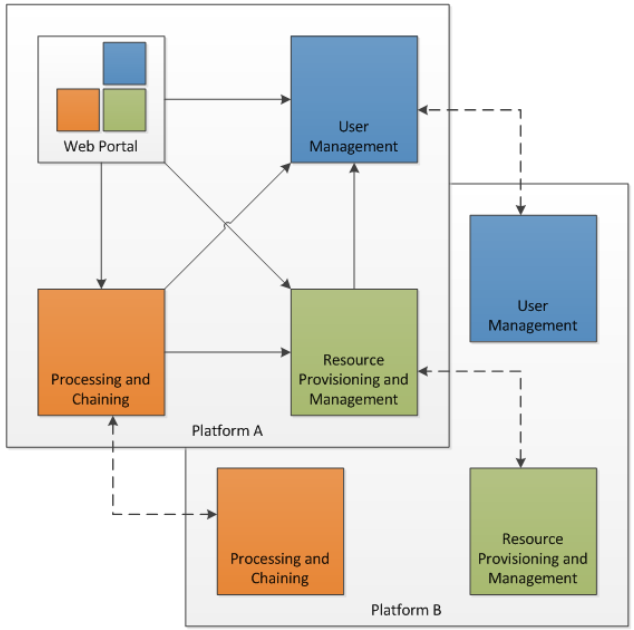
TELESPAZIO
a LEONARDO and THALES company

EOEPCA

Earth Observation Exploitation Platform Common Architecture

Operator Training



20th September 2022

Welcome

Agenda

- **Overview (20 mins)** - Richard
- **Building Blocks**
  Demonstration and description
  - **Processing (45 mins)** – Fabrice/Blasco
  - **Resource Catalogue (30 mins)** - Angelos
  - **Data Access (45 mins)** - Fabian
  - **Workspace (20 mins)** - Bernhard
  - **User Management (20 mins)** - Alvaro
- **Deployment (30 mins)** - Richard
- **Q&A (15+ mins)**

Overview

Demonstration

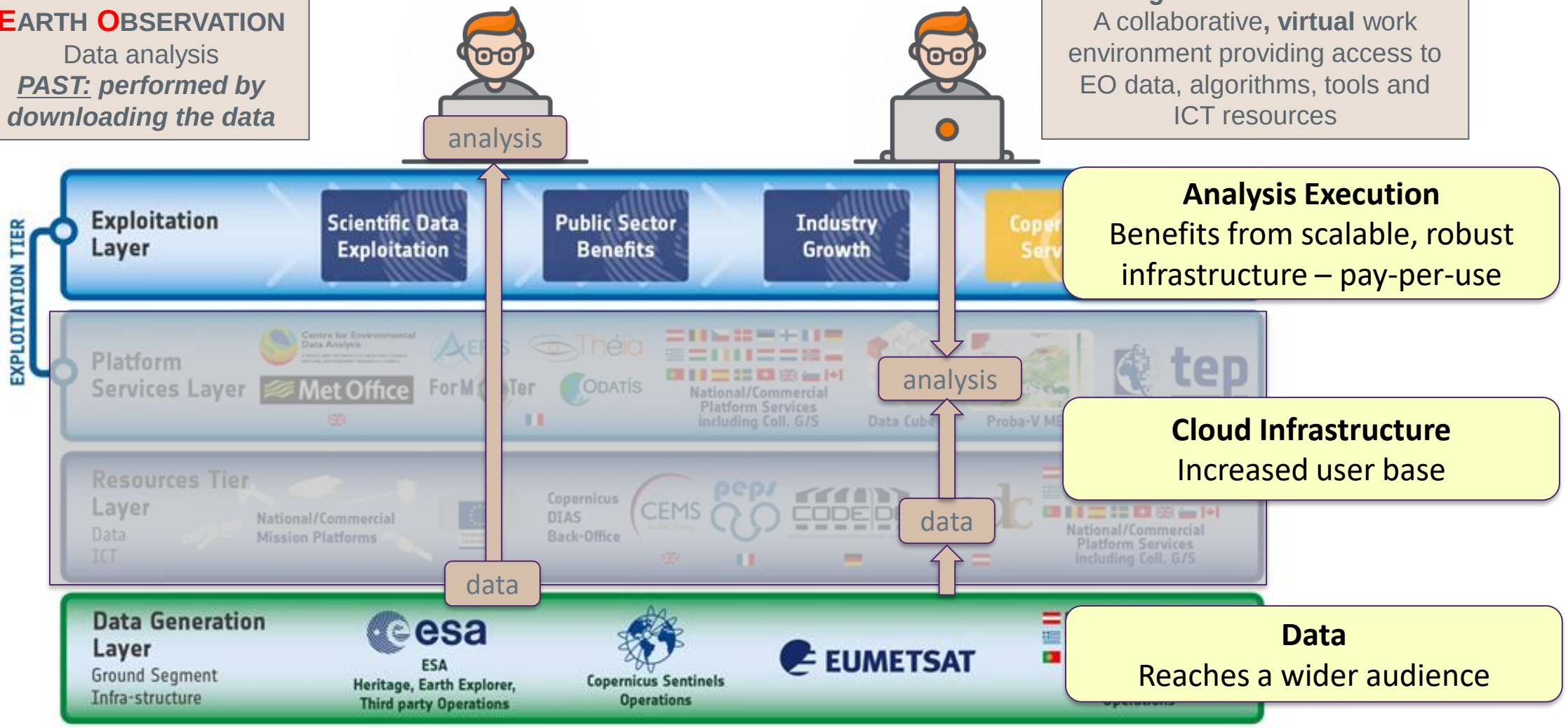
Deployment

Q&A

Exploitation Platform

EARTH OBSERVATION
Data analysis
PAST: performed by downloading the data

EXPLOITATION PLATFORM
"Bring the user to the data"
A collaborative, **virtual** work environment providing access to EO data, algorithms, tools and ICT resources



Analysis Execution
Benefits from scalable, robust infrastructure – pay-per-use

Cloud Infrastructure
Increased user base

Data
Reaches a wider audience

Platform Ecosystem – Network of Resources

Platforms

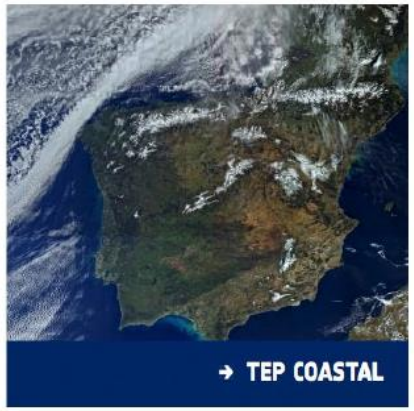
- Virtual work environment
- Access data
- Develop algorithms
- Conduct analysis
- Share value-adding outcomes
- Collaborative communities

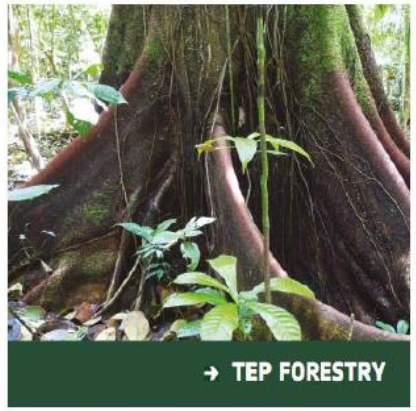
Platform Ecosystem

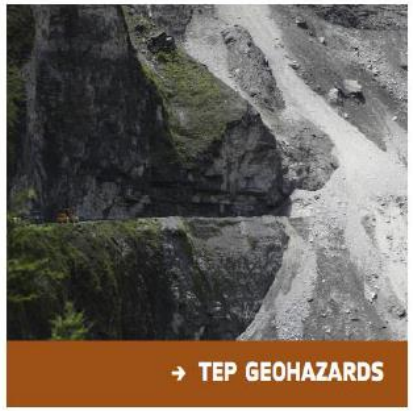
- Data sources
- Analysis tooling
- Cloud processing

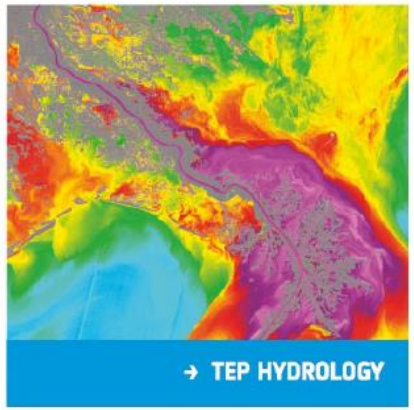
Interoperation

Users of one platform may consume the services of another directly platform-to-platform









Wouldn't it be nice if ... I didn't need to be an ICT wizard or instrument expert to integrate different data into my research or application?

