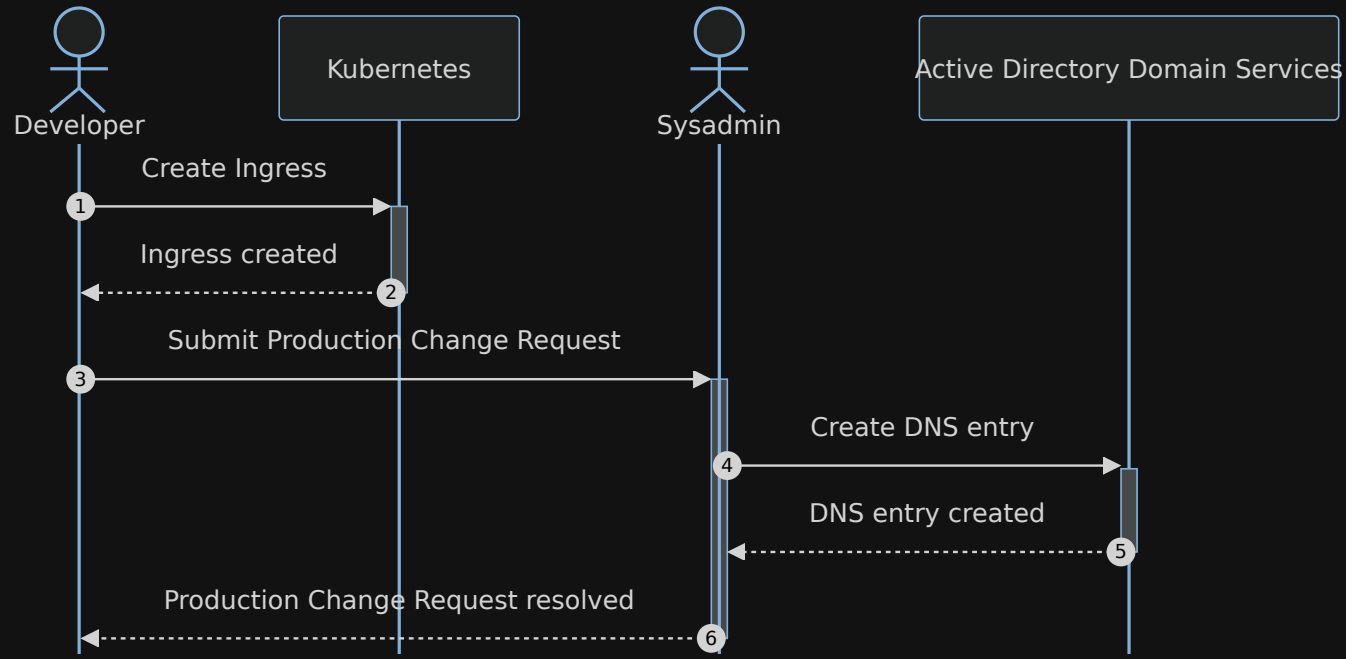
DNS + Certificates

Automated generation of DNS A records and TLS certificates for multi-cluster Kubernetes

