Remote Communications and Cloud Processing for Environmental Data Sets

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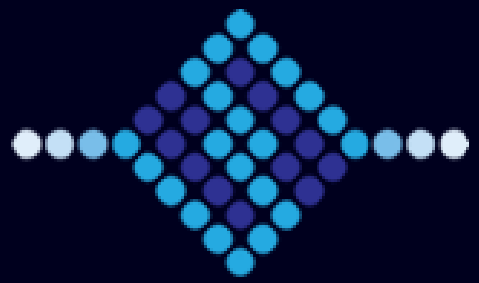
June 20, 2024



STREAM

WALTON Institute for Information and Communication Systems Science

Outline

Background

IT Infrastructure

Consumers/Applications

Aggregation Layer

Storage Layer

Collection Layer

Sensor Layer

Current Deployment

Conclusion & Thanks

Background

- Website at www.marinestream.eu
- ERDF Funded project until the Ireland Wales Programme 2014-2020
- Total Budget of 5.4 Million with a Duration of 4.5 Years
- Partners included:
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    - Centre for Sustainable Aquatic Research
  - Munster Technological University
    - Mass Spectroscopy Group
    - Halpin Centere for Research and Innovation at the National Maritime College of Ireland

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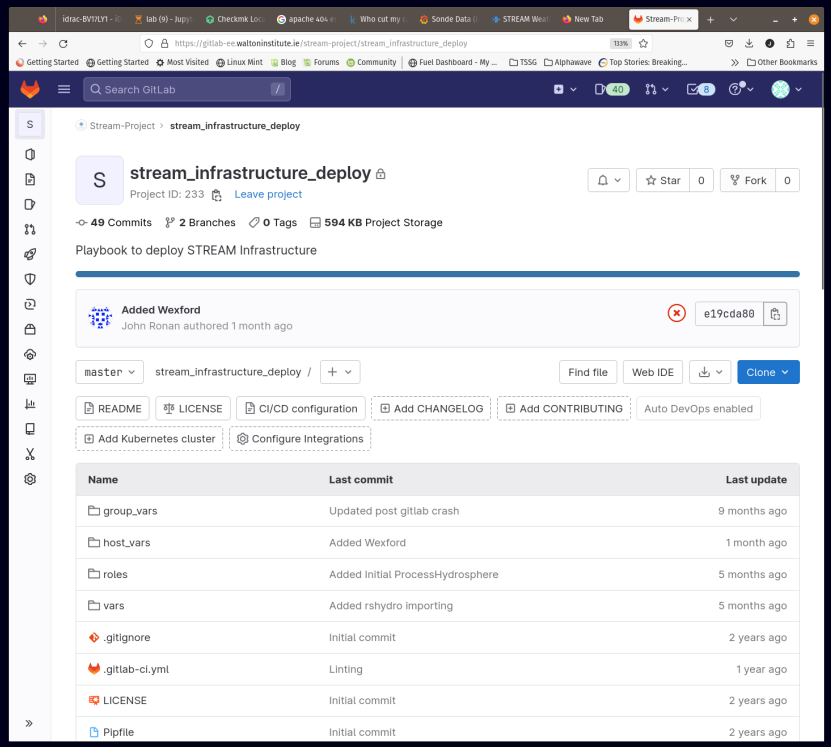
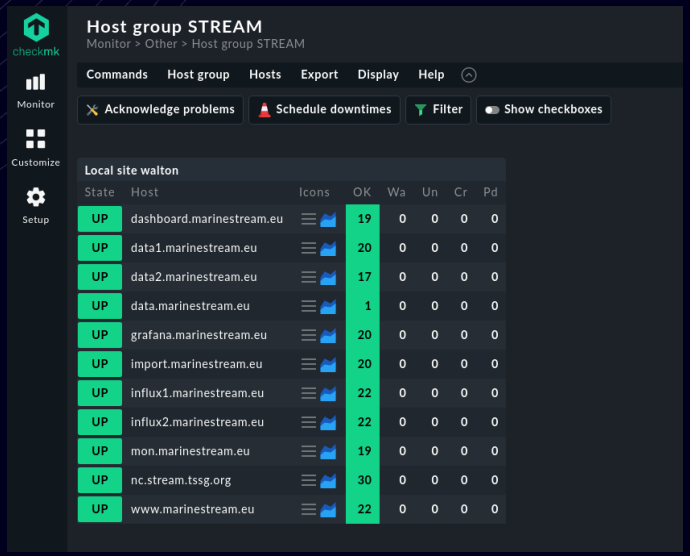
  - Phase 1 - Deploy state of the art sensors
  - Phase 2 - Deploy *consumer grade* sensors & weather stations
  - Phase 3 - Deploy novel sensors (MEMS Spectroscopy and electronic printed sensor probes)