Aspiration – Platform Interoperability

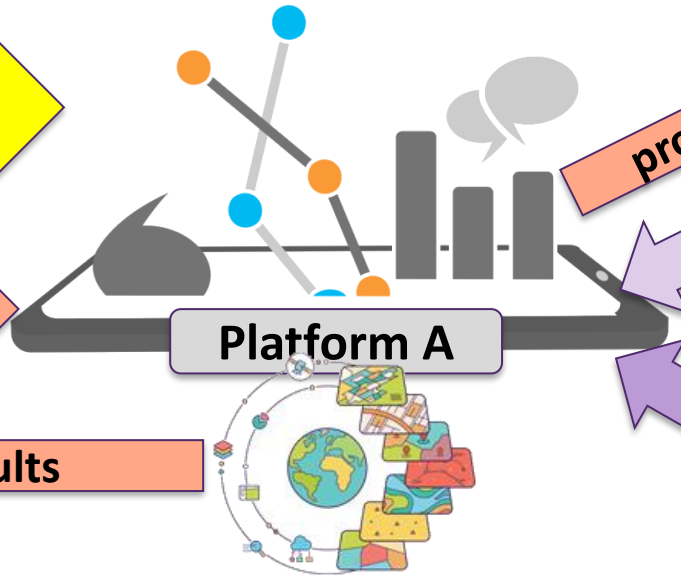
Multi-platform Workflow
Processing at Platform A Combines *processing* at Platform B, with *data* from Platform C

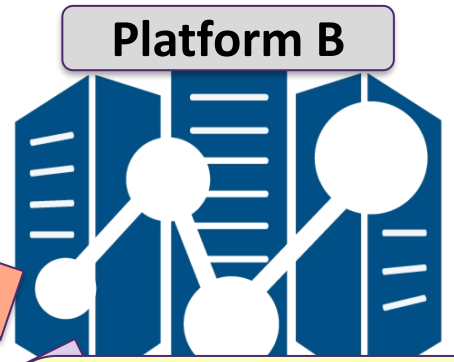
DISCOVER: data + applications

VER: data + applications

EXECUTE: workflow

Workflow results



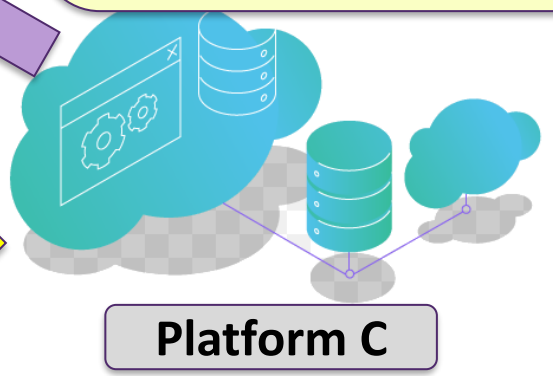


processing

results

Open Interfaces
Standardisation through open interfaces seeks to reduce the friction between inter-platform points of contact

data



GOAL – Common Architecture

EOEPCA

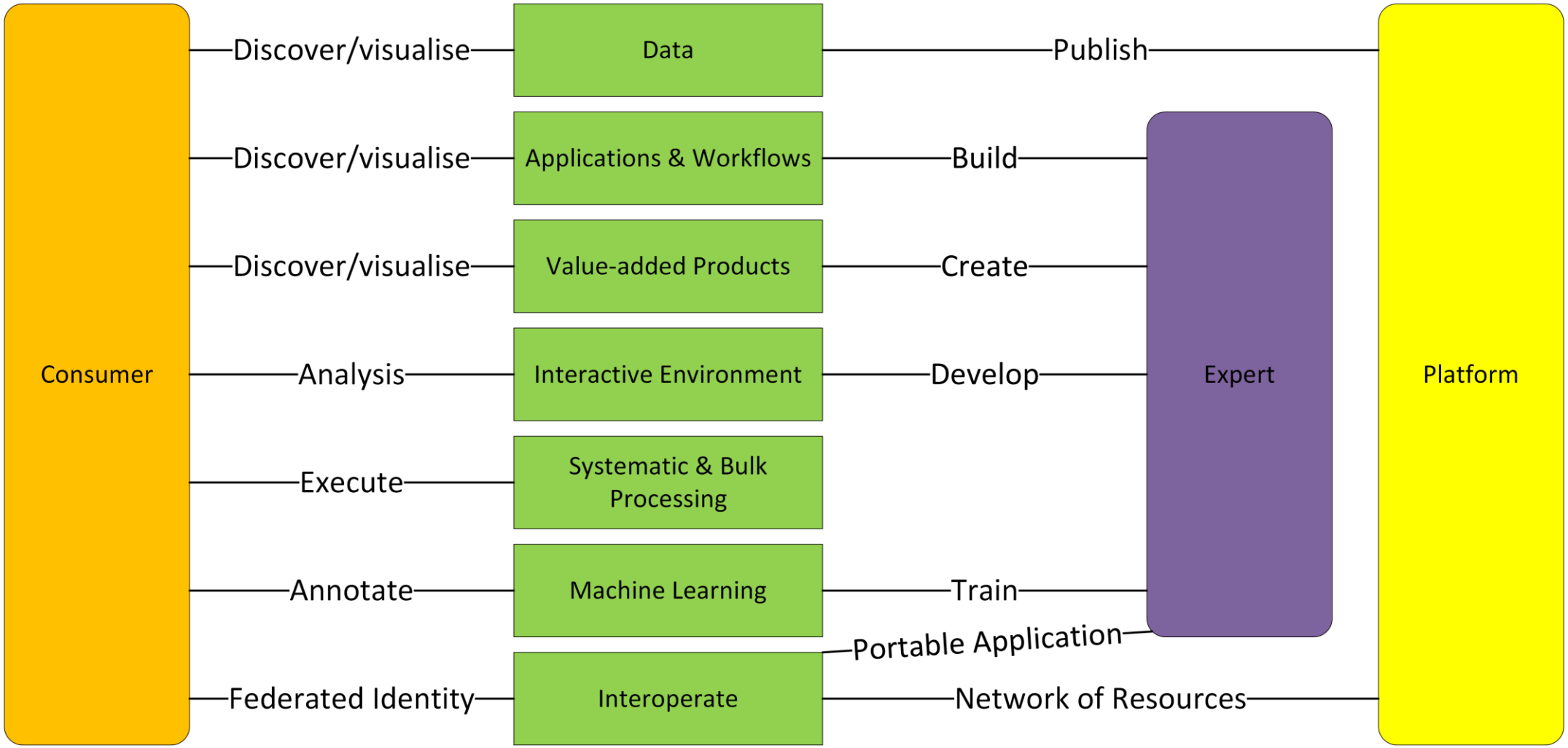
EARTH OBSERVATION EXPOITATION PLATFORMS
COMMON ARCHITECTURE

The goal of the Common Architecture is to define and agree a **re-usable exploitation platform architecture** by identifying a set of common building blocks that provide their services through open interfaces

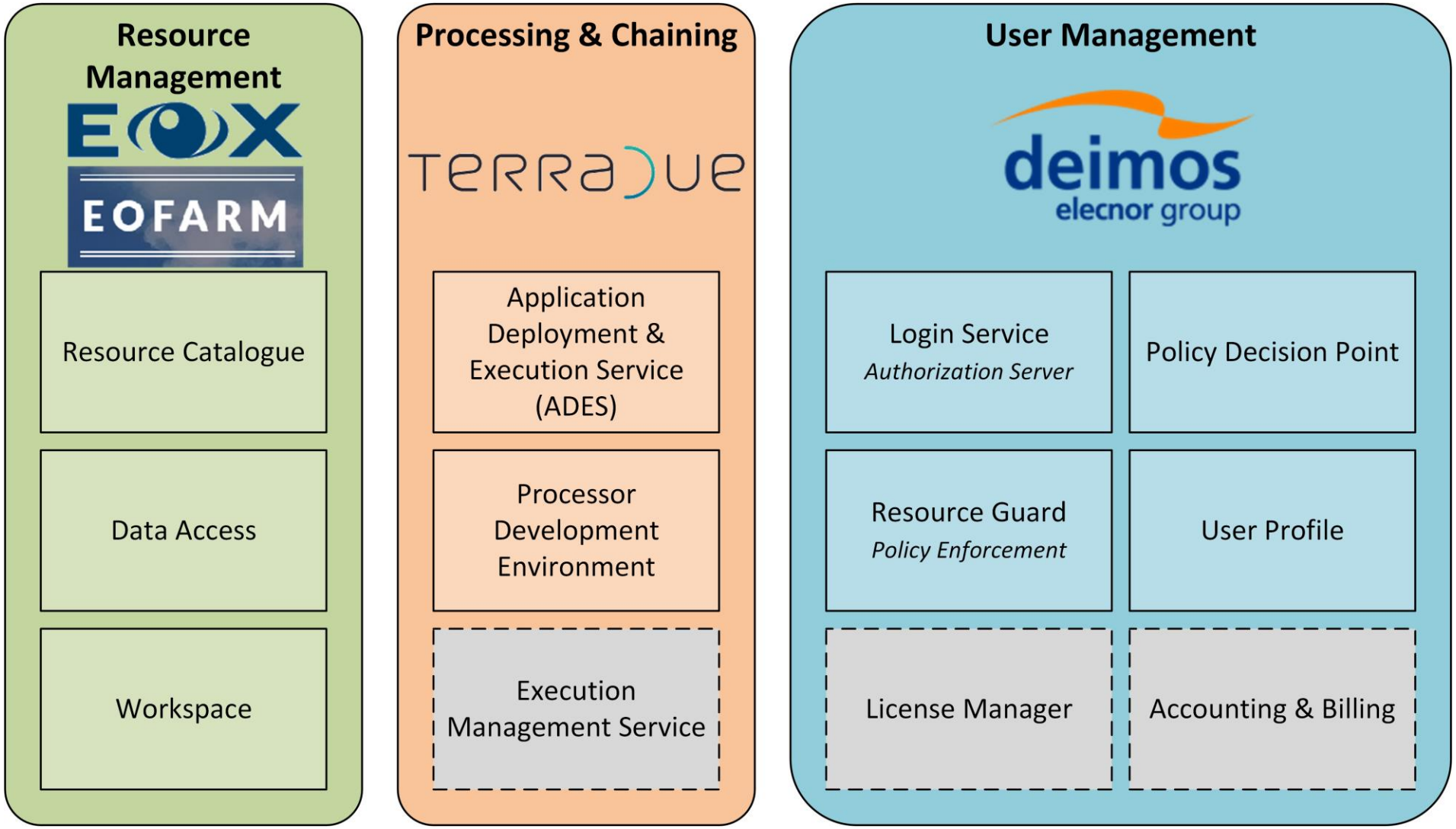
To encourage federation of EPs through an open consensus-based architecture for EPs in the Network of Resources

