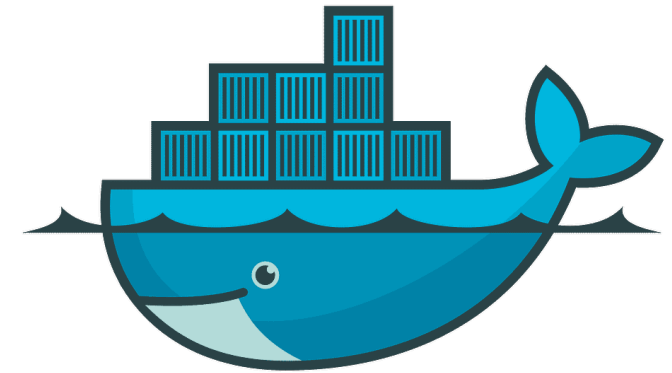


OpenNCP

Containerization and Deployment (Docker, Kubernetes)

Streamlining Healthcare Data Exchange
with Modern Container Technologies

Canciu Ionut Cristian
Panayiotis Savva
Prof. Constantinos Pattichis



docker



kubernetes

Introduction to OpenNCP

OpenNCP (Open National Contact Point) is an open-source software framework designed to facilitate secure and efficient cross-border health data exchange.

It enables interoperability between national health systems, ensuring that healthcare providers can access and share patient information seamlessly across different European Union countries.



Why Containerization?

1. **Improved Portability:** Containerization ensures that OpenNCP can run consistently across different environments, from local development to acceptance and production.
2. **Enhanced Scalability:** Containers allow for easy scaling of services to handle increased load, leveraging tools like Kubernetes for orchestration.
3. **Isolation and Security:** Each application runs in its own isolated container, reducing the risk of host privileged access and enhances security by design.
4. **Faster Deployment:** Containers enable rapid deployment of the OpenNCP stack while provides minimal downtime during updates and version upgrades.
5. **Consistency and Reliability:** Containers ensure consistent runtime environments, reducing the *"it works on my machine"* problem and improving reliability.

Architecture of Containerized OpenNCP (1)

OpenNCP is composed by the following Nodes:

1. Node A

- Acting as NCP-A, other countries connect to this to retrieve patient data.

2. Node B

- Acting as NCP-B, where national system connects to and requests data from other countries' NCP-A nodes.

3. Officer Node

- Acting as intermediary logging/auding and gateway configuration.

Architecture of Containerized OpenNCP (2)

1. Node A

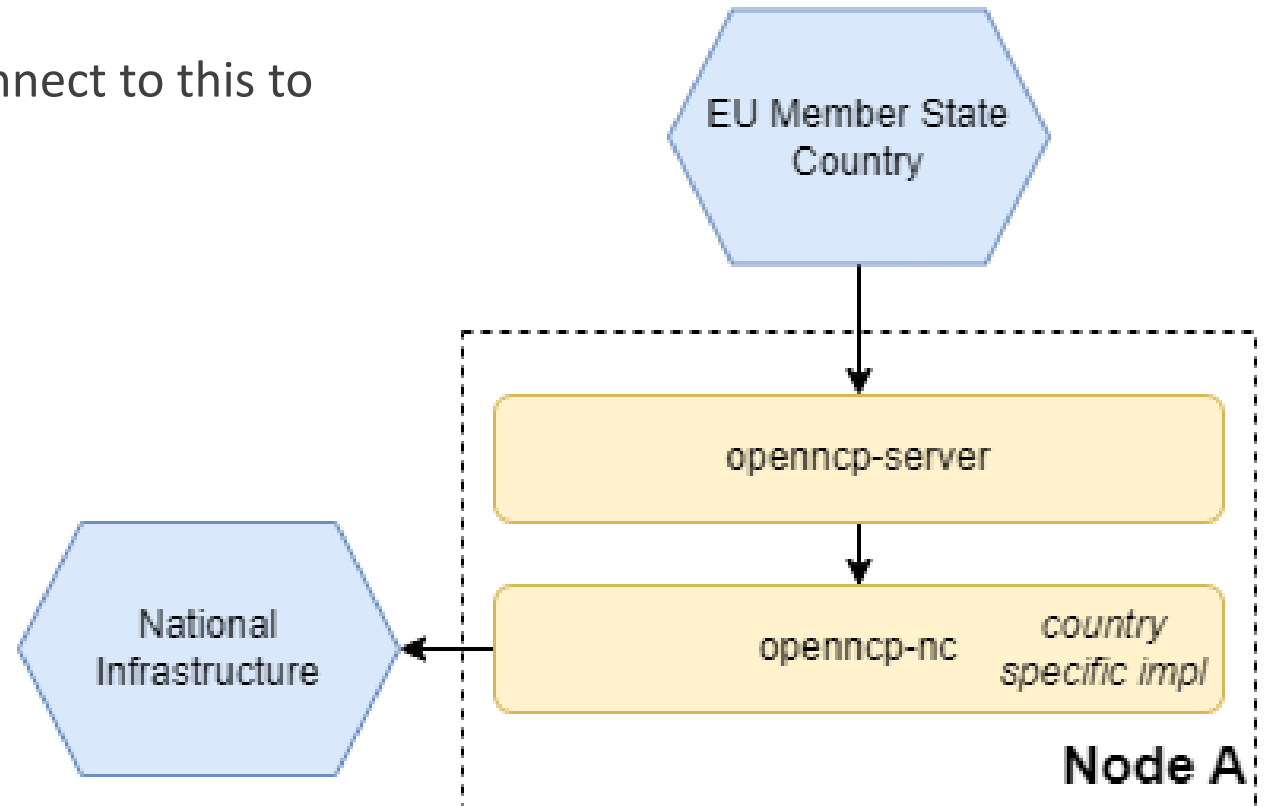
- Acting as NCP-A, other countries connect to this to retrieve patient data

