DCRPi:
data center on a RPi

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Lab alert

The number of variables in the lab settings is huge (computer operating system, firewall, device firmware version, code version, network, etc)

Things will go wrong :-)

Be patient, we will solve all issues!

Found a bug? Let me know! Feedback is welcome.

Our Lab equipment

Raspberry Pi

SD with latest Raspbian OS

Keyboard

Mouse

Screen

Raspberry Pi

The Raspberry Pi is a small single-board computer developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science.

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Raspbian

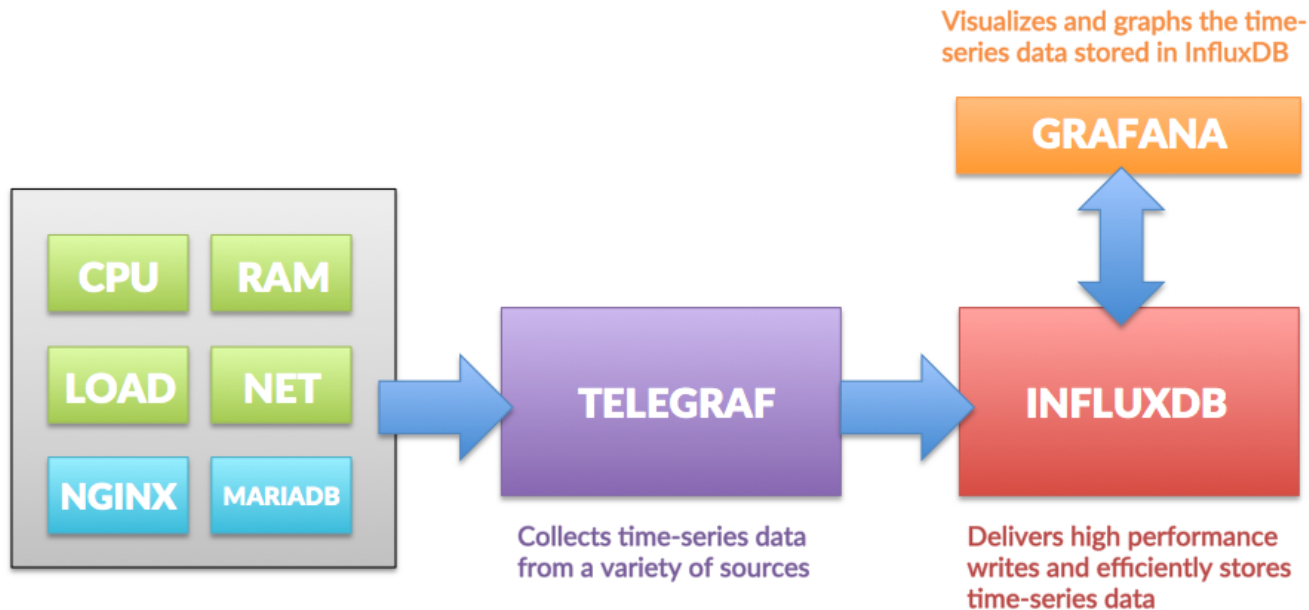Raspbian is a Debian-based computer operating system for Raspberry Pi.