To provide an **open-source Reference Implementation** of the architecture

Use Cases



Building Blocks



Discovery – Resource Catalogue

Based on pycsw

Interfaces

- OGC CSW 2.0.2/3.0
- OGC API Records
- STAC
- OpenSearch with EO, Geo, Time

Data Model

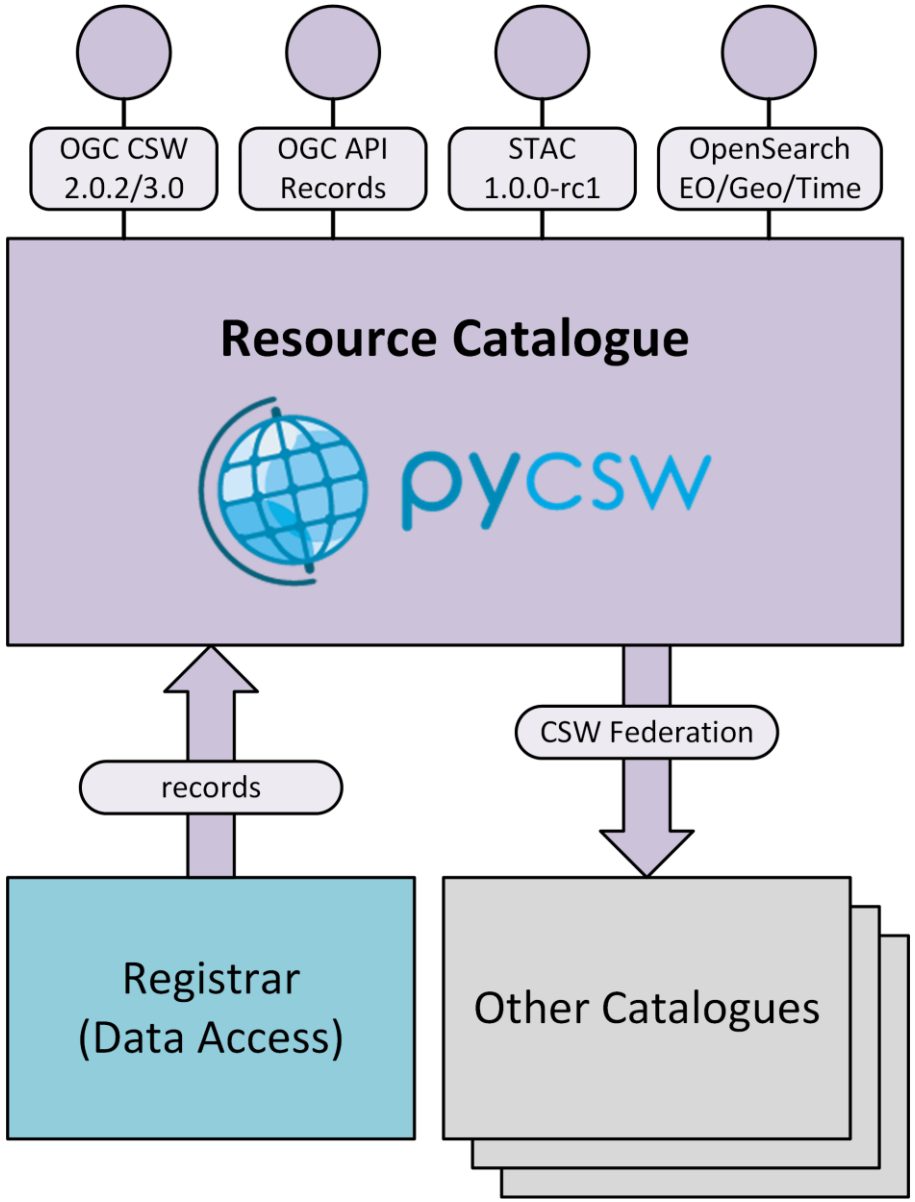
- ISO 19115-1/2

Harvesting

- Push from Registrar/Harvester (Data Access)

Federation

- Via OGC CSW



pycsw

EOEPCA Resource Catalogue

Home

Based on pycsw, a Python

- Collections
- OpenAPI
  - Swagger
  - JSON
- Conformance
- CSW 3.0.0
- CSW 2.0.2
- OpenSearch
- STAC API
- OAI-PMH
- SRU

Home / Collections / EOEPCA Resource Catalogue / Items JSON | Contact

Prev Next

Title	Type
S2A_MSIL1C_20210521T125141_N0300_R138_T29WNT_20210521T145846.SAFE	dataset
S2A_MSIL1C_20201118T095311_N0209_R079_T34UCA_20201118T110128.SAFE	dataset
S2A_MSIL1C_20210521T125301_N0300_R138_T28VCQ_20210521T145846.SAFE	dataset
S2A_MSIL1C_20210521T125301_N0300_R138_T27WVM_20210521T145846.SAFE	dataset
S2A_MSIL1C_20201118T095311_N0209_R079_T33TXG_20201118T110128.SAFE	dataset
S2A_MSIL2A_20210521T125301_N0300_R138_T28VDQ_20210521T153745.SAFE	dataset
S2A_MSIL1C_20210521T125301_N0300_R138_T28WES_20210521T145846.SAFE	dataset
S2A_MSIL1C_20210521T125301_N0300_R138_T28VDR_20210521T145846.SAFE	dataset
S2A_MSIL1C_20210521T125141_N0300_R138_T29WNV_20210521T145846.SAFE	dataset
S2A_MSIL1C_20210521T125141_N0300_R138_T28WEE_20210521T145846.SAFE	dataset

Prev Next

Retrieval – Data Access

Based on EOxServer

Interfaces

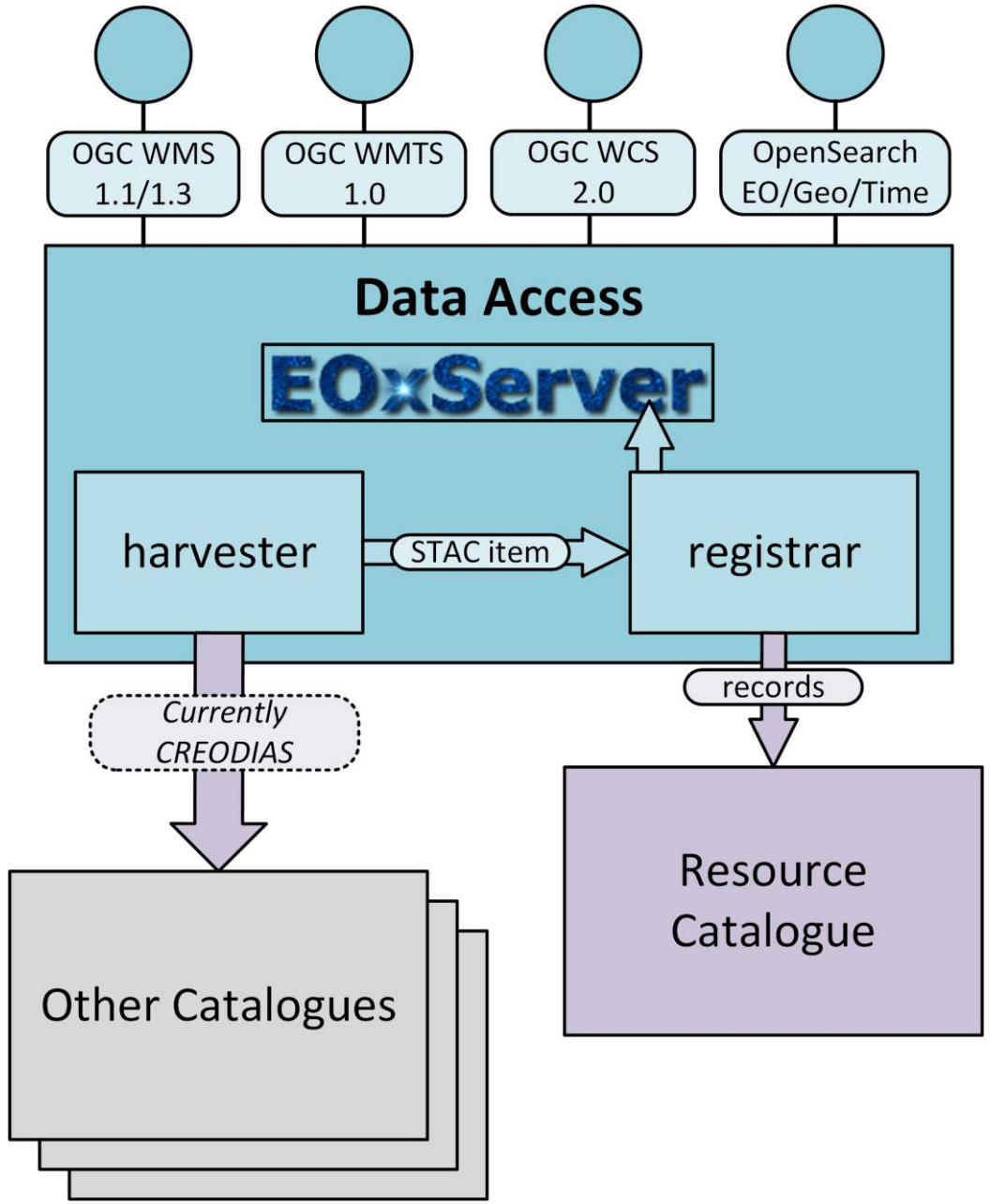
- OGC WMS 1.1-1.3
- OGC WMTS 1.0
- OGC WCS 2.0
- OpenSearch with EO, Geo, Time