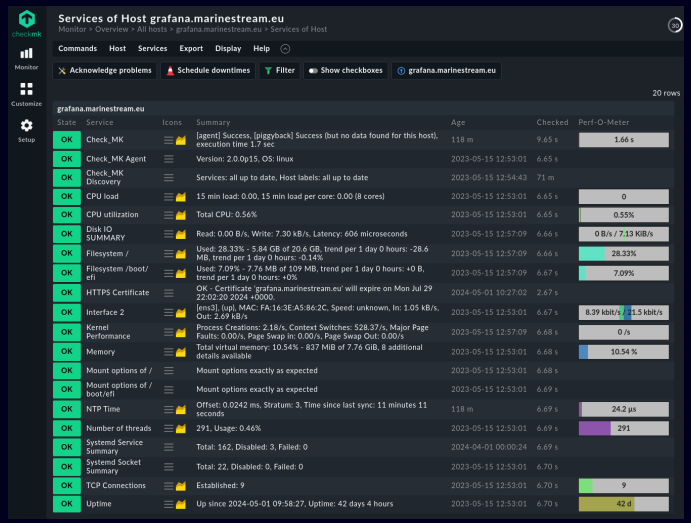
IT Infrastructure - Orchestration



Everything is version controlled, 60 code repositories and counting. All servers, applications and weather stations are *mostly* configured by Ansible, which is a commonly used orchestration tool.

