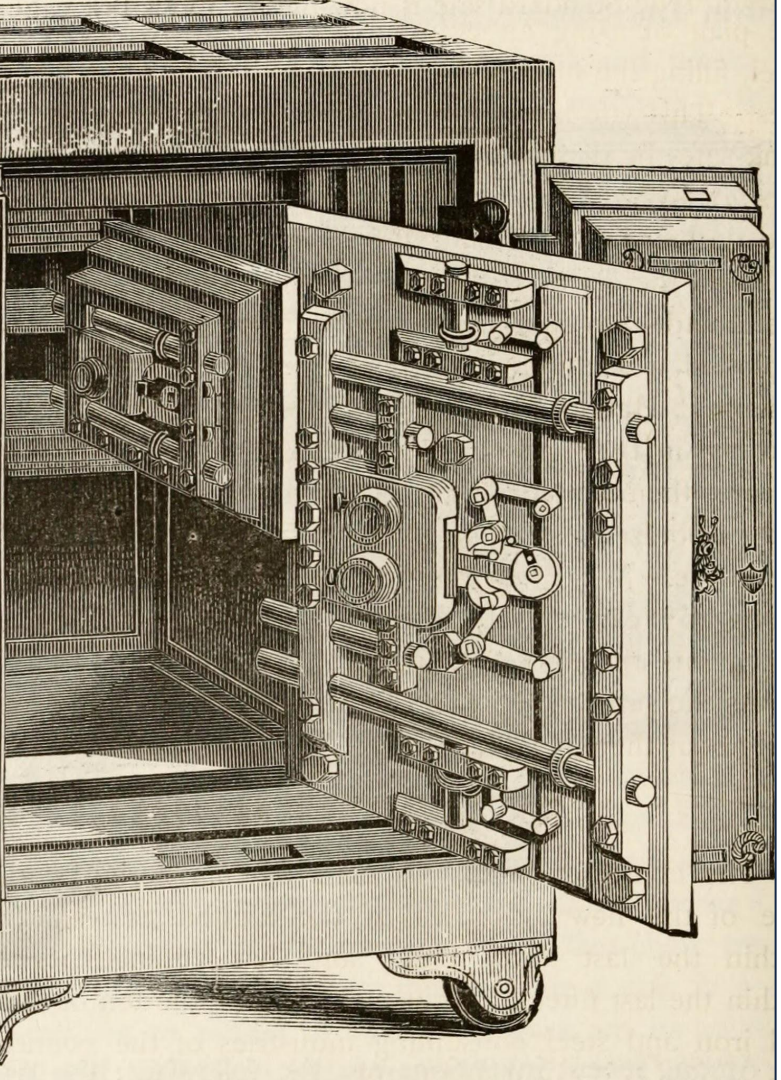
forto

Cloud & Offline Secrets Management

Managing operational secrets with SOPS

15./16. November 2023, Continuous Lifecycle Conference, Mannheim

Schlomo Schapiro, Principal Engineer, Forto GmbH



forto

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

forto

Happy DevOps Campers

forto

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?

```
GET https://service.com/resource
Authorization: Basic Base64(<username>:<password>)
```

```
HTTP/1.1 200 OK

… Content …
```

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

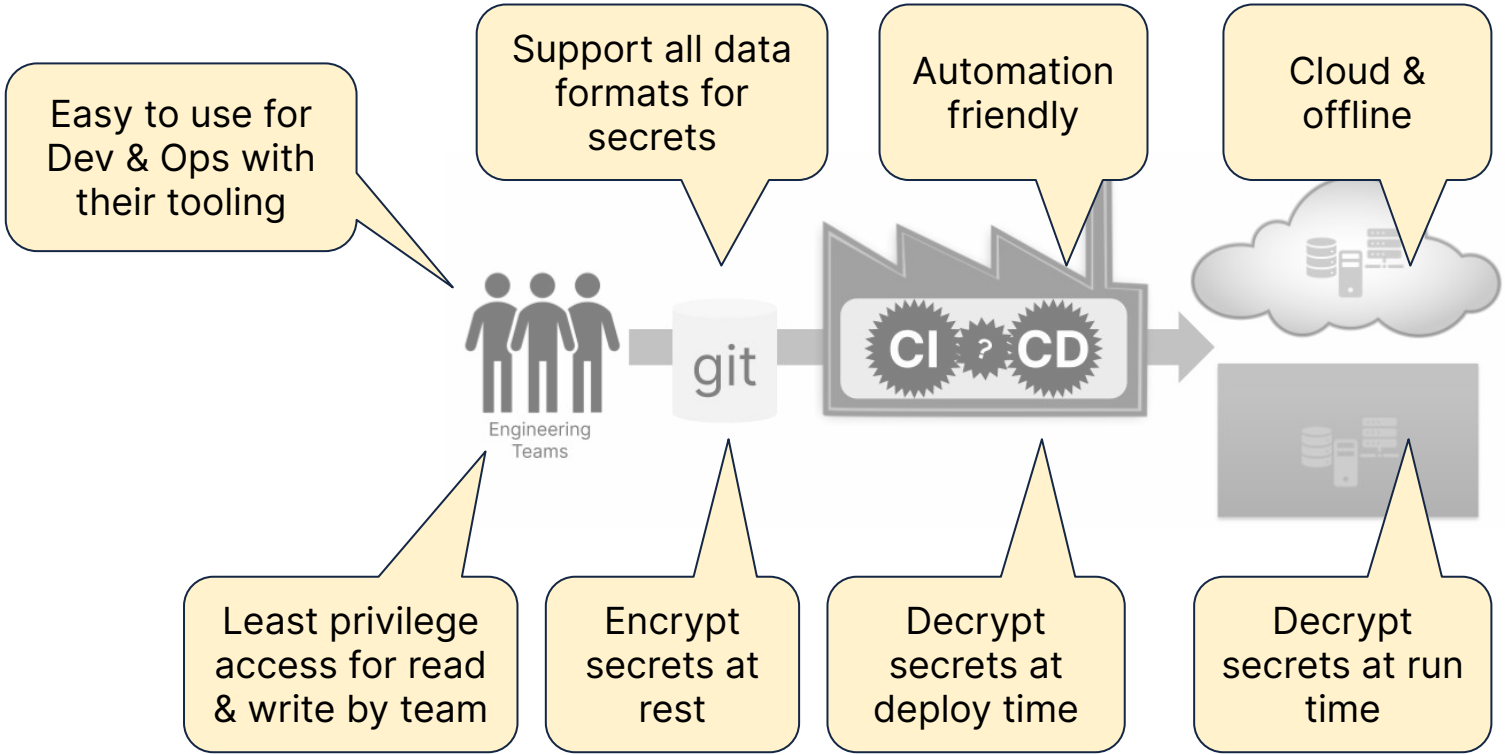
schlomo.schapiro.org/2017/06/eliminating-password-of-shared-accounts.html