CHUA SONG ANN

We don’t enjoy manual work

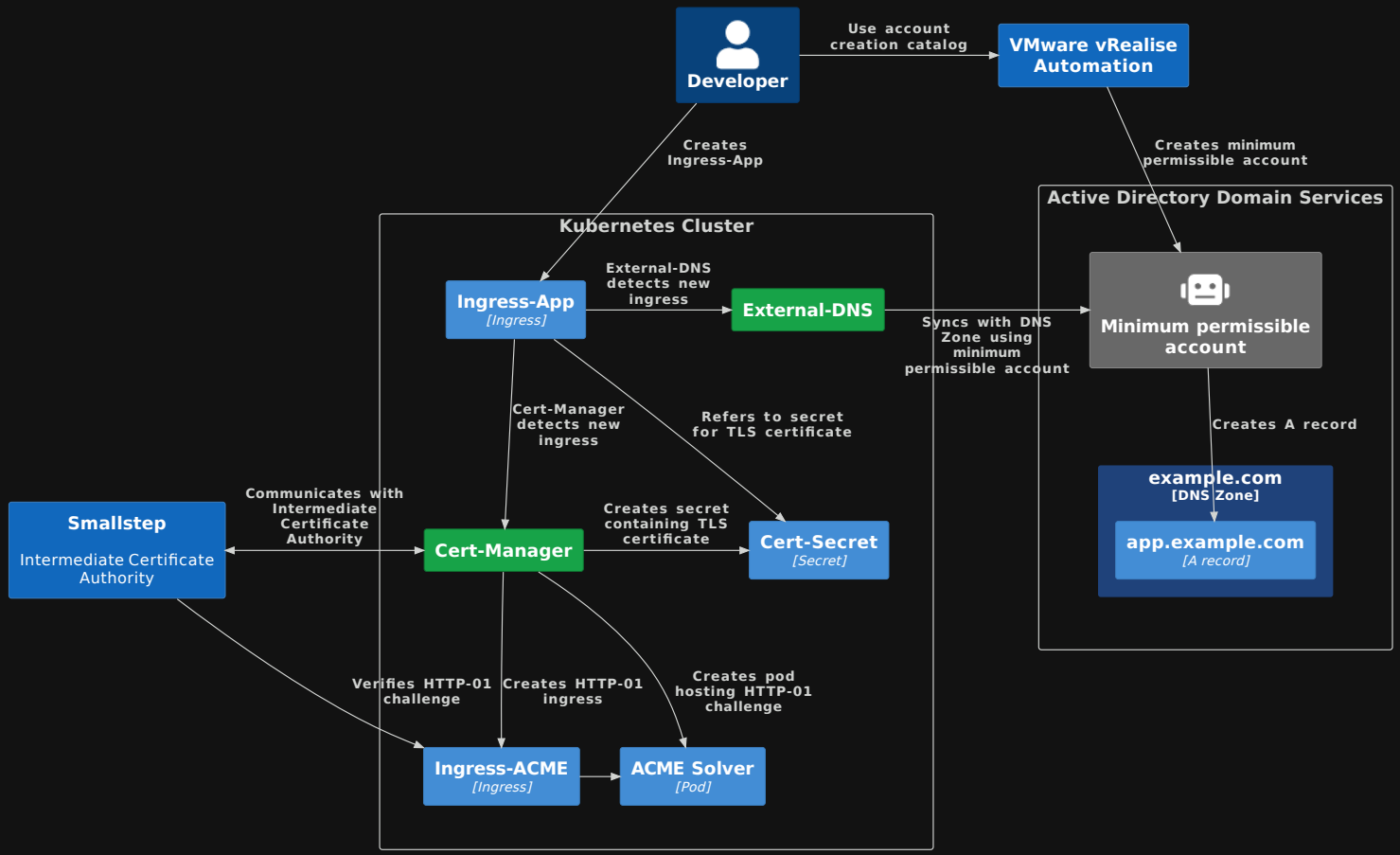
Manual DNS Creation



Manual TLS Certificate Creation

Let’s automate it!

Architecture



External-DNS

- Allows controlling of DNS records dynamically via Kubernetes in a DNS provider-agnostic way
- Available for various DNS providers, including RFC2136 with Kerberos for Windows Server Active Directory
- Deployed into individual downstream clusters
- Does not support multi-cluster natively

Active Directory

- Enable VMware vRealize Automation to create minimum permissible accounts
- Minimum permissible accounts can only create A records in a specific DNS zone, update and delete own records
- Zone-Transfer needs to be enabled for External-DNS to be able to compare A records
- Allow Zone-Transfer only for specific DNS zone to Tanzu Egress CIDR range