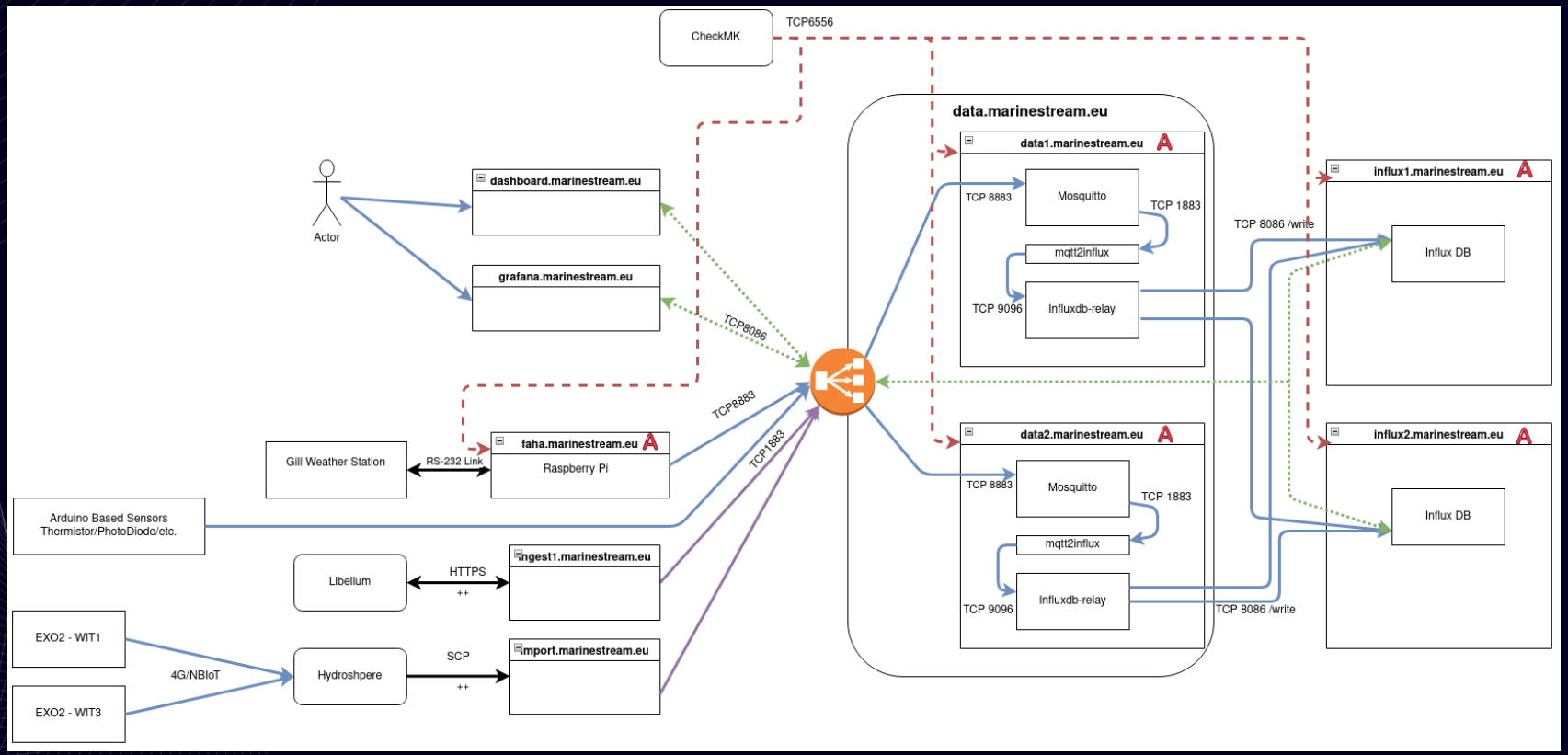
IT Infrastructure - Monitoring





12 Active Hosts at the moment, 230 services

IT Infrastructure - Overall Architecture



Monitor hardware, virtual machines and also data gathering processes

Consumers/Applications

- Manufacturer Specific
  - Xylem & TRIOS - Hydrosphere
  - In-SitU - HydroVu

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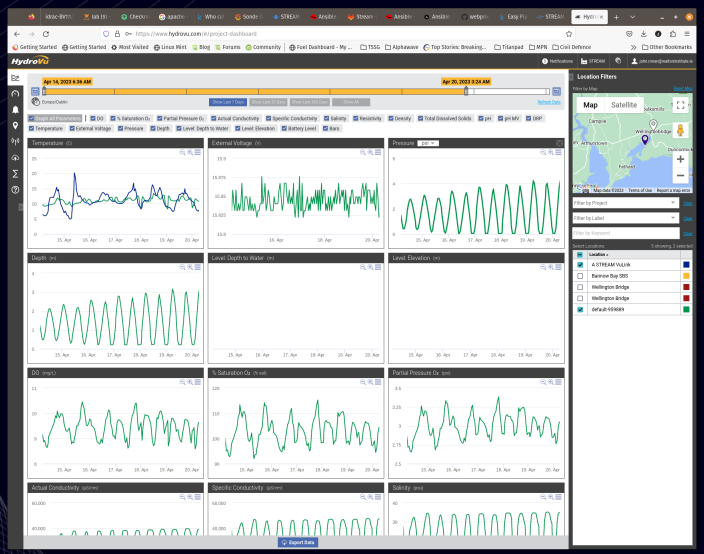
- Third Parties
  - WOW - Met Éireann
  - CWOP - Citizens Weather Observation Program
  - PWS Weather
  - WindGuru

