Tampereen ammattikorkeakoulu
Tampere University of Applied Sciences

Results of TAMK Fiware-piloting

FIIF Event: FIWARE
Feb. 15th, 2024, Tampere

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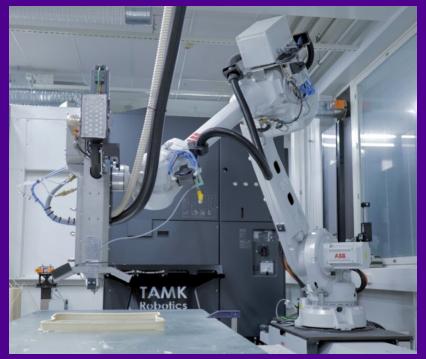
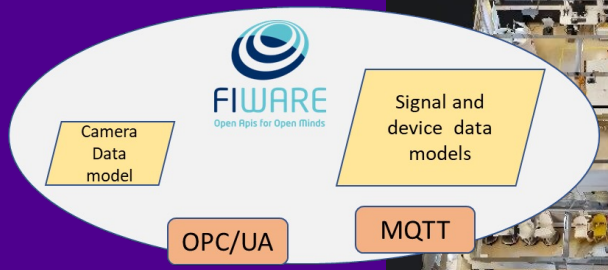
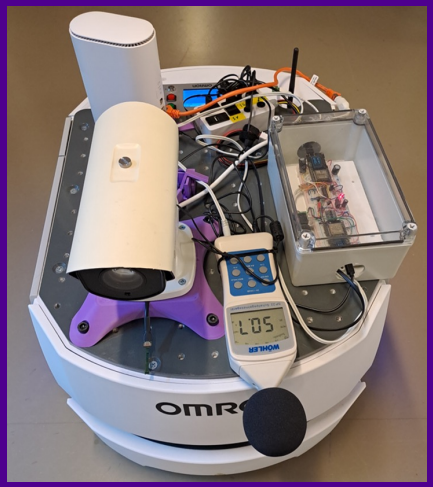
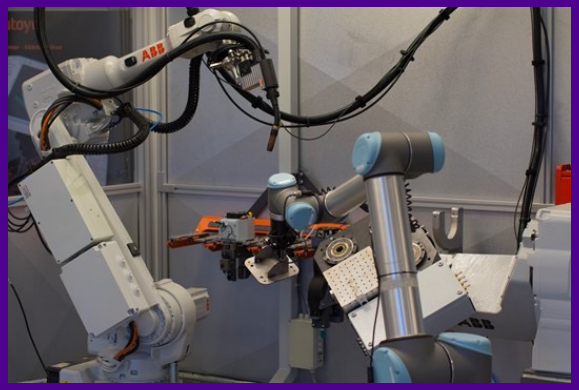


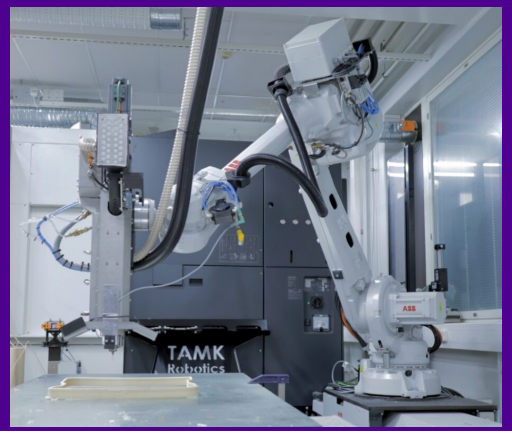


Project ”FieldLab- The testbed and capability creation for Industry 4.0”

- Industry 4.0 machines available
- 5-axis machining center
- Track Mounted 6-axis Industrial Robot
- Large scale enabled 3D printing platform
- Industrial automated welding operations
- Mobile robot fleet
- ”Nuusku” mobile robot







Flab – FIWARE – 5G : I4.0 testbed : IoT/ Data/ AI/ Data models

Objective:

Flab is testbed for local SME companies, for IoT/Data utilization/ AI trials/ POC:s

Give ideas for SME companies what are new possibilities with data utilization by demonstrating practical SME level use cases

