IT Infrastructure for Medical Technologies and Training

Paula Moreno Fajardo
Instituto Tecnológico de Canarias (ITC)
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MAC2/5.11a/270 OpenDx28

Content

- ITC - DCCT

- MAC 2014 - 2020

- OpenDx28 - Macaronesian Open Diagnostics Network

- OpenDx28 - Components

- OpenDx28 - platform

- 3dSlicer-hub

- NLP for HL7/FHIR

- Future Work

- Development Methodology

- Train the trainers program

ITC - DCCT SCIENTIFIC COMPUTING DEPARTMENT

Experience:

- **Applied software engineering. Examples:**
  - **I+D+i**
    - Bioinformatics for biodiversity conservation
    - Climate change
    - Sustainable development
    - Support for differents I+D+i areas in ITC
  - **Management:** public administration and business
  - **Others:** agriculture with AI, virtual worlds, websites, etc.
- **~ 26 people**
- **~ 1.7 M€**

Projects:

- **H2020:** MAGIC Nexus, Tilos, Sentinel Energy (subcontracted)
- **MAC, Atlantic Area:** Nextgendem, Climarisk, Datalab, Nauticom, Eeres4water

MAC - Interreg Projects

MAC 2014 - 2020 149 million (126.5 million ERDF).

Interreg Madeira - Azores - Canarias

Programme Thematic Objectives:

Research and innovation:
- **Improving scientific and technological capabilities in priority sectors**

- **Increase the transfer and dissemination of technology and the cooperation between companies and universities or other research in the priority sectors.**

Better Public administration:
- **Strengthen cooperation strategies between the different actors operating in the programme cooperation area.**

Competitiveness of SMEs

- Creating conditions for the internationalization of enterprises

Combating Climate change

- Increase the transfer and dissemination of technology and the cooperation between companies and universities or other research in the priority sectors

Environment and resource efficiency
- Raising the attractiveness of natural and cultural heritage of tourist areas
- Protect and improve the conservation of natural areas and biodiversity

OpenDx28 - Macaronesian Open Diagnostics Network

Redress the difficulties of access to diagnostic procedures for rural communities through the active participation of all public health services in the cooperating territories.

General Objective:

To improve the efficiency of the public health systems of the Canary Islands, Cape Verde, Mauritania and Senegal by strengthening institutional relations **through the exchange of experience, access to medical technology** and facilitating access for the population to improve their health.

Specific Objectives:

1. Improve health management through the implementation of a **health and medical data collection** system and an **early warning system** for communicable diseases.
2. To increase the knowledge and skills of healthcare personnel in the diagnosis and treatment of diseases through a **train-the-trainer programme** in the economic evaluation of health technologies and projects.
3. To set up a system that generates synergies and promotes the exchange of experiences between institutions and people linked to the health sector.

https://www.itccanarias.org/web/es/actividad/proyectos/opendx28

Red Macaronésica de diagnóstico abierto

PARTICIPATING ENTITIES BENEFICIARY OF FEDER (Madeira, Azores, Canary Islands)

Lead Partner: Servicio Canario de la Salud - *Canarias/España*

Socios:

1. Fundación Canaria Instituto de Investigación Sanitaria de Canarias
2. (FUNDACIÓN CANARIA IISC) - *Canarias/España*
3. Instituto Tecnológico de Canarias, S.A. (ITC) - *Canarias/España*
4. Universidad de Las Palmas de Gran Canaria (ULPGC) - *Canarias/España*

PARTICIPANTES DE TERCEROS PAÍSES DEL PROGRAMA (Cabo Verde, Senegal, Mauritania)

Socios:

5. Ministère de la Santé et de l'Action Sociale - *Senegal*
6. Institut de Recherche en Santé, de Surveillance Epidémiologique et de Formation - *Senegal*
7. Ministério da Saúde e da Segurança Social - *Cabo Verde*
8. Hospital Dr. Agostinho Neto - *Cabo Verde*
9. Ministere de la Sante de la Mauritanie - *Mauritania*
10. Centre Hospitalier des Spécialités de la Tête, du Cou et de l´Appareil Locomoteur - *Mauritania*
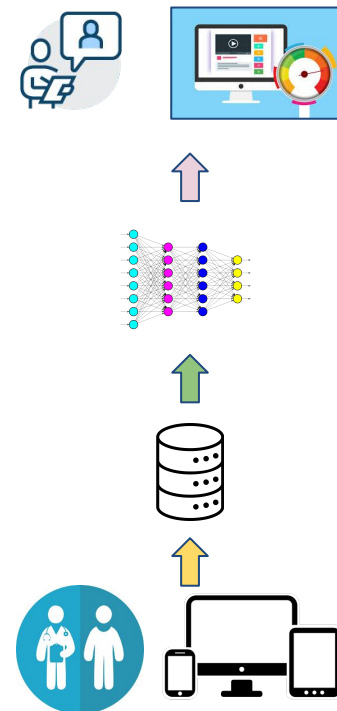
Objective

1. Improve health management through the implementation of a **health and medical data collection** system and an **early warning system** for communicable diseases.