Username: pi

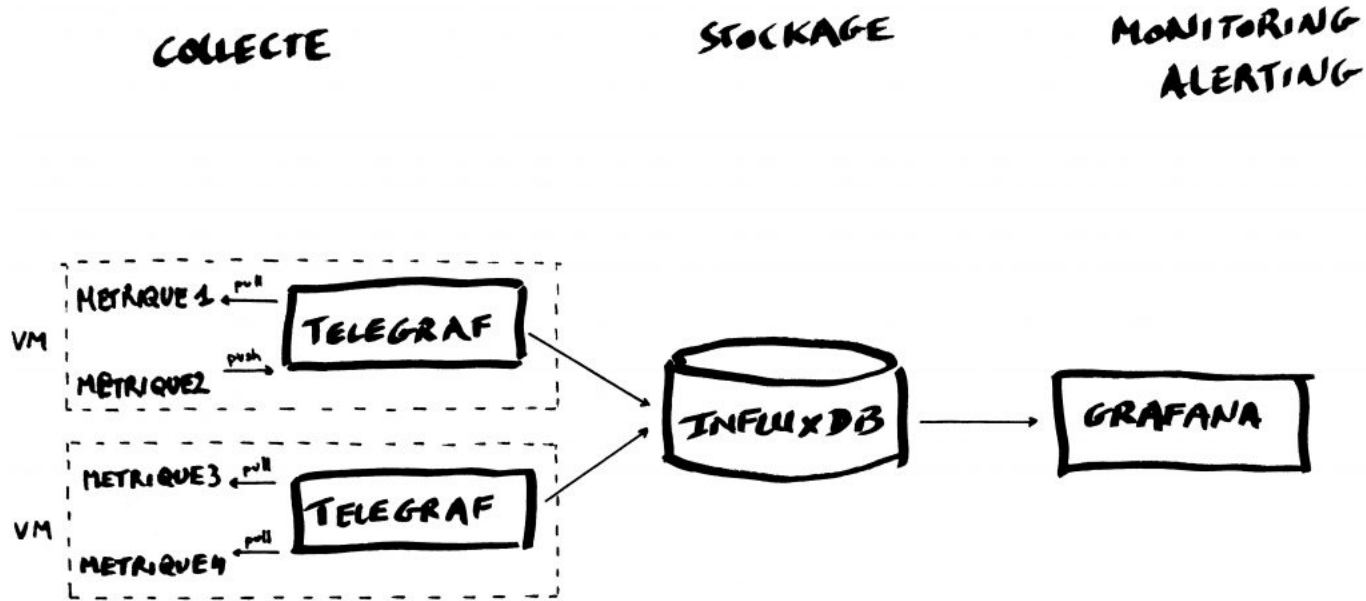Password: raspberry

What is the TIG Stack?

The **TIG Stack** is an acronym for a platform of open source tools built to make collection, storage, graphing, and alerting on **time series data** incredibly easy.

What is the TIG Stack?

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What is a time series?

A time series is simply any set of values with a timestamp where time is a meaningful component of the data. The classic real world example of a time series is stock currency exchange price data.

What is the TIG Stack?

Telegraf: A metrics collection agent. Use it to collect and send metrics to InfluxDB. Telegraf's plugin architecture supports collection of metrics from 100+ popular services right out of the box.

InfluxDB is a high performance Time Series Database. It can store hundreds of thousands of points per second. The InfluxDB SQL-like query language was built specifically for time series.

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What is the TIG Stack?

Grafana is an open-source platform for data visualization, monitoring and analysis. In Grafana, users can to create dashboards with panels, each representing specific metrics over a set time-frame. Grafana supports graph, table, heatmap and free text panels.

Installing TIG on a RPi

Let's start by adding the influxdb repositories:

```
curl -sL https://repos.influxdata.com/influxdb.key | sudo apt-key add -

echo "deb https://repos.influxdata.com/debian stretch stable" | sudo tee /etc/apt/sources.list.d/influxdb.list

sudo apt-get update
```

Installing TIG on a Rpi

We can now install Telegraf and Influxdb:

`sudo apt-get install telegraf`

`sudo apt-get install influxdb`

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Installing TIG on a RPi

Starting from v5.2.0-beta1 Grafana introduced official support for armv7 and arm64 linux platforms. Install it with:

```
sudo wget https://dl.grafana.com/oss/release/grafana-rpi_6.2.2_armhf.deb
```

```
sudo dpkg -i grafana-rpi_6.2.2_armhf.deb
```

Installing TIG on a RPi

We can now activate all the services:

sudo systemctl enable influxdb

sudo systemctl start influxdb

sudo systemctl enable telegraf

sudo systemctl start telegraf

sudo systemctl enable grafana-server

sudo systemctl start grafana-server

Getting started with InfluxDB

InfluxDB is a time-series database compatible with SQL, so we can setup a database and a user easily. You can launch its shell with the *influx* command.

pi@raspberrypi:~ $ influx

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Creating a database

Next step is creating a database. Choose your name!

> CREATE DATABASE <mark>database_name</mark>

> SHOW DATABASES

name: databases

name

_internal

database_name

Retention Policy

A Retention Policy (RP) is the part of InfluxDB's data structure that describes for how long InfluxDB keeps data.

InfluxDB compares your local server's timestamp to the timestamps on your data and **deletes data that are older than the RP's DURATION.** A single database can have several RPs and RPs are unique per database.

Installing TIG on a RPi

> CREATE RETENTION POLICY thirty_days ON database_name
DURATION 30d REPLICATION 1 DEFAULT

> SHOW RETENTION POLICIES ON database_name

thirty_days 720h0m0s 1 TRUE

> exit

Configuring Telegraf

Next, we have to configure the Telegraf instance to read from the TTN (The Things Network) server.

Luckily TTN runs a simple MQTT broker, so all we have to do it to edit the Telegraf configuration file to connect via MQTT to TTN.