Practical/realistic example cases/environment for education (TAMK courses)

Experience of data models and their usage

Developing and verify IT-environment (TITE cloud) for IoT/ Data/ AI system

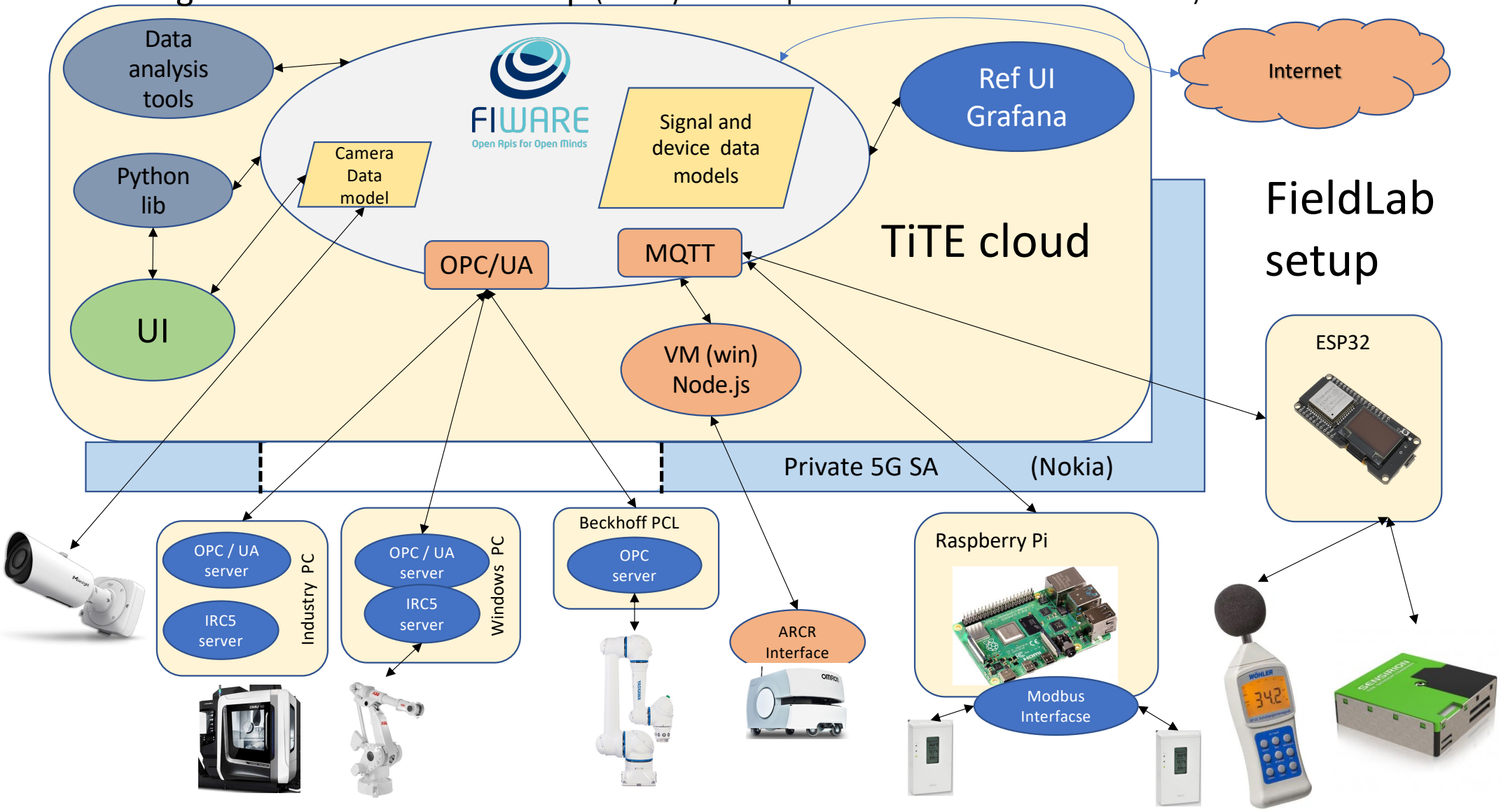
Flab – FIWARE – 5G : I4.0 testbed : IoT/ Data/ AI/ Data models

Why FIWARE ?