Harvester

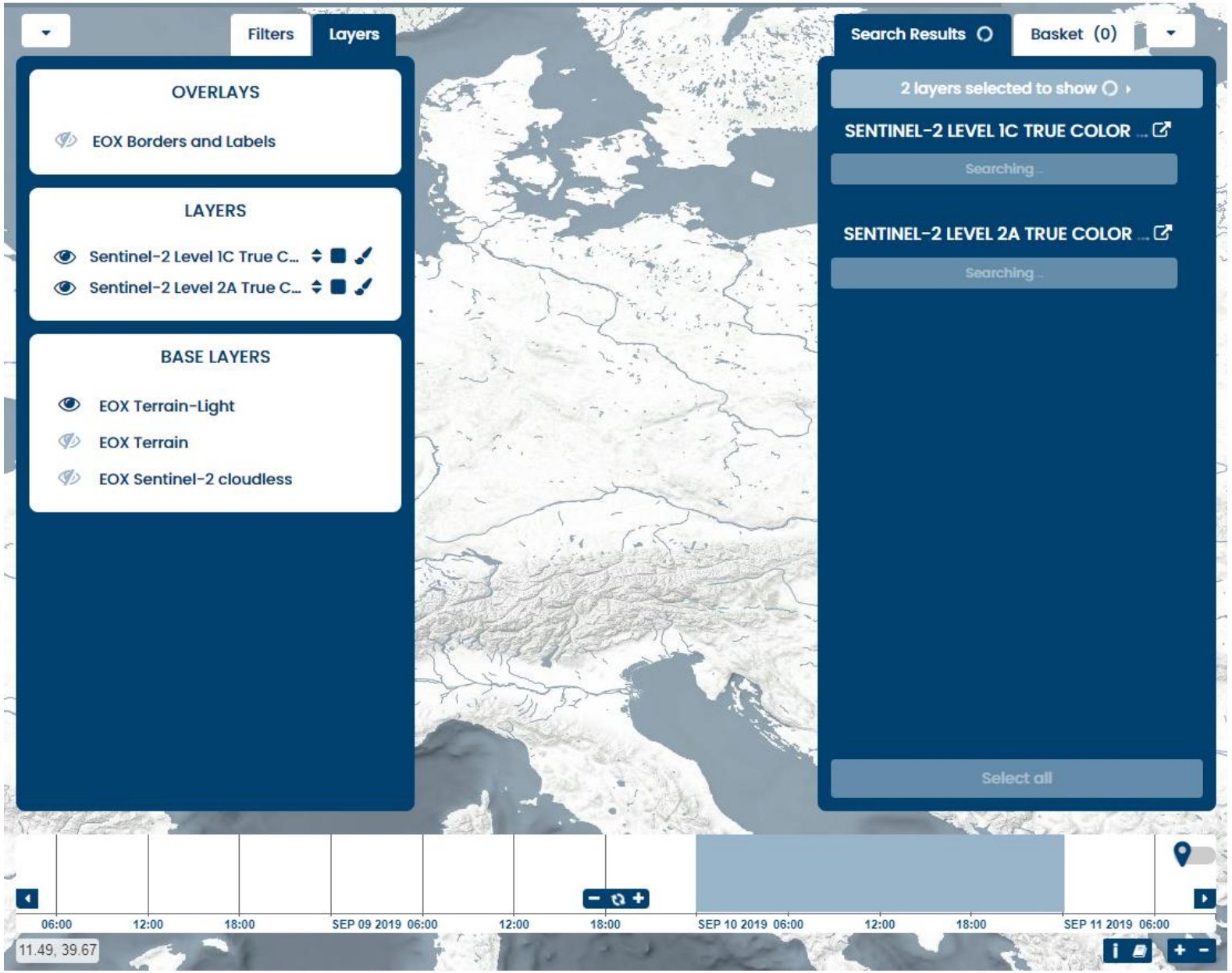
- Currently integrated with CREODIAS

Registrar

- STAC Items from harvester
- Populates Resource Catalogue and EOX View Server



EOEPCA Data Access View Server (VS) Client powered by EOX



Processing - ADES

Based on ZOO project

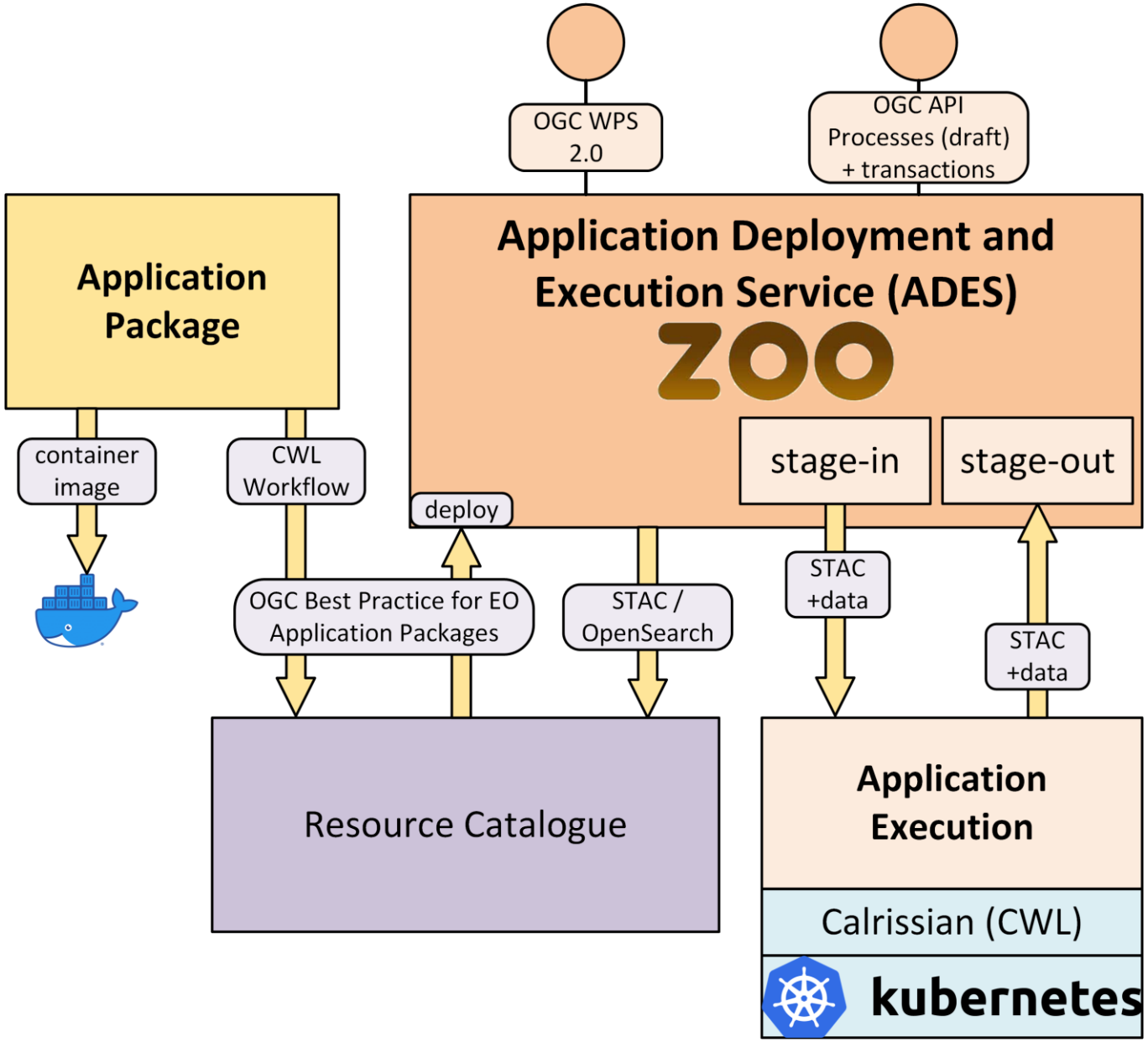
ADES

Deployment & execution of user-defined processing

- OGC WPS 2.0
- Draft API Processes
- + deploy/undeploy
- STAC abstraction
- Calrissian
  CWL runner for Kubernetes