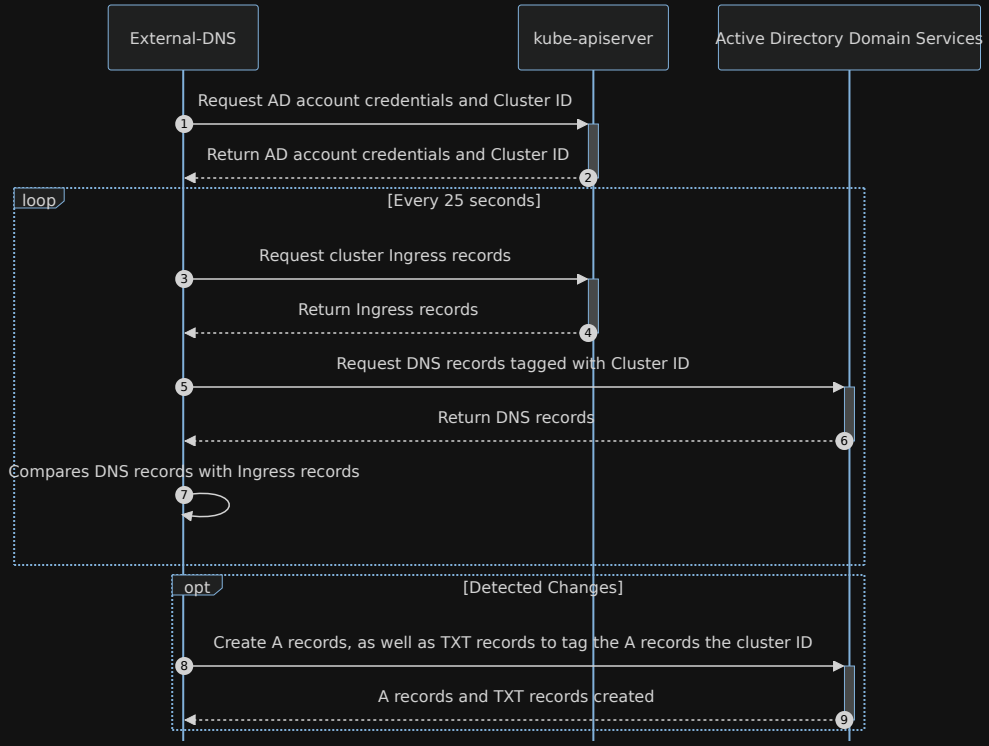
Multi-cluster External-DNS

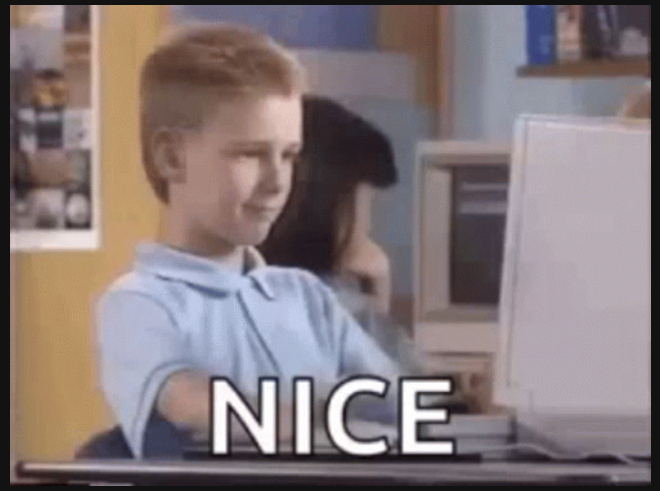
We control External-DNS's access to Active Directory on 2 levels

1. **Cluster ID** — A unique text tagged to DNS records created, to identify the owner of the DNS record
   - Automatically created in the format `` `supervisor_namespace`-`cluster_name` `` when cluster is onboarded to Rancher Dashboard

2. **AD account credentials** — Required for External-DNS to be able to create and modify DNS records
   - Minimum permissible account created through VMware vRealize Automation

Automated multi-cluster DNS Creation




NICE

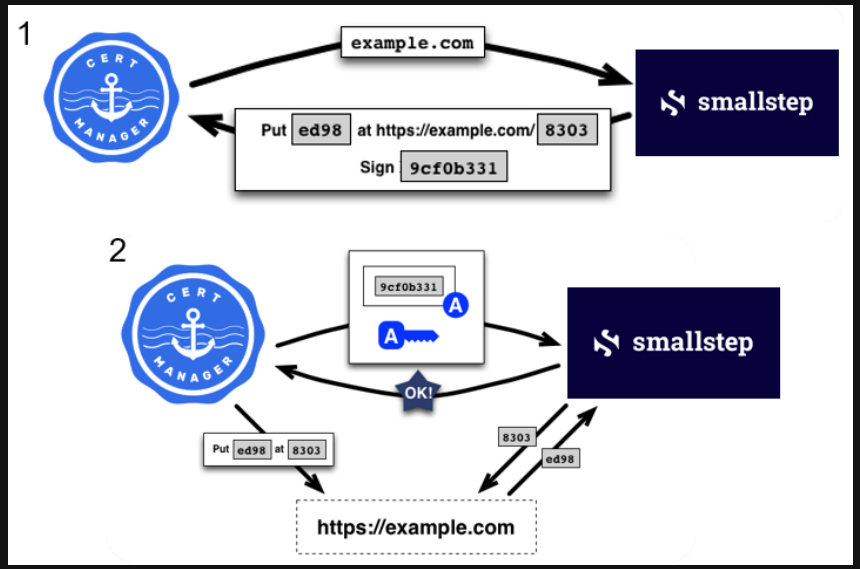
What is ACME?