2. To increase the knowledge and skills of healthcare personnel in the diagnosis and treatment of diseases through a **train-the-trainer programme** in the economic evaluation of health technologies and projects.
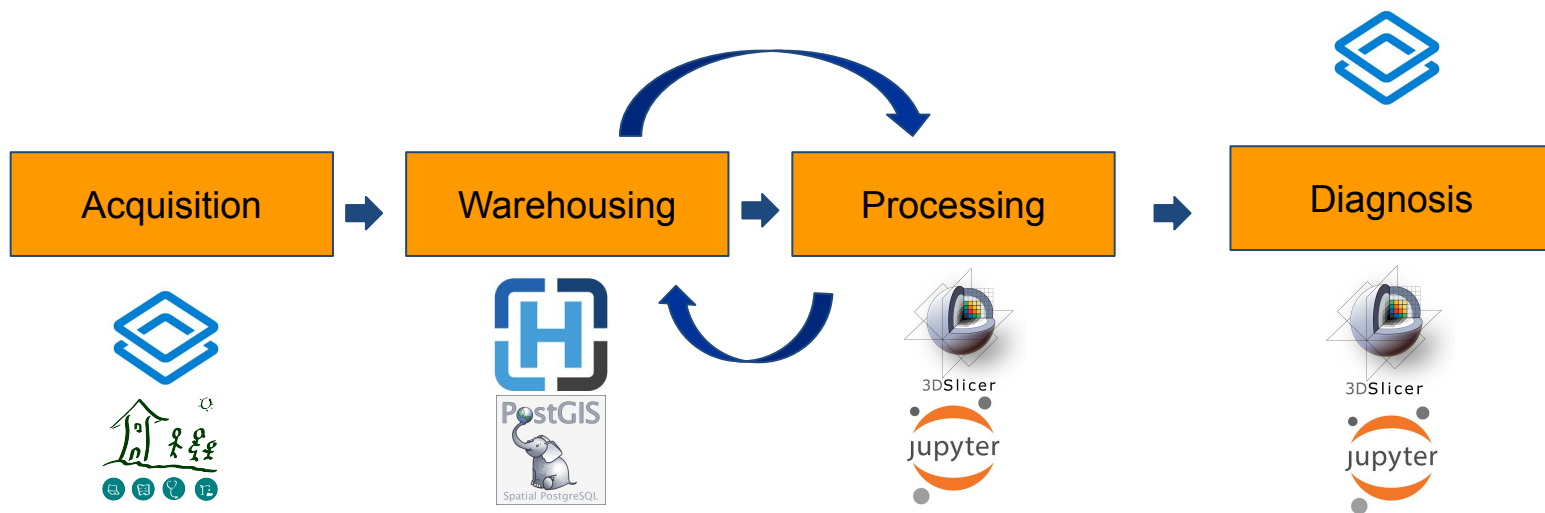
Our tasks:

1. **Design, prepare and develop infrastructure to support:**
   a. Data collection and health early warning systems
   b. Diagnostic imaging

2. **Transferring knowledge through online courses and workshops.**

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Early warning system structure - Requirements and Characteristics

- **Multi**:
    - Organisation
    - Information source (and format)
    - Pathology
- **Asynchronous**: data input at any time
- **Reactive**: update of dashboards (of indicators previously) when new data is available
- **Indicators**
    - May involve the use of advanced techniques such as deep learning
    - Scalar observations, with metadata
    - Geographical component
- **Dictionary** with terms in forms and dashboards
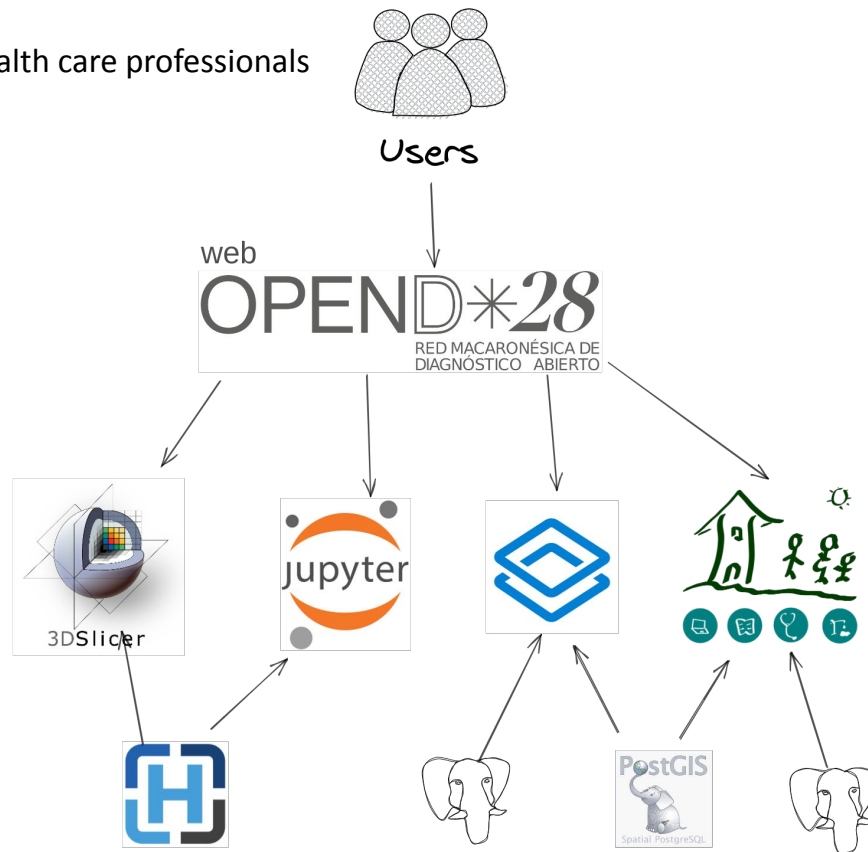- **Users**: health decision-makers