Application Package

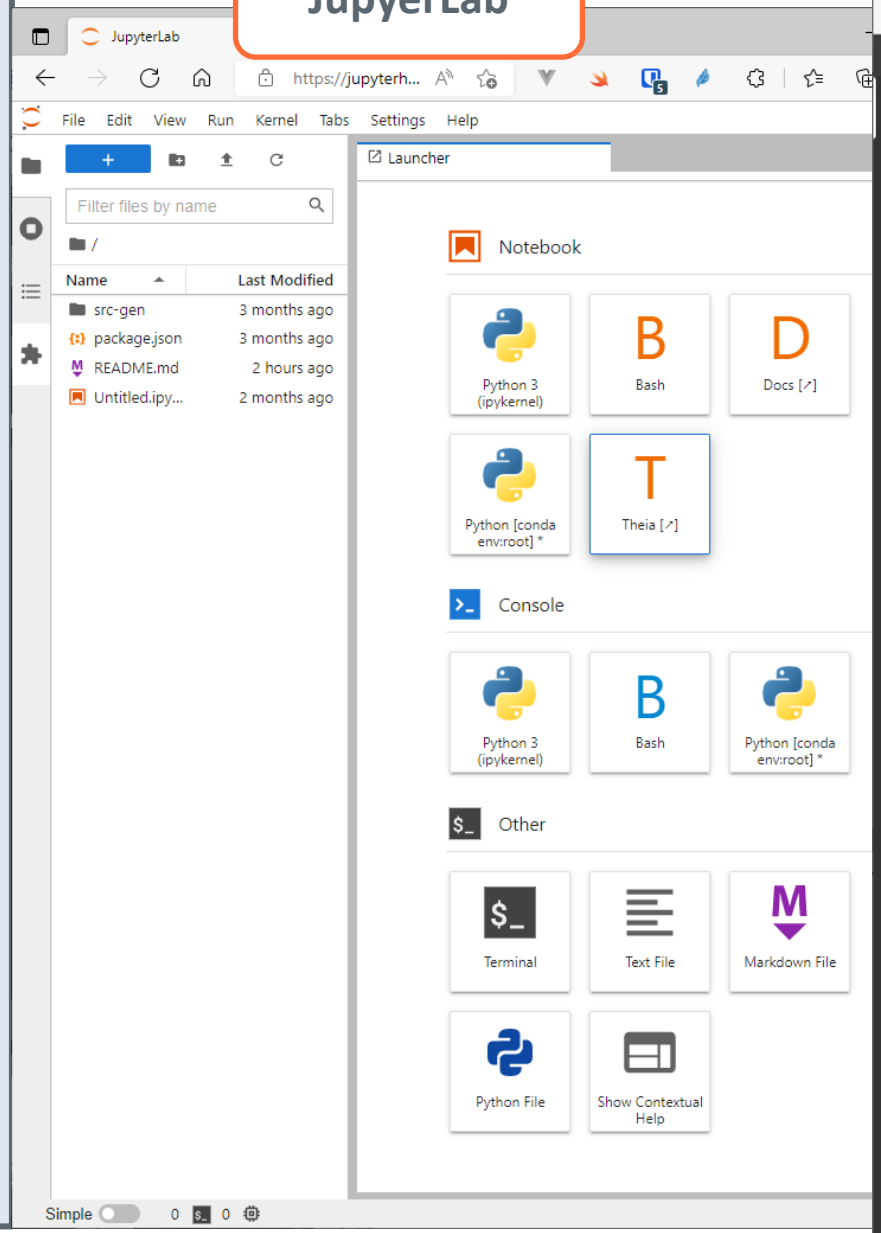
- Metadata descriptor (CWL)
- Container image
- ***OGC Best Practice for EO Application Packages***



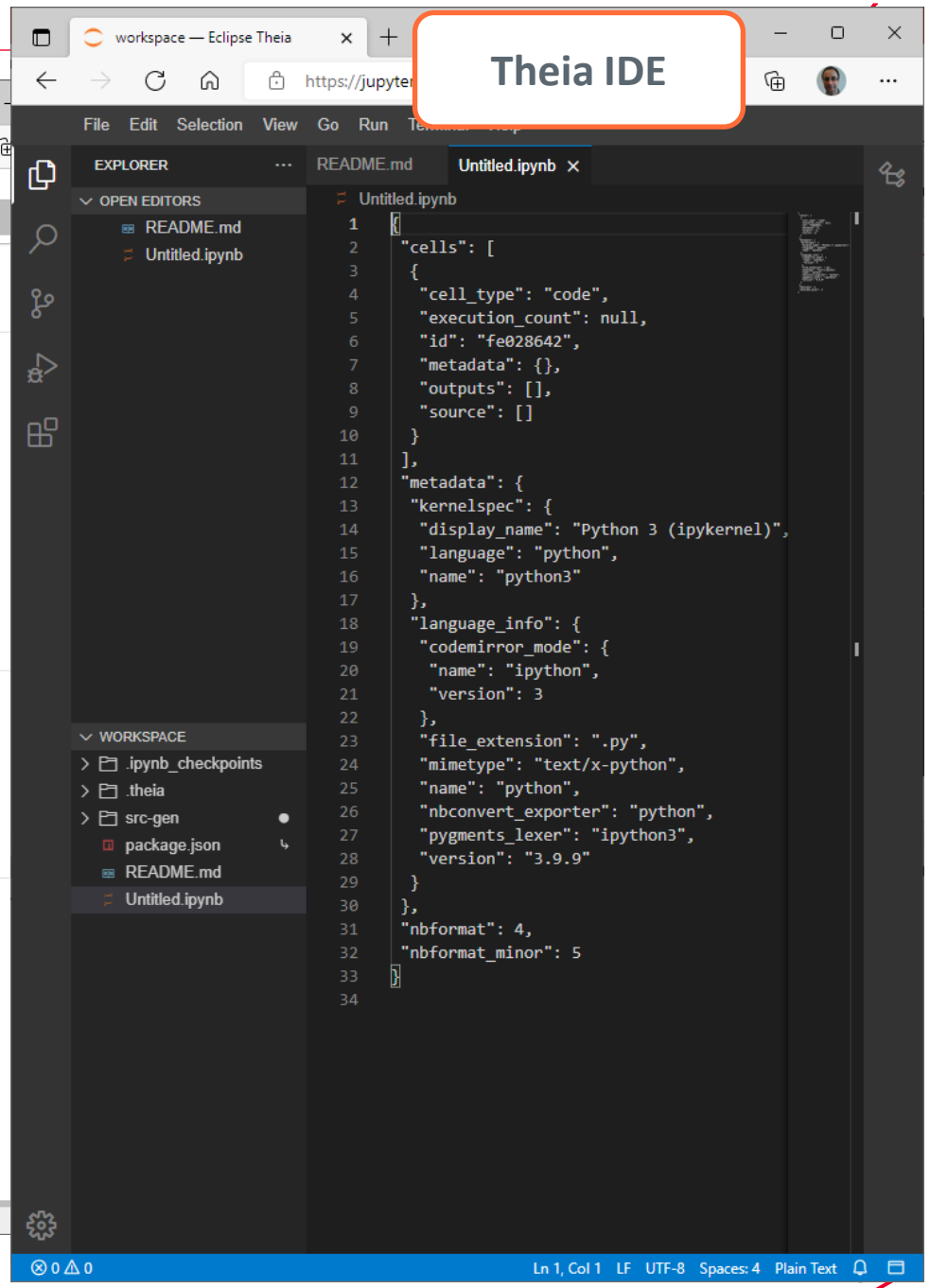
Processor Development Environment (PDE)

- Integrated web tooling
  - Interactive analysis
  - Develop, test and package applications
- JupyterHub
  - Login integrates with platform authentication
- Spawns JupyterLab instance for user
- Replicate the conditions an application experiences when running in the ADES on a platform
- NEXT STEP – Integrate with User Workspace for Application publishing

