JETSTACK by Venafi

Rotate Roots Right Round

Using cert-manager for Safer Private PKI

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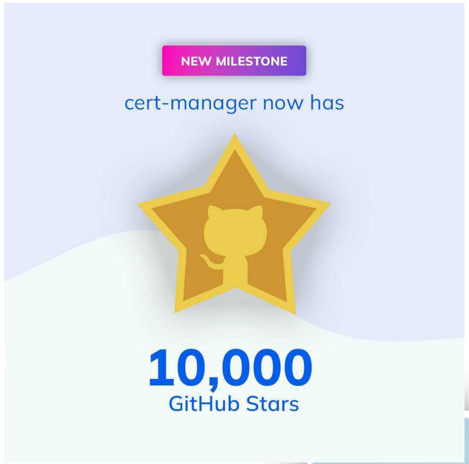
github.com/SgtCoDFish

cert-manager

"cert-manager is the easiest way to automatically manage certificates in Kubernetes clusters.

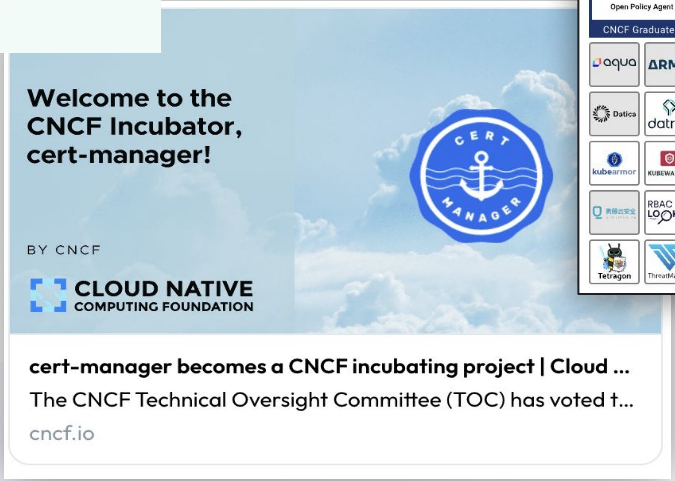
— Literally us, the cert-manager team

CLOUD NATIVE
COMPUTING FOUNDATION


NEW MILESTONE

cert-manager now has

10,000
GitHub Stars


Welcome to the CNCF Incubator, cert-manager!

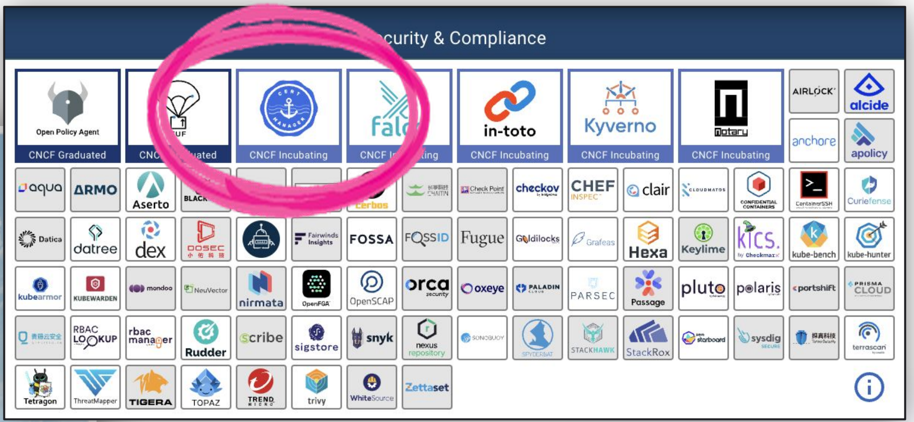
BY CNCF

CLOUD NATIVE COMPUTING FOUNDATION

cert-manager becomes a CNCF incubating project | Cloud ...

The CNCF Technical Oversight Committee (TOC) has voted t...

cncf.io



```
kind: ClusterIssuer
apiVersion: cert-manager.io/v1
metadata: { name: my-ca-issuer }
spec:
  ca: { secretName: root-secret }
```