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Health data processing

Acquisition → Warehousing → Processing → Diagnosis

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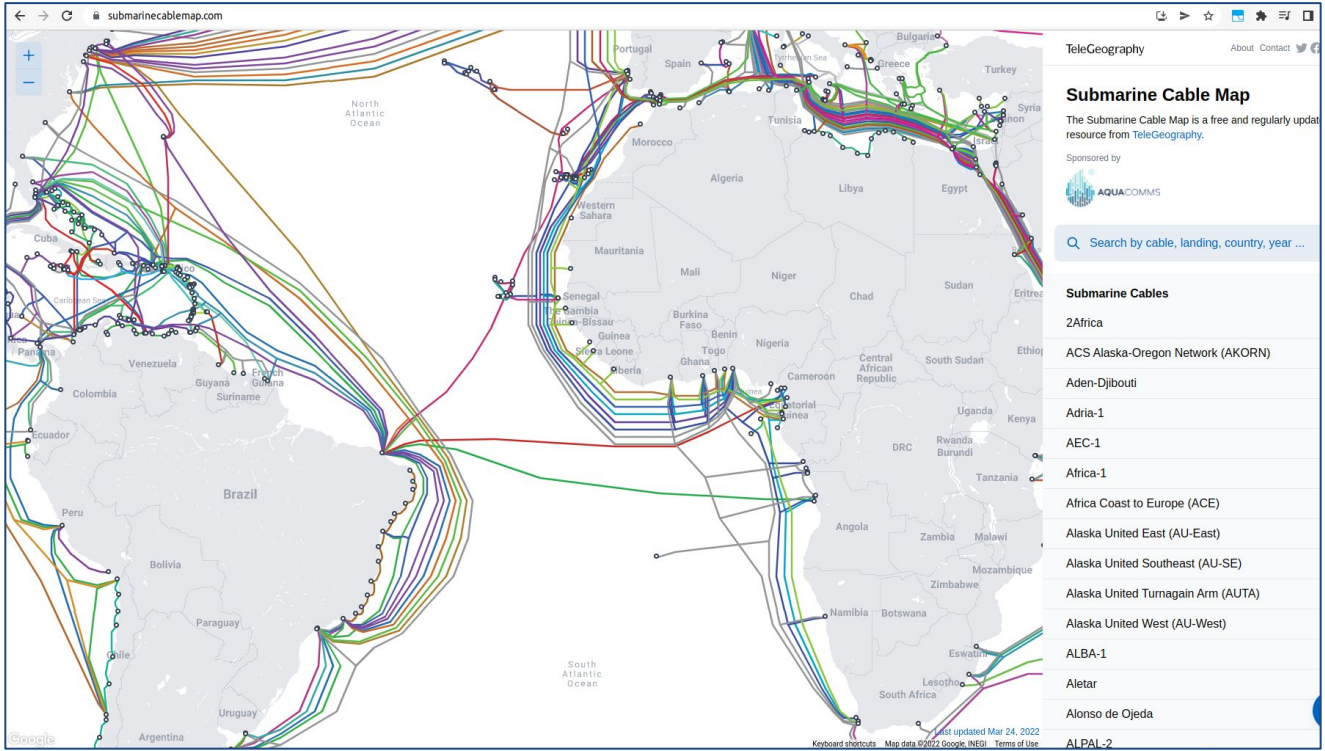# Healthcare (O)SaaS

Teide HPC

IaaS-PaaS Service

TEIDE-HPC (High Performance Computing) infrastructure will be used both as platform to deploy the services and as computing service to execute GPU algorithms.
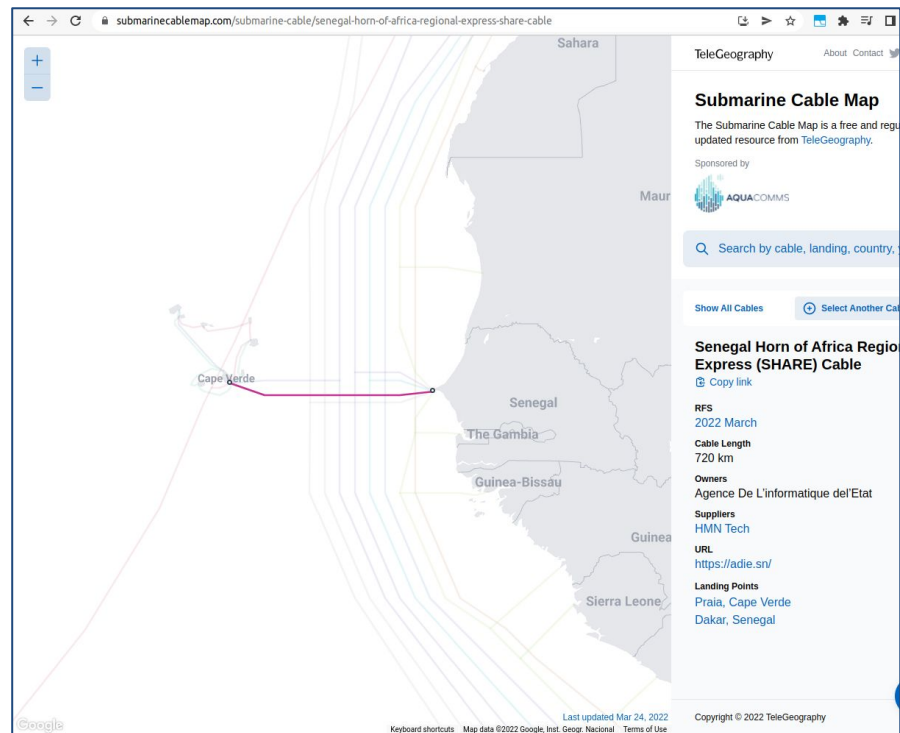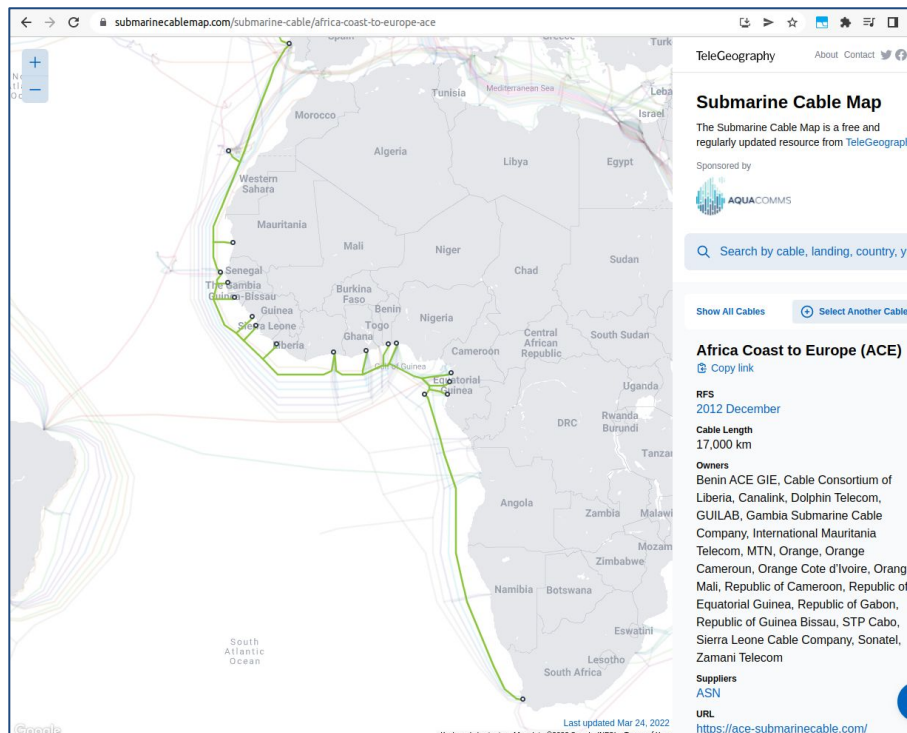
- Connectivity:
  - ACE, SHARE (Senegal, Mauritania, Cabo Verde)
  - MainOne, SAT-3/WASC
- Docker support capability
- Computing and storage capacity
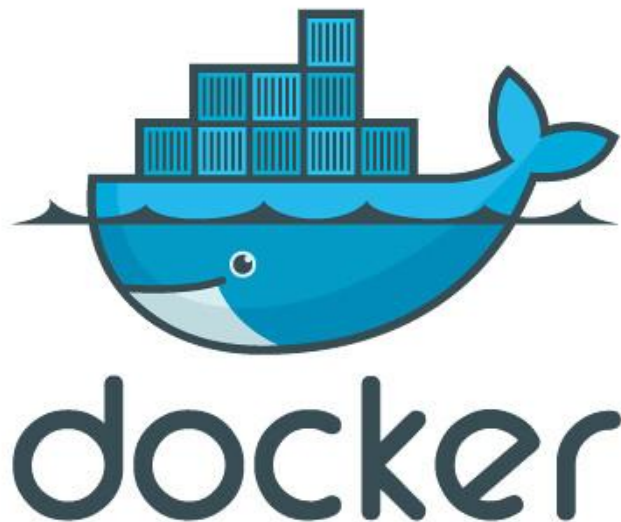- User support

