



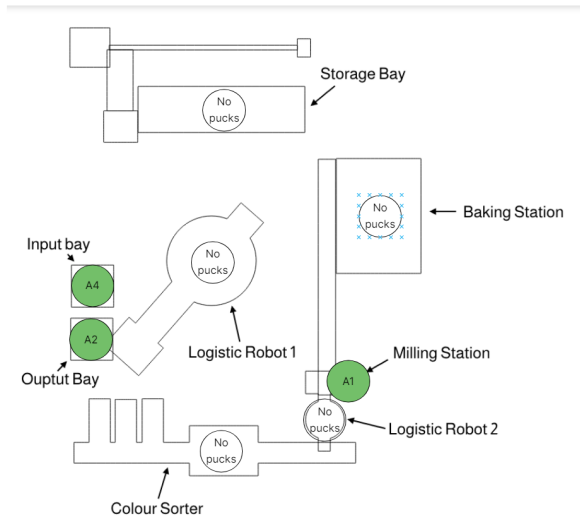
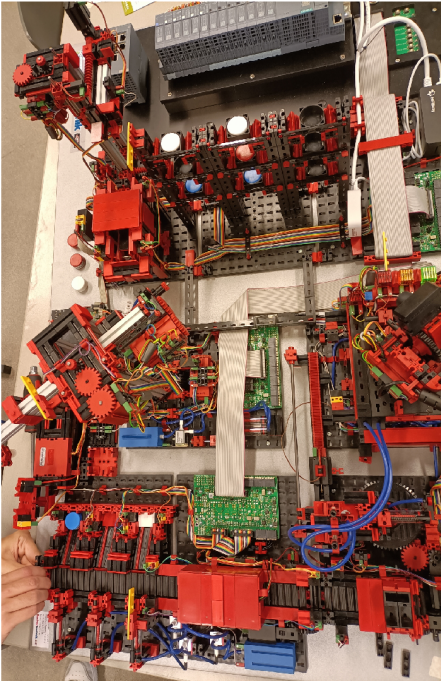
Dashboards, from data to infographics

IOT en Dashboards

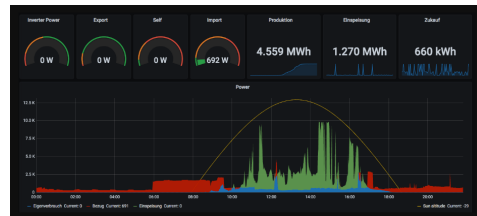
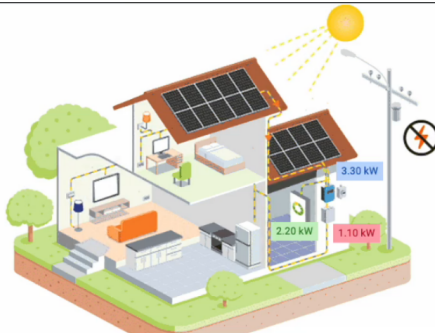
Derek Land (d.d.land@hhs.nl)

Suzanne Verspaandonk - de Jong (s.d.dejong@hhs.nl)

28 februari 2024



Grafana



Today

7 min Where does the data come from?

13 min Data storage?

10 min Display data in Dashboards

► Using data for sustainable manufacturing

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7 min Where does the data come from?

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10 min Display data in Dashboards

- ▶ Using data for sustainable manufacturing

Details

- ▶ Measuring data with an IOT device
- ▶ Sending data from an IOT device
- ▶ Receiving data using a IOT message protocol (MQTT)
- ▶ Collecting data in a graphical interface (Grafana)
- ▶ Using the information → up to you!

Today

7 min Where does the data come from?

13 min Data storage?

10 min Display data in Dashboards

- ▶ Using data for sustainable manufacturing

Applied University

- ▶ Working from sensor to Dashboard
- ▶ Hands-on experience
- ▶ Background information for further applications



Who am I

And why do I give this talk?

Who am I

And why do I give this talk?

- ▶ Lecturer at the Applied Physics department (THUAS)
 - Teaching computational related physics courses
- ▶ Researcher at the Smart Sensor Systems research group
 - Extracting the right data at the right time from sensors
 - In various fields (agriculture, predictive maintenance, well-being)

IOT Device - What is data?

Sensor Data

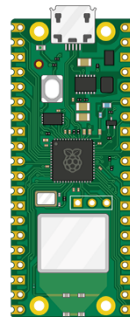
The output from a device that responds to the environment

IOT Device - What is data?

Sensor Data

The output from a device that responds to the environment

- ▶ RaspberryPi - Pico (WH)
- ▶ Many possible use-cases
- ▶ Onboard temperature sensor
- ▶ Wireless capabilities

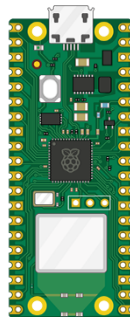


IOT Device - What is data?