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Configuring Telegraf

First create a backup copy of the config file:

> mv /etc/telegraf/telegraf.conf /etc/telegraf/telegraf.conf_original

Then edit the config file:

> sudo nano /etc/telegraf/telegraf.conf

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Telegraf config 1/3

[agent]

hostname = "myserver"

flush_interval = "15s"

interval = "15s"

Telegraf config 2/3

```
[[inputs.mqtt_consumer]]
servers = ["tcp://eu.thethings.network:1883"]
qos = 0
connection_timeout = "30s"
topics = [ "+/devices/+/up" ]
client_id = ""
username = "test-bsfrance"
password = "ttn-account-v2.TsFoWEWZe0xENIS_wjwTLuXavF3esk7tXME0ozwZCw8"
data_format = "value"
```

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Telegraf config 2/3

APPLICATION OVERVIEW

Application ID   test-bsfrance   ← username

Description   test bsfrance lora device

Created   11 months ago

Handler   ttn-handler-eu *(current handler)*

password

ACCESS KEYS   ⚙ manage keys

default key   devices messages   ⌀ ttn-account-v2.TsFoWEWZe0xENIS_wjwTLuXavF3esk7tXME0ozv base64 📋

Telegraf config 3/3

[[outputs.influxdb]]

database = ”database_name"

urls = ["http://localhost:8086"]

Restart Telegraf

Then we can restart telegraf and the metrics will begin to be collected and sent to InfluxDB.

pi@raspberrypi:~ $ service telegraf restart

Check database

We can check if the data is sent from Telegraf to InfluxDB:

pi@raspberrypi:~ $ influx

Enter an InfluxQL query

> use database_name

Using database telegraf

> select * from "mqtt_consumer"

Database is populated!

```
1557323990319369114 292    myserver 287744000      868.3          15                    1
45.703526              13.72079              1                 -112            -5.8
294082396             0             0              1008.1         23.6
45         0              2.92         7204              23.3         3.9              0
0              292         8459640         1   test-bsfrance/devices/bsfabp0001/up

1557324301943104151 293    myserver 287744000      868.5          15                    2
45.703526              13.72079              1                 -112            -6.2
605705244             0             0              1008.1         23.5
45         0              2.92         7204              23.3         3.9              0
0              293         8482785         1   test-bsfrance/devices/bsfabp0001/up
```
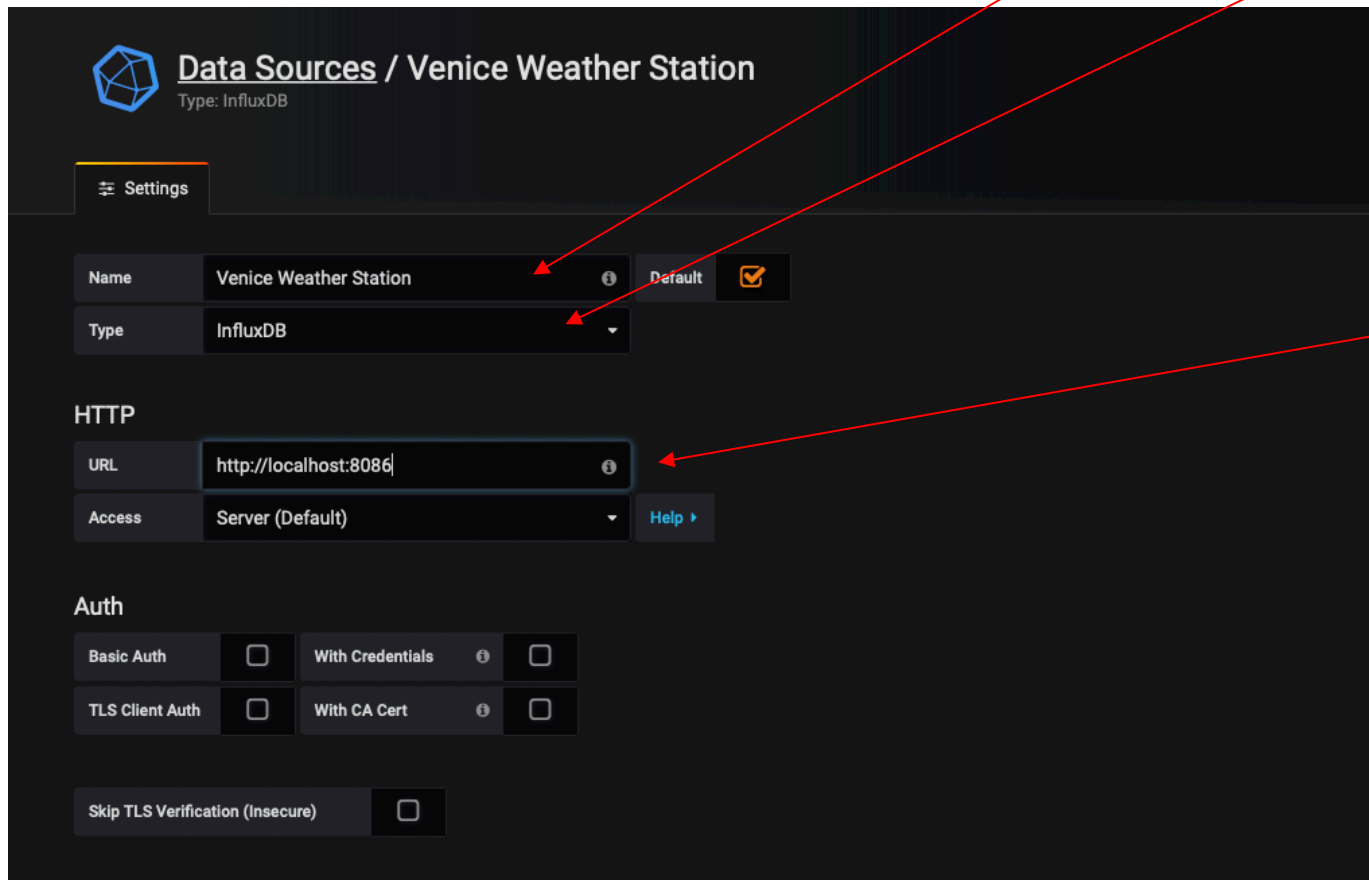
Log into Grafana