Data Centre - Connectivity

Data Centre - Cables ACE (from 2021) y SHARE (~2022)

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Docker is a set of [platform as a service](#) (PaaS) products that use [OS-level virtualization](#) to deliver software in packages called containers.

main advantages:

- minimal runtime requirements of the application that allows them to **deploy faster.**
- The Docker containers can swiftly move from the **cloud environment** to localhost and vice-versa.

Open source HTTP routing, reverse proxy and load balancer.

It works with various backends such as Docker, Swarm, Kubernetes, Marathon, Mesos, etc.

main advantages:

- constantly updates its configuration – no restarts required
- enables HTTPS to your microservices by leveraging "Let's Encrypt (wildcard certificates support)"

Free, open-source, high-performance HTTP server and reverse proxy.

main advantages :

- Simple configuration, and low resource consumption
- Used for websocket proxy in for 3dSlicer

Open source Technologies
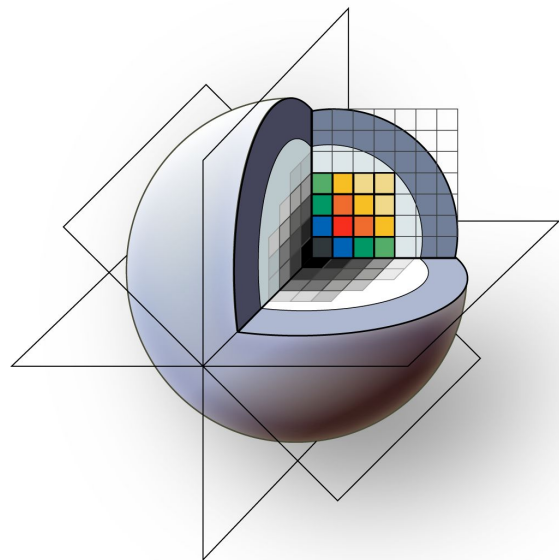
A software application for visualization and analysis of medical image computing data sets.

A research software platform, which allows researchers to quickly develop and evaluate new methods and distribute them to clinical users.

Capabilities:

- Handling DICOM images and reading/writing a variety of other formats
- Interactive visualization of volumetric Voxel images, polygonal meshes, and volume renderings
- Manual editing
- Fusion and co-registering of data using rigid and non-rigid algorithms
- Automatic image segmentation
- Analysis and visualization of diffusion tensor imaging data
- Tracking of devices for image-guided procedures.

3DSlicer

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Open source Technologies

Lightweight, standalone server, with DICOM / DICOMWEB support and REST API.

main advantages:

- specifically designed for research
- Provides a modern RESTful API so Orthanc can be driven from any computer language to automate clinical processes.

Open source Technologies

DHIS2:

Open source, web-based platform most commonly used as a health management information system (HMIS).