JupyerLab



Theia IDE



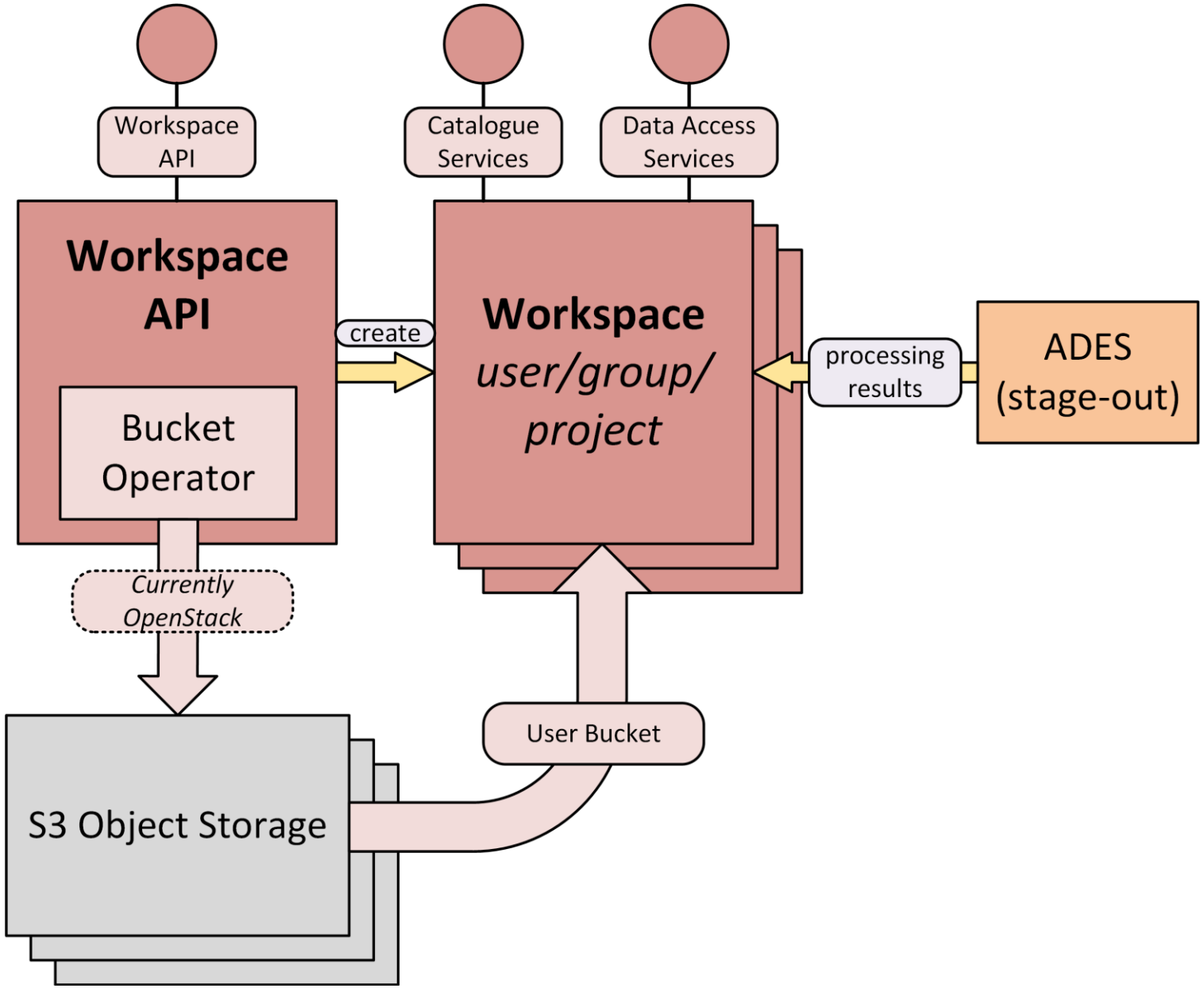
Resources - Workspace

Workspace

- Centralised management of user's owned resources:
  - Processing outputs
  - Application Packages
  - Uploaded products
- Can also be used as a Group/Project Workspace
- Dedicated Resource Catalogue
- Dedicated Data Access
- S3 bucket integration

Workspace API

- REST API
- Admin: create and manage workspaces
- User: register resources



User Identity & Authorization

Federation of user requests amongst platforms

User Identity

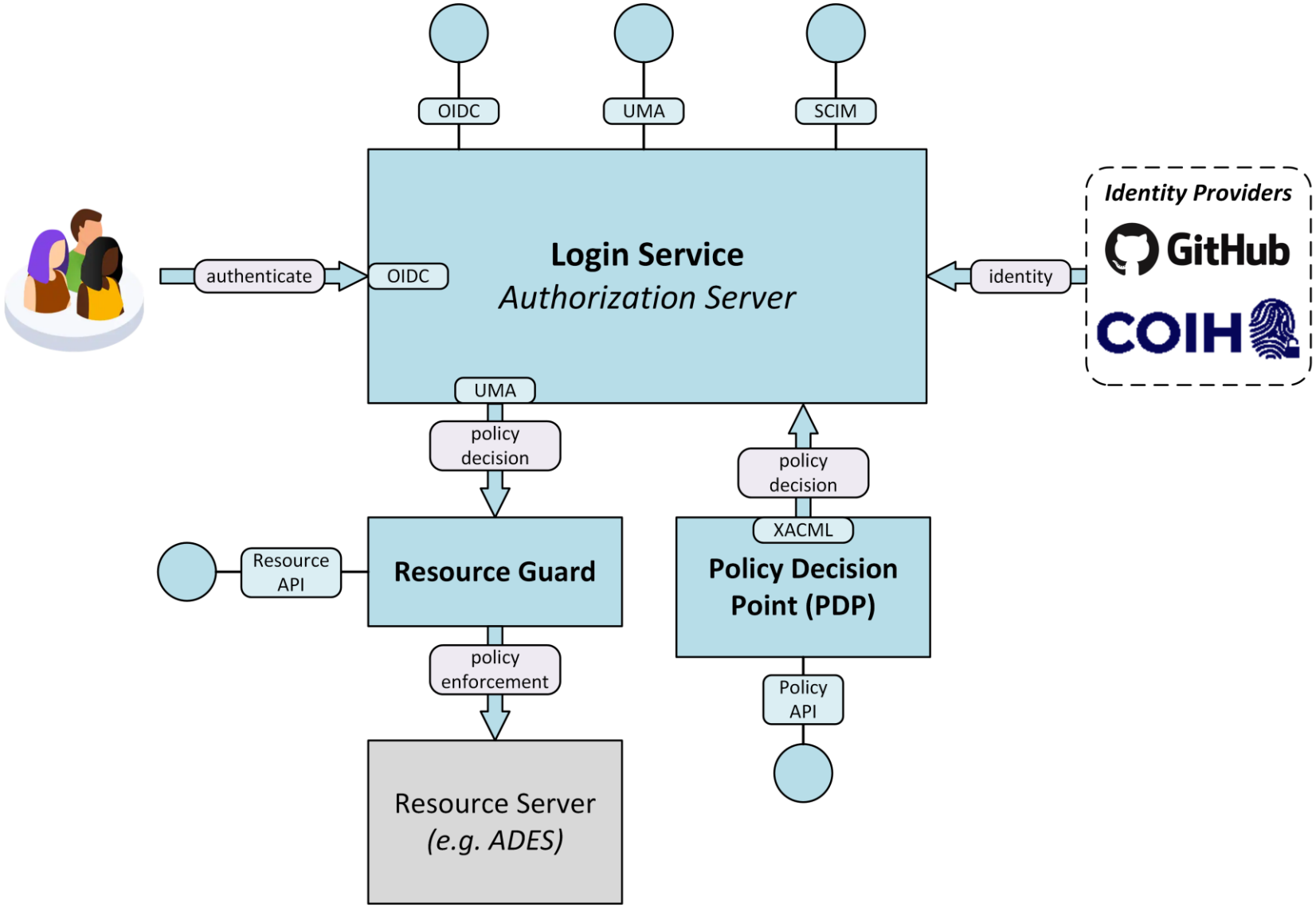
- OpenID Connect (OIDC)
- External identity
  - GitHub
  - COIH

Access Management

- User Managed Access (UMA)
- Policy-based resource protection

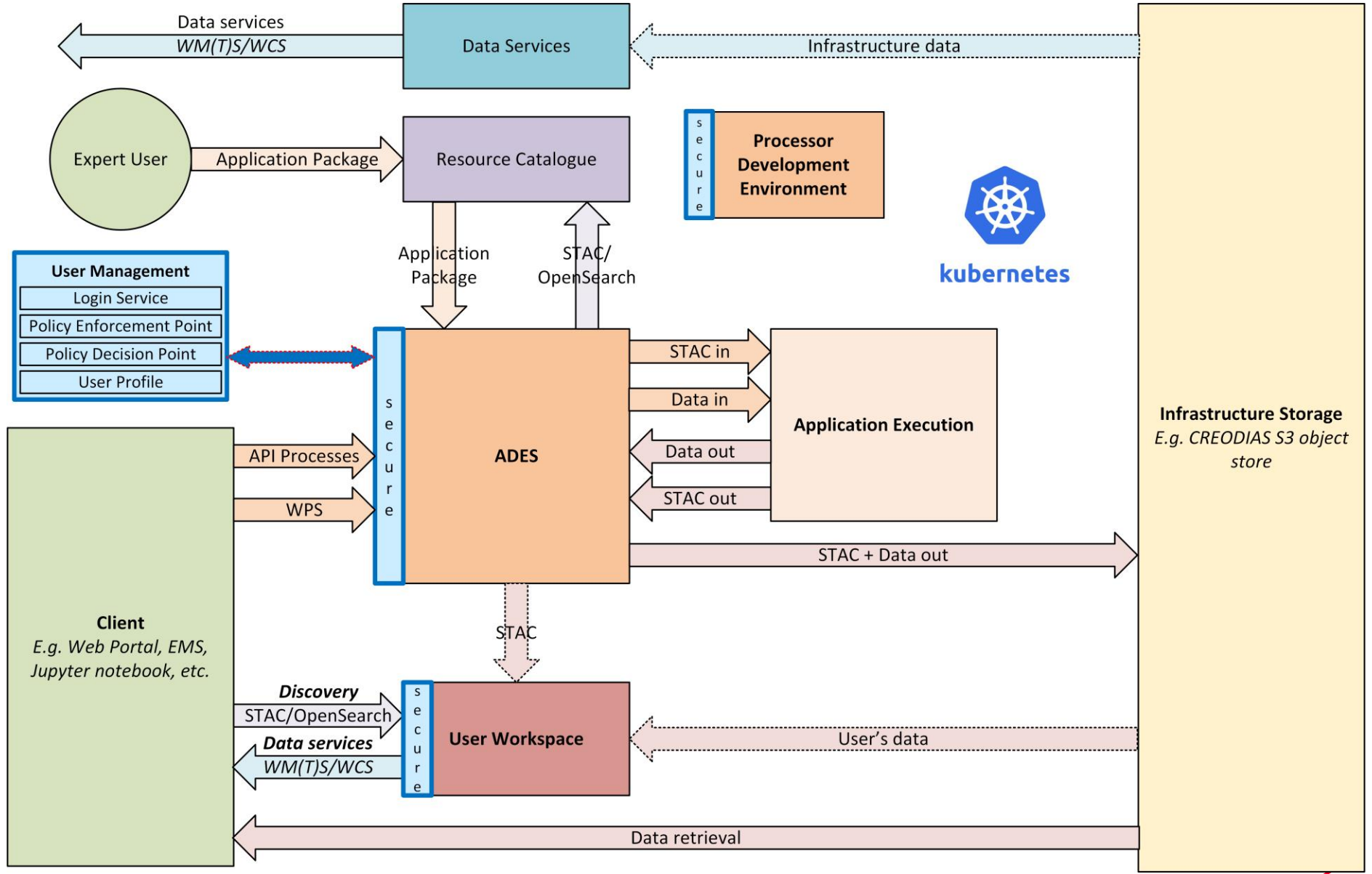
Resource Management

- Resource API ~ registration
- Policy API ~ access rules



Platform – Reference Implementation

- Kubernetes ‘abstract’ infrastructure
- Containerised components
- Helm charts for Kubernetes
- Deployed to CREODIAS