- all available IoT/AI system blocks available
- configurable for different kind of setups, scalable
- available API:s for OPC/UA, MQTT, Rest-API
- support for different DB:s like Mongo/Crate etc.
- Open Source (free)
- could be run in docker
- free support organization
- easy to replicate/clone

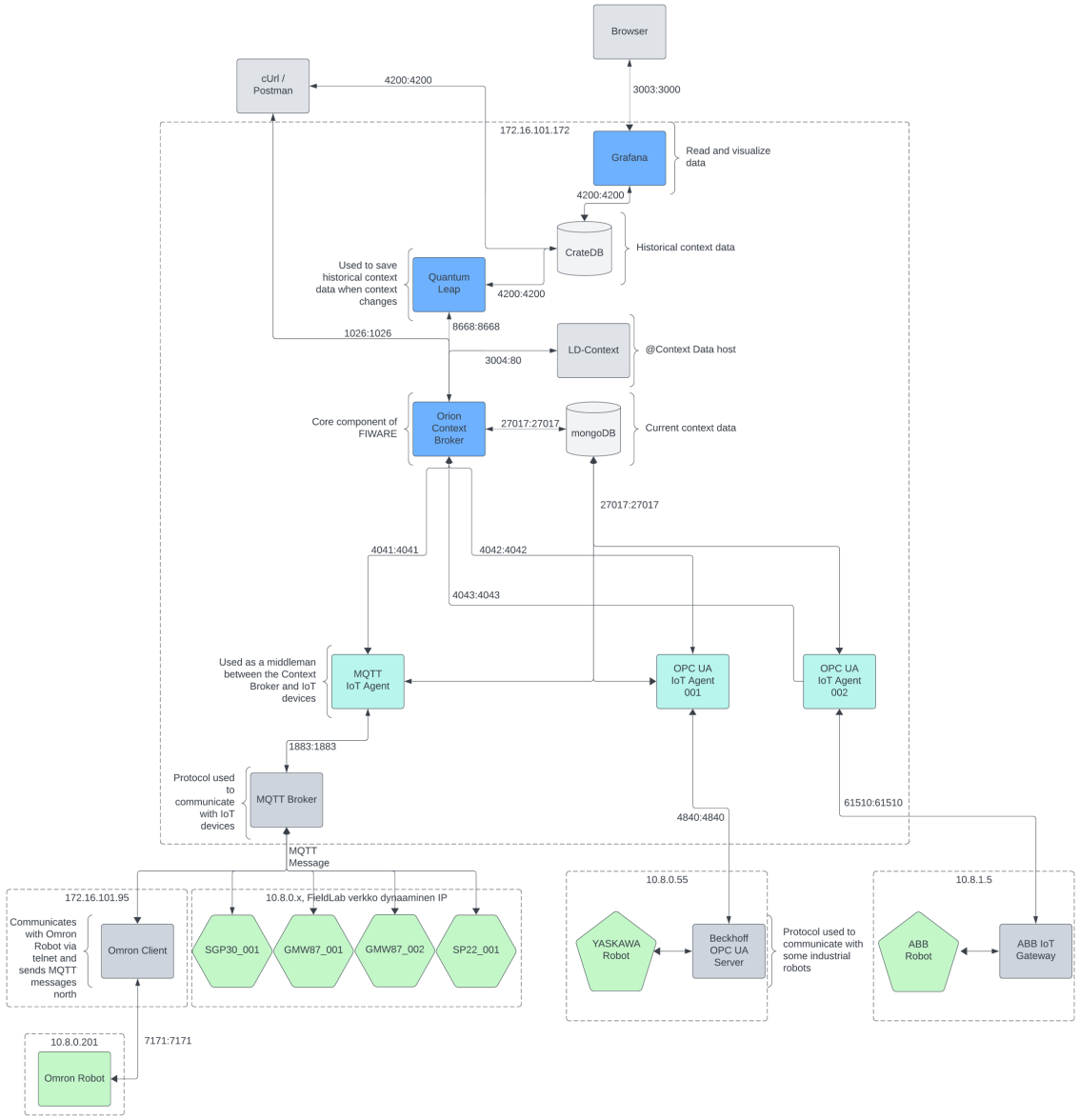
L2L
- tutorial examples mostly working as they are, implementing own features required studies/work
- human support available from Fiware org