- Address: http://127.0.0.1:3000/login
- Username: admin
- Password: admin

Add data source
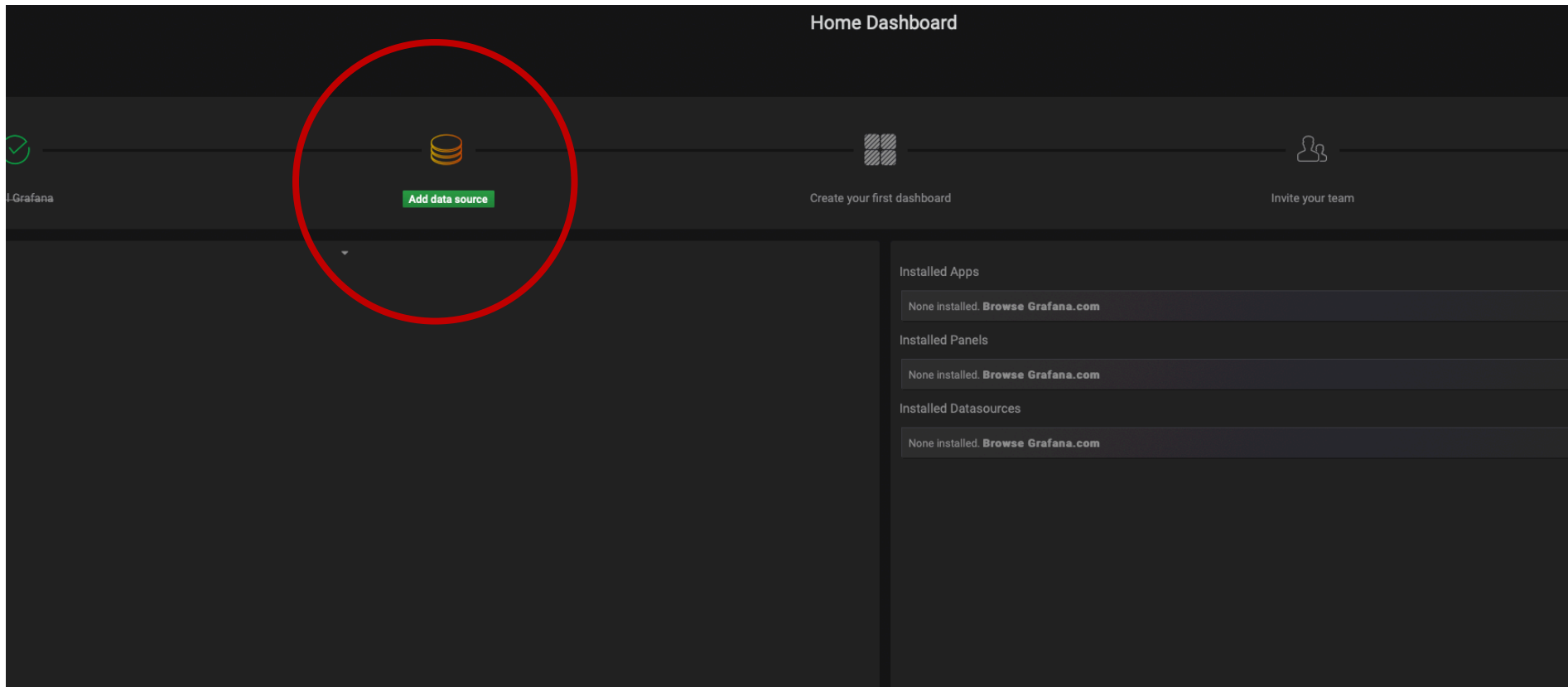
Add data source 1/2

Add data source 2/2

InfluxDB database name

InfluxDB database username

InfluxDB database passwd

InfluxDB Details

Database	telegraf

User	telegraf	Password	••••

Database Access

Setting the database for this datasource does not deny access to other databases. The InfluxDB query syntax allows switching the database in the query. For example: `SHOW MEASUREMENTS ON _internal` or `SELECT * FROM "_internal".."database" LIMIT 10`

To support data isolation and security, make sure appropriate permissions are configured in InfluxDB.