The DHIS2 platform boasts data warehousing, visualization features, and the possibility for data users and policy makers to generate analysis from live data in real-time.

https://dhis2.org/about/

Open source Technologies

GNU Health

The GNU Health project provides the tools for individuals, health professionals, institutions and governments to proactively assess and improve the underlying determinants of health, from the socioeconomic agents to the molecular basis of disease. From primary health care to precision medicine.

https://www.gnuhealth.org/about-us.html

Open source Technologies

Open source implementation of the Lightweight Directory Access Protocol.

LDAP is a protocol that facilitates directory building, querying, and management. It can also authenticate and authorize users to resources like:

- Technical applications.
- Server infrastructure.
- File servers.
- Networking equipment.

main advantages:
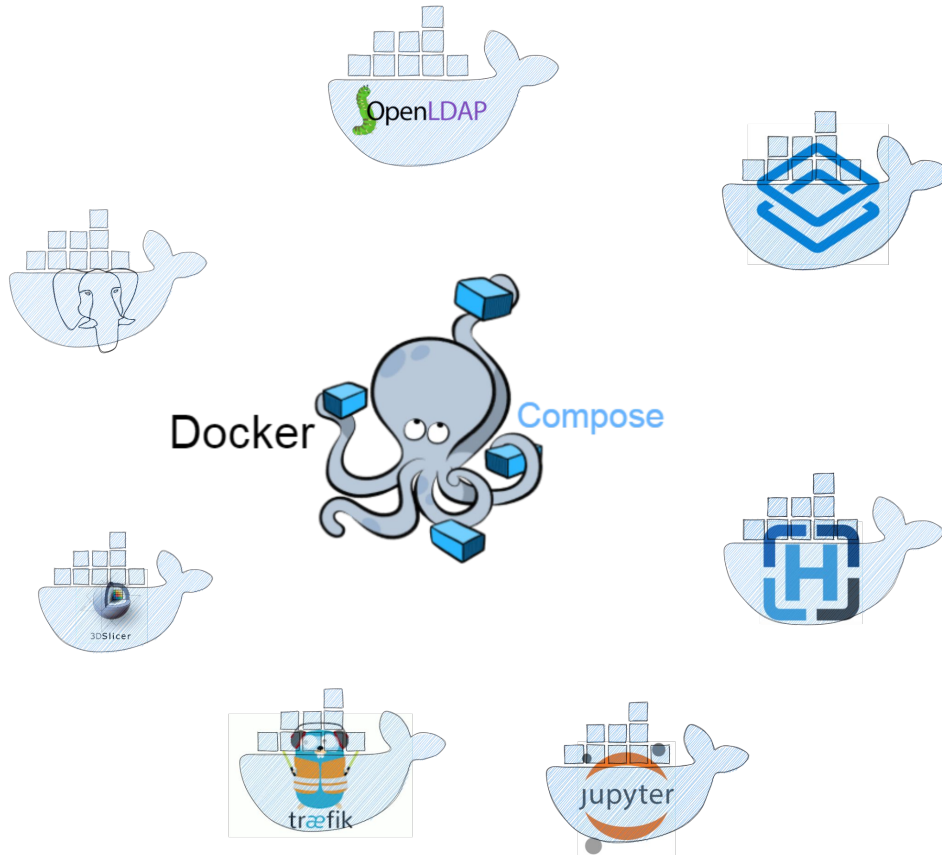
flexibility, scalability, and OS-agnosticism.