- Automated Certificate Management Environment
- Protocol for automatic validation and issuance of certificates from a Certificate Authority
- No human interaction required

Summarized steps:

1. The agent proves to the Certificate Authority that the webserver controls a domain
2. The agent then can proceed to request, renew, and revoke certificates for that domain

HTTP-01 Example



Possible choices

ACME-ACDS-Server

- Enables installing ACME-ACDS as a website in Windows Server Active Directory to enable ACME certificate requests from Windows Server Active Directory Certificate Services
- Hobby project with no enterprise level support
- Installing custom components in Active Directory may lead to downstream issues with patching/upgrading

Vault

- Generic secrets management product
- Does not have ACME support
- Need to solve the bottom turtle problem ("Secret Zero")

What we chose

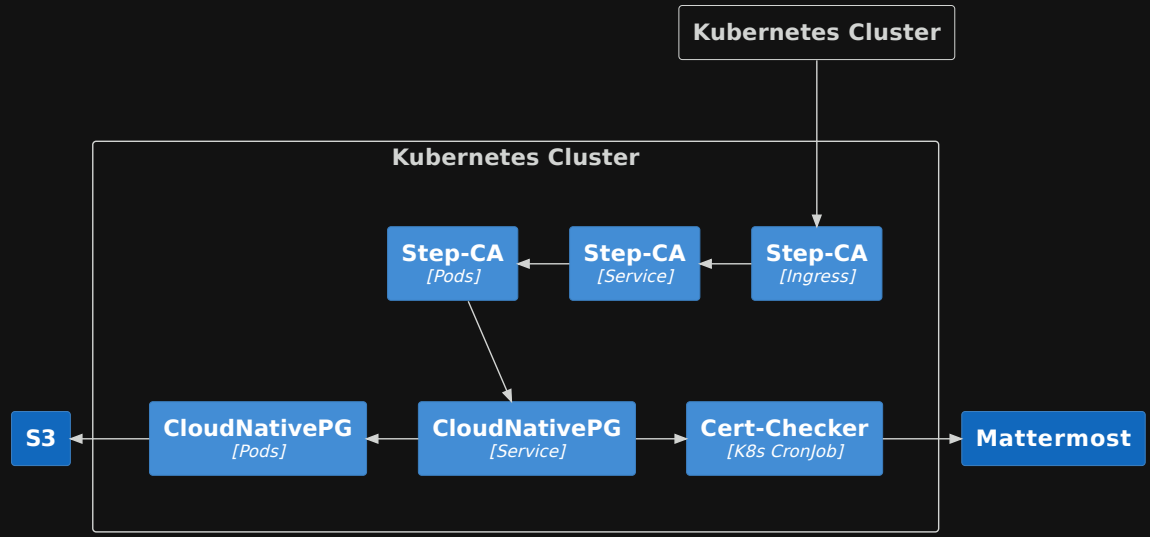
Smallstep

- Specialised Intermediate Certificate Authority to issue certificates
- Supports ACME protocol HTTP-01 challenge
- Templates to customise certificate fields for Subject Alternative Names
- Plays well with Cert-Manager
- No sensitive data stored in the database
- Certificate Authority signing key is encrypted at disk

Certificate Lifetime

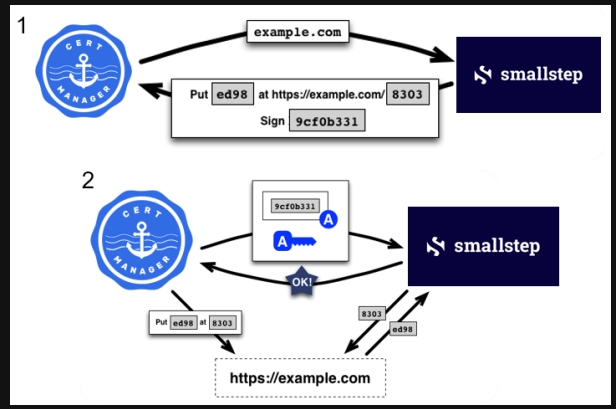
- Certificates should be short-lived
- Reduce ecosystem reliance on "broken" revocation checking solutions that cannot fail-closed
  - If revocation check response does not come back, the browser simply forgets about it
  - Chrome doesn’t even do revocation checks
- **90-days validity** follows best practices from Lets Encrypt and Google