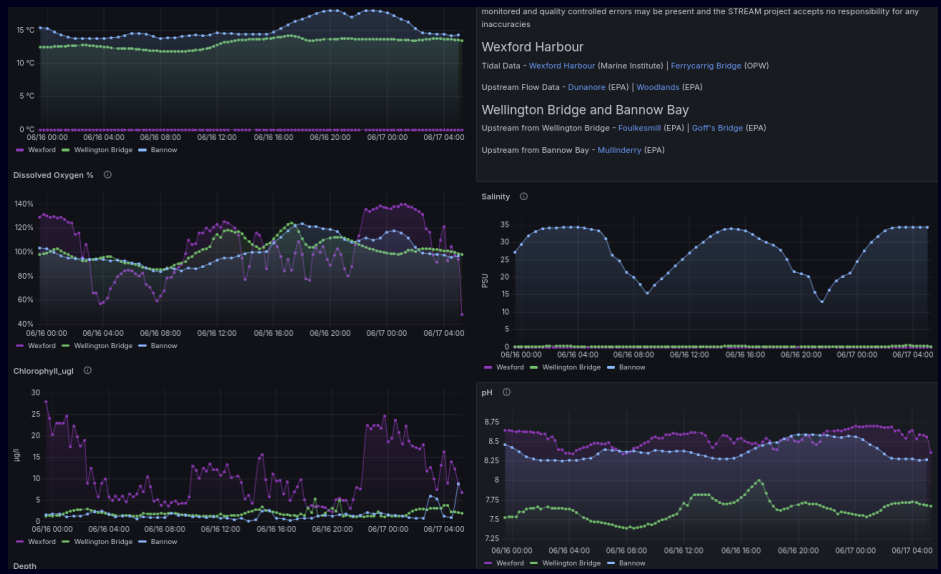
Consumers - Manufacturers

Hydrosphere - Xylem EXO2 Multiparameter Sonde

Consumers - Manufacturers

Hydrovu - AquaTROLL from In-Situ





Consumers - MQTT

MQTT

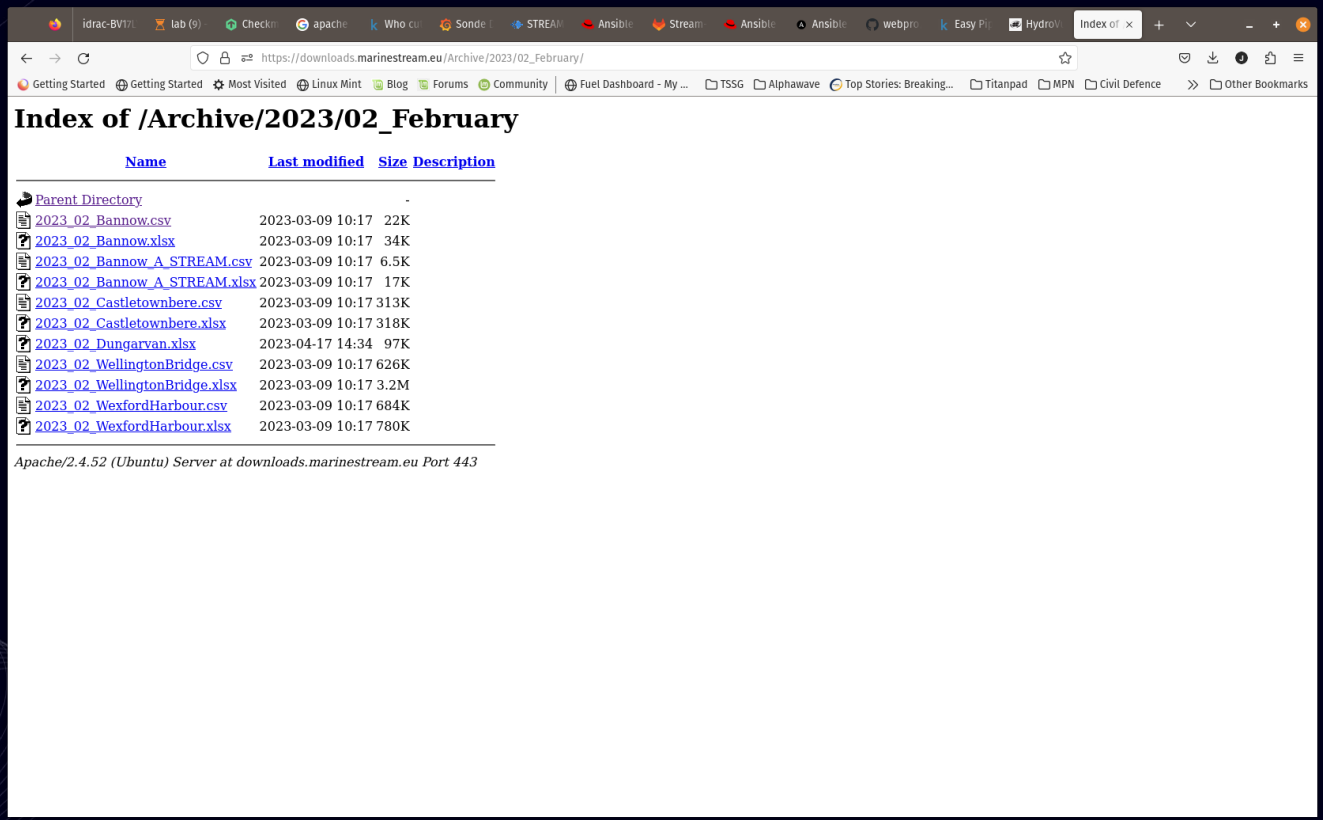
```
mosquitto_sub -h data1.marinestream.eu -p 1884 -t RSHydro/# -u USER -P PASSWORD -v
```

```
sysadmin@data2:~$ mosquitto_sub -h data2.marinestream.eu -p 1884 -t RSHydro/# -u  transec -P fA6uQcoMdjT6ud -i testb -v
RSHydro/status Running
RSHydro/op55219/data {"Datestring": "2023-04-26T12:24:48+00:00", "Battery": NaN, "Cable Power": NaN,
"CDOM TempCorr.": NaN, "Chlorophyll-A": NaN, "Counter 1": NaN, "DOC": NaN, "External Volts": NaN,
"HDO ": NaN, "mAh Adjusted": NaN, "pH": NaN, "pH m/V": NaN, "Proteus S/N 12215244": NaN,
"Proteus S/N 12215244.1": NaN, "Signal": 26, "Spare node": NaN, "Spare node.1": NaN, "SpCond.": NaN,
"Temperature": NaN, "TOC": NaN, "Turbidity": NaN, "location": "360_Aquaculture",
"latitude": "51.610889", "longitude": "-3.915065"}
RSHydro/status Sleeping
RSHydro/status/uptime 22 days, 3:46:37.591255
RSHydro/status/loop 8567
```