Min time interval	10s	ⓘ

Add data source

If everything is fine you should see:
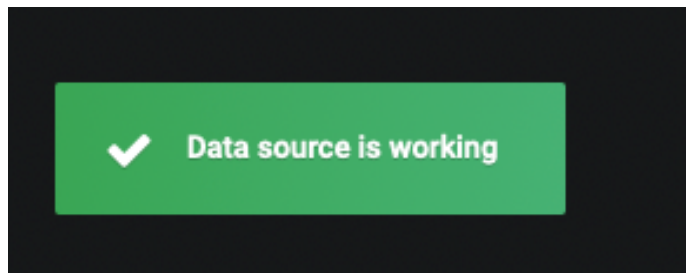
Add data source

If everything is fine you should see:

Add Dashboard

New
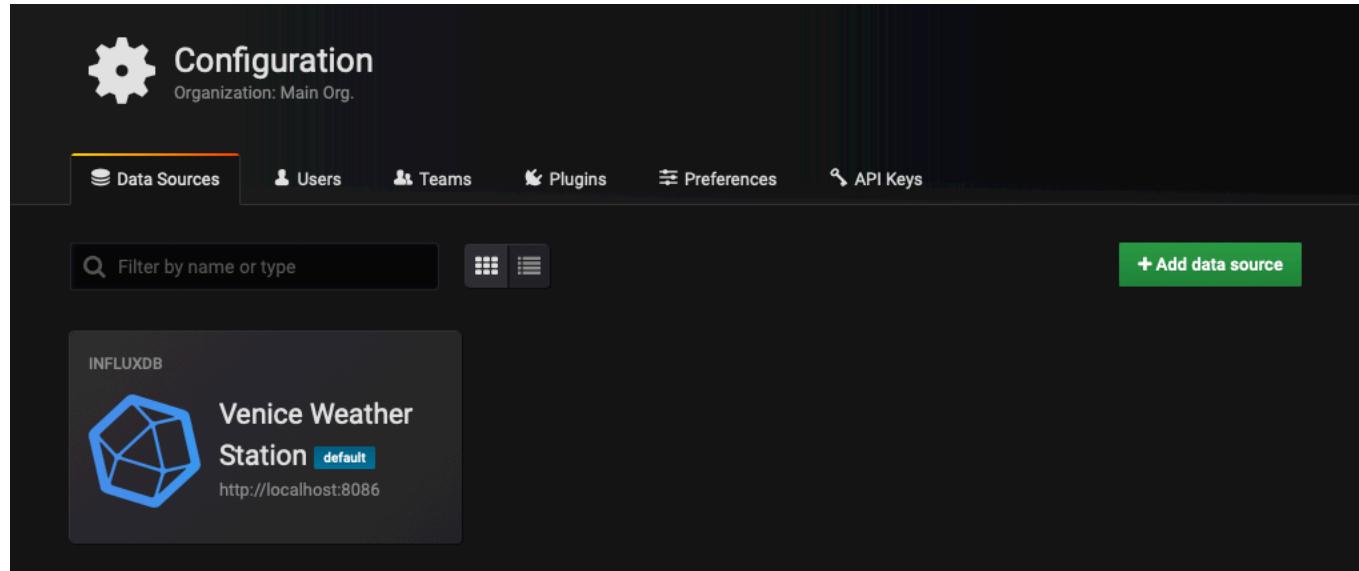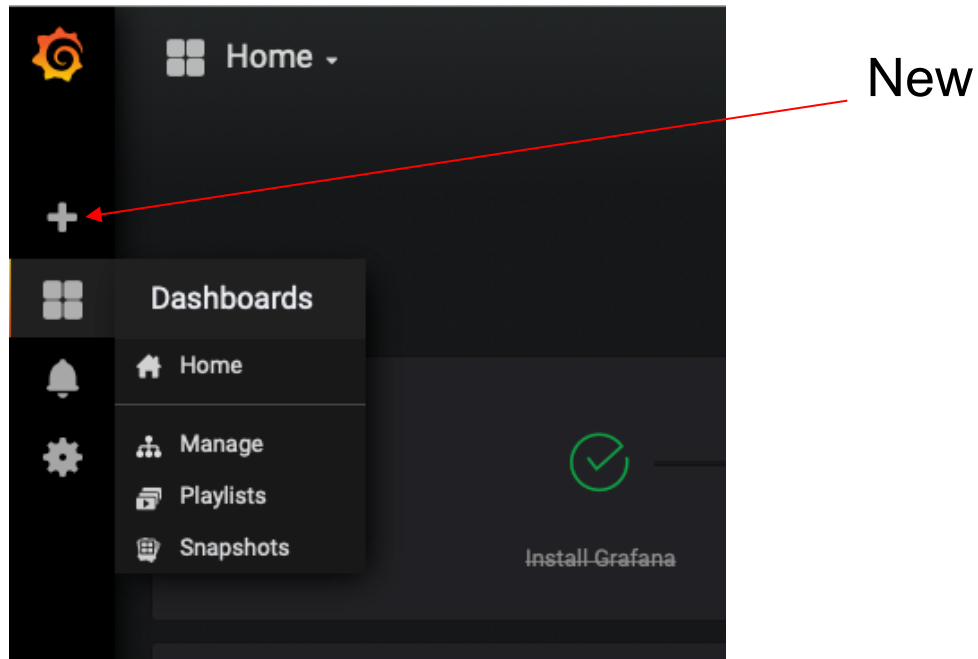
Add graph
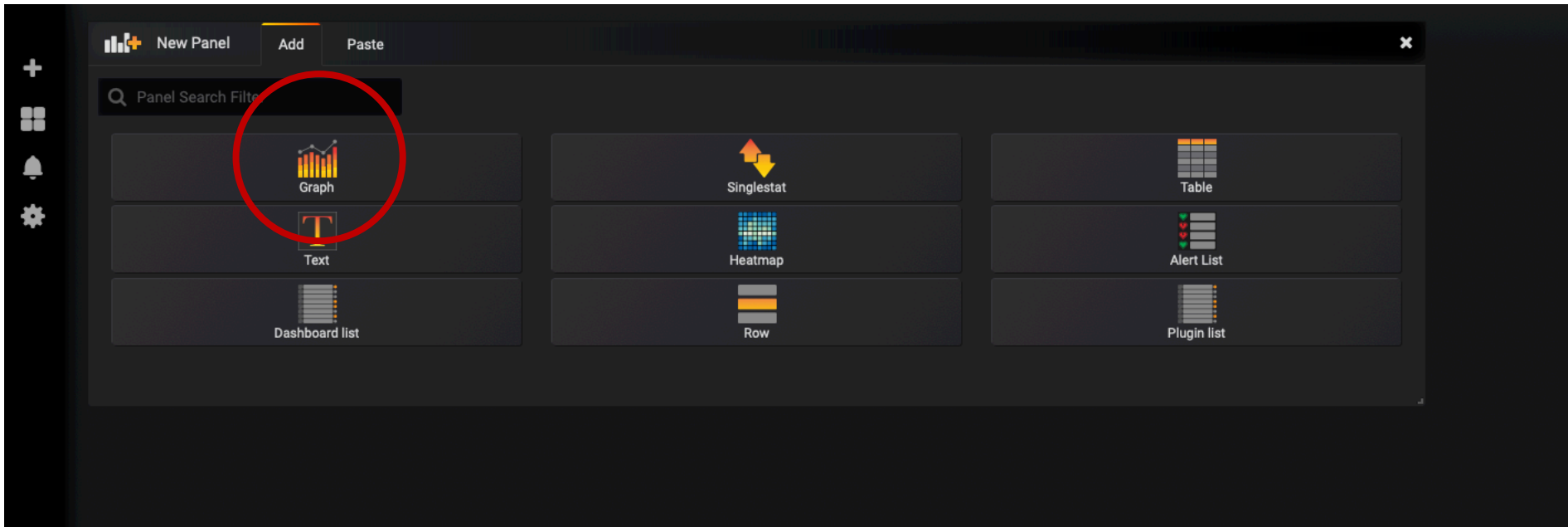
Empty graph!