HashiCorp Vault

Venafi Platform

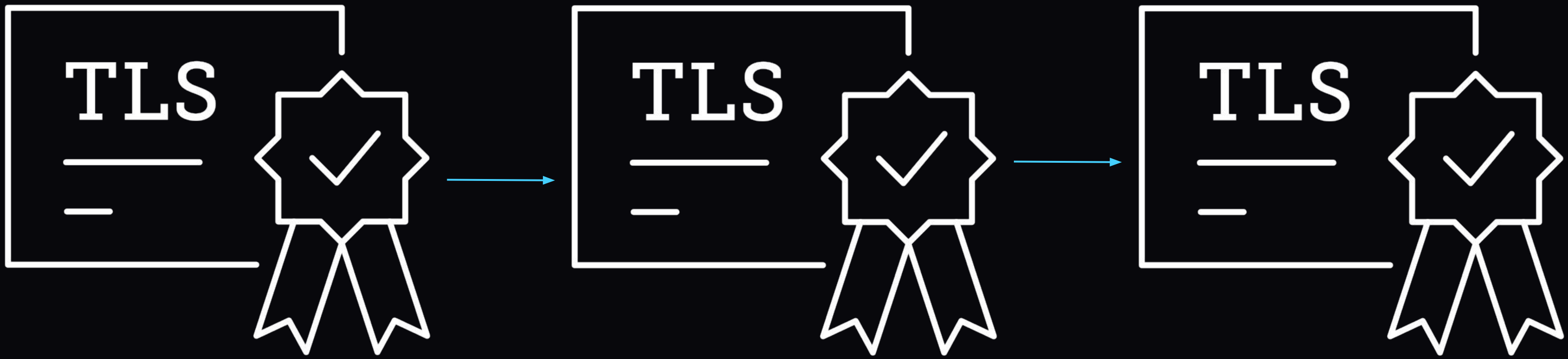
Let's Encrypt

What’s PKI?

- PKI stands for **P**ublic **K**ey **I**nfrastructure
- PKI = Chains of certificates
- Private PKI: Private certificates controlled by you

- Private PKI:
  - Is cost-effective (free or at least cheap)
  - Gives total control over certs
  - Has no artificial rate limits

- Certificates are the things you need for TLS / SSL
- Many / most services today need certificates
- Enables encryption in transit.
- That applies for Kubernetes too!



Root

Certificate

Intermediate

Certificate

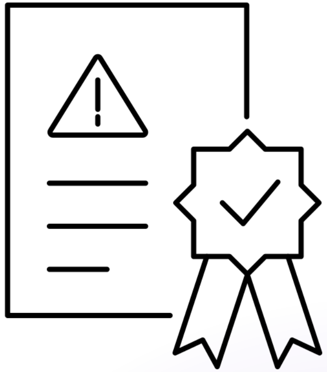
Leaf

Certificate

- Traditionally, intermediates issue leaf certificates
- Roots are stored offline
- Roots are only used to issue new intermediates

- This architecture isn’t required!
- Roots could issue directly
- What’s best depends on your architecture

Risks of Private PKI



- Private PKI is no free lunch
- There are serious issues to consider
- Some risks are specific to cert-manager
- Some are true for PKI generally

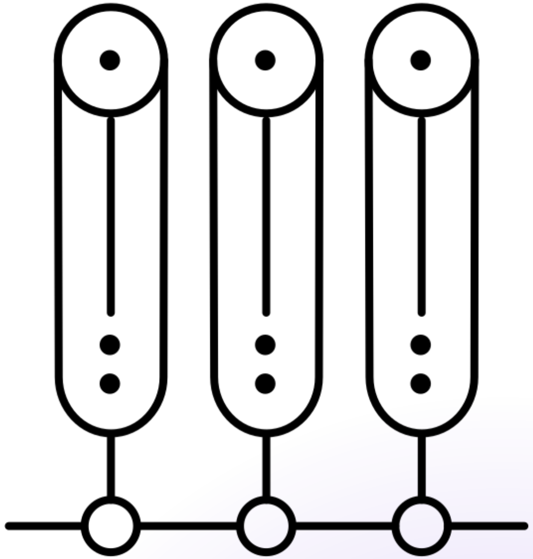
- **Risk #1:** Not Locking Down
- CA issuers will issue anything
- Including other CA certificates!
- Can be mitigated with approver-policy

- **Risk #2:** Root Rotation!
- Lots of gotchas, easy to get wrong
- Requires a plan; this is unavoidable
- Generally tricky to automate
- Luckily, this talk will cover this!

- **Risk #3:** Trust
- Private CAs aren’t useful if nothing trusts them
- Subtleties with rotation
- trust-manager can help
- You still need to prepare

- We’ll mitigate these risks
- And we’ll produce a sustainable plan
- Must be production ready and easy to maintain

Safe
Private PKI



- There's a repo for this!
- https://github.com/SgtCoDFish/rotate-roots
- Don't copy from slides!
- Link shared again later

Issuance

- Simplest approach is entirely in-cluster
- Could just use cert-manager
- Safer to use approver-policy and trust-manager
- Other methods are available!

```yaml
apiVersion: cert-manager.io/v1
kind: Certificate
metadata: { name: root-certificate, namespace: cert-manager }
spec:
  isCA: true
  commonName: root-certificate
  secretName: root-secret
  duration: 219000h # ~25y
  issuerRef: <selfsigned issuer ref>
```