Near Real time feed from MQTT

Consumers - CSV and Excel

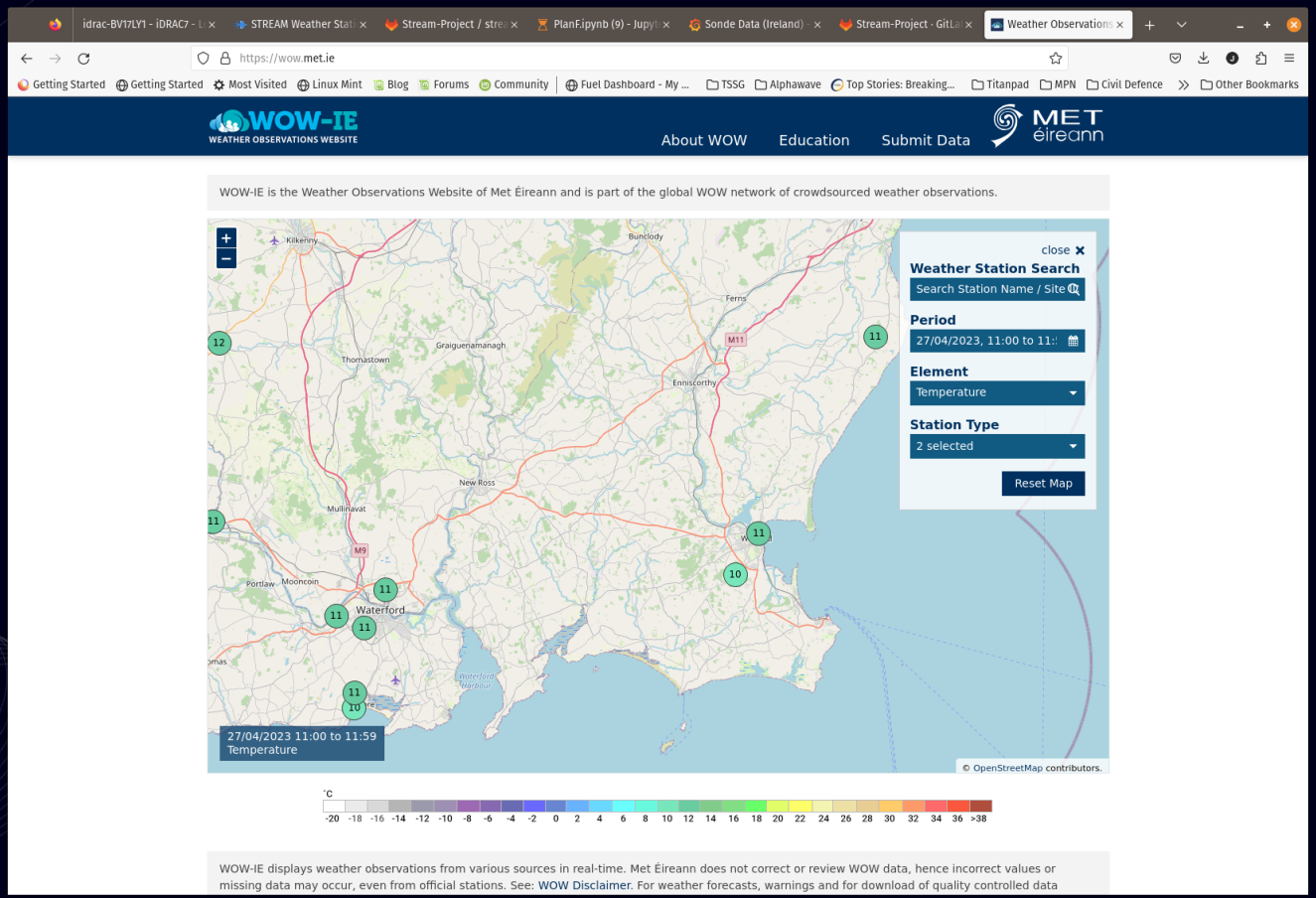
CSV and XLS Archives



Available from grafana.marinestream.eu -> Sonde Data (Ireland) -> Archives

Consumers - Third Parties

Met Éireann



Aggregation Layer - Software Components

- Haproxy/Keepalived
  - High Availability/Redundancy
- Apache
  - Websockets - convert to MQTT

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- MQTT
  - Raspberry Pi based Weather Stations
    - WeeWX
  - Arduinos
    - Nutrient Sensors, Thermistor Strings

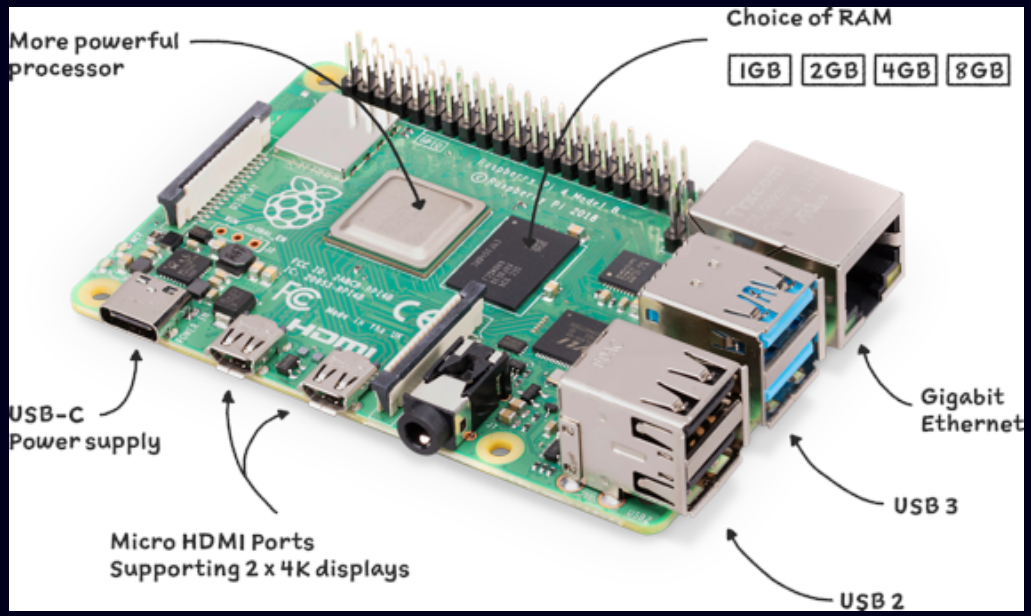
Storage Layer

- Influxdb
  - Open Source Time Series Database
- Influxdb-relay
  - Buffers writes and adds resiliency to actual influxdb