Existing TAMK Fieldlab trial setup (new systems implementation with Fiware continue)



TAMK FieldLab FIWARE platform Block diagram

- **IoT agents**
  - **OPC/UA**
  - **MQTT**
- **MongoDB – snapshot data + data models**
- **CrateDB – time series data**
- **Orion API for context broker for MongoDB**
- **QuantumLeap API for CrateDB**



TAMK FieldLab
Data model

fieldlabCamelCase.yaml

createEntities.py

Real world entity

Create a template for entity

Datamodel concept

```
Robot:
    type: object
    required:
      - ownedBy
      - entityType
    description: >
      An autonomous robot in TAMK
FieldLab`.
    properties:
      robotType:
        type: array
      robotManufacturer:
        type: object
      robotModel:
        type: object
      robotMaximumLoad:
        type: object
      robotMaximumSpeed:
        type: object
      robotKitType:
        type: object
      robotSafety:
        type: array
      robotStandards:
```

Filling the data model with data and creating an entity with it via Orion API

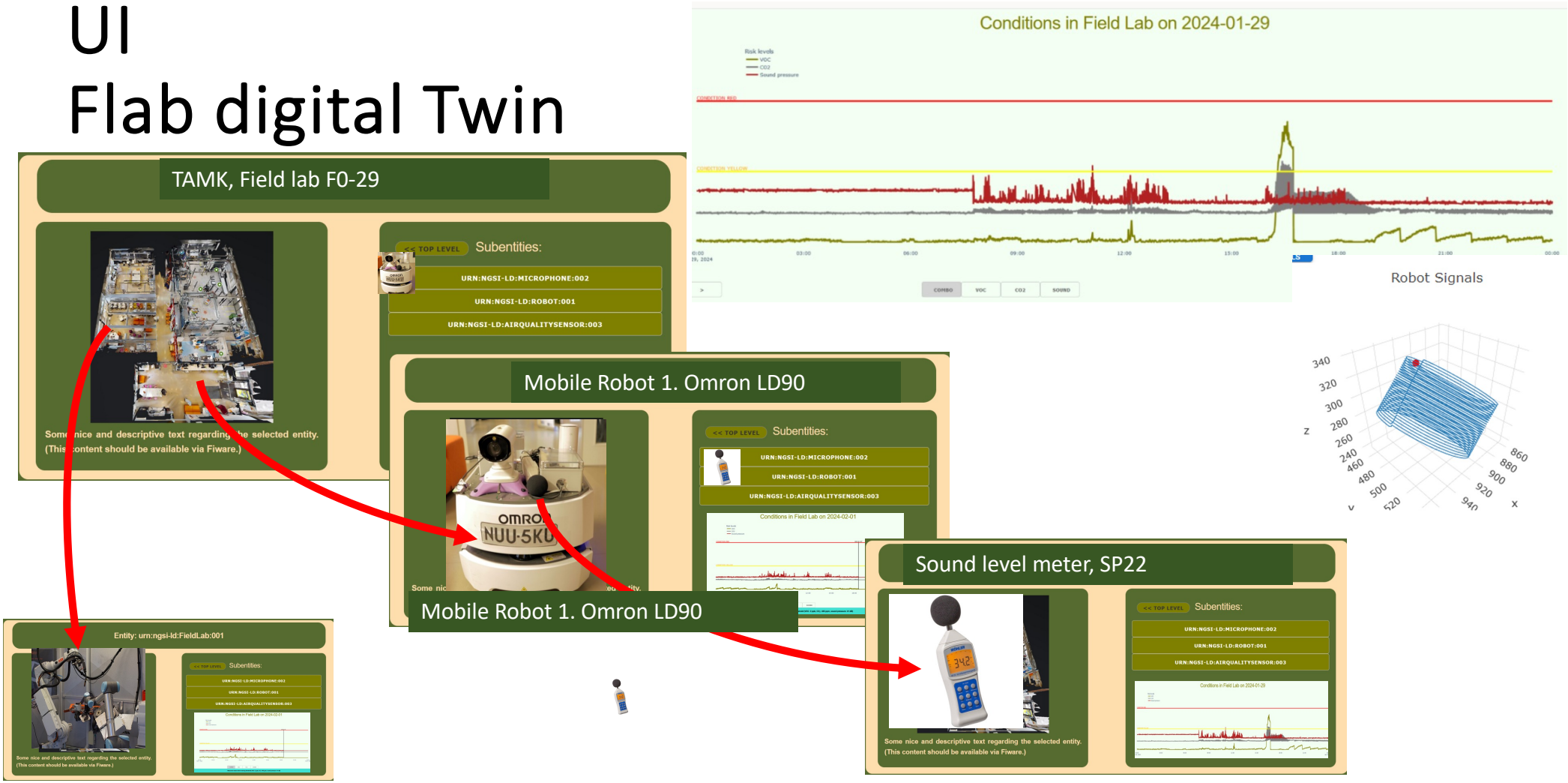
Datamodel in use

```
{
    "id": "urn:ngsi-ld:Robot:001",
    "type": "Robot",
    "robotType": [{
        "type": "Property",
        "value": "Mobile robot"
    },{
        "type": "Property",
        "value": "LD-90"
    }],
    "robotManufacturer": {
        "type": "Property",
        "value": "Omron"
    },
    "robotModel": {
        "type": "Property",
        "value": "LD-90"
    },
    "robotMaximumLoad": {
        "type": "Property",
        "value": "60",
        "unitCode": "kg"
    },
```