OPENDX - Platform
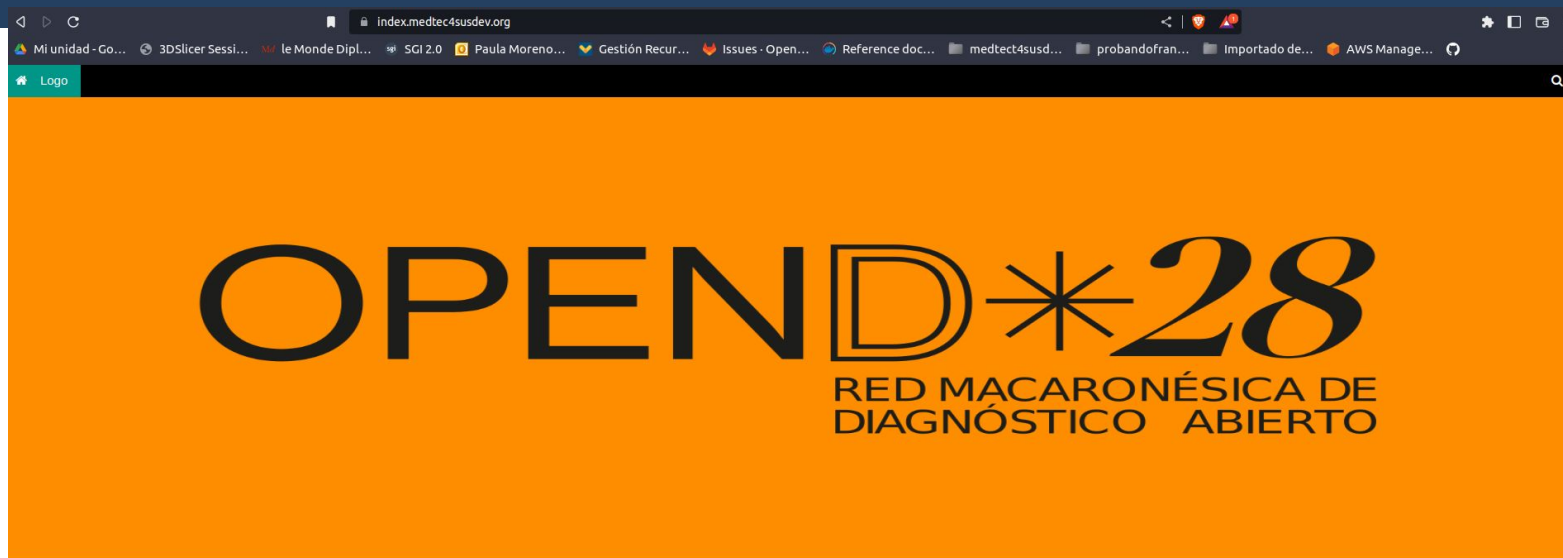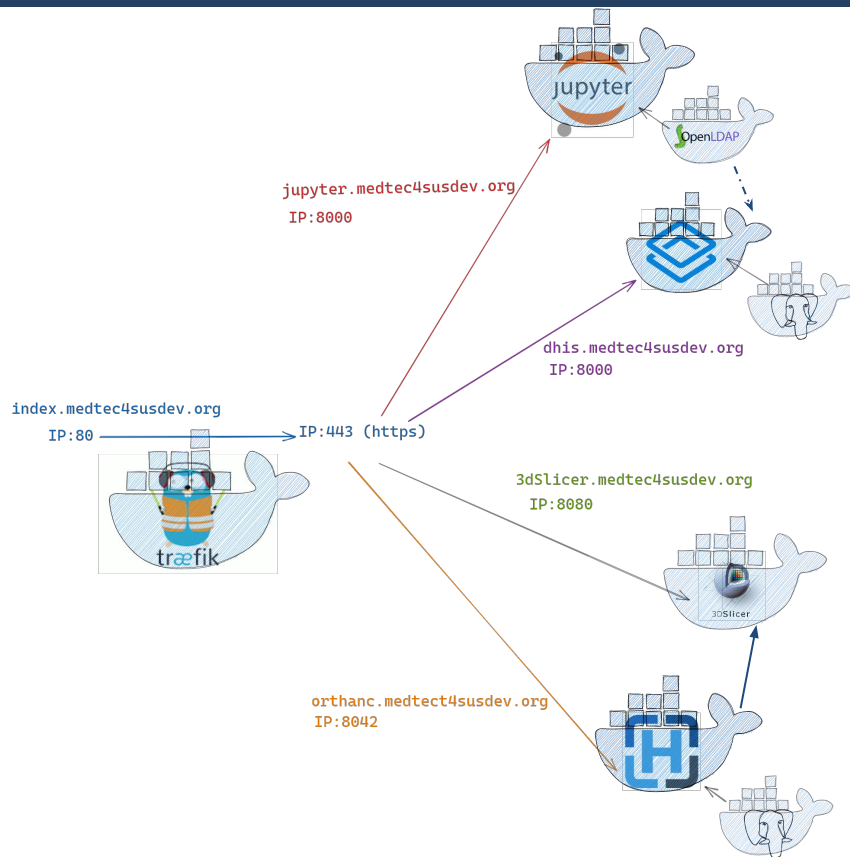
OpenDx28 -Platform

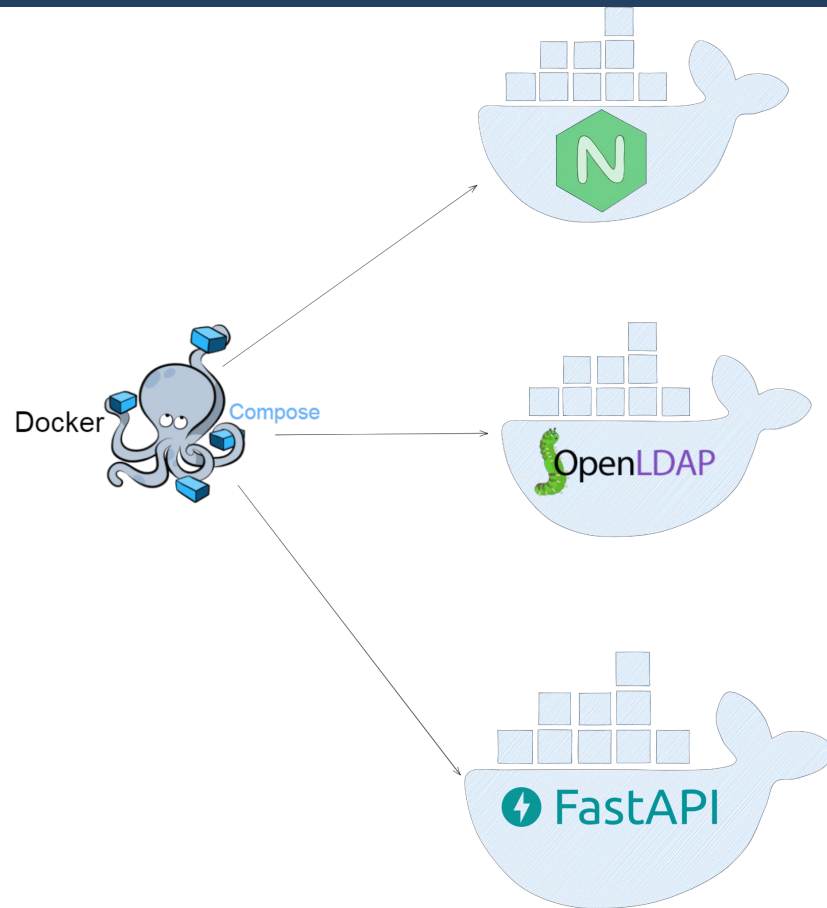Use Docker compose to easily orchestrate and connect all containers