Smallstep deployment

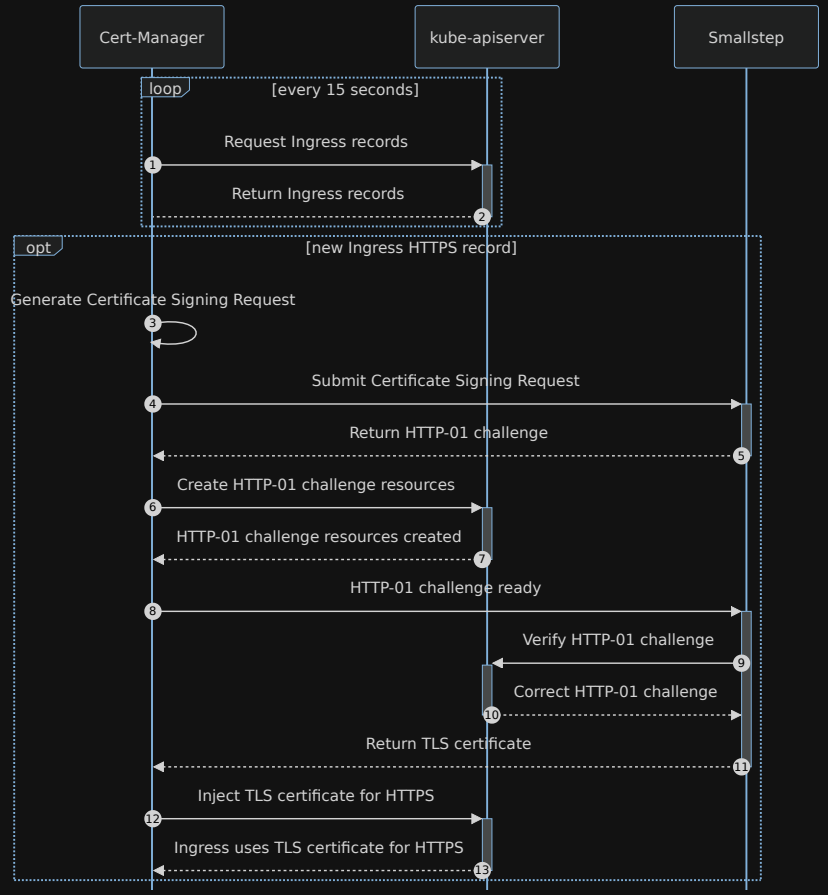


Cert-Manager

- Adds certificates and certificate issuers as resource types in Kubernetes clusters
- Simplifies process of obtaining, renewing and using those certificates
- Deployed into individual downstream clusters

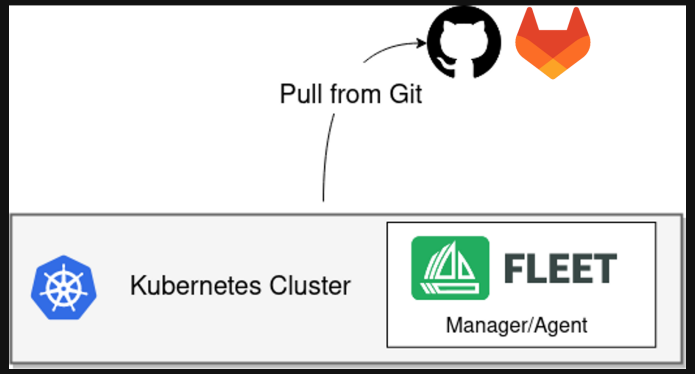


Automated TLS Certificate Creation



GitOps for Configuration Management at Scale

- Git as the single source of truth
- Pull-based approach — don’t need to expose kubeconfig secrets
- Distributed initialisation system that makes it easy to customize applications and manage clusters from a single point



Thank you