TAMK FieldLab Data model example:


```
{
    "id": "urn:ngsi-ld:Robot:001"
    "type": "Robot",
    "robotType": [{
        "type": "Property",
        "value": "Mobile robot"
    },{
        "type": "Property",
        "value": "LD-90"
    }],
    "robotManufacturer": {
        "type": "Property",
        "value": "Omron"
    },
    "robotModel": {
        "type": "Property",
        "value": "LD-90"
    },
    "robotMaximumLoad": {
        "type": "Property",
        "value": "60",
        "unitCode": "kg"
    },
    "robotConnections": [{
        "type": "Property",
        "value": "WLAN OFF"
    },{
        "type": "Property",
        "value": "RJ45 ON"
    }],
    "robotDatasheet": {
        "type": "Property",
        "value": "https://industrial.omron.fi/fi/products/ld-60-90",
        "unitCode": "url"
    },
    "ownedBy": [{
        "type": "Relationship",
        "object": "urn:ngsi-ld:FieldLab:001"
    }],
    "ownerOf": [{
        "type": "Relationship",
        "object": "urn:ngsi-ld:Microphone:001"
    },{
        "type": "Relationship",
        "object": "urn:ngsi-ld:Camera:001"
```

TAMK FieldLab - Data model visualization UI
Flab digital Twin



Flab – FIWARE – 5G : I4.0 testbed : IoT/ Data/ AI/ Data models

Next steps

- working protype version of UI

Measured Data

- traditional time series
- 2D – omron mobile robot
- 3D – printing head position

Data models

protype versions of device datamodel's
Usability feedback

- time synchronized image/video data for visualization of process
(images are equal data as time series measurements in FIWARE/Grate)

> Visual analysis > Image data for AI/ML to create quality loop control

Flab – FIWARE – 5G : I4.0 testbed : IoT/ Data/ AI/ Data models

Next steps

- TAMK use case's
- **3D / large scale Abb printer**
- **Abb/ WAAM**
- **Cobot - mobile robot (Omron)/ Yaskawa**
- **5-axis machining center - DG Mori**

- use case's from SME
- **under projects (Datatehdas)**

- data utilization with automatic tools / AI / ML / etc.
- **> 1. non Realtime feedback loop for improve functionality**
- **> 2. Realtime control loop – final goal**

- technical cross function trials (data and data models) with other sites
- **project activities**