This Node is composed by:

openncp-server

openncp-nc

*The openncp-server must also communicate with the **translations-and-mappings-ws** (shown in next slide)*

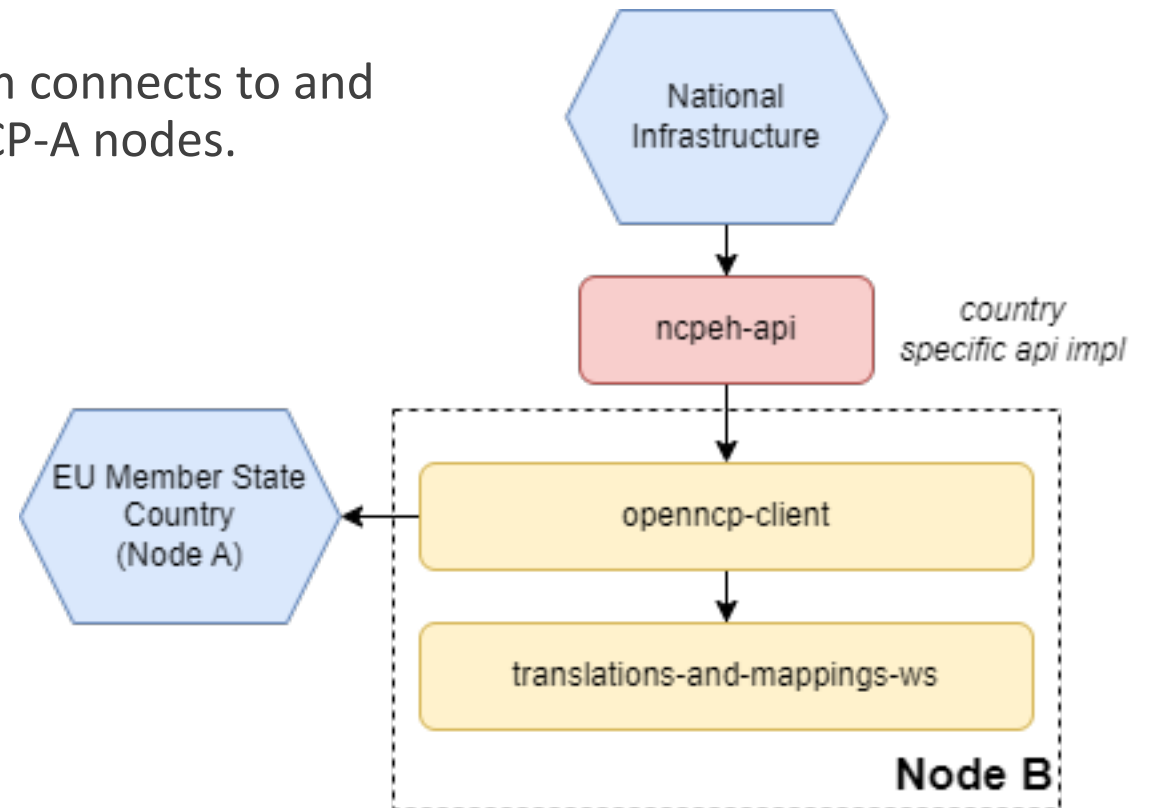


Architecture of Containerized OpenNCP (3)

2. Node B

- Acting as NCP-B, where national system connects to and requests data from other countries' NCP-A nodes.