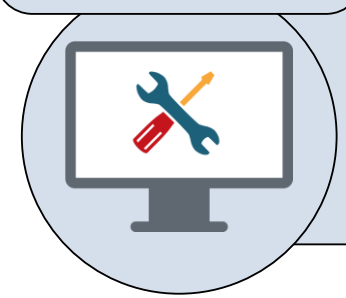
In Summary

- Exploitation Platform blueprint
- Reference implementation building blocks
- Embraces the ‘apps-to-the-data’ architecture
- Open interface standards
- Encourage platform interoperability

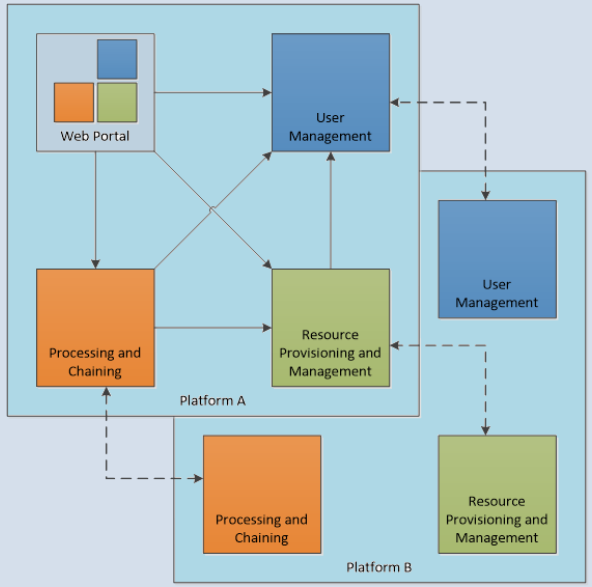
ADES
App Deploy/Execute

OGC Best Practice
EO App Package

Processor Development Environment

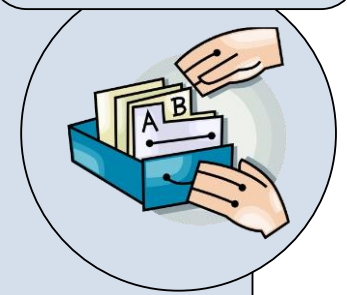


EOEPCA
Common Architecture



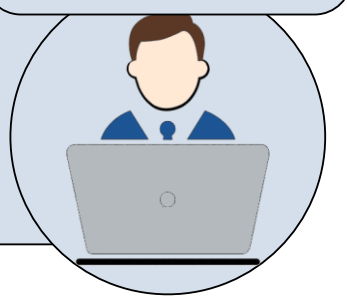
Federated Identity & Access Management

Resource Catalogue



Data Access

User Workspace



Overview

Demonstration

- Processing
- Resource Catalogue
- Data Access
- Workspace
- User Management

Deployment

Q&A

Jupyter Notebook Demo

- https://github.com/EOEPCA/demo

Overview

Demonstration

Deployment

Q&A

Deployment Overview

Deployment Guide

- https://deployment-guide.docs.eoepca.org/
- Versions match EOEPCA releases – v1.0, v1.1 and ‘latest’ development tip
- Describes:
  - **Cluster** ~ Kubernetes requirements and prerequisites
  - **EOEPCA** ~ Deployment of EOEPCA building blocks using helm
  - **Quickstart** ~ Scripted example deployments using bash and helm

Prerequisites

- Kubernetes cluster
- helm ~ for deployment of building blocks
- kubectl ~ for Kubernetes interactions

Additional for Scripted Deployment

- minikube ~ target Kubernetes cluster
- docker ~ for minikube’s docker driver

Kubernetes

Kubernetes v1.22.x (ref. eoepca v1.1)

- Rancher Kubernetes Engine (RKE) and minikube
- Helm charts provided for each building block:
  - EOEPCA: https://eoepca.github.io/helm-charts/
  - Data Access BB: https://charts-public.hub.eox.at/

Development Cluster (@CREODIAS)

- Rancher Kubernetes Engine (RKE) v1.3.4
- Kubernetes version v1.22.5
- 1 Master node (2 vCPU, 8 GB RAM)
- 5 Worker nodes (4 vCPU, 16 GB RAM)
- 1 NFS server (2 vCPU, 8 GB RAM)

Example Deployment

- Single node for minikube
- 8 vCPU, 32 GB RAM

Supporting Services

- Nginx Ingress Controller
  - Helm: https://kubernetes.github.io/ingress-nginx
- Cert Manager ~ for Ingress TLS with letsencrypt
  - Helm: https://charts.jetstack.io
- NFS Storage Provisioner
  - Helm: https://kubernetes-sigs.github.io/nfs-subdir-external-provisioner
- Harbor ~ container registry for Workspace
  - Helm: https://helm.goharbor.io

Other Services

- Sealed Secrets ~ for secret management in git
  - Helm: https://bitnami-labs.github.io/sealed-secrets
- MinIO ~ S3-compatible object storage
  - Helm: https://charts.bitnami.com/bitnami

RKE Example

```
$ rke --version
rke version v1.3.4
$
$ rke config -l -a
v1.18.20-rancher1-3
v1.20.14-rancher1-1
v1.19.16-rancher1-2
v1.22.5-rancher1-1
v1.21.8-rancher1-1
```

File cluster.yml

```yaml
cluster_name: demo
kubernetes_version: "v1.22.5-rancher1-1"
nodes:
  - address: 192.168.100.9
    user: eouser
    role:
      - controlplane
      - etcd
  - address: 192.168.100.7
    user: eouser
    role:
      - worker
  - address: 192.168.100.12
    user: eouser
    role:
      - worker
  - address: 192.168.100.3
    user: eouser
    role:
      - worker
  - address: 192.168.100.14
    user: eouser
    role:
      - worker
  - address: 192.168.100.18
    user: eouser
    role:
      - worker

ingress:
  provider: none

bastion_host:
  address: 185.52.195.34
  user: eouser

private_registries:
  - user: eoepcaci
    password: XXXXXXXXXXXXX
```

Once the configuration is in place then the cluster creation can be initiated...

```
$ rke up
```

minikube

Limited local deployment can be made using a suitable local single-node kuberbetes deployment using - for example using minikube...

```
minikube -p eoepca start --cpus max --memory max --kubernetes-version v1.22.5
minikube profile eoepca
```

Storage & Persistence

Component persistence

- Persistent Volume Claims
- Dynamic Claims via Storage Class
- Configured via helm release values

ReadWriteMany Storage

- Volume can be mounted as read-write by many nodes
- Required by some BBs – e.g. ADES
- Dynamically provisioned via Storage Class

Options

- NFS
- Clustered: e.g. Longhorn, GlusterFS
- Minikube ‘standard’ storage class (host)

EOEPCA Development Team Approach

- NFS Server – outside Kubernetes cluster

- NFS Subdirectory External Provisioner
  - Supports ReadWriteMany storage

- Pre-defined Persistent Volumes & Claims – per domain:
  - Resource Management: eoepca-resman-pv/pvc
  - Processing: eoepca-proc-pv/pvc
  - User Management: eoepca-userman-pv/pvc

- Storage Classes (for dynamic provisioning)
  - managed-nfs-storage (reclaimPolicy: Delete)
  - managed-nfs-storage-retain (reclaimPolicy: Retain)

Helm Repositories

Building Blocks

- ***EOEPCA***
  - https://eoepca.github.io/helm-charts
  - *ADES*
  - *Bucket Operator*
  - *Login Service*
  - *PDE*
  - *PDP*
  - *Resource Catalogue*
  - *Resource Guard*
  - *User Profile*
  - *Workspace API*
- ***EOX***
  - https://charts-public.hub.eox.at/
  - *vs (Data Access)*

Others

- ***Jetstack***
  - https://charts.jetstack.io/index.yaml
  - *Cert Manager*
- ***NGINX***
  - https://kubernetes.github.io/ingress-nginx/
  - *NGINX Ingress Controller*
- ***Bitnami***
  - https://charts.bitnami.com/bitnami
  - *Minio*
- ***Bitnami Labs***
  - https://bitnami-labs.github.io/sealed-secrets
  - *Sealed Secrets*
- ***Harbor***
  - https://helm.goharbor.io/
  - *Harbor*

Login Service Deployment

Provides the platform Authorization Server for authenticated user identity and request authorization

Helm Chart

Installed via ‘login-service’ helm chart in the EOEPCA chart repository

```
helm install –repo
  https://eoepca.github.io/helm-charts
  --version 1.1.5
  --values login-service-values.yaml
  login-service
  login-service
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/login-service

Values

Many values can be specified.

Typically, at minimum…

- **Public hostname of Authorization Server**
  e.g. auth.myplatform.org
- **Public IP address**
  e.g. of LoadBalancer, reverse-proxy etc.
- **Initial password for the admin user**
  >=6 chars, >=1 each of uppercase, lowercase, digit, special
- **Volume claim for persistence**
  The name of an existing claim is expected
- **TLS configuration**
  incl. certificate provider – e.g. for letsencrypt

- Plus, ‘front-end’ customizations via ConfigMap

User Profile Deployment

Provides access to the user's 'account' in the platform

Helm Chart

Installed via 'user-profile' helm chart in the EOEPCA chart repository

```
helm install -repo
  https://eoepca.github.io/helm-charts
  --version 1.1.3
  --values user-profile-values.yaml
  user-profile
  user-profile
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/login-service

Values

Typical values to specify…

- **Public hostname of Authorization Server**
  e.g. auth.myplatform.org
- **Public IP address**
  e.g. of LoadBalancer, reverse-proxy etc.
- **Volume claim for persistence**
  The name of an existing claim is expected

PDP Deployment

Provides the platform policy database and associated service for access policy decision requests

Helm Chart

Installed via ‘pdp-engine’ helm chart in the EOEPCA chart repository

```
helm install –repo
  https://eoepca.github.io/helm-charts
  --version 1.1.3
  --values pdp-values.yaml
  pdp
  pdp-engine
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/pdp-engine

Values

Typical values to specify…

- **Public hostname of Authorization Server**
  e.g. auth.myplatform.org
- **Public IP address**
  e.g. of LoadBalancer, reverse-proxy etc.
- **Volume claim for persistence**
  The name of an existing claim is expected

Resource Protection (access authorisation)

Multiple instances - deployed ‘in front of’ each resource server (e.g. ADES etc.) to apply protection that integrates with Login Service, PDP.

Injects itself into the `auth_request` path of the Nginx Ingress Controller

Helm Chart

Installed via ‘resource-guard’ helm chart in the EOEPCA chart repository

```
helm install –repo
  https://eoepca.github.io/helm-charts
  --version 1.0.7
  --values myservice-guard-values.yaml
  myservice-guard
  resource-guard
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/resource-guard

Values

Wraps the charts for the PEP and the UMA User Agent:

- https://github.com/EOEPCA/helm-charts/tree/main/charts/pep-engine
- https://github.com/EOEPCA/helm-charts/tree/main/charts/uma-user-agent

Typically, at minimum…

- **Public hostname and IP of Authorization Server**
  e.g. auth.myplatform.org + LoadBalancer/Proxy IP
- **Authorization Server Client Credentials**
  Supplied via a Kubernetes Secret
- **Volume claim for PEP persistence**
  Can be created ‘on-demand’ by the chart
- **Ingress configuration**
  For the services at the protected resource server
- **TLS configuration**
  incl. certificate provider – e.g. for letsencrypt

ADES Deployment

Provides a platform-hosted execution engine through which users can initiate parameterised processing jobs using applications made available within the platform

Helm Chart

Installed via ‘ades’ helm chart in the EOEPCA chart repository

```
helm install –repo
  https://eoepca.github.io/helm-charts
  --version 1.1.10
  --values ades-values.yaml
  ades
  ades
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/ades

Values

Many values can be specified.

Typically, at minimum…

- **StorageClass for dynamic persistence**
  Must be ReadWriteMany
- **Stagein/out configuration**
  CWL to override the chart built-in
- **S3 Object Store integration**
  To persist stage-out of results
- **Workspace integration**
  For registration of results during stage-out
- **PEP integration**
  For dynamic registration of resources

PDE Deployment

The Processor Development Environment (PDE) provides a web-based application that allows the user to perform platform-hosted interactive analysis and application development

Helm Chart

Installed via ‘pde’ helm chart in the EOEPCA chart repository

```
helm install –repo
  https://eoepca.github.io/helm-charts
  --version 1.1.12
  --values pde-values.yaml
  pde
  jupyterhub
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/pde-jupyterhub

Values

Typical values to specify…

- **Public service URL**
  e.g. pde.myplatform.org
- **StorageClass for dynamic persistence**
- **JupyterHub -> login-service integration for authentication**
  OAuth service URLs
- **Initial admin password**

Resource Catalogue Deployment

Provides a standards-based EO metadata catalogue that includes support for OGC CSW / API Records, STAC and OpenSearch

Helm Chart

Installed via ‘rm-resource-catalogue’ helm chart in the EOEPCA chart repository

```
helm install –repo
  https://eoepca.github.io/helm-charts
  --version 1.1.0
  --values resource-catalogue-values.yaml
  resource-catalogue
  rm-resource-catalogue
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/rm-resource-catalogue

Values

Many values can be specified.

Typically, at minimum…

- **Public service URL**
  e.g. catalogue.myplatform.org
- **StorageClass for dynamic persistence**
- **Metadata describing the Catalogue instance**
  E.g. for Inspire compliance
- **Tuning configuration for PostgreSQL**
  Optional – for advanced tweaking

Data Access Deployment

Provides standards-based services for access to platform hosted data - OGC WMS/WMTS (visualisation), OGC WCS(retrieval), plus data harvesting and registration

Helm Chart

Installed via ‘vs’ helm chart in the EOX chart repository

```
helm install –repo
  https://charts-public.hub.eox.at/
  --version 2.1.4
  --values data-access-values.yaml
  data-access
  vs
```

Reference

https://vs.pages.eox.at/documentation/operator/main/configuration.html#helm-configuration-variables

Values

Many values can be specified.

Typically, at minimum…

- **Public service URL**
  e.g. data-access.myplatform.org
- **StorageClass for dynamic persistence**
- **Metadata describing the service instance**
- **Data Specification**
  Layers, data collections and product types
- **Harvester configuration**
  Defining search endpoints and query params
- **Volume claims for persistence**
  To re-use existing volume claims (database, redis)
- **Object storage details**
  For data and cache components

Workspace API Deployment

Provides protected user resource management that includes dedicated storage and services for resource discovery and access

Helm Chart

Installed via ‘rm-workspace-api’ helm chart in the EOEPCA chart repository

```
helm install -repo
 https://eoepca.github.io/helm-charts
  --version 1.1.11
  --values workspace-api-values.yaml
  workspace-api
  rm-workspace-api
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/rm-workspace-api

Values

Many values can be specified.

Typically, at minimum…

- **Public service URL**
  e.g. workspace-api.myplatform.org
- **Workspace naming prefix**
  Acts as a namespace, to avoid name clashes
- **Object storage access details**
  Url, credentials, etc.
- **Container registry access details**
  Url, credentials, etc.
- **Workspace helm charts – ConfigMap…**
  - *template-hr-resource-catalogue.yaml*
  - *template-hr-vs.yaml*
  - *template-hr-resource-guard.yaml*
- **Optional installation of flux**

Bucket Operator Deployment

Provides a Kubernetes operator through which object storage ‘buckets’ are created for users

Helm Chart

Installed via ‘rm-bucket-operator’ helm chart in the EOEPCA chart repository

```
helm install -repo
 https://eoepca.github.io/helm-charts
  --version 0.9.9
  --values bucket-operator-values.yaml
  bucket-operator
  rm-bucket-operator
```

Reference

https://github.com/EOEPCA/helm-charts/tree/main/charts/rm-bucket-operator#readme

https://github.com/EOEPCA/rm-bucket-operator#readme

Values

Typical values to specify…

- **OpenStack details…**
  member role ID, service project ID, …
- **OpenStack credentials (secret)…**
  username, password, domain

Container Registry Deployment

Harbor container registry to support the development and deployment of ADES application packages

Helm Chart

Installed via ‘harbor’ helm chart in the Harbor chart repository

```
helm install –repo
  https://helm.goharbor.io
  --version 1.7.3
  --values harbor-values.yaml
  harbor
  harbor
```

Reference

https://goharbor.io/docs/2.4.0/install-config/harbor-ha-helm/

Values

Many values can be specified.

Typically, at minimum…

- **Public service URL**
  e.g. harbor.myplatform.org
- **StorageClass for dynamic persistence**
- **Initial admin password**

Quickstart Deployments

Scripted Deployment

- Full system deployment via helm + bash scripts

```
git clone https://github.com/EOEPCA/deployment-guide
cd deployment-guide
./deploy/eoepca/eoepca.sh
```

- Configured via cmdline args and environment variables
- **By default:**
  - Creates a minikube cluster + support services
  - Deploys EOEPCA building blocks into cluster
- **Environment variables:**
  - Control cluster creation + service selection
    Ref. variables REQUIRE_<cluster-component>
  - Control EOEPCA building block selection
    Ref. variables REQUIRE_<eoepca-component>
  - Configure common aspects of helm chart values
- https://deployment-guide.docs.eoepca.org/current/quickstart/scripted-deployment/#environment-variables

Customised Deployments

- **Simple:** `./deploy/simple/simple`
- **Processing:** `./deploy/processing/processing`
- **Data Access:** `./deploy/data-access/data-access`
- **CREODIAS:** `./deploy/creodias/creodias`

How to use these?

- **Instantiate a local cluster in minikube**
  Provides an environment for experimentation
- **Deploy to existing cluster**
  - Disable minikube: `REQUIRE_MINIKUBE=false`
  - Ensure `KUBECONFIG` is set
- **Inspect deployments with helm**
  - `helm get values <name>`
    See configured helm chart values
  - `helm get manifest <name>`
    See resultant Kubernetes yaml
- **Inspect the scripts to observe examples**
- **Customise your own deployment**
  By adapting the examples

Overview
Demonstration
Deployment
Q&A

THANK **YOU**
FOR YOUR ATTENTION

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