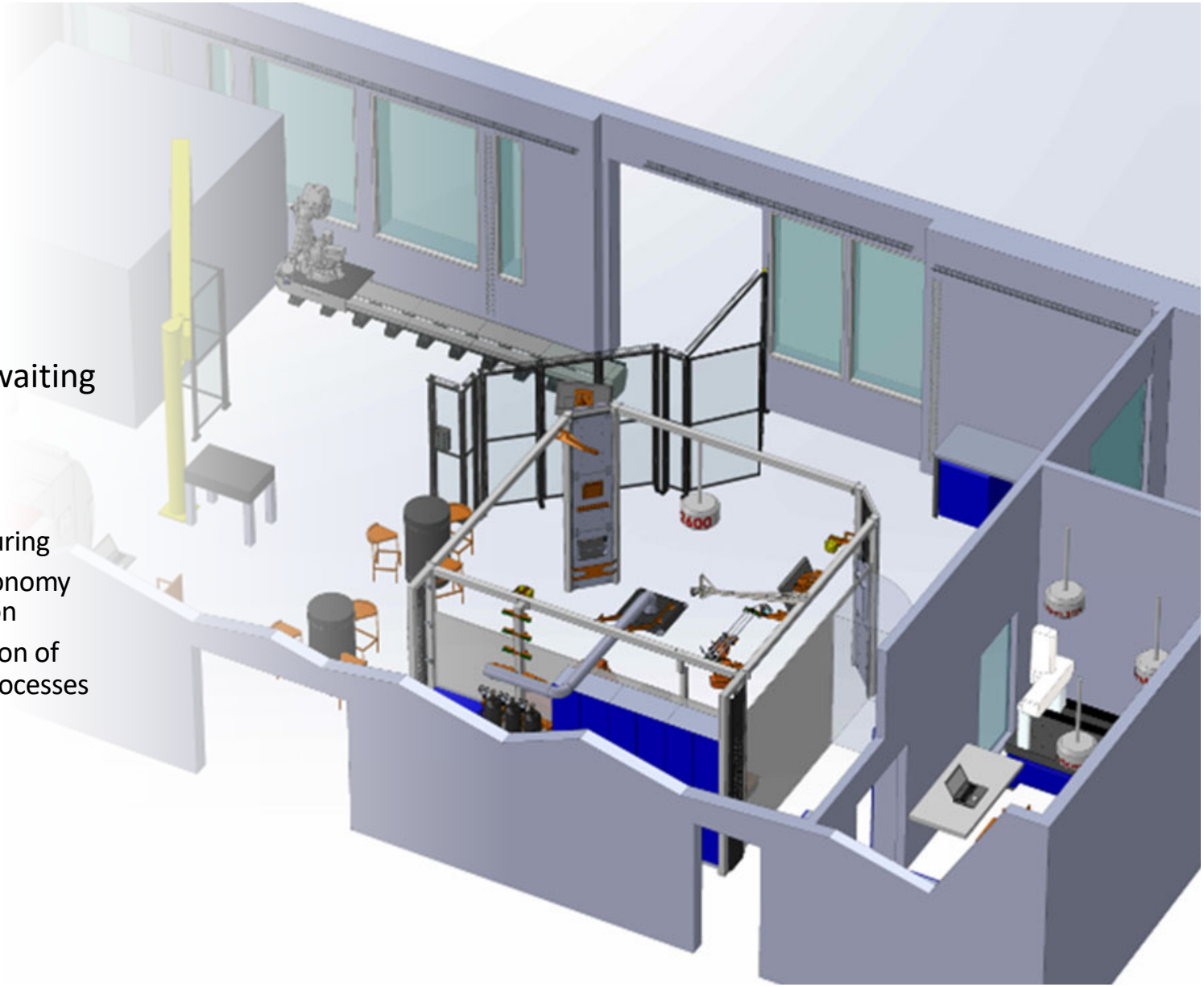
How to collaborate with us?