Docker compose main pros:
- Fast and simple configuration. Thanks to **YAML scripts** and environment variables.
- Secure internal communication. Compose creates a network for all the services to share. This adds an extra security layer for the app since the services cannot be accessed externally.
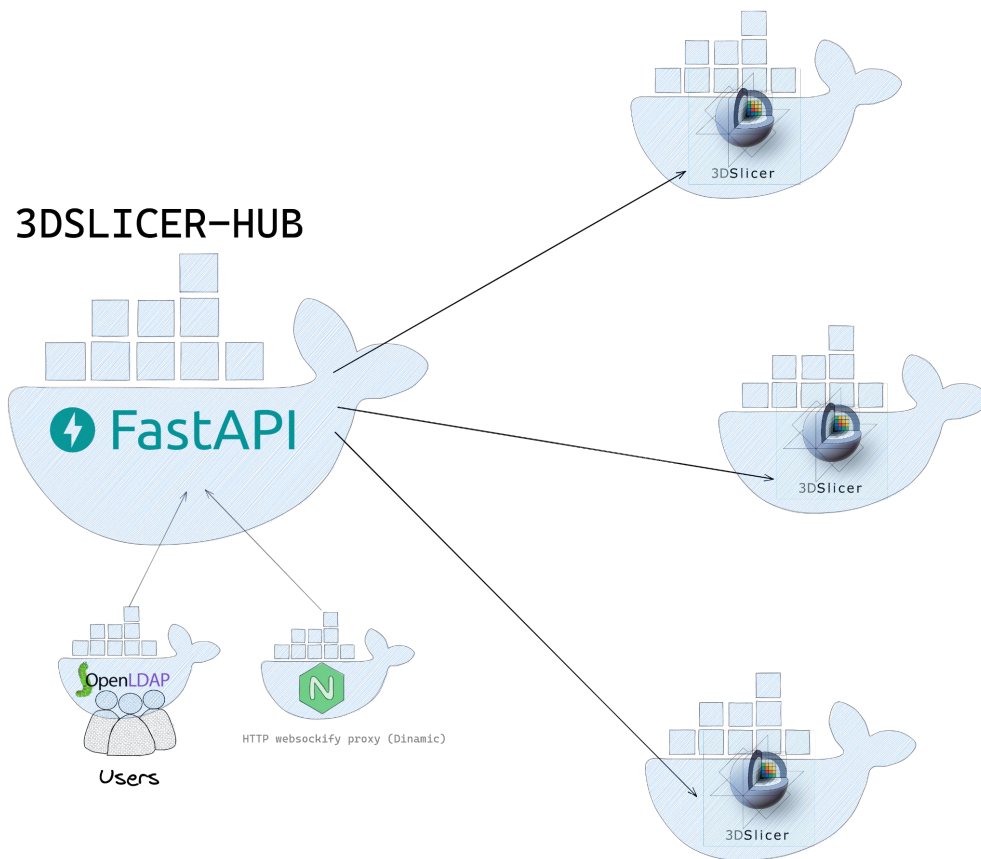
OpenDx28 -platform

jupyter.medtec4susdev.org
IP:8000

dhis.medtec4susdev.org
IP:8000

index.medtec4susdev.org
IP:80 —————→ IP:443 (https)

3dSlicer.medtec4susdev.org
IP:8080

orthanc.medtect4susdev.org
IP:8042

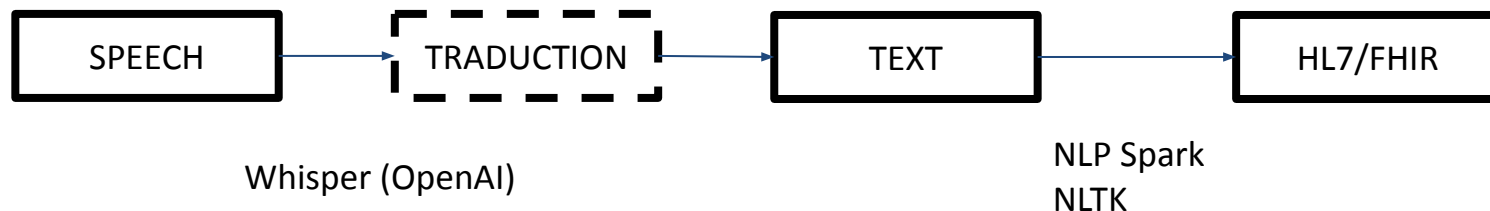# 3DSlicer-hub

3dslicer-hub

3DSLICER-HUB

- Turn single user 3DSlicer web into multiuser platform.
- 3DSlicer containers are created and managed dynamically for every user.
- Workspace for every user stored in Teide HPC.
- Objective:
  - Educational purposes.
  - make available to anyone the computational resources necessary for the use of 3DSlicer
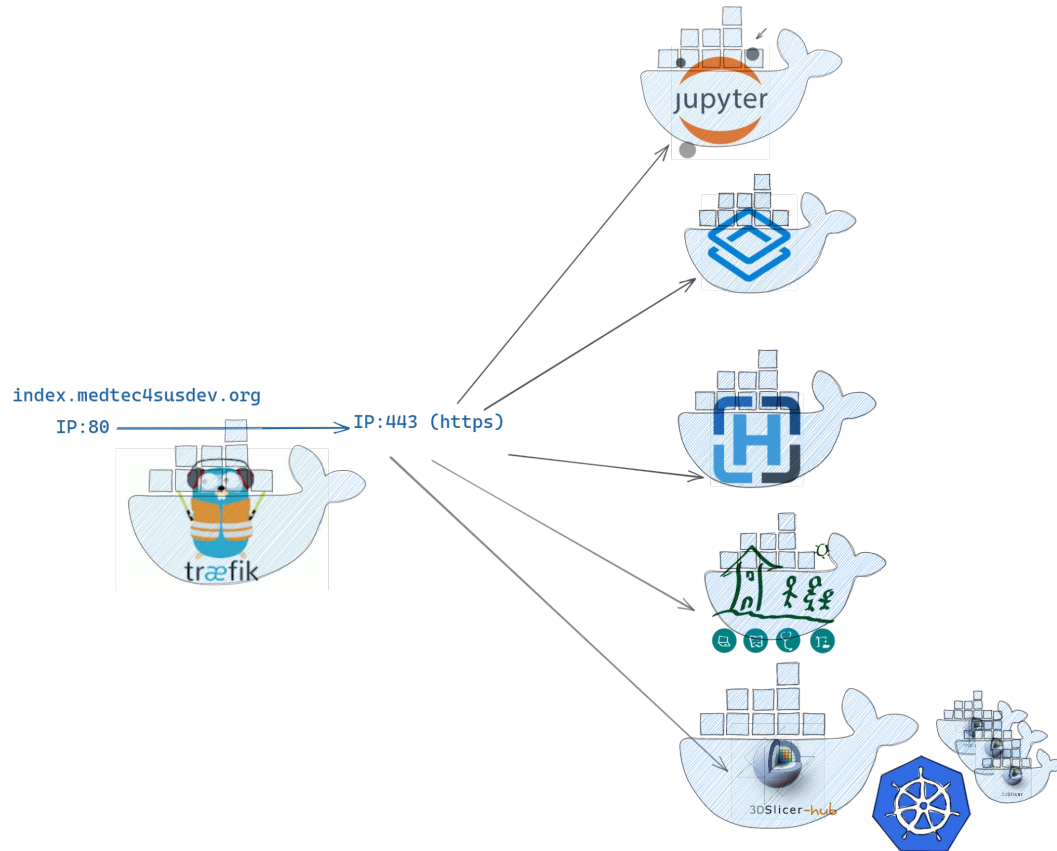
NLP for HL7/FHIR