Select Edit
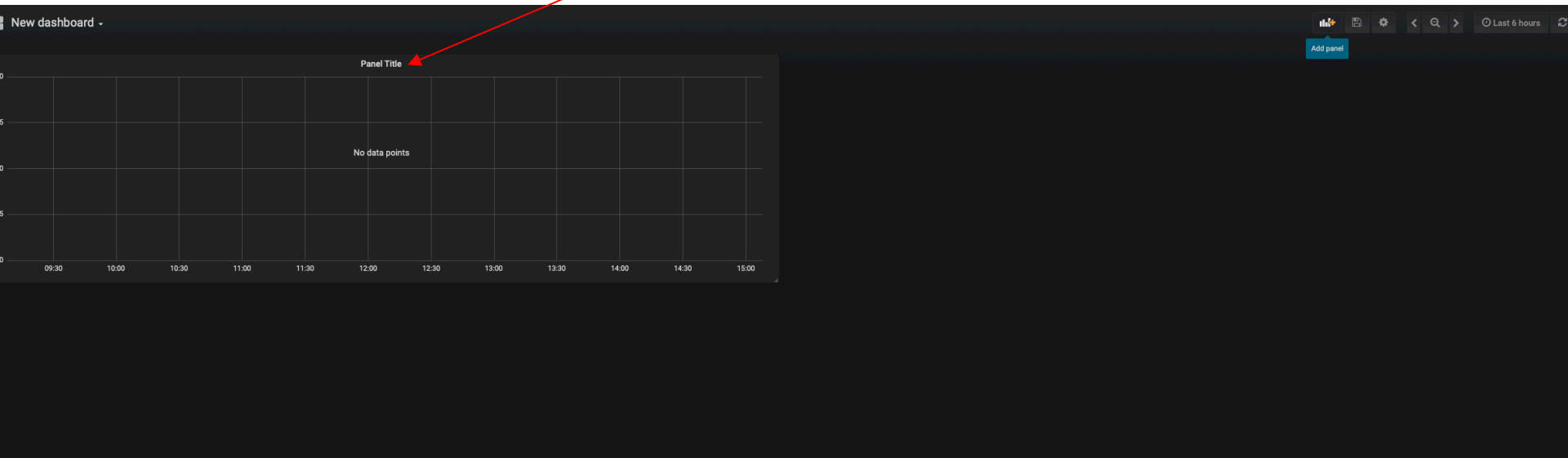
Add info to Graph: General

Add Title and Description

Add info to Graph: Metrics

Your InfluxDB database name

Add info to Graph: Metrics
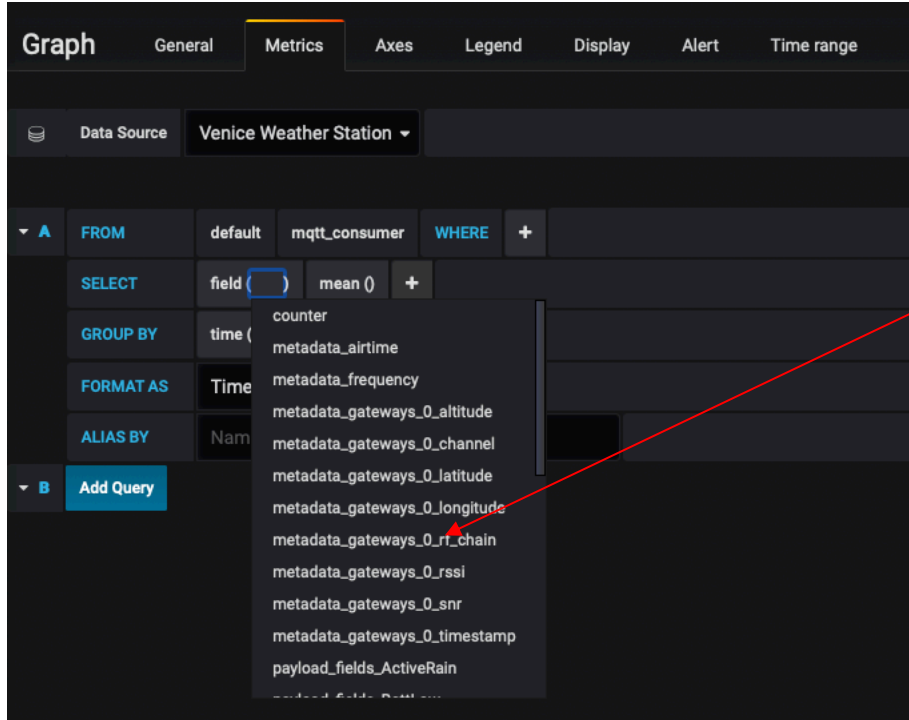
Select mqtt_consumer

Add info to Graph: Metrics

Select
the variable
you want to
graph

Add info to Graph: Metrics
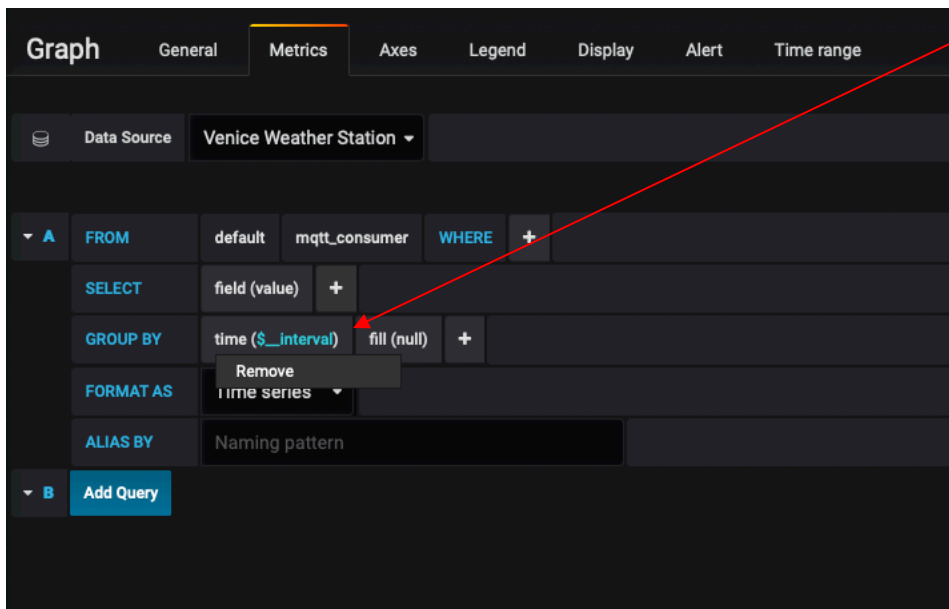
Remove mean()