- Two ongoing projects
  - DataFactory
    - Manufacturing data from FieldLab using FIWARE, demostrations and pilots
    - We will be more than happy to discuss with companies regarding use case and demonstration definitions
    - Forthcoming Open Lab day and demo event
  - FairDatAct
    - Multidiscplinary project (health, construction, manufacturing and business) considering also data managament, ethical and business value cases from data
    - Skills and education for data and AI
    - Company input for use cases, interviews, surveys, information sharing
- Participation is free for the companies

- We are also open for research collaboration

Next steps

- Project topics in prep on waiting for funding decision
  - Data sharing
  - Traceability
  - Digital twins for manufacturing
  - Data and AI for circular economy and CO2 emission reduction
  - Simulations and optimization of different manufacturing processes
- Collaboration possibilities depend on the topic



Flab – FIWARE – 5G : I4.0 testbed : IoT/ Data/ AI/ Data models

Questions ?
Comments ?
Thanks !

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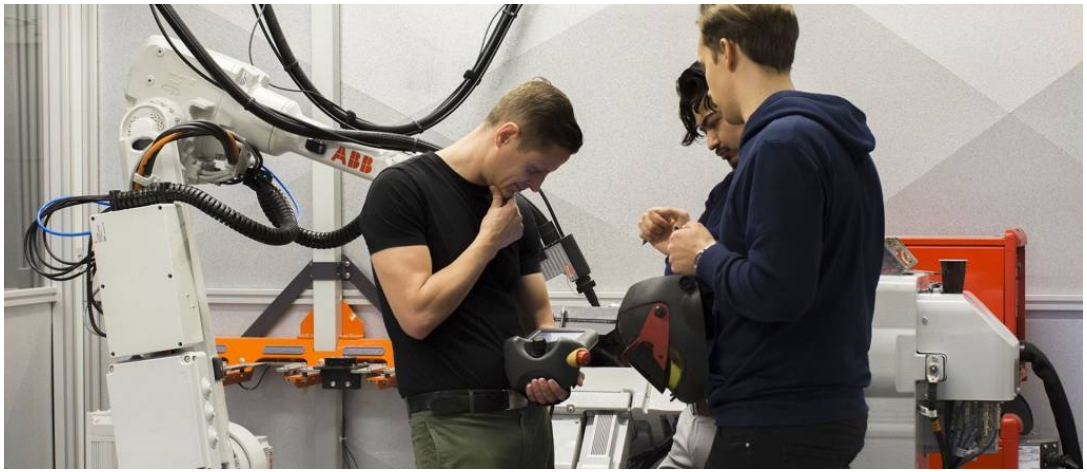
New skills unleashing the engineering potential



https://sites.tuni.fi/fieldlab-en/

Contact

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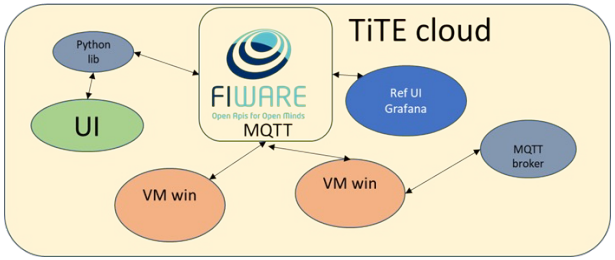
Flab – FIWARE – 5G - mobile environment sensing trial

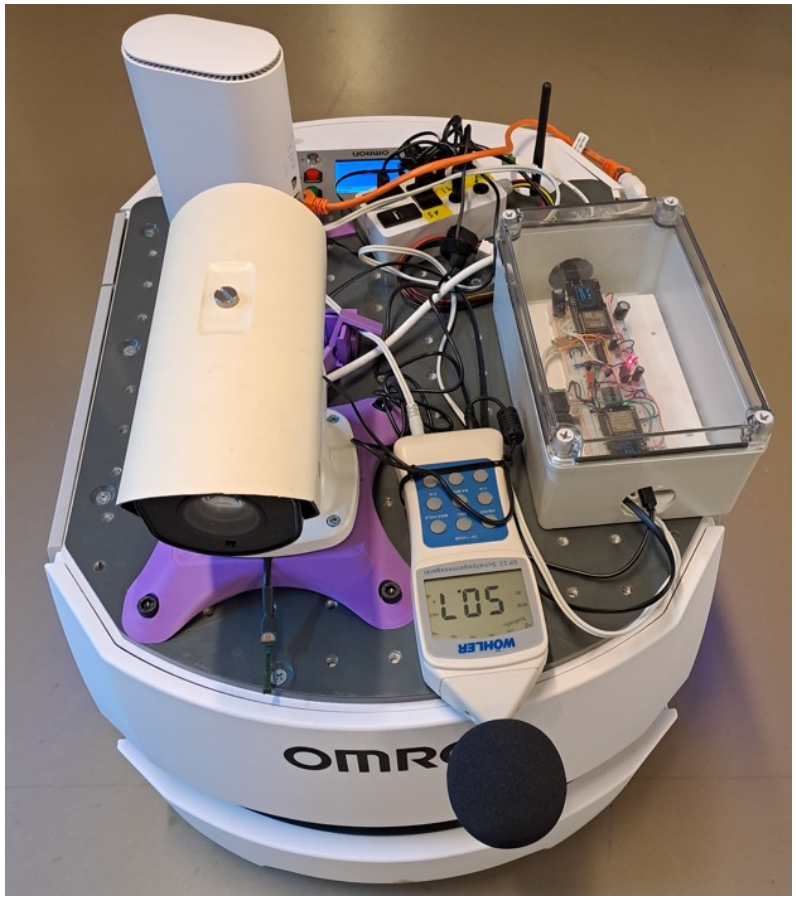
Objective:

Create
simple
fast
trial Use case
with

FIWARE
Data models
5G
Robot
Environment sensing
Camera



Flab – FIWARE – 5G - mobile environment sensing trial



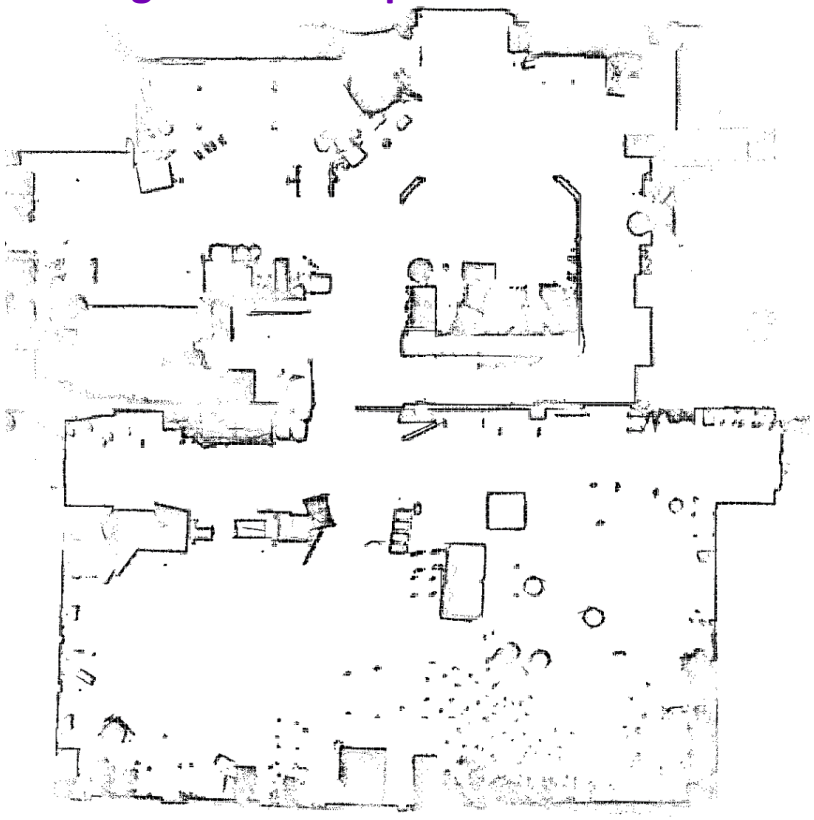
Private 5G network:	**Nokia**
5G modem:	**MC801A**
Robot:	**OMRON LD90**
dB :	**Wöhler SP22**
CO2/TVOC:	**SGP30**
Particle sensor	**SPS30**
Camera:	**Milesight PRO PTZ**

FIWARE

- **ORION,**
- **MONGO DB,**
- **Grate DB,**
- **MQTT broker,**
- **OPC UA server**
- **Data models for**
  - **devices**
  - **measurements**

Flab – FIWARE – 5G - mobile environment sensing trial

Original scan map from Omron LIDAR



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