3. A Login Security Architecture Without Passwords

schlomo.schapiro.org/2022/02/login-security-architecture-without-passwords.html

forto

Functional Requirements for Secrets Management



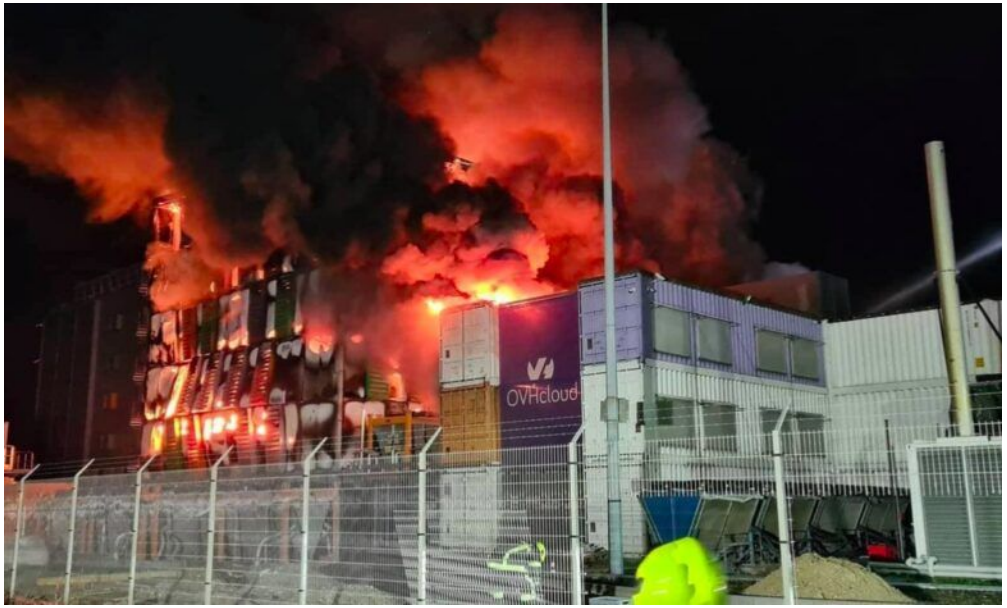
forto

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 within Forto 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
- 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
- …

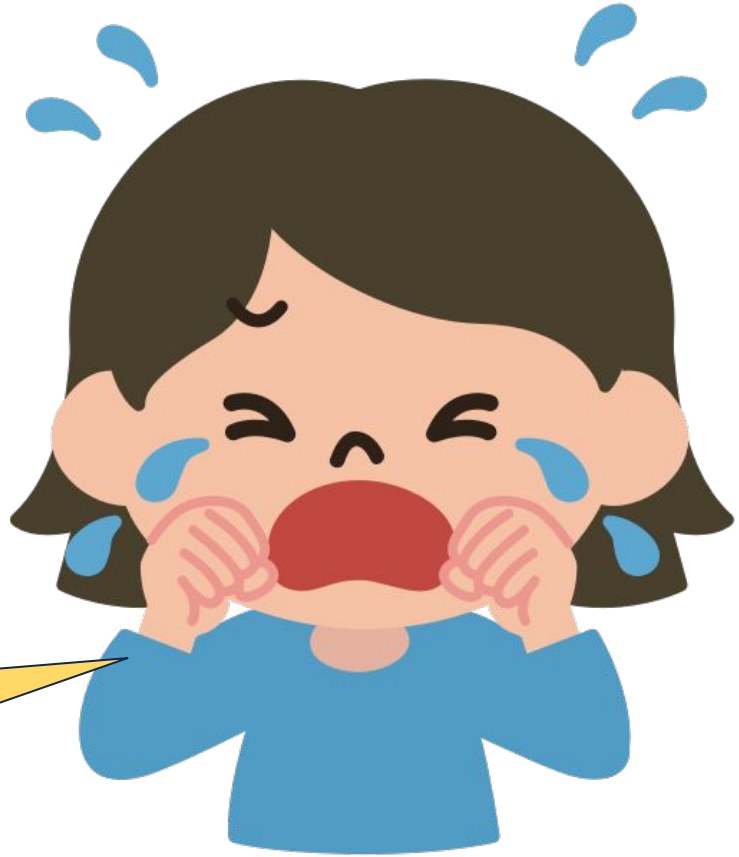
What Could Possibly Go Wrong?