- Roots can have longer lifetimes
- As long as rotation policy is in place
- Feel free to use more descriptive names!

```yaml
apiVersion: cert-manager.io/v1
kind: ClusterIssuer
metadata: { name: root-issuer }
spec:
  ca: { secretName: root-secret }
```

Policy

- Policy prevents several vulnerabilities:
  - Issuing unexpected CA certificates
  - Issuing for privileged domains
  - Dangerously long lifetimes

```yaml
apiVersion: policy.cert-manager.io/v1alpha1
kind: CertificateRequestPolicy
metadata: { name: ca-issuer-policy }
spec:
  allowed:
    isCA: false
    commonName: { value: "*", required: true }
    dnsNames: { values: ["*"], required: true }
  constraints: { maxDuration: 48h }
  selector: { issuerRef: { name: root-issuer, … } }
```

- In prod: restrict allowed dnsNames
- Max duration should be as low as possible
- Really shouldn’t run private PKI without something like this!

Trust

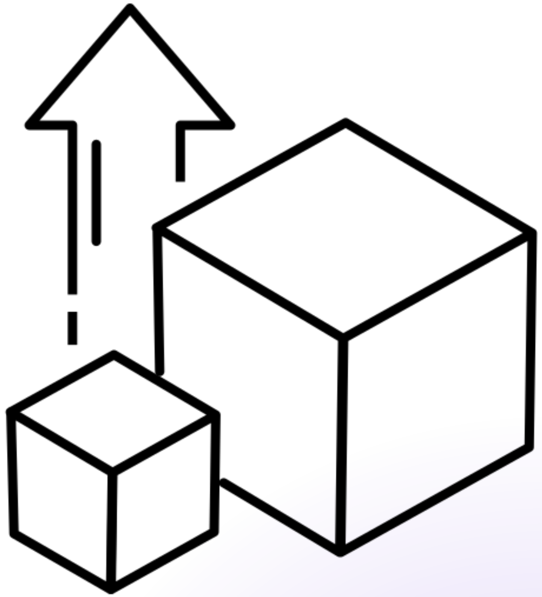
- How do we use our root?
- Pods need to trust it
- Pods also need to trust public certificates
- Enter trust-manager!

```yaml
apiVersion: trust.cert-manager.io/v1alpha1
kind: Bundle
metadata: { name: trust-bundle }
spec:
  sources:
  - useDefaultCAs: true
  - configMap: { name: "cluster-root", key: "root.pem" }
  target: { configMap: { key: "root-certs.pem" } }
```

- Pods mount the resulting ConfigMap and trust our CA
- Bundle means we only have one thing to update
- Avoid rebuilding every container if there’s a new bundle!

- **Warning:** *Don’t use “ca.crt” from the root, directly!*
- If the cert is changed in-place, trust will be updated immediately
- This would break running applications
- Copy the cert into a ConfigMap instead

Scaling Up and Operationalizing



Root Rotation 🐘

- “Rotating intermediates is easier!”
- True - but context matters
- Rotating intermediates in a disaster is hard
- So you need to practice rotating roots!

- What about revocation?
- Very, *very* hard to get right
- Unlikely you'll defend against all attacks
- Lukewarm take: Revocation is not worth it

- Assumptions:
    - No downtime for regular rotation
    - Automated where possible

1. Create new root certificate
2. Add root to Bundle
3. Ensure everything uses new trust bundle
4. Shift issuance to new root
5. Remove old root

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- Almost impossible to automate this generally
- Within k8s, redeploy everything (thanks, trust-manager!)
- Outside k8s? Your org needs to keep track

```yaml
apiVersion: trust.cert-manager.io/v1alpha1
kind: Bundle
metadata: { name: trust-bundle }
spec:
  sources:
  - useDefaultCAs: true
  - configMap: { name: "cluster-root", key: "root.pem" }
  - configMap: { name: "cluster-root-2", key: "root.pem" }
  target: { configMap: { key: "root-certs.pem" } }
```

There's No One Answer

- **Key point #1:** Your Architecture Matters
- Designing PKI depends on your architectural choices
- Probably default to one root per workload / one per cluster

- **Key point #2:** Rotation Is Key
- Architecture aside, you need to plan rotation
- Rotating roots is fairly simple with trust-manager
- Needs regular practice
- Might need to be done in an emergency

- **Key point #3:** Revocation Isn’t Reliable
- You need a rotation plan anyway, so…
- Lean on your rotation plan!

- **Key point #4:** Try Private PKI
- At the very least you’ll learn!
- Maybe you’ll save some money or time, too!

https://github.com/SgtCoDFish/rotate-roots

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Thank you! 🚀

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