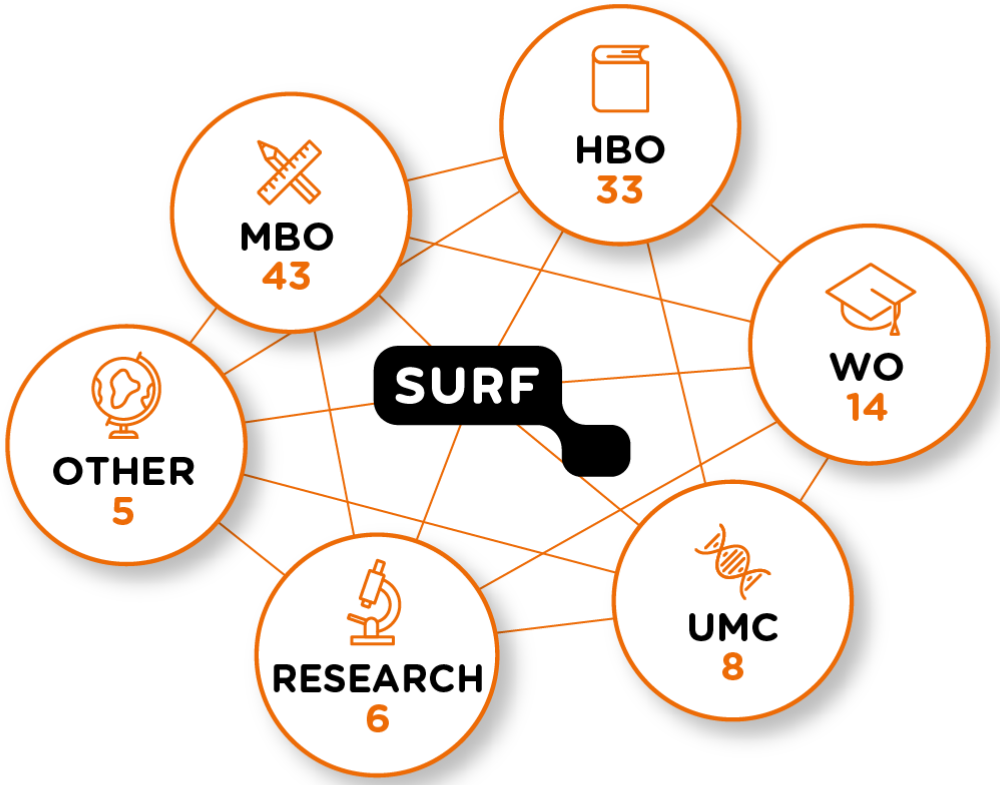
SENSEMAKERS IOT PLATFORM

David Šálek (SURFsara)

Sensemakers meetup

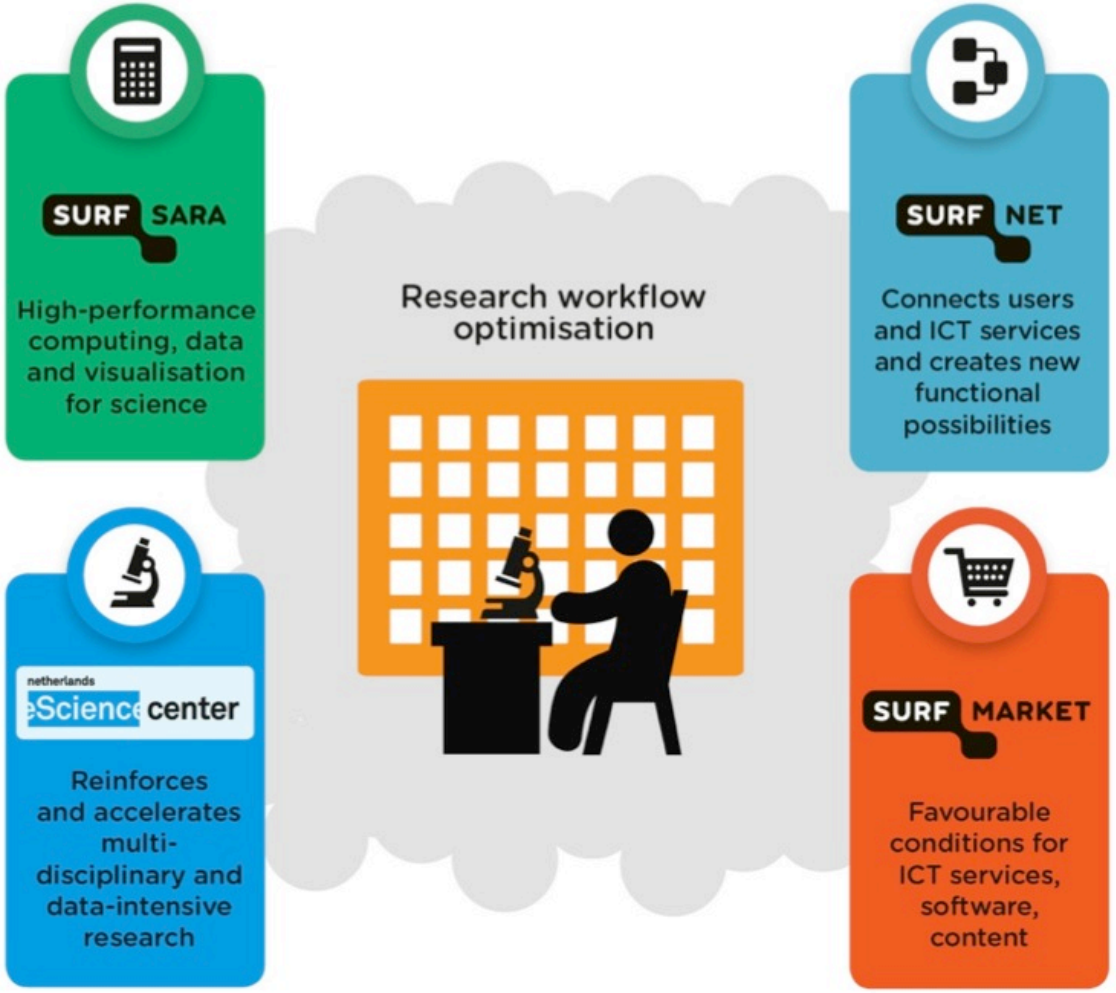
19/06/2019

About SURF

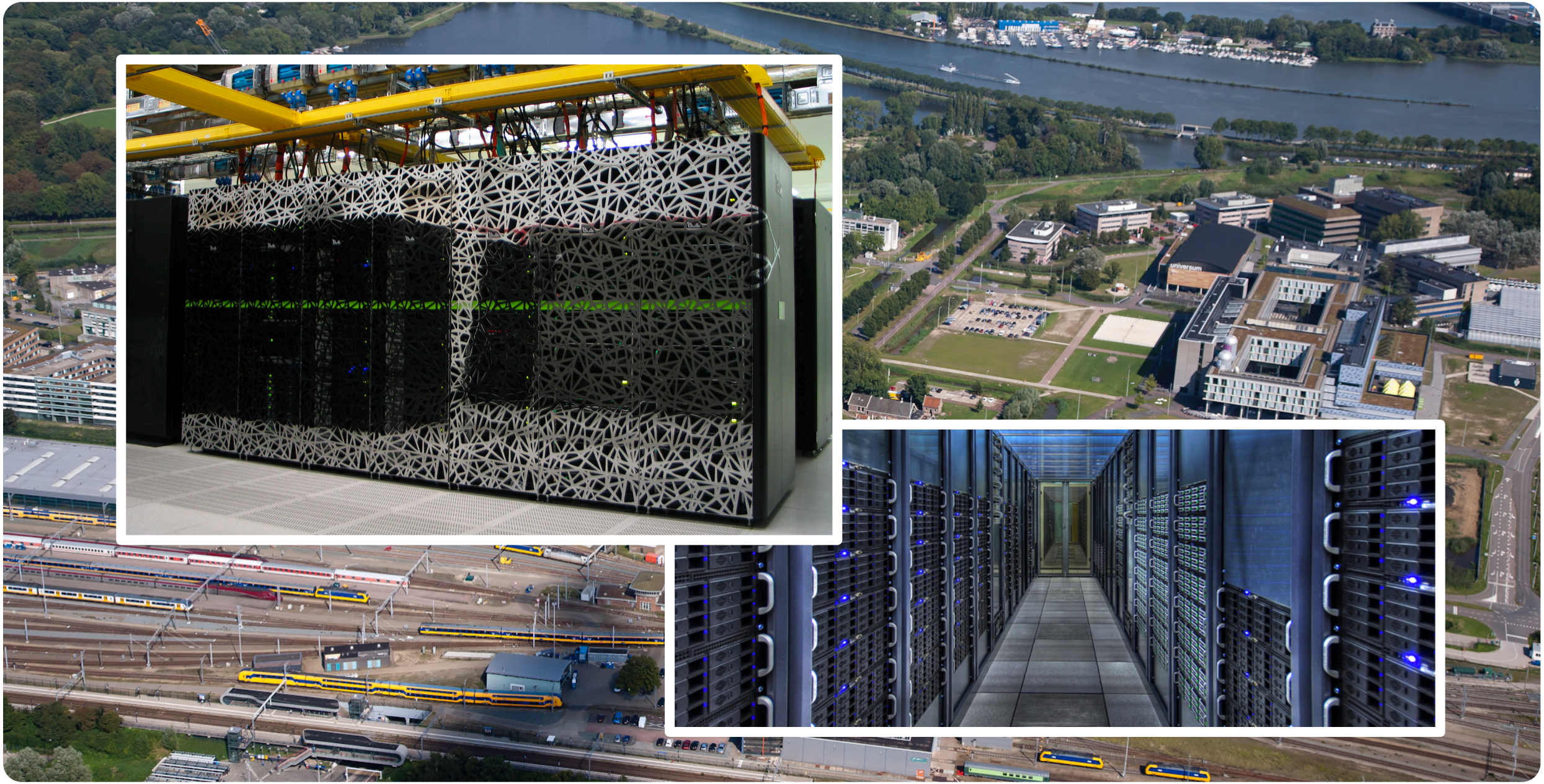


WO: Research-oriented higher education
HBO: Higher professional education
MBO: Vocational education and training
UMC: University teaching hospital

About SURF

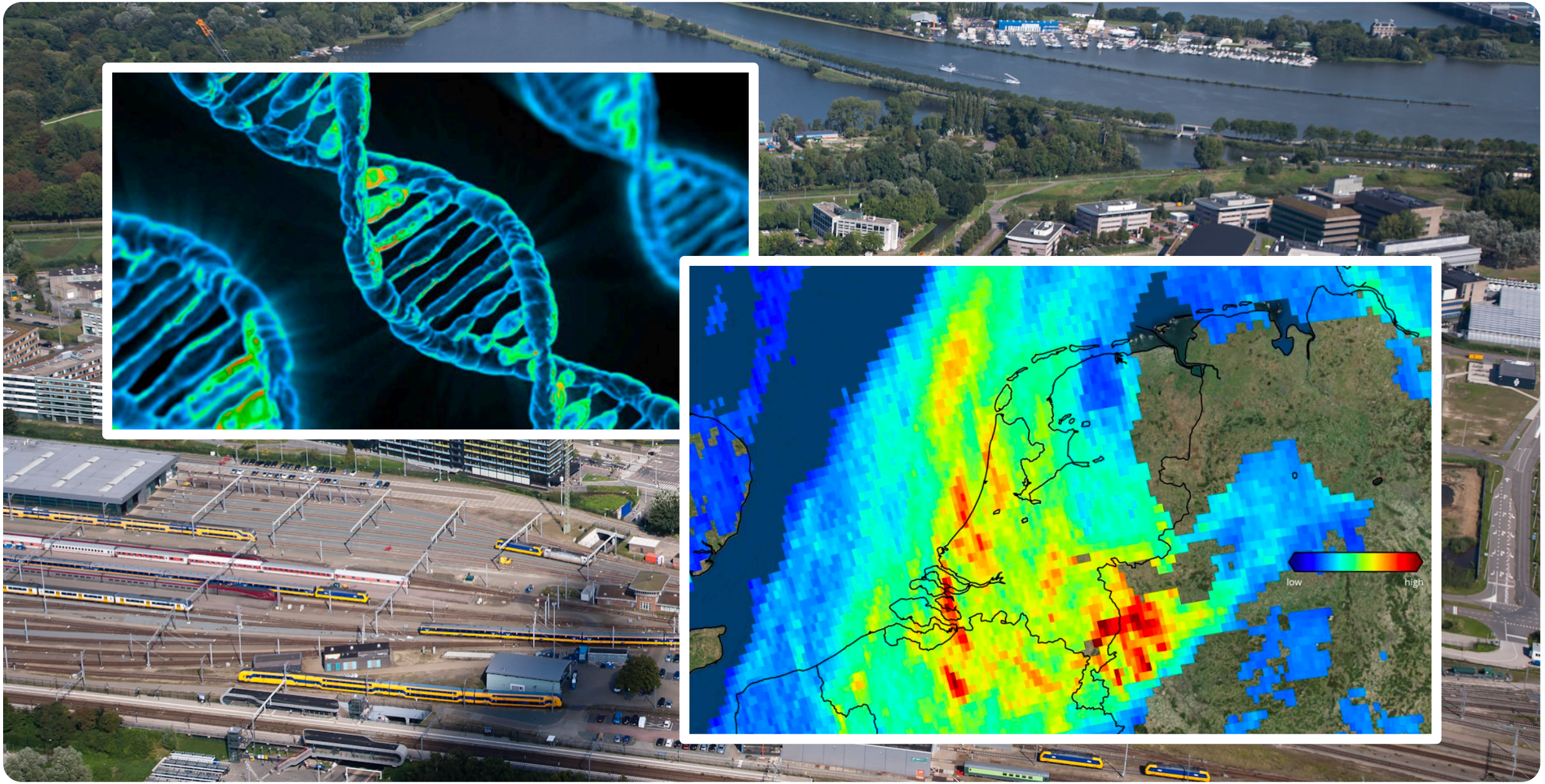

SURF SARA
High-performance computing, data and visualisation for science
Research workflow optimisation
SURF NET
Connects users and ICT services and creates new functional possibilities
netherlands eScience center
Reinforces and accelerates multi-disciplinary and data-intensive research
SURF MARKET
Favourable conditions for ICT services, software, content

SURF SARA



SURF SARA

SURF SARA



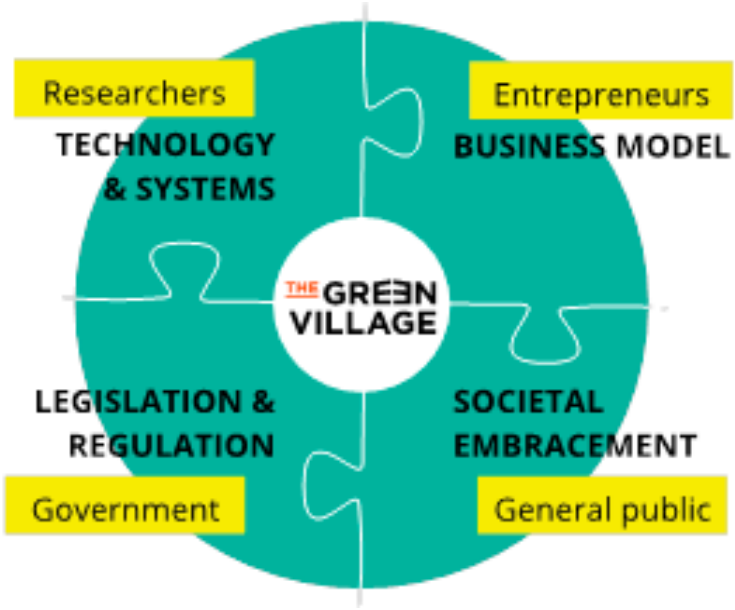
SURF SARA

SURF SARA

The Green Village

The Green Village

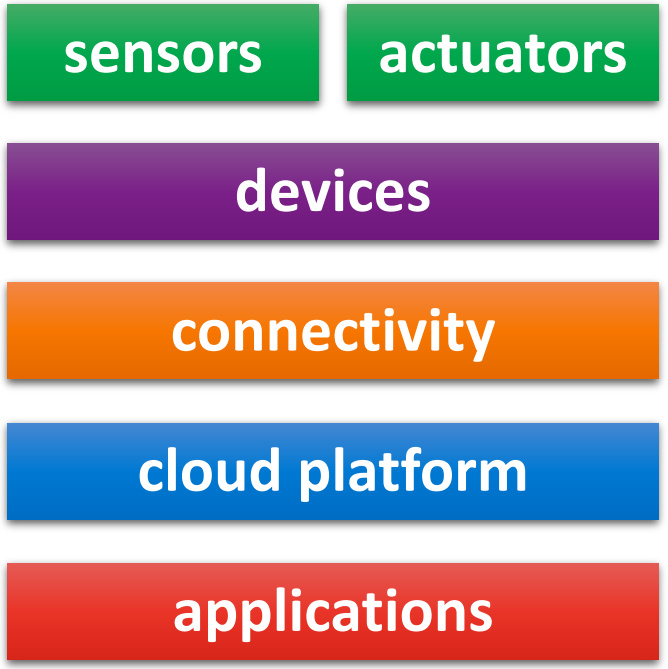
- https://www.thegreenvillage.org/
- The Green Village's site takes a unique position in the chain from fundamental research and development to large-scale application of innovations in society.



- Solving the world's largest challenges requires radically new connections. Combinations of technologies that were never linked before, or innovation partnerships between unlikely partners → **data sharing platform**
- https://www.thegreenvillage.org/projects

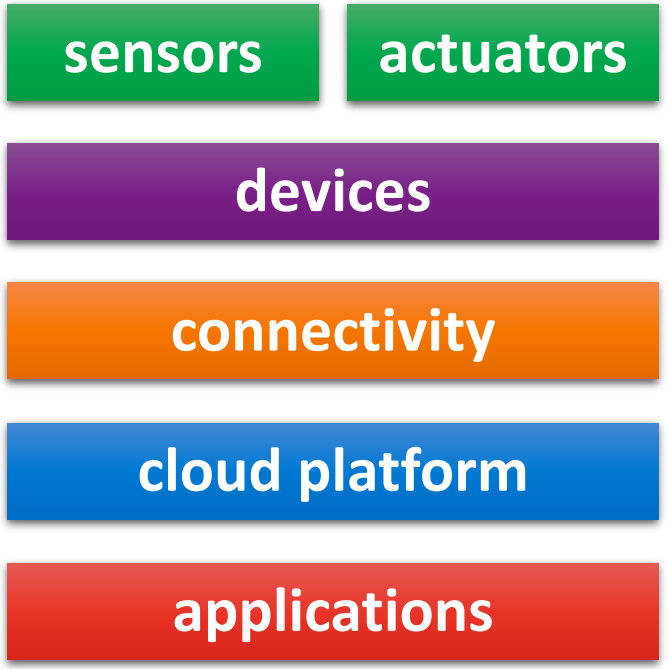
Internet of Things

- Low cost devices
- Affordable and high speed connectivity
- Standardized communication protocols
- Affordable and available cloud computing
- Open source software and hardware
- Advances in data science and data processing

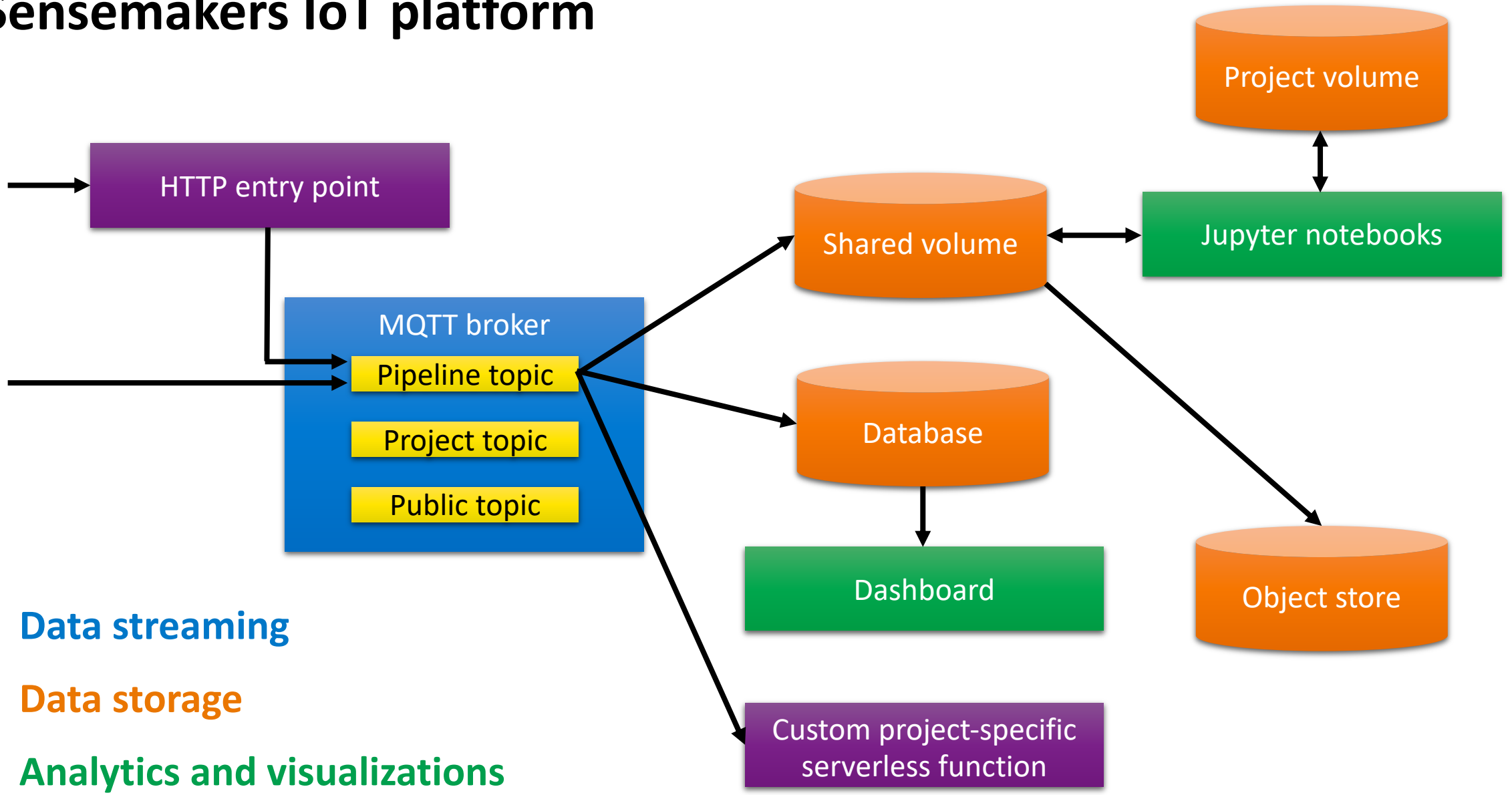


Internet of Things

- Low cost devices
- Affordable and high speed connectivity
- **Standardized communication protocols**
- **Affordable and available cloud computing**
- **Open source software** and hardware
- Advances in data science and data processing

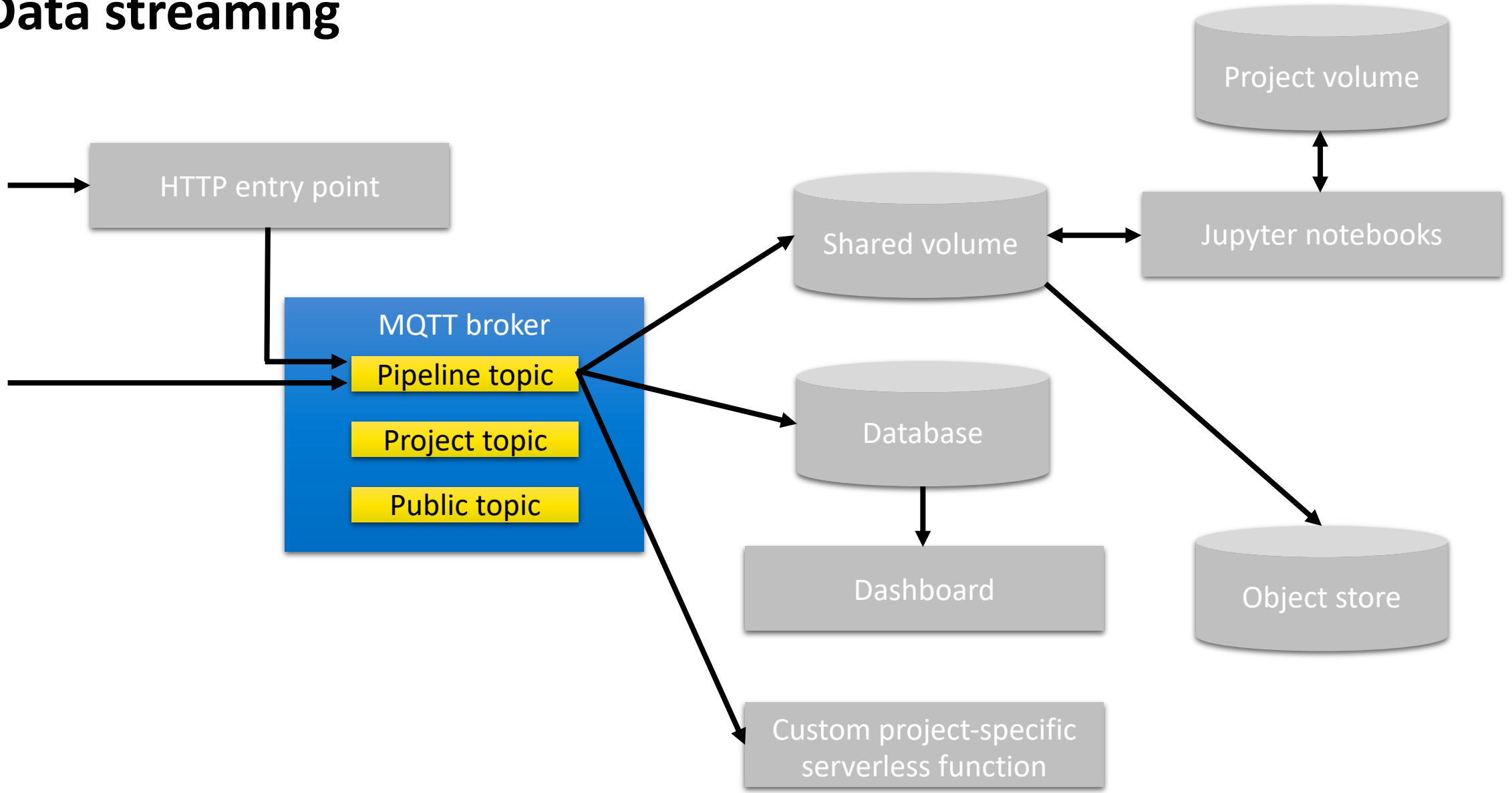


Sensemakers IoT platform



- Data streaming
- Data storage
- Analytics and visualizations
- Event-driven actions

Data streaming



MQTT

- MQTT stands for Message Queuing Telemetry Transport
- extremely simple and lightweight messaging protocol designed for constrained devices and low-bandwidth, high-latency or unreliable networks
- became a standard for the Internet of Things

- **Mosquitto** is an open-source MQTT broker and serves as a backbone of the Sensemakers IoT platform. https://mosquitto.org/
- publish/subscribe to topics
- User authentication, access control lists

Ingesting data

- Data can be sent to the platform in two ways:
  - **publish to MQTT**
  - **HTTP entry point**
    (works well with The Things Network HTTP integration)

- MQTT topics
  - **public** → for anyone to use
  - **private** → dedicated to each project
  - **automated pipeline** → store data in the platform and trigger actions

Automated data pipeline

- Messages sent to the **pipeline/<app_id>/<dev_id>** topic are automatically:
  - stored in InfluxDB database
  - appended in JSON format to files in a shared volume
  - sent to a serverless function (if in place) to enable event-driven actions

```
https://openfaas.sensemakersams.org/async-function/<app_id>
```

Automated data pipeline – Message format

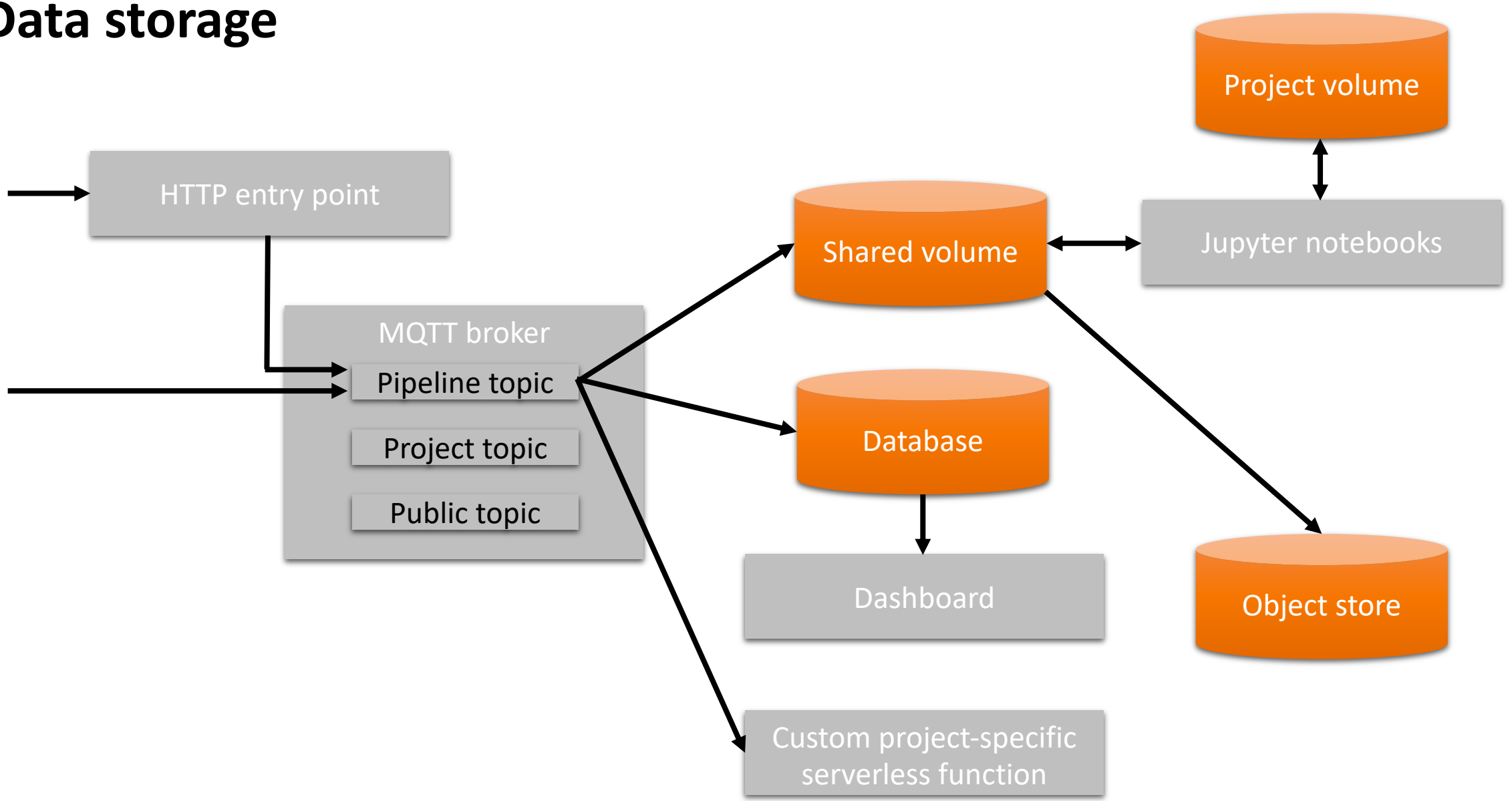
- Messages sent to the **pipeline/<app_id>/<dev_id>** topic have to comply with this JSON format.
- **Standardized message format** is important for:
  - **data sharing**
  - **data management** and metadata extraction
- Example messages:

```
{"app_id": "test_project", "dev_id": "test_device",
"payload_fields": {"temperature": 42},
"time": 1557244616000}
```

```
{"app_id": "test_project", "dev_id": "test_device",
"payload_fields": {"temperature": 42, "foo": "bar" },
"tag_fields": {"foo": "bar"}, "foo": "bar"}
```

```
{
    "type": "object",
    "properties": {
        "app_id": {
            "type": "string"
        },
        "dev_id": {
            "type": "string"
        },
        "payload_fields": {
            "type": ”object"
        },
        "time": {
            "type": "integer”
        },
        "tag_fields": {
            "type": ”object"
        }
    },
    "required": [
        "app_id",
        "dev_id",
        "payload_fields"
    ]
}
```

Data storage



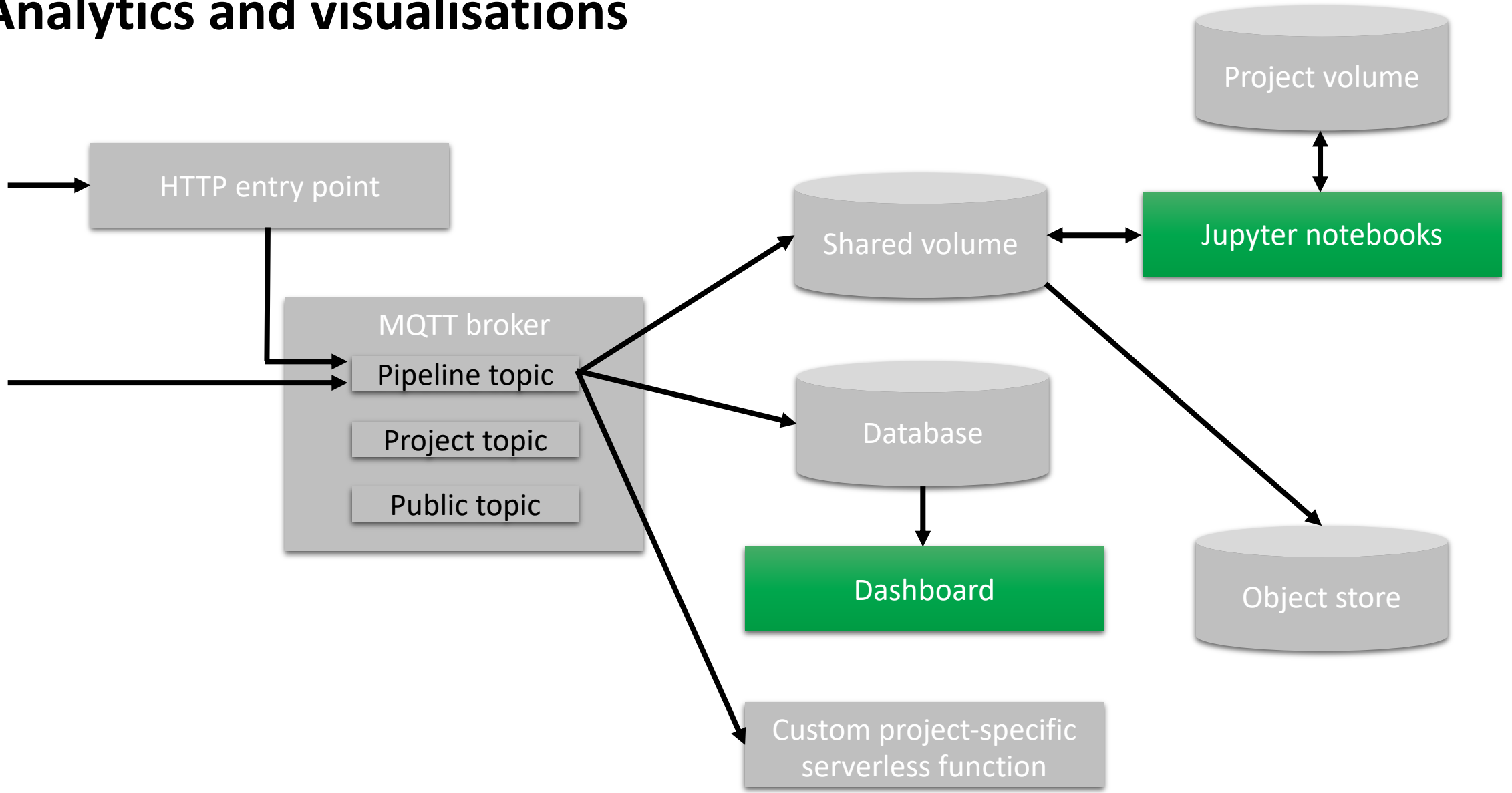
Data storage

- **Shared volume**
  - Every message is appended to a file specific to a device and a calendar day.
- **InfluxDB** https://docs.influxdata.com/influxdb/

  - InfluxDB is an open-source time series database.
  - Data is available immediately.
- **Object store**
  - Minio is an open-source object store compatible with Amazon S3 https://min.io/
  - used for periodic backups on a daily basis and metadata
  - can be used for uploading larger files, e.g. images

SURF SARA

Analytics and visualisations



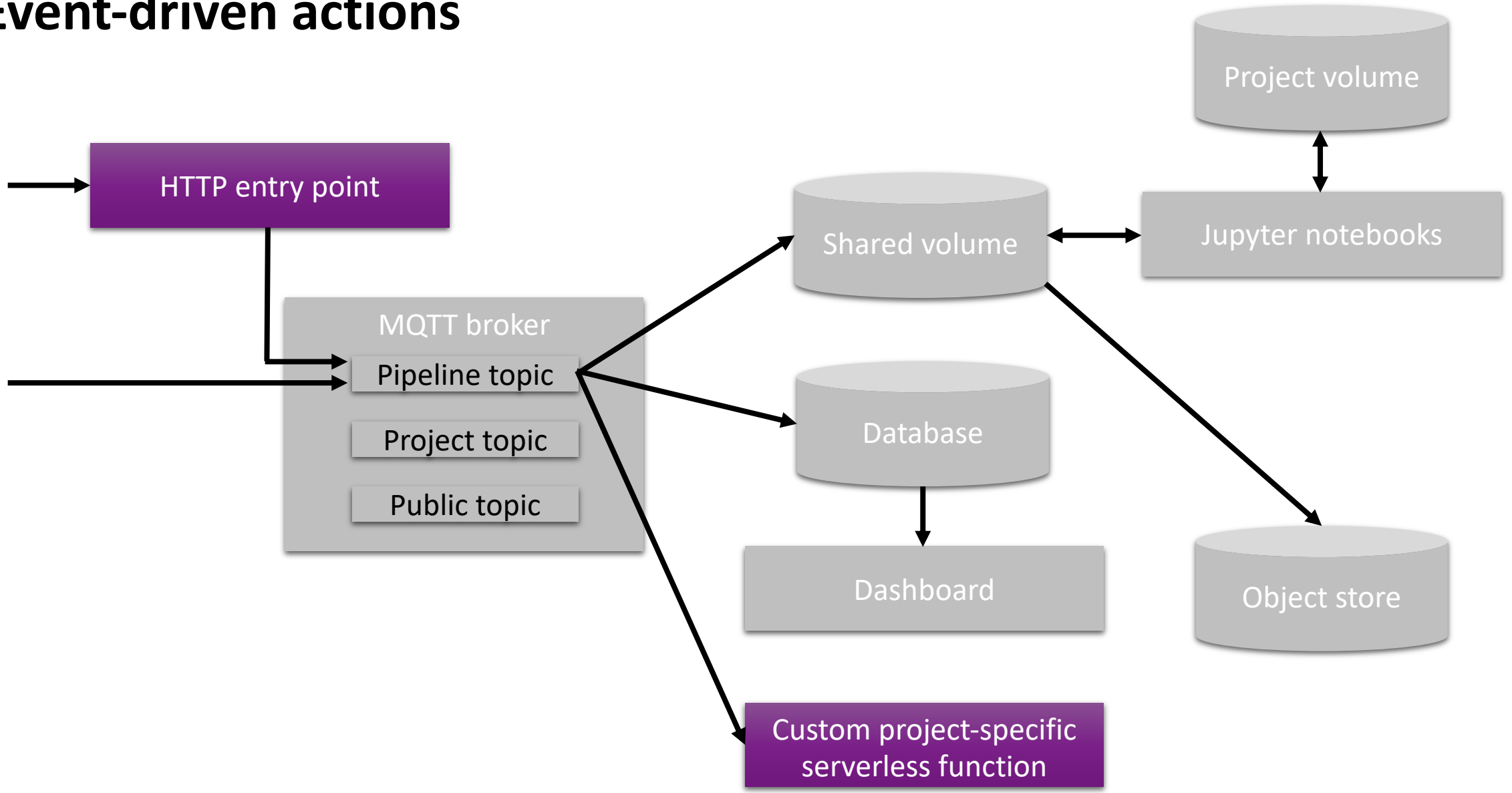
Dashboards

- **Grafana** is available for visualizing data from InfluxDB and alerting.
- http://docs.grafana.org/

- **Jupyter** notebooks are available for data analytics purposes.
- https://jupyter.org/hub
- Every project gets its own Jupyter server with private storage space and access to the shared storage.

SURF SARA

Event-driven actions



Serverless functions

- **OpenFaaS** framework is available to deploy serverless functions.
- https://www.openfaas.com/

- Functions can be deployed by a platform administrator.

- The HTTP endpoint for ingesting data to the platform is an OpenFaaS function that publishes the received message over MQTT to the pipeline topic for the corresponding project.

Event-driven actions/talking back to devices

- Event-driven actions (i.e. executing code triggered by an incoming message) can be implemented in the following ways:
  - Run code that subscribes to an MQTT topic on your own machine.
  - Run code that subscribes to an MQTT topic on the Linux machine in the Sensemakers IoT platform.
  - Deploy a serverless function.

```
https://openfaas.sensemakersams.org/async-function/<app_id>
```

- The MQTT broker can be used to send messages back to devices. (provided the devices are capable of subscribing to MQTT topics)

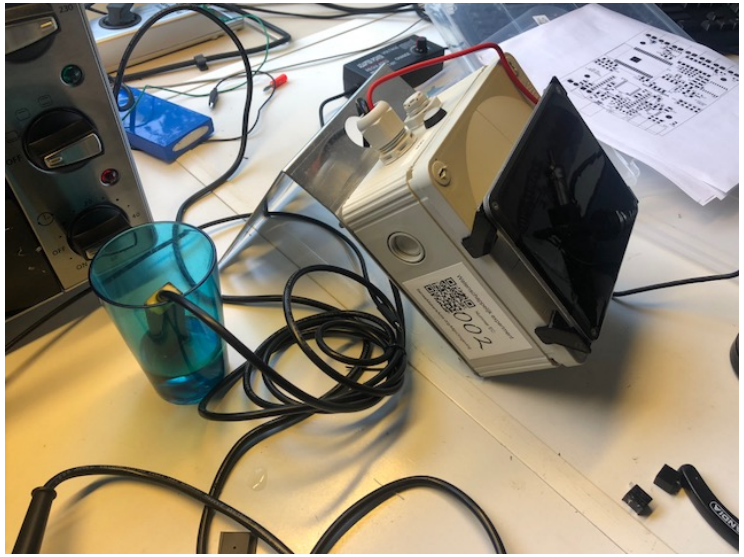
Using the Sensemakers IoT platform

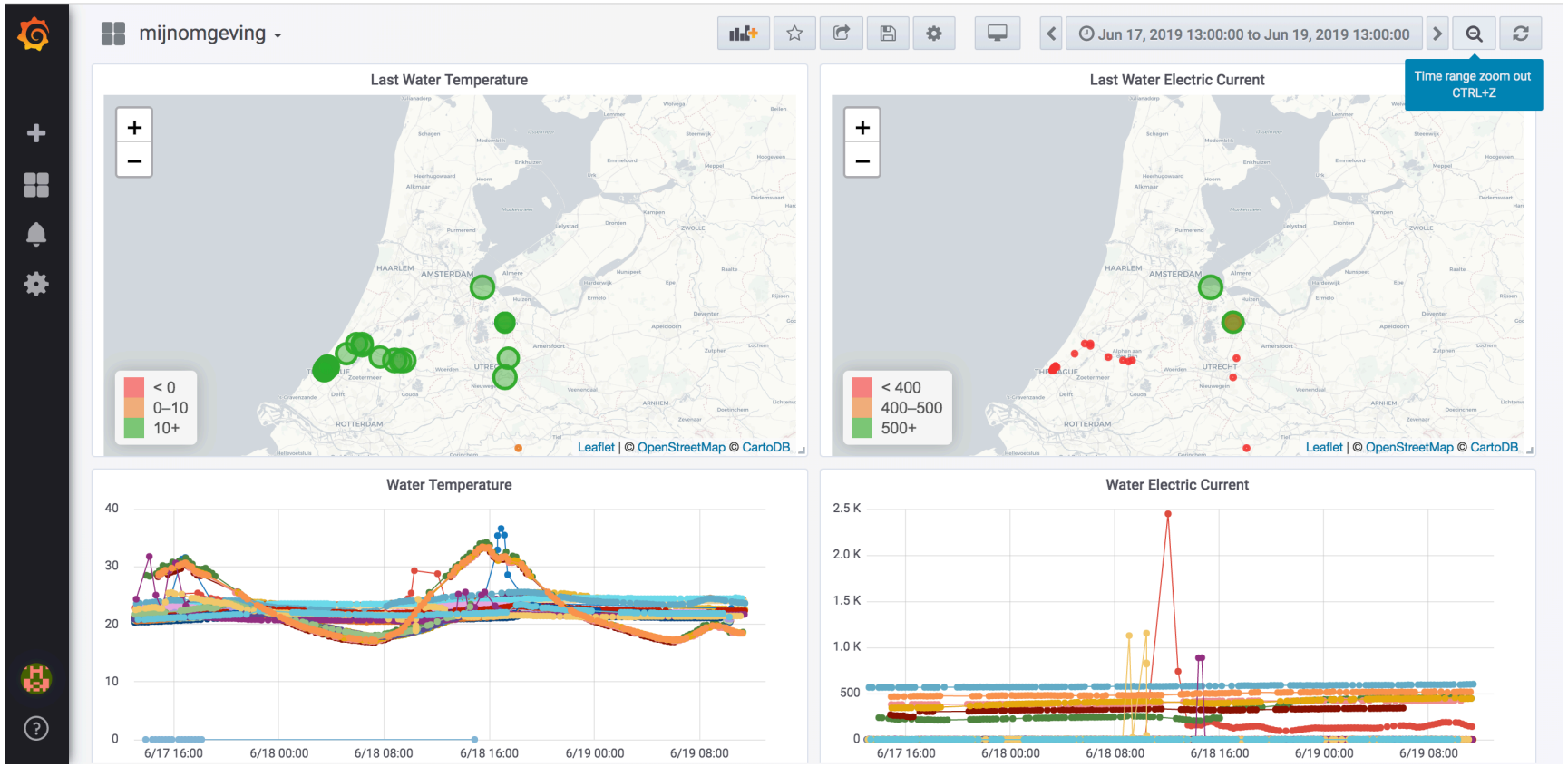
- The Sensemakers IoT platform is designed to host **multiple projects**. (credentials/resources are given on a project-basis)
- One project is dedicated to **experimentation** → available for everyone (ask the credentials)

- There is a dedicated **github repository** for:
  - platform overview and technical **documentation**
  - **example code**
  - dashboard backups
  - https://github.com/sensemakersamsterdam/sensemakers-iot-platform

Mijn Omgeving

- citizen science project initiated by The Dutch Police, Vodafone and SODAQ
- 40 sensors have been handed out to measure water quality
- https://www.sensemakersams.org/mijnomgeving/





SENSEMAKERS IOT PLATFORM

David Šálek

E-mail: david.salek@surfsara.nl

https://www.linkedin.com/in/davidsalek/

Driving innovation together

SURF SARA

Driving innovation together

Useful links

- Website: https://www.sensemakersams.org

- Minio object store: https://minio.sensemakersams.org
- Grafana dashboards: https://grafana.sensemakersams.org
- Jupyter notebooks: https://jupyter.sensemakersams.org
- OpenFaaS serverless functions: https://openfaas.sensemakersams.org

- Github repository: https://github.com/sensemakersamsterdam/sensemakers-iot-platform