Source: https://www.nytimes.com/2021/04/29/arts/disaster-girl-meme-nft.html



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)

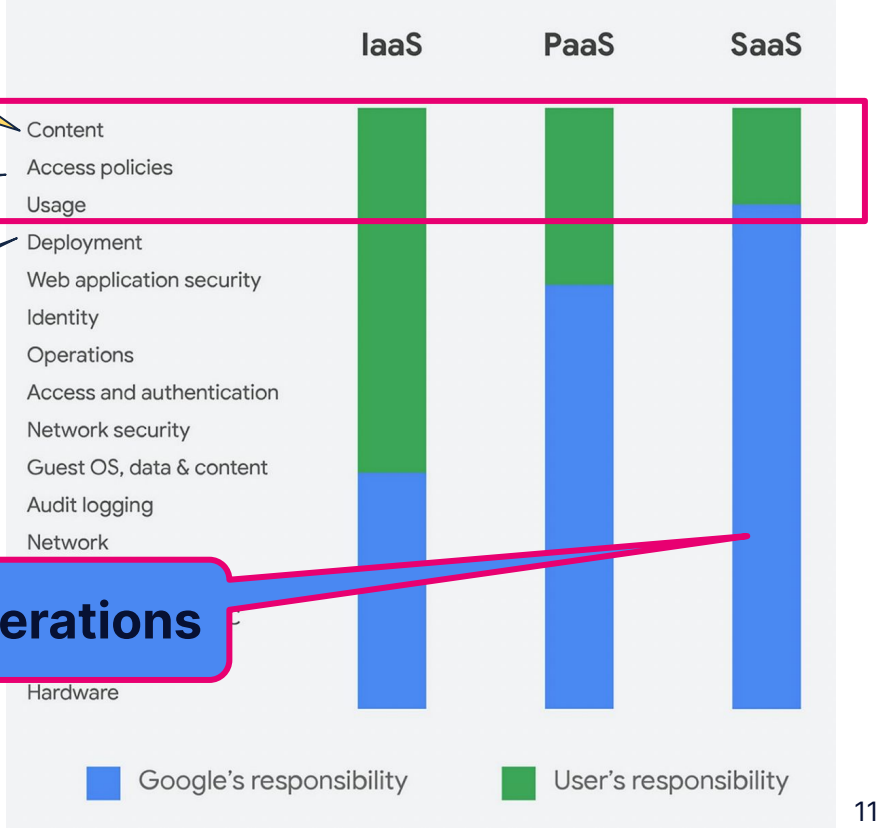
The Problem: Users are Responsible for Content

Accidentally or maliciously deleting data?

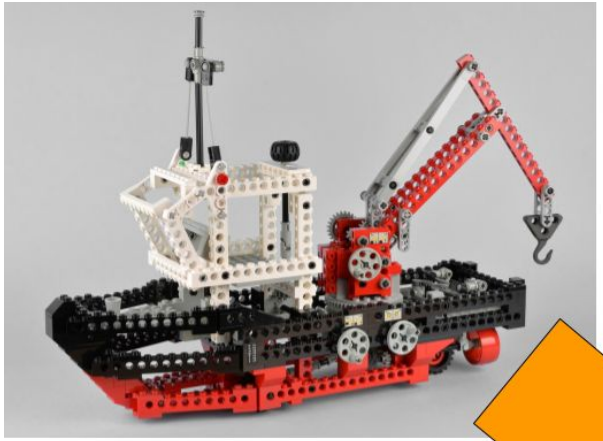
Granting access to malicious apps?

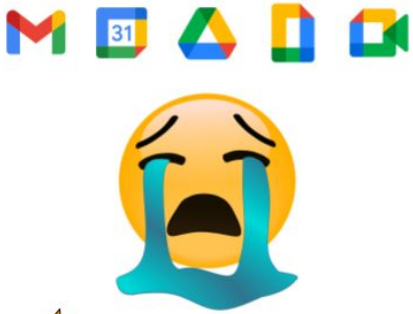
Deleting entire user account or Domain?