Sensor Data

The output from a device that responds to the environment

- ▶ RaspberryPi - Pico (WH)
- ▶ Many possible use-cases
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Code already installed, ready to send data to the cloud!

IOT device - Cloud - Dashboard

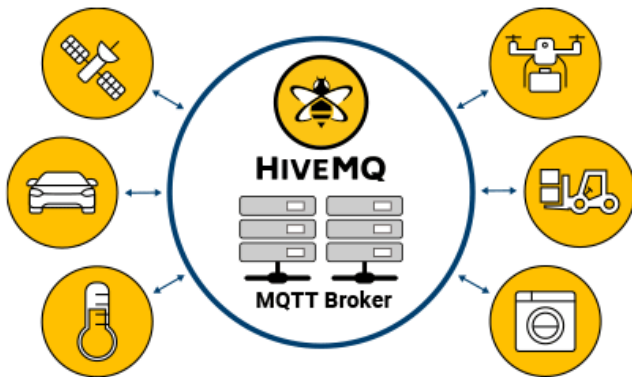


Many other options... But this one for today

MQTT - cloudprovider

hiveMQ.com

A free Cloud MQTT Broker that enables you to connect up to 100 devices.



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- ▶ Easy to see what is going on
- ▶ Nice for testing / learning / demonstrations
- ▶ Free to use with limited devices connected, easy to replace with other tools

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At home: RaspberryPi with mosquitto (MQTT) and a database container
Professional: Surf (Apache Kafka) or paid HiveMQ or own infrastructure

hiveMQ.com - registration




Get HiveMQ

We make it easy for you to try HiveMQ



A free Cloud MQTT Broker that enables you to connect up to 100 devices.

Sign up now
(No credit card required)



Download HiveMQ and you're ready to try our reliable, scalable and fast MQTT broker.

Download HiveMQ

Install HiveMQ with

- HiveMQ Docker [Quickstart](#).
- [HiveMQ AMI](#) for AWS.

Select the HiveMQ Cloud plan you need

Serverless

FREE

By selecting **Get Started** you agree to our current [SaaS Terms](#).

Get Started

A basic MQTT broker for learning and experimenting with MQTT.

A great place to play

✓ Shared MQTT platform

RECOMMENDED

Starter

Starts from ⓘ

\$0.34/hour + **\$0.80**/million
\$250/month* messages

*estimated total

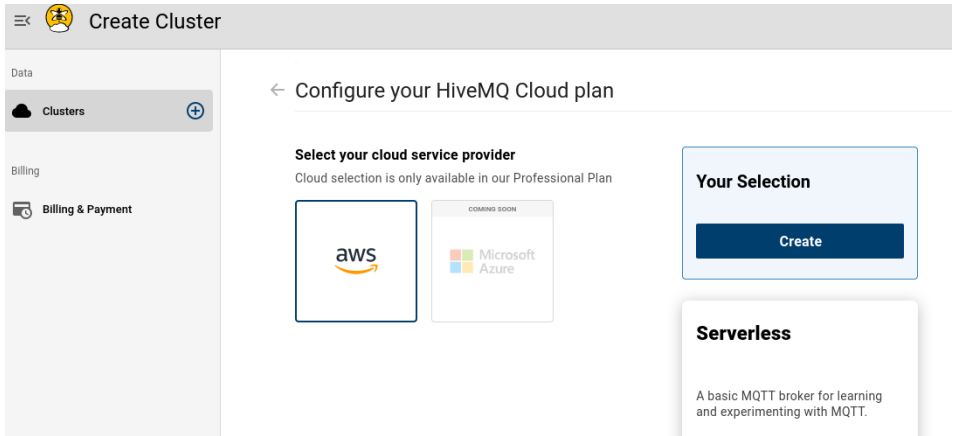
Try with Free Credits

Complete MQTT platform for testing and small-scale production.

Everything in Serverless, plus

✓ Dedicated MQTT platform

hiveMQ.com - registration



The screenshot shows the HiveMQ Cloud registration interface. On the left is a sidebar with navigation links: 'Data', 'Clusters' (highlighted with a plus icon), and 'Billing & Payment'. The main content area is titled 'Configure your HiveMQ Cloud plan'. It features a section 'Select your cloud service provider' with a note that cloud selection is only available in the Professional Plan. Two options are shown: 'aws' (Amazon Web Services) and 'Microsoft Azure' (marked as 'COMING SOON'). To the right, there is a 'Your Selection' box with a 'Create' button, and a 'Serverless' section describing it as a basic MQTT broker for learning and experimentation.

hivemq.com - registration

Create Cluster

Data

Clusters

Billing

Billing & Payment

← Configure your HiveMQ Cloud plan

Select your cloud service provider

Cloud selection is only available in our Professional Plan

aws

COMING SOON

Microsoft Azure

Your Selection

Create

Serverless

A basic MQTT broker for learning and experimenting with MQTT.

hiveMQ.com - registration

CREATE NEW CLUSTER

Serverless
FREE

● Running

URL

f30fffc2f4634495adba5b658610278c.s1.eu.hivemq.cloud

Port (TLS)

8883

Started

Fri, Sep 15, 2023, 10:38 AM

MANAGE CLUSTER

note the URL (will need that later!)

hiveMQ.com - cluster

OVERVIEW

ACCESS MANAGEMENT

INTEGRATIONS NEW

Access Credentials

Currently you have not created any credentials. Fill out the following form to create an access credentials pair and limit access to your HiveMQ Cloud MQTT instance. To learn more [check out our Security Fundamentals guide](#).

Username *

At least 5 characters

Password *

At least 8 characters, 1 digit, 1 uppercase character

Confirm Password *

Passwords must match

Permission *

This field is required

> CREATE CREDENTIAL

Username	Permission type	Actions
You do not have any credentials at the moment		

create an account for your device (and the webviewer)

RaspberryPi Pico WH

- ▶ Circuitpython installed
- ▶ Accessable as a USB-device
- ▶ Connect Pico-W and edit `settings.toml`

Only need to change:

1. `HIVE_cluster_url`
2. `HIVE_username`
3. `HIVE_password`

With the generated credentials!

<https://github.com/ddland/MasterClass-Dashboards> for complete code!

Data?

- ▶ Web client receives (and displays) data
- ▶ Temperature data with Timestamps
- ▶ Topic per sensor

The screenshot displays the HAASE Web Client interface. The top navigation bar includes tabs for OVERVIEW, ACCESS MANAGEMENT, INTEGRATIONS (marked as NEW), and WEB CLIENT. The main content area is titled 'Web Client' and shows 'Client Connection Settings' with a 'Web-Client connected' status. Below this, there are fields for 'Topic Subscriptions' and a 'Publish Message' section. A table at the bottom lists received messages with columns for Message, Topic, QoS, and Timestamp.

Message	Topic	QoS	Timestamp
24.7977	sensors/temperature/d83add767a55	0	1708626789723
29.8473	sensors/temperature/28cdc17277	0	1708626788299

Dashboard



How to display the data?



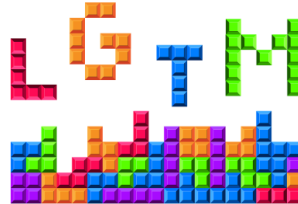
The (actually useful) free forever plan

Grafana, of course +

10K series Prometheus metrics,
50GB logs, 50GB traces, 50GB profiles,
500VU/h k6 testing

Create free account

(No credit card required)



- ▶ Self-hosted, opensource
- ▶ Cloudbased, subscription model
- ▶ Free account nice for testing and learning



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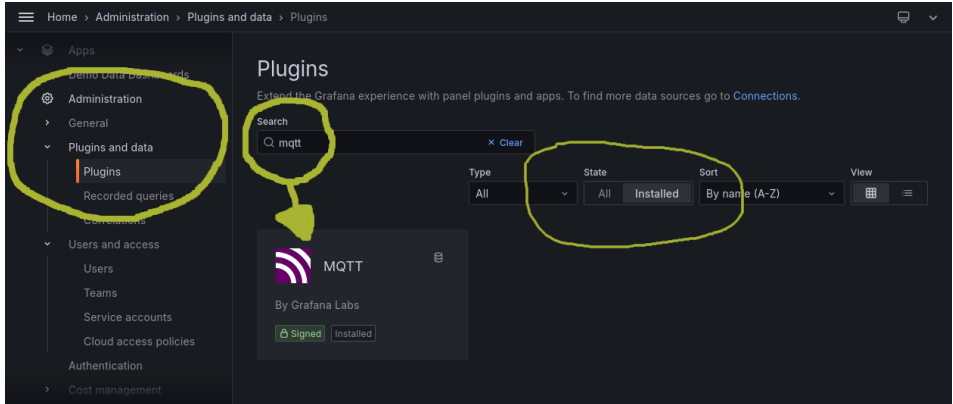
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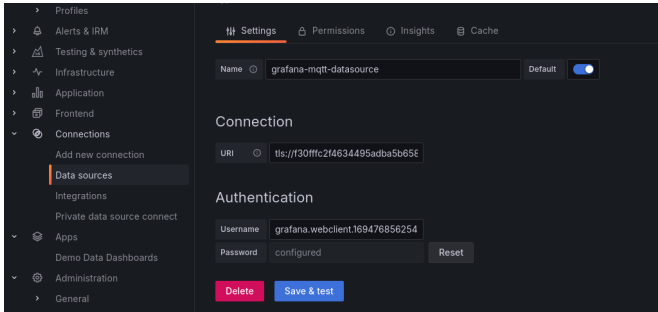
- ▶ Self-hosted, opensource
 - ▶ Cloudbased, subscription model
 - ▶ Free account nice for testing and learning
- sign-up... and launch Grafana-stack (skip introduction)

HiveMQ - Grafana



- ▶ Install MQTT plugin
- ▶ Only streaming data, no storage!

Grafana - MQTT



The screenshot shows the Grafana 'Data sources' configuration page. The left sidebar contains a menu with options like Profiles, Alerts & IRM, Testing & synthetics, Infrastructure, Application, Frontend, Connections, Data sources (highlighted), Integrations, Private data source connect, Apps, Demo Data Dashboards, Administration, and General. The main panel is titled 'Settings' and shows the configuration for a data source named 'grafana-mqtt-datasource'. The 'Connection' section has a 'URI' field with the value 'tls://f30fffc2f4634495adba5b65E'. The 'Authentication' section has a 'Username' field with the value 'grafana.webclient.169476856254' and a 'Password' field with the value 'configured'. There are 'Delete' and 'Save & test' buttons at the bottom.

Profiles

Alerts & IRM

Testing & synthetics

Infrastructure

Application

Frontend

Connections

Add new connection

Data sources

Integrations

Private data source connect

Apps

Demo Data Dashboards

Administration

General

Settings Permissions Insights Cache

Name grafana-mqtt-datasource Default ☒

Connection

URI tls://f30fffc2f4634495adba5b65E

Authentication

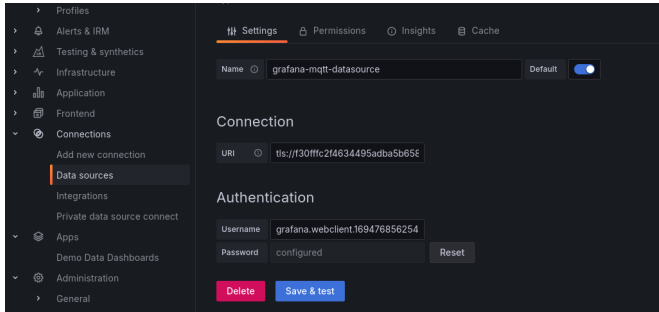
Username grafana.webclient.169476856254

Password configured Reset

Delete Save & test

- ▶ URL from HiveMQ (add the `tls://`, port `:8883` at the end of the address)
- ▶ Username / password credentials from HiveMQ
- ▶ Save & Test

Grafana - MQTT



- ▶ URL from HiveMQ (add the `tls://`, port `:8883` at the end of the address)
- ▶ Username / password credentials from HiveMQ
- ▶ Save & Test

Testing OK? → explore data

Copy TOPIC from HiveMQ (or Raspberrypi Pico) in Explore Topic field

Do you see some data?

Grafana - Dashboard

Grafana Dashboard

A Grafana dashboard consists of panels displaying data in beautiful graphs, charts, and other visualizations.

So explore, add some panels and visualise the sensor data!

Grafana - Dashboard

Grafana Dashboard

A Grafana dashboard consists of panels displaying data in beautiful graphs, charts, and other visualizations.

So explore, add some panels and visualise the sensor data!

- ▶ Does your temperature measure the same as your neighbours?
- ▶ When should there be an alert colour?
- ▶ What do you want to bring across with the panel?
- ▶ Who is the intended audience?

Take aways

- ▶ Where does the data come from?
- ▶ Does your measurement represent the data your want?
- ▶ How do you get the data to the end-user?
- ▶ What do you want to display?
- ▶ How do you make sure your message is understood?



Transforming data to information

First challenge in dashboard design is defining the information value of your data

Transforming data to information

First challenge in dashboard design is defining the information value of your data

- ▶ Average temperature?

Transforming data to information

First challenge in dashboard design is defining the information value of your data

- ▶ Average temperature?
- ▶ Realtime temperature?

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- ▶ Average temperature?
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- ▶ Temperatures below or above a certain value?

Transforming data to information

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- ▶ Combination?

Transforming data to information

Then you can choose how to present that information

Transforming data to information

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- ▶ Average temperature? → Number, bar graph

Transforming data to information

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Transforming data to information

Then you can choose how to present that information

- ▶ Average temperature? → Number, bar graph
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- ▶ Temperatures below or above a certain value? → Graph, number, gauge chart (with boundaries)

Transforming data to information

Then you can choose how to present that information

- ▶ Average temperature? → Number, bar graph
- ▶ Realtime temperature? → Graph, table, gauge chart
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- ▶ Combination?

Make it easy and attractive

- ▶ Alignment
- ▶ Colour
- ▶ Avoid information overflow

Make it easy and attractive

- Alignment
- Colour
- Avoid information overflow