Add info to Graph: Metrics

Remove time($_interval)

Final result
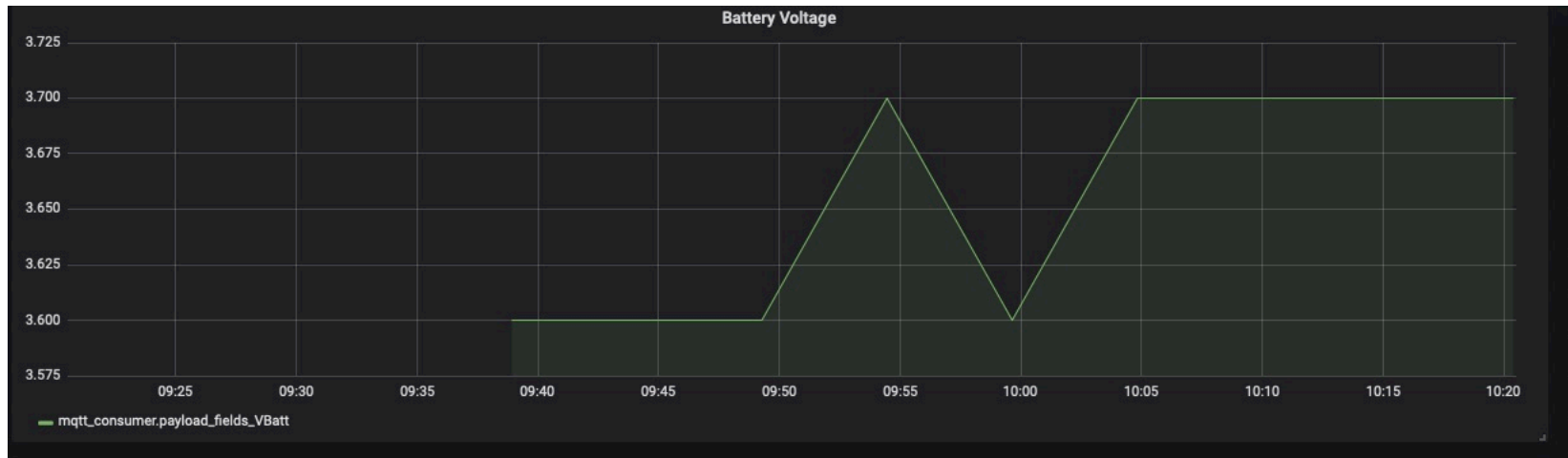
Final result

- You can add as many variables as you want to the same Dashboard
- You can add users and different users can have access to different Dashboards
- You can export Dashboards

- Have fun exploring Grafana!

InfluxDB and Python

- You can interact with your Influx database using Python
- You need to install a library called *influxdb*
- Complete instructions are here:
  https://www.influxdata.com/blog/getting-started-python-influxdb/

InfluxDB and Python

Like many Python libraries, the easiest way to get up and running is to install the library using pip:

$ python3 -m pip install influxdb

Now let's launch Python and import the library:

>>> from influxdb import InfluxDBClient

InfluxDB and Python

Next we create a new instance of the InfluxDBClient with information about the server that we want to access.

```
>>> client = InfluxDBClient(host='localhost', port=8086)
```

If Influx has username and password then:

```
>>> client = InfluxDBClient(host='mydomain.com', port=8086,
username='myuser', password='mypass' ssl=True,
verify_ssl=True)
```

InfluxDB and Python

Finally, we will list all databases and set the client to use a specific database:

>>> client.get_list_database()

>>> client.switch_database('database_name')

InfluxDB and Python

Let's try to get some data from the database:

```
>>> client.query('SELECT * from "mqtt_consumer"')
```

The query() function returns a ResultSet object, which contains all the data of the result along with some convenience methods. Our query is requesting all the measurements in our database.

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InfluxDB and Python

You can use the get_points() method of the ResultSet to get the measurements from the request, filtering by tag or field:

```
>>> points=results.get_points()

>>> for item in points:

        print(item['time'])
```

InfluxDB and Python

You can get mean values, number of items, etc:

```
>>> client.query('select count(payload_fields_Rainfall) from mqtt_consumer')
```

```
>>> client.query('select mean(payload_fields_Rainfall) from mqtt_consumer')
```

```
client.query('select * from mqtt_consumer  WHERE time > now() - 7d')
```

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Influx and Python: Exercises

1) Save the data as csv (comma separated values) using Python and InfluxDB.

2) Produce a graph of the last 20 temperature measurements using Python and InfluxDB.

Summary

We learned how to install Telegraf, InfluxDB and Grafana.

We learned how to use Grafana to visualize data coming from an IoT network.

We learned how to interact with InfluxDB using Python.

Feedback?

Email mzennaro@ictp.it