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

schlomo.schapiro.org/2022/04/mission-impossible-complete-google-workspace-disaster-recovery.html

Secrets OPerationsS

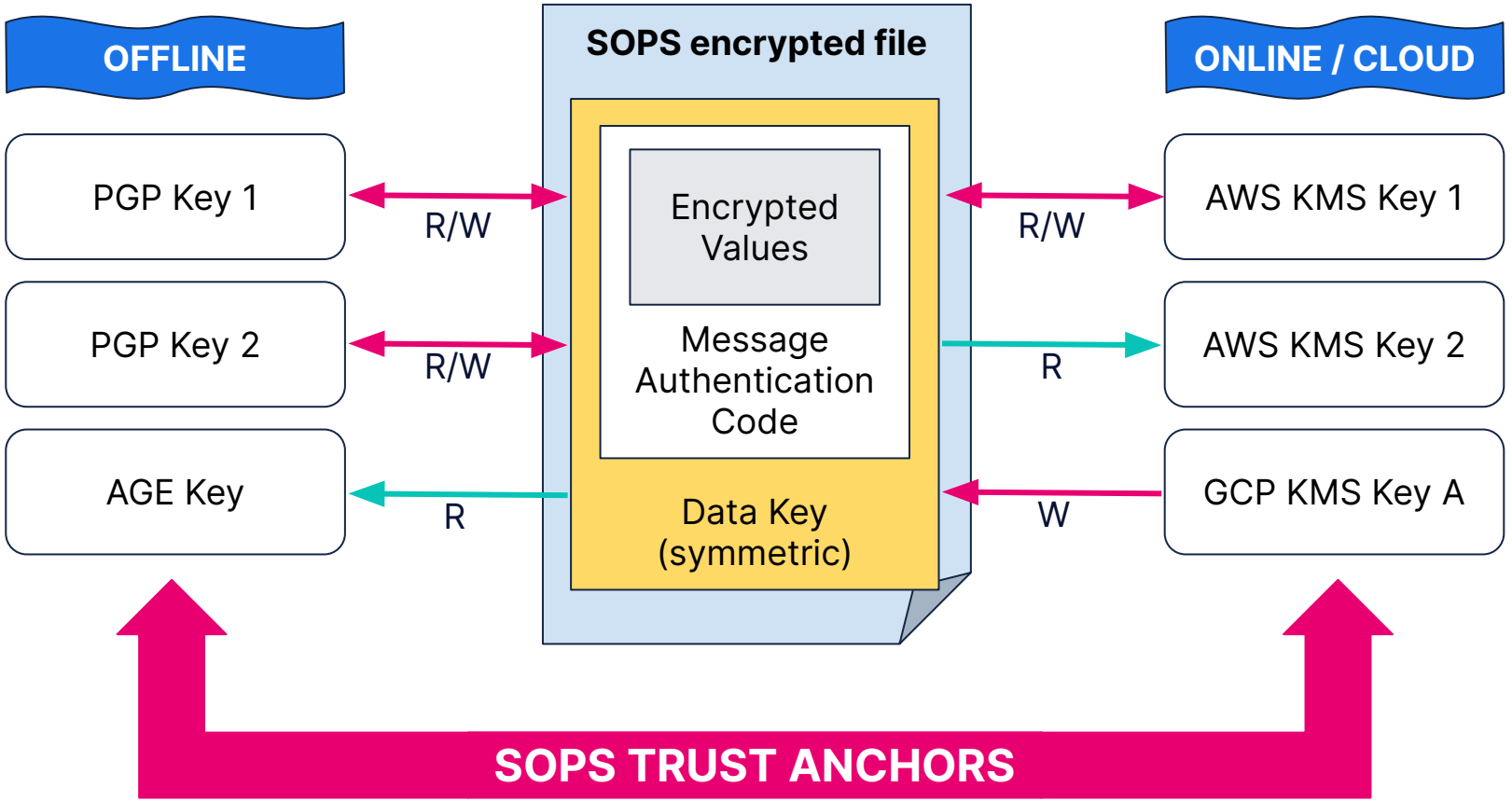
CLOUD NATIVE COMPUTING FOUNDATION

"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 a one of the supported **Key Management Systems** (KMS), **PGP**, or **age**."

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 OPerationsS Architecture



forto

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
```

forto

Secrets OPerationsS - encrypted file

```
info: ENC[AES256_GCM,data:HYGEJNOq3C6c4Id6d9CE4OVa15mX/8uE+M2DrO5ONd2hDTpUKw5oNEJ
example_key: ENC[AES256_GCM,data:h4ZPZQVP3V3hVxt6Mw==,iv:x8mYCxxpzWBbN5sfOfr2V5IB
#ENC[AES256_GCM,data:6gX78q+XkdVTGYd1CHxXCw==,iv:ce5lH6voUQnea70Ksu1DWSAgKTgZ7mOh
example_array:
   - ENC[AES256_GCM,data:HC5zVU6LaVzehk77Hos=,iv:6C/pusncdpKGZFTX569+5lVRkoJHNhsl
   - 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/3D4Waa1kXz3RBF68nhZDV4CHuPFOZc84I=
   - ENC[AES256_GCM,data:NGOxinc=,iv:Tj9bSL5d1HlX5yAZ07jpyNL3keVYAvUJi9VNDNcD0B4=
sops:
   kms: []
   gcp_kms: []
   azure_kv: []
   hc_vault: []
   age:
       - recipient: age12pewudxq53khcgm49flqq7t6l5na8jscsnn4lqyxla4nzzm4l92qsk7qq
         enc: |
           -----BEGIN AGE ENCRYPTED FILE-----
```

forto

Secrets OPerationsS - encrypted file explained