How much data? Approximately 2.1 million rows of data from STREAM deployed devices using approximately 620MB of HD Space per server

Collection Layer

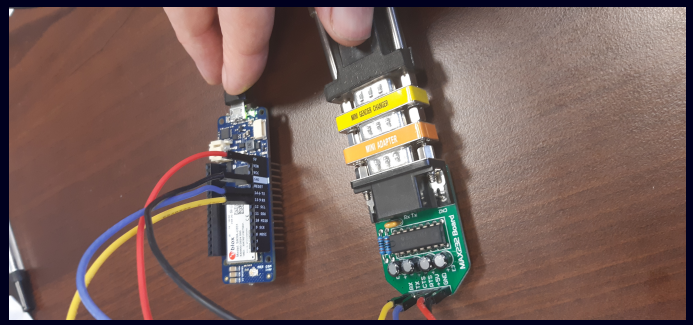
Raspberry Pi



- Powered over USB, 2.5A @5Volts (12 watts approx.)
- Fully functional general purpose computer
- Pi4 Starter Kit now €76 from Radionics
  - Built in Ethernet and WiFi

Collection Layer

Arduino



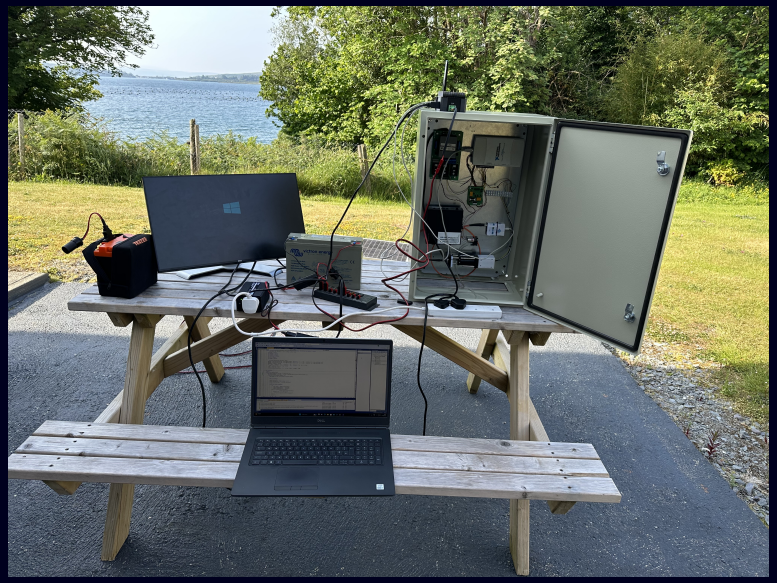
- Powered over USB or Dedicated Pins, 190mA @3.3Volts (approximately 1 Watt)
- Microcontroller. NOT General purpose
  - Has to be specifically programmed for each task
  - In STREAM we programmed them for specific purposes
    - i.e. Temperature/Nitrite/Nitrate/Ammonia/Ph
- Now €81.5 from Radionics
  - Needs PSU, Antenna and SIM Card to operate

Sensor Layer

Weather Stations

Sensor Layer

STREAM Sensors



Locations as of June 2024

- Wexford Quay - Weather Station, EXO2 and Opus
- Wellington Bridge - EXO2 and Opus, STREAM - Nitrate and CDOM
- Dungarvan Harbour - Weather Station (Faha)
- Bannow Bay - Aquatroll
- 360 Aquaculture, Swansea Bay - RSHydro
- Tawe Lock, Swansea - RSHydro
- Tramore, Castletownbere & Kilmore Quay - Weather Station
- Future locations under review for EXO2, STREAM Nitrate, CDOM and Weather Station

Tionól Réigiúnach an Deiscirt
Southern Regional Assembly

Cláir Chistí Eorpacha Struchtúrtha agus Infheistíochta na hÉireann 2014–2020

Cómhaoinithe ag Rialtas na hÉireann agus ag an Aontas Eorpach

UNDEB EWROPEAIDD
EUROPEAN UNION

Llywodraeth Cymru
Welsh Government

Cronfa Datblygu Rhanbarthol Ewrop
European Regional Development Fund

Thank You!
Any questions?