TFG - INTERNSHIP

Prototype:

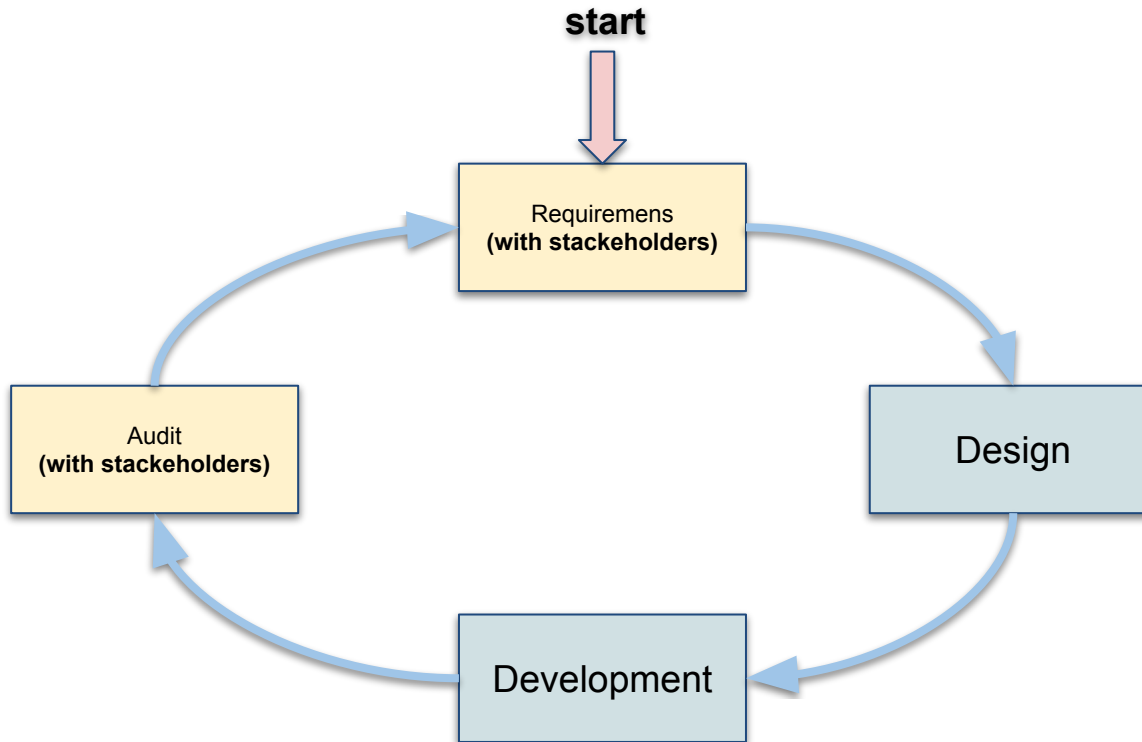1. PipeLine for speech to HL7/FHIR processing
2. API

```
┌──────────────┐     ┌ ─ ─ ─ ─ ─ ─ ─ ┐     ┌──────────────┐     ┌──────────────┐
│              │        TRADUCTION         │              │     │              │
│    SPEECH    │ ──▶ │               │ ──▶ │     TEXT     │ ──▶ │   HL7/FHIR   │
│              │                           │              │     │              │
└──────────────┘     └ ─ ─ ─ ─ ─ ─ ─ ┘     └──────────────┘     └──────────────┘
```

        Whisper (OpenAI)   NLP Spark
                                                   NLTK

Objectives:
  ● Ease patient care by removing the computer barrier.
  ● Making it less difficult for healthcare professionals
    hospital digitisation.

Future work: integration

Agile development methodology

Information Technologies for Health Management Systems (60 hours - 6ECTS)

Deployment and configuration (30 hours)

- Docker and Docker Compose Basics
- Deployment of every technology using Docker and Docker compose (3DSlicer, Orthanc, GNU Health, DHIS2)

Student Profile:

- Hospital IT staff or similar

Minimum Skills:

- Notions of Linux environments
- Notions of how to use the terminal in Linux

When and Where?

- **https://training.itccanarias.org/my/**
- **Workshops during Naemic conference 30 January - 3 February**

Use and management (30 hours)

3DSlicer, Orthanc, DHIS2, GNU Health

Student Profile:

- Hospital staff
- Researchers

Minimum Skills:

- user-level computer skills

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e-mail: pmoreno@itccanarias.org

Thank you

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