```
example_array:
    - ENC[AES256_GCM,data:HC5zVU6LaVzehk77Hos=,iv:6C/pusncdpKGZFTX569+5l
    - ENC[AES256_GCM,data:r6DuIBIn+mbi70M2f2E=,
sops:
    kms: []
    gcp_kms: []
    azure_kv: []
    hc_vault: []
    age:
        - recipient: age12pewudxq53khcgm49flqg7t6l5na8jscsnn4lqyxla4nzzm
          enc: |
            -----BEGIN AGE ENCRYPTED FILE-----
            YWdlLWVuY3J5cHRpb24ub3JnL3YxCi0+IFgyNTUxOSBUNlNPaEtNT01nRVZx
        …
            -----END AGE ENCRYPTED FILE-----
    lastmodified: "2023-11-14T13:06:19Z"
    mac: ENC[AES256_GCM,data:GcnG90R58SeOf06kukMUiBfB8MJ+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
- …

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

forto

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
```

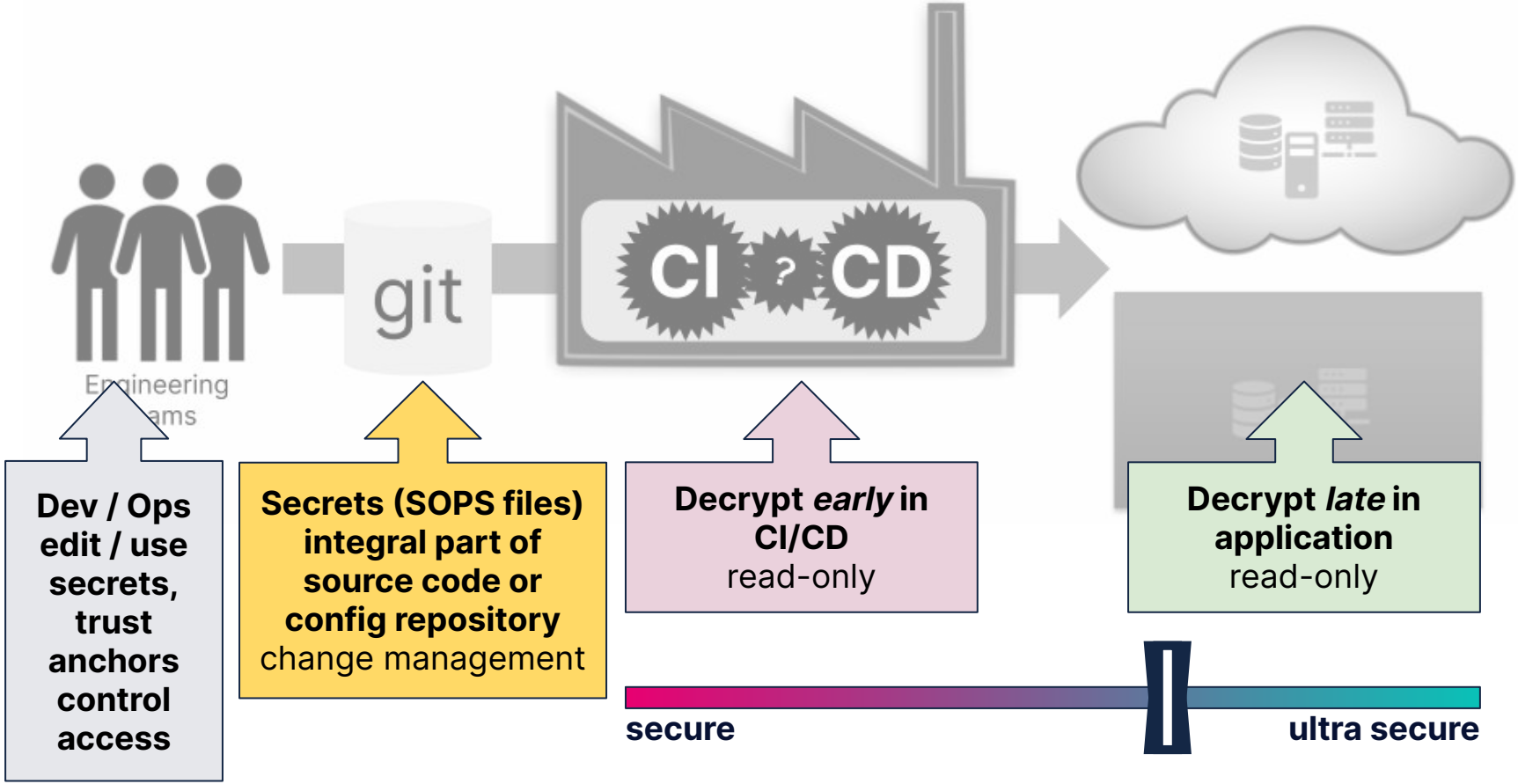
```
sops -d secrets.env
```

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

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

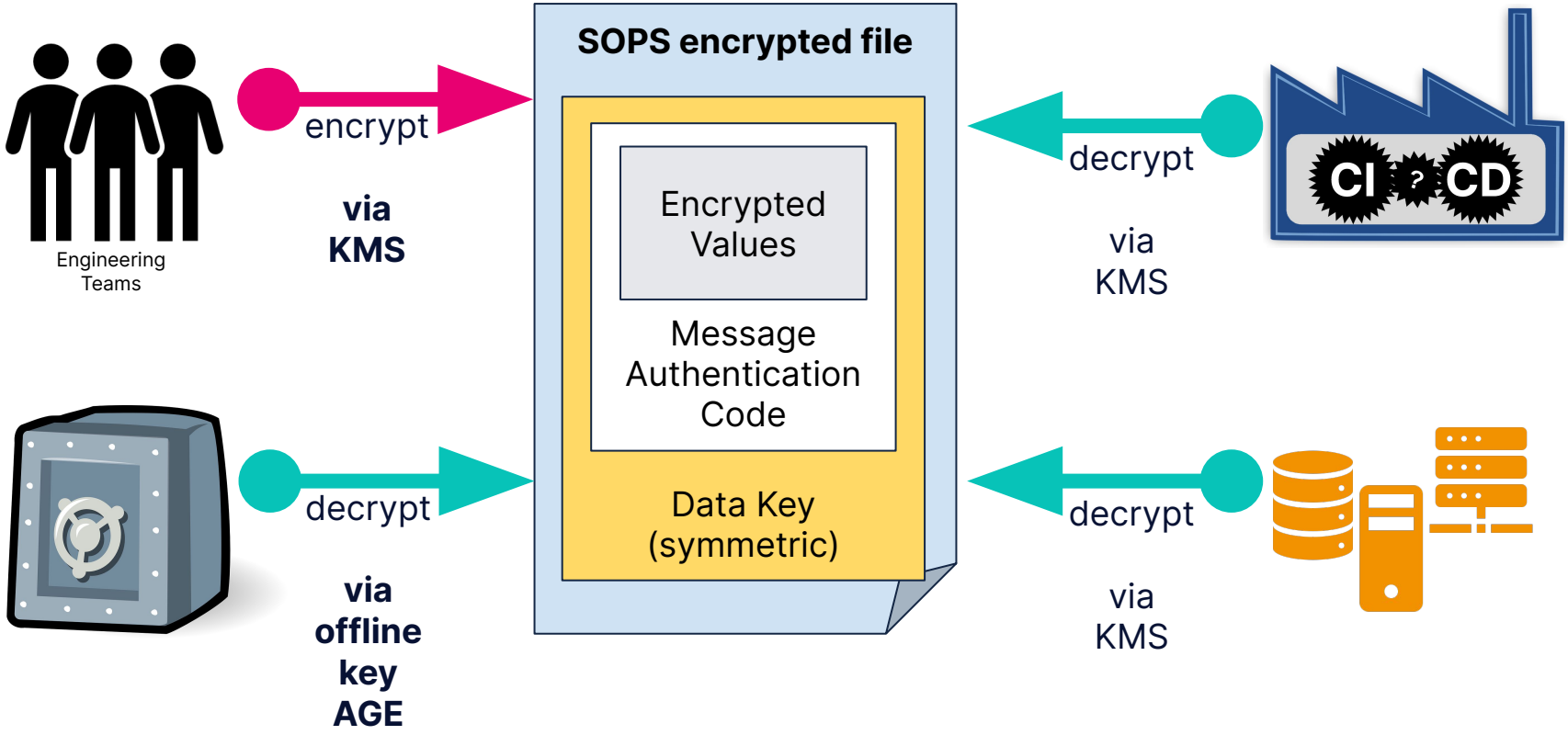
forto

SOPS in the Software Delivery Life Cycle



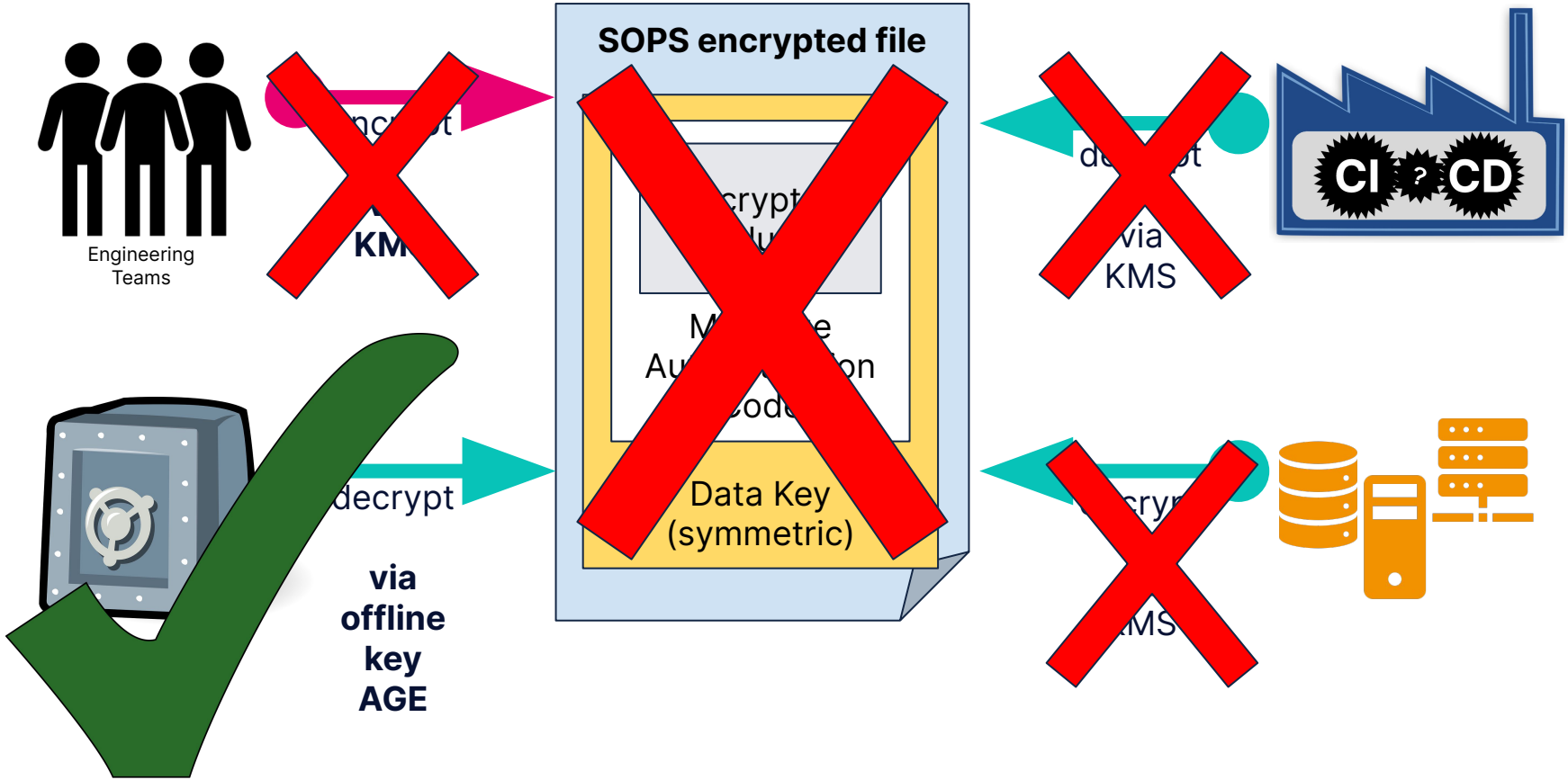
forto

SOPS Trust Anchors → “Secrets Management”



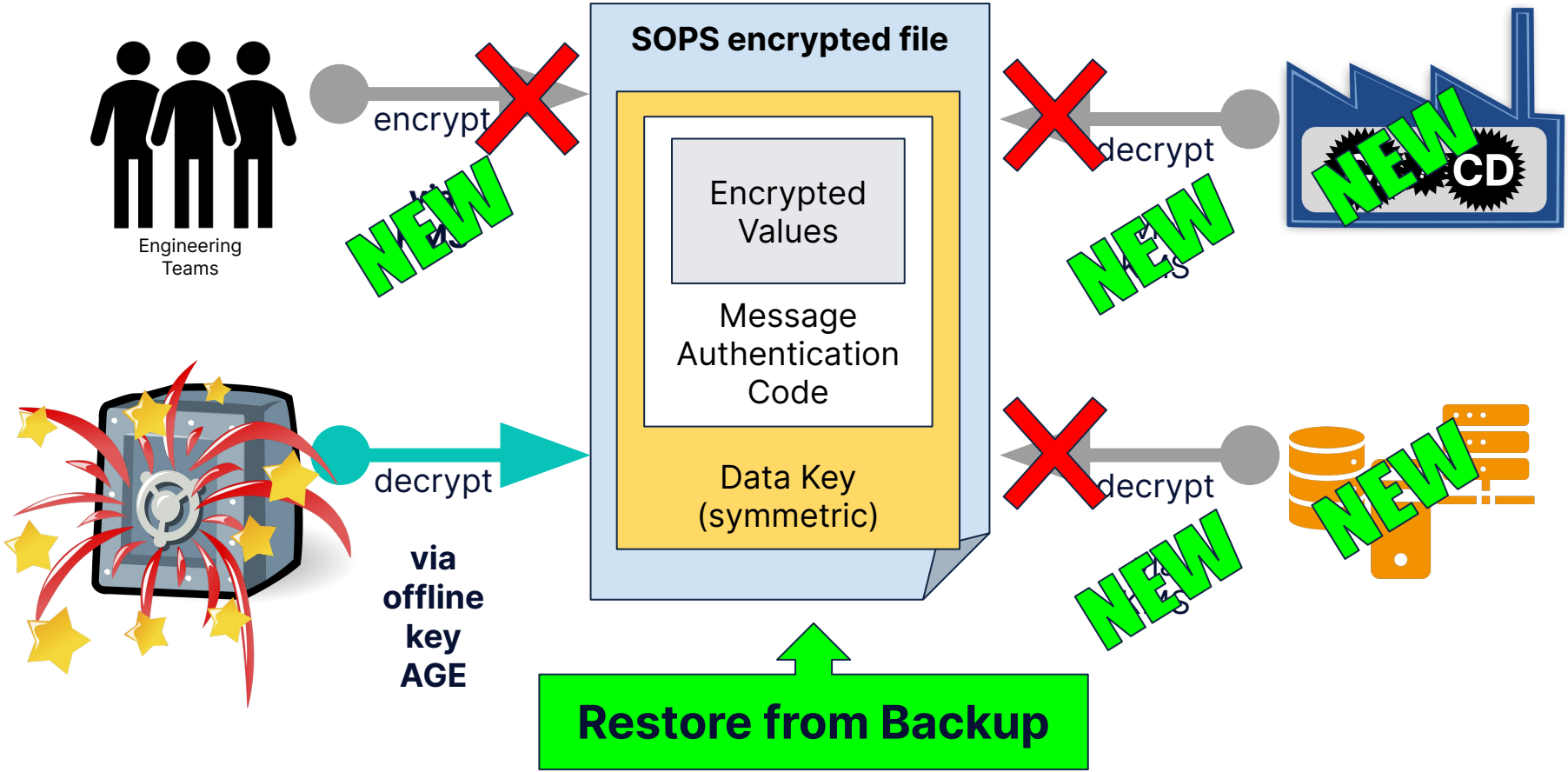
forto

Disaster — All Cloud Data or Services are Gone!



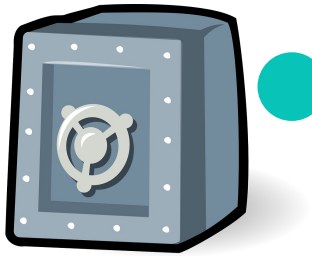
forto

Recovery — All Cloud Data and Services are New!



forto

Recovery — Restore Access for New SOPS Trust Anchors



decrypt

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
--- age1g45d2ymssutc3d3qvsk66qagtwwvpejpf4tz9ve8uej4p7tcu5uq5c8qgn
2023/11/15 17:01:09 File /Users/schlomoschapiro/Downloads/demo.env synced with new keys
```

02.06.2023 Schlomo Schapiro

forto

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**.

	AGE-SECRET-KEY-1URQG46XWU80J408HUDAXP3FQZQ5Z5DZWS2YZCCKMQ76HLKGCM65QTC9WK3FAKE
Mozilla SOPS: github.com/mozilla/sops	AGE: github.com/FiloSottile/age
This document: Offline Disaster Recovery for SOPS	The HOW-TO: Encrypted Files with SOPS

Usage Hints:

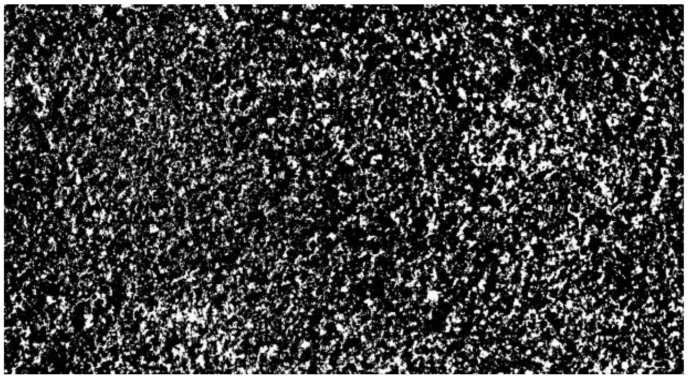
```
SOPS_AGE_KEY=AGE-SECRET…. sops -d secrets.yaml # decrypt
SOPS_AGE_KEY=AGE-SECRET…. sops –add-age age1… -r -i secrets.yaml # reencrypt
echo AGE-SECRET…. | qrencode -s 100 -o key.png # create QR code
```

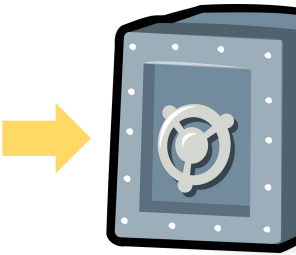
Please export this file from Google Docs as ODT and replace the demo QR code and AGE key with the real data before printing.

Offline Disaster Recovery Decryption Key for SOPS files

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

Key:age1rh03azryvlhmmgecw2v6afar7pv
zucr767m9cvxp8s9vgzf394gq462kzk
```





forto

forto

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 <a href="[redacted]g">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

Cloud & Offline Secrets Management & Disaster Recovery 😀

Managing operational secrets with SOPS

No Backup? No Mercy!

schlomo.schapiro.org