This Node is composed by:
openncp-client
translations-and-mappings-ws

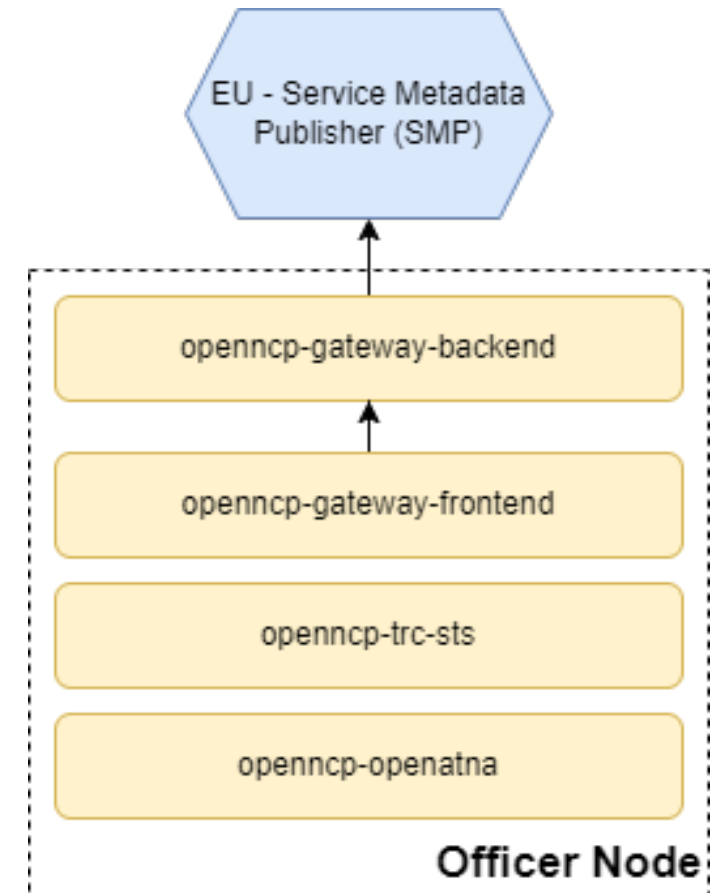


Architecture of Containerized OpenNCP (4)

3. Officer Node

- Acting as intermediary logging/auding and gateway configuration.

This Node is composed by:
openncp-gateway-backend
openncp-gateway-frontend
openncp-trc-sts
openncp-openatna



Architecture of Containerized OpenNCP (5)

OpenNCP also ships with the following key Jobs:

1. TSAM-Sync

- Used to synchronize the Master Value Catalogue (MVC) from the Central Terminology Service (CTS). This saves the terminologies in the database.

2. TSAM-Exporter

- Used to export the terminologies from the database to .xml files.

3. OpenNCP Configuration Utility

- Used to configure the database with the OpenNCP properties.

NAME	COMPLETIONS	DURATION	AGE
copy-epsos-configuration	1/1	10s	49d
openncp-configuration-utility	1/1	14s	49d
openncp-openncp-tsam-exporter	1/1	97s	27h
openncp-tsam-sync	1/1	19m	28h

Open-Source Containerization Repository

OpenNCP source code:

<https://code.europa.eu/ehdsi/ehealth>

OpenNCP Deployments source code:

<https://github.com/UCY-eHealthLab/OpenNCP-Deployments>

Project	Version
OpenNCP	version 7.1.0
Portal	version 1.1.0

Docker

Step-by-Step Containerization Process (1)

1. Clone the Deployments Repository:

- Clone the repository containing the deployment scripts and configurations for OpenNCP.

2. Configure Environment Variables:

- Copy the ``example.env`` file to `` .env`` and configure it with the necessary environment variables.

3. Build and Prepare Artifacts:

- Run the ``process-artifacts.sh`` script to build the OpenNCP artifacts from the source code (using the configured version). This script also moves the files to their designated folders.

4. Set Up OpenNCP Properties:

- Configure the **openncp-configuration.properties** file inside the **openncp-configuration-utility** folder with the required OpenNCP settings.

5. Deploy Using Docker Compose:

- Execute the **docker-compose.yml** file using the `docker compose up -d` command to start the OpenNCP services in detached mode.

Building OpenNCP using Docker

```
@REM --- Variables ---  
set OPENNCP_VERSION=7.1.0  
set OPENNCP_SOURCE_REPO=https://code.europa.eu/ehdsi/ehealth  
set OPENNCP_SOURCE_BRANCH=master  
set OPENNCP_SOURCE_TAG=7.1.0  
  
@REM --- Build OpenNCP ---  
docker build -f Dockerfile.openncp ^  
  --build-arg OPENNCP_VERSION=%OPENNCP_VERSION% ^  
  --build-arg OPENNCP_SOURCE_REPO=%OPENNCP_SOURCE_REPO% ^  
  --build-arg OPENNCP_SOURCE_BRANCH=%OPENNCP_SOURCE_BRANCH% ^  
  --build-arg OPENNCP_SOURCE_TAG=%OPENNCP_SOURCE_TAG% ^  
  -t openncp-artifacts:%OPENNCP_VERSION% .
```

Cloning and Building OpenNCP from source

```
# Stage 1: Build Maven artifacts
FROM maven:3.9.5-eclipse-temurin-11 AS build-openncp-maven

RUN apt-get update && apt-get install -y git

# Copy maven-settings.xml file (comment out maven-default-http-blocker mirror)
COPY configs/maven-settings.xml /usr/share/maven/conf/settings.xml

ARG OPENNCP_VERSION
ARG OPENNCP_SOURCE_REPO
ARG OPENNCP_SOURCE_BRANCH
ARG OPENNCP_SOURCE_TAG

WORKDIR /usr/src

# Clone the OpenNCP source code
RUN git clone --branch ${OPENNCP_SOURCE_TAG} ${OPENNCP_SOURCE_REPO} openncp

# Build the OpenNCP source code
RUN cd openncp && mvn clean package install -DskipTests
```

Moving artifacts to Working Directory

```
# opennncp-ws-server
RUN mv opennncp/protocol-terminators/epsos-ncp-server/epsos-ws-server/target/opennncp-ws-server-${OPENNCP_VERSION}.war
opennncp-ws-server.war

# opennncp-client-connector
RUN mv opennncp/protocol-terminators/epsos-ncp-client/epsos-client-connector/target/opennncp-client-connector-${
OPENNCP_VERSION}.war opennncp-client-connector.war

# opennncp-trc-sts
RUN mv opennncp/trc-sts/target/opennncp-trc-sts-${OPENNCP_VERSION}.war opennncp-trc-sts.war

# openatna-web
RUN mv opennncp/openatna/web/target/openatna-web-${OPENNCP_VERSION}.war openatna-web.war

# opennncp-gateway-backend
RUN mv opennncp/opennncp-gateway/opennncp-gateway-backend/target/opennncp-gateway-backend-${OPENNCP_VERSION}.war
opennncp-gateway-backend.war

# opennncp-configuration-utility
RUN mv opennncp/opennncp-common-components/opennncp-configuration-utility/target/opennncp-configuration-utility-${
OPENNCP_VERSION}.jar opennncp-configuration-utility.jar

# opennncp-tsam-sync
RUN mv opennncp/tsam-sync/target/opennncp-tsam-sync-${OPENNCP_VERSION}.jar opennncp-tsam-sync.jar

# opennncp-tsam-exporter
RUN mv opennncp/cda-display-tool/tsamexporter/target/opennncp-tsamexporter-${OPENNCP_VERSION}.jar opennncp-tsam-exporter.
jar

# translations-and-mappings-ws
RUN mv opennncp/translations-and-mappings-ws/target/translations-and-mappings-ws-${OPENNCP_VERSION}.war
translations-and-mappings-ws.war
```

Moving artifacts to Host

```
# Stage 3: Combine Maven and Node artifacts
FROM ubuntu:22.04 AS merge-openncp-artifacts
```

```
WORKDIR /usr/src
```

```
# Copy Maven artifacts
```

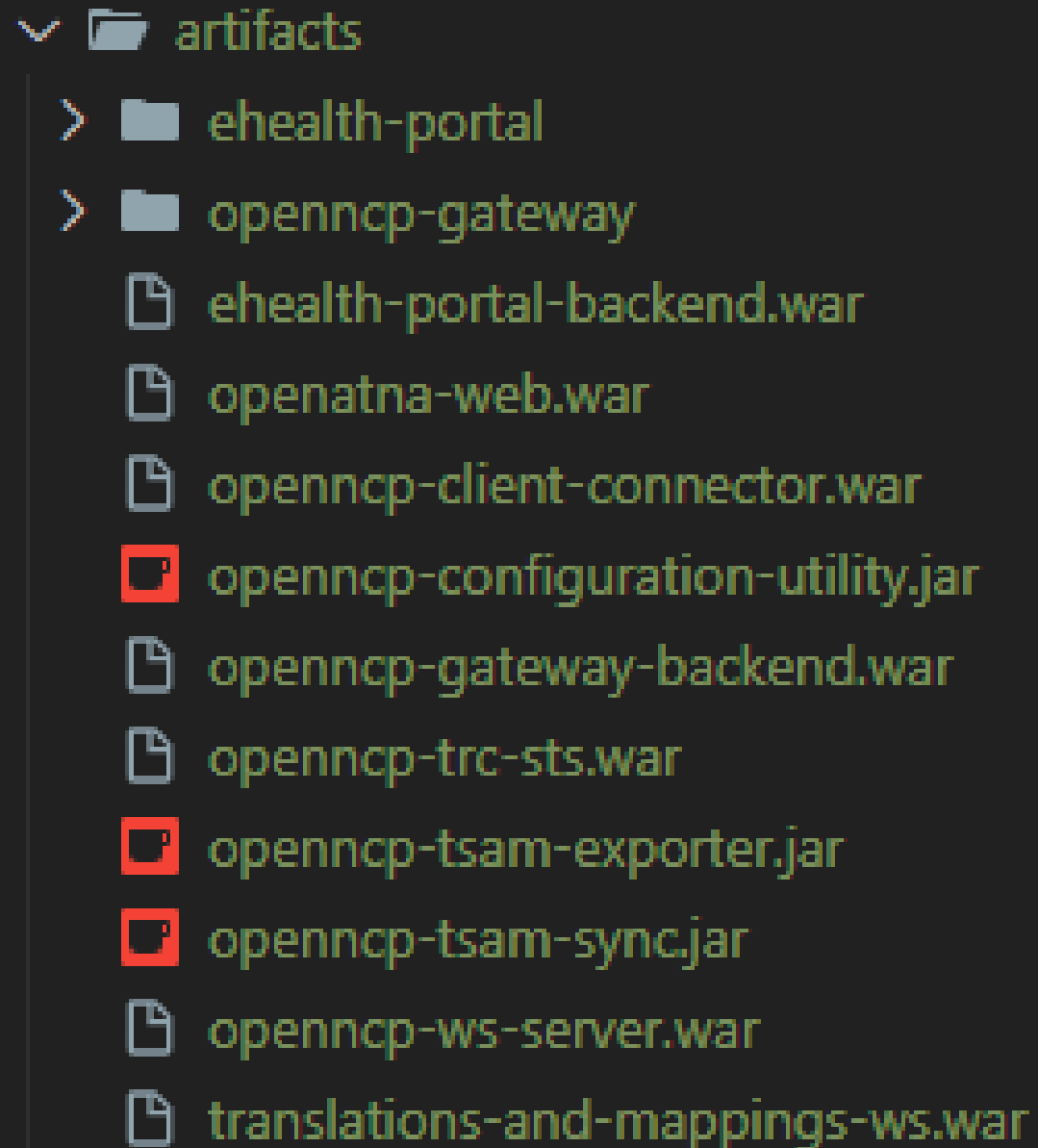
```
COPY --from=build-openncp-maven /usr/src/openncp-ws-server.war openncp-ws-server.war
COPY --from=build-openncp-maven /usr/src/openncp-client-connector.war openncp-client-connector.war
COPY --from=build-openncp-maven /usr/src/openncp-trc-sts.war openncp-trc-sts.war
COPY --from=build-openncp-maven /usr/src/openatna-web.war openatna-web.war
COPY --from=build-openncp-maven /usr/src/openncp-gateway-backend.war openncp-gateway-backend.war
COPY --from=build-openncp-maven /usr/src/openncp-configuration-utility.jar openncp-configuration-utility.jar
COPY --from=build-openncp-maven /usr/src/openncp-tsam-sync.jar openncp-tsam-sync.jar
COPY --from=build-openncp-maven /usr/src/openncp-tsam-exporter.jar openncp-tsam-exporter.jar
COPY --from=build-openncp-maven /usr/src/translations-and-mappings-ws.war translations-and-mappings-ws.war
```

```
# Copy Node artifacts
```

```
COPY --from=build-openncp-node /usr/src/openncp-gateway openncp-gateway
```

```
CMD ["bash"]
```

Final Artifacts



opennncp-server Dockerfile

```
FROM tomcat:9.0.82-jre11-temurin-jammy

RUN apt-get update \
    && apt-get install -y wget \
    && rm -rf /var/lib/apt/lists/*

ARG OPENNCP_VERSION
ARG MYSQL_HOST
ARG MYSQL_PORT
ARG MYSQL_USERNAME
ARG MYSQL_PASSWORD
ARG JAVA_OPTS
ARG EPSOS_PROPS_PATH
ARG CATALINA_OPTS
WORKDIR /usr/local/tomcat/webapps

COPY lib/* /usr/local/tomcat/lib/
COPY server.xml /usr/local/tomcat/conf/server.xml
COPY context.xml /usr/local/tomcat/conf/context.xml

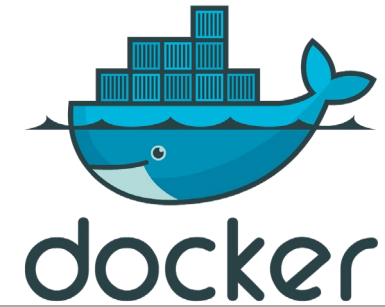
COPY webapps/opennncp-ws-server.war /usr/local/tomcat/webapps/opennncp-ws-server.war

CMD ${CATALINA_HOME}/bin/catalina.sh run
```


Docker Compose (openncp-server service)

```
# OpenNCP Server (Node A)
openncp-server:
  container_name: openncp-server
  build:
    context: ./openncp-server
    dockerfile: Dockerfile
  ports:
    - "6080:6080"
    - "6443:6443"
  depends_on:
    mysql:
      condition: service_healthy
    openncp-configuration-utility:
      condition: service_completed_successfully
    openncp-tsam-sync:
      condition: service_completed_successfully
    openncp-tsam-exporter:
      condition: service_completed_successfully
  environment:
    EPSOS_PROPS_PATH: ${EPSOS_PROPS_PATH}
    CATALINA_OPTS: "
      -DopenATNA.properties.path=file:/opt/epsos-configuration/ATNA_resources/openatna.properties
      -Dfile.encoding=UTF-8"
    JAVA_OPTS: "
      -DopenATNA.properties.path=file:/opt/epsos-configuration/ATNA_resources/openatna.properties
      -Dfile.encoding=UTF-8
      -Dmysql_host=${MYSQL_HOST}
      -Dmysql_port=${MYSQL_PORT}
      -Dmysql_username=${MYSQL_USERNAME}
      -Dmysql_password=${MYSQL_PASSWORD}
      -Dtls_key_alias=${TLS_KEY_ALIAS}
      -Dtls_keystore_pwd=${TLS_KEYSTORE_PWD}
      -Dtls_keystore_path=${TLS_KEYSTORE_PATH}
      -Dtls_truststore_pwd=${TLS_TRUSTSTORE_PWD}
      -Dtls_truststore_path=${TLS_TRUSTSTORE_PATH}"
    LOGGING_LEVEL_ROOT: DEBUG
```

Docker Deployment



```
[+] Running 12/13
✓ Volume "openncp-deployments_mysql-data"      Created
✓ Container db                                  Healthy
✓ Container openncp-deployments-openncp-configuration-utility-1  Exited
- Container openncp-deployments-openncp-tsam-sync-1  Waiting
✓ Container openncp-openatna                     Started
✓ Container openncp-gateway-backend              Started
✓ Container openncp-gateway-frontend             Started
✓ Container openncp-trc-sts                      Started
✓ Container openncp-deployments-openncp-tsam-exporter-1  Created
✓ Container ehealth-portal-frontend              Created
✓ Container ehealth-portal-backend              Created
✓ Container openncp-server                      Created
✓ Container openncp-client                      Created
```

Kubernetes

Step-by-Step Containerization Process (2)

Before running the services in Kubernetes, make sure that the steps 1-4 were completed on the previous Step-by-Step description (Docker)

1. **Navigate to the Kubernetes folder**
2. **Configure OpenNCP Kubernetes secrets:**
 - Configure the secrets for the OpenNCP Kubernetes deployment.
3. **Run the script to deploy the containers in Kubernetes:**
 - Run the script ``deploy-Kubernetes.bat`` to initialize the Kubernetes deployment of the manifests. The script is configured to wait for different jobs to finish before deploying the Nodes.

Kubernetes Testing and Deployment



kubernetes

Jobs					
Name	Images	Labels	Pods	Created ↑	
● openncp-openncp-tsam-exporter	ghcr.io/ucy-ehealthlab/openncp-tsam-exporter:7.1.0	<div>batch.kubernetes.io/controller-uid: 9abecaca-2be1-4927-8b30-6fbbd83174c1</div> <div>batch.kubernetes.io/job-name: openncp-openncp-tsam-exporter</div> <div>controller-uid: 9abecaca-2be1-4927-8b30-6fbbd83174c1</div> <div>Show all</div>	0 / 1	32 seconds ago	⋮
● openncp-tsam-sync	ghcr.io/ucy-ehealthlab/openncp-tsam-sync:7.1.0	<div>batch.kubernetes.io/controller-uid: cf0ea279-9a95-41a0-8988-f4607e659677</div> <div>batch.kubernetes.io/job-name: openncp-tsam-sync</div> <div>controller-uid: cf0ea279-9a95-41a0-8988-f4607e659677</div> <div>Show all</div>	0 / 1	44 seconds ago	⋮
● openncp-configuration-utility	ghcr.io/ucy-ehealthlab/openncp-configuration-utility:7.1.0	<div>batch.kubernetes.io/controller-uid: bd440ad0-8ee0-4aba-95be-0193d3f5f850</div> <div>batch.kubernetes.io/job-name: openncp-configuration-utility</div> <div>controller-uid: bd440ad0-8ee0-4aba-95be-0193d3f5f850</div> <div>Show all</div>	0 / 1	7 minutes ago	⋮

Kubernetes Testing and Deployment



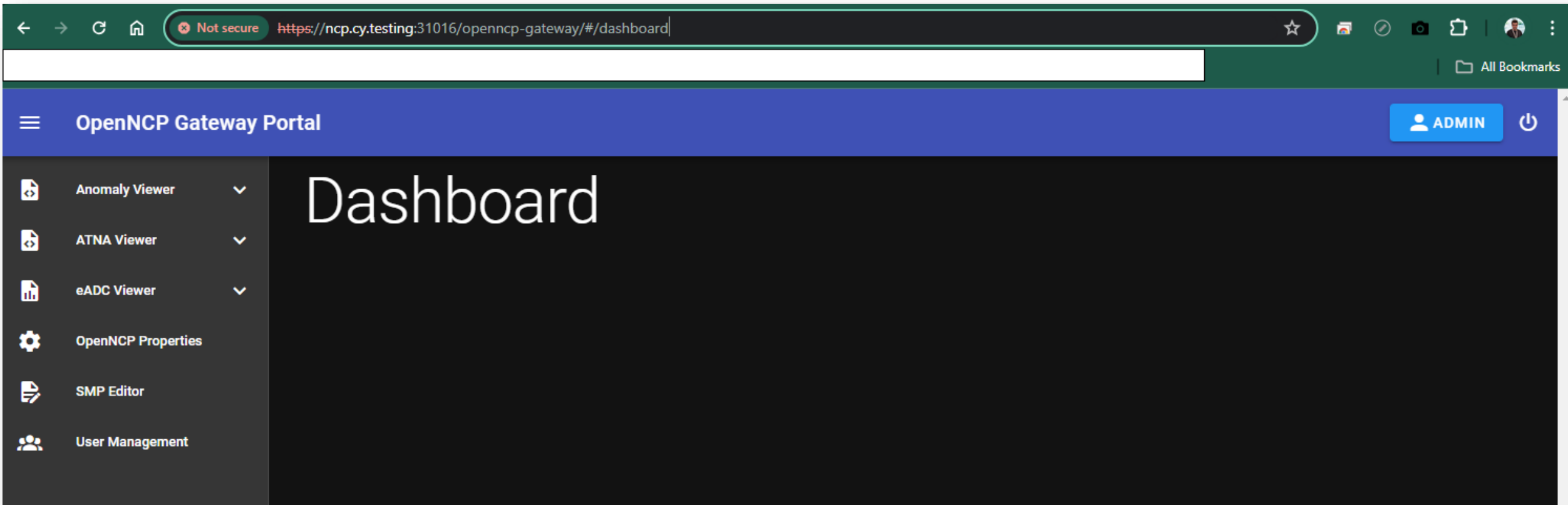
Deployments

Name	Images	Labels	Pods	Created ↑	
<div><div></div><div>openncp-openatna</div></div>	<div>ghcr.io/ucy-ehealthlab/openncp-openatna:7.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>openncp-trc-sts</div></div>	<div>ghcr.io/ucy-ehealthlab/openncp-trc-sts:7.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>openncp-gateway-backend</div></div>	<div>ghcr.io/ucy-ehealthlab/openncp-gateway-backend:7.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>openncp-gateway-frontend</div></div>	<div>ghcr.io/ucy-ehealthlab/openncp-gateway-frontend:7.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>ehealth-portal-frontend</div></div>	<div>ghcr.io/ucy-ehealthlab/ehealth-portal-frontend:1.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>ehealth-portal-backend</div></div>	<div>ghcr.io/ucy-ehealthlab/ehealth-portal-backend:1.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>openncp-client</div></div>	<div>ghcr.io/ucy-ehealthlab/openncp-client:7.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>openncp-server</div></div>	<div>ghcr.io/ucy-ehealthlab/openncp-server:7.1.0</div>	-	1 / 1	3 minutes ago	<div></div>
<div><div></div><div>mysql-deployment</div></div>	<div>mysql:5.7</div>	-	1 / 1	10 minutes ago	<div></div>

Kubernetes Testing and Deployment



kubernetes



Kubernetes Container Components






kubernetes

NAME	READY	STATUS	RESTARTS	AGE
openncp-gateway-backend-799f4b8997-f5s8h	1/1	Running	0	6d4h
ehealth-portal-backend-85857b97c5-czv22	1/1	Running	0	6d4h
ehealth-portal-frontend-75585659fb-c4wj8	1/1	Running	0	6d4h
mysql-deployment-69b5c5ddc7-t89tx	1/1	Running	0	6d4h
openncp-client-5c79b7b949-cll4b	1/1	Running	0	6d4h
openncp-gateway-frontend-778689484c-krpmv	1/1	Running	0	6d4h
openncp-openatna-7bd4d857cc-lw8tw	1/1	Running	0	6d4h
openncp-server-77c4fc7777-z6gdh	1/1	Running	0	6d4h
openncp-trc-sts-b5bf67f65-ljqpt	1/1	Running	0	6d4h
openncp-configuration-utility-tph9t	0/1	Completed	0	49d
copy-epsos-configuration-kdsd6	0/1	Completed	0	49d
openncp-openncp-tsam-exporter-cgrvc	0/1	Completed	0	27h
openncp-tsam-sync-kbpri	0/1	Completed	0	28h

ArgoCD



Testing and Deployment



 **ehealth-portal**  

Project: openncp

Labels:

Status:  Healthy  Synced

Repository: https://ehealthlab0862@dev.azure.com/ehealt...

Target Revi... openncp-deployment




Path: acc/openncp/ehealth-portal



Destination: in-cluster

Namespace: openncp

Created At: 02/28/2024 12:55:11 (3 months ago)



Last Sync: 05/14/2024 12:49:37 (9 days ago)

 SYNC  REFRESH  DELETE

 **openncp-configuration-utility** 

Project: openncp

Labels:

Status:  Healthy  Synced

Repository: https://ehealthlab0862@dev.azure.com/ehealt...

Target Revi... main




Path: acc/openncp/configuration-utility



Destination: in-cluster

Namespace: openncp

Created At: 02/27/2024 10:13:04 (3 months ago)



Last Sync: 05/22/2024 11:59:16 (a day ago)

 SYNC  REFRESH  DELETE

 **openncp-mysql** 

Project: openncp

Labels:

Status:  Healthy  Synced

Repository: https://ehealthlab0862@dev.azure.com/ehealt...

Target Revi... openncp-deployment




Path: acc/openncp/mysql




Destination: in-cluster

Namespace: openncp

Created At: 02/23/2024 12:46:46 (3 months ago)



Last Sync: 05/13/2024 10:02:35 (10 days ago)

 SYNC  REFRESH  DELETE

 **openncp-node-a**  

Project: openncp

Labels:

Status:  Healthy  Synced

Repository: https://ehealthlab0862@dev.azure.com/ehealt...

Target Revi... openncp-deployment




Path: acc/openncp/node-a




Destination: in-cluster

Namespace: openncp

Created At: 02/27/2024 11:13:23 (3 months ago)



Last Sync: 05/14/2024 12:54:09 (9 days ago)

 SYNC  REFRESH  DELETE

 **openncp-node-b**  

Project: openncp

Labels:

Status:  Healthy  Synced

Repository: https://ehealthlab0862@dev.azure.com/ehealt...

Target Revi... main




Path: acc/openncp/node-b




Destination: in-cluster

Namespace: openncp

Created At: 04/03/2024 17:28:23 (2 months ago)



Last Sync: 05/14/2024 12:54:09 (9 days ago)

 SYNC  REFRESH  DELETE

 **openncp-officer**  

Project: openncp

Labels:

Status:  Healthy  Synced

Repository: https://ehealthlab0862@dev.azure.com/ehealt...

Target Revi... openncp-deployment




Path: acc/openncp/officer

Destination: in-cluster

Namespace: openncp

Created At: 02/27/2024 11:19:50 (3 months ago)

Last Sync: 05/13/2024 10:02:35 (10 days ago)

 SYNC  REFRESH  DELETE

OpenNCP Containerization and Deployment

Project Information



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<https://github.com/UCY-eHealthLab/OpenNCP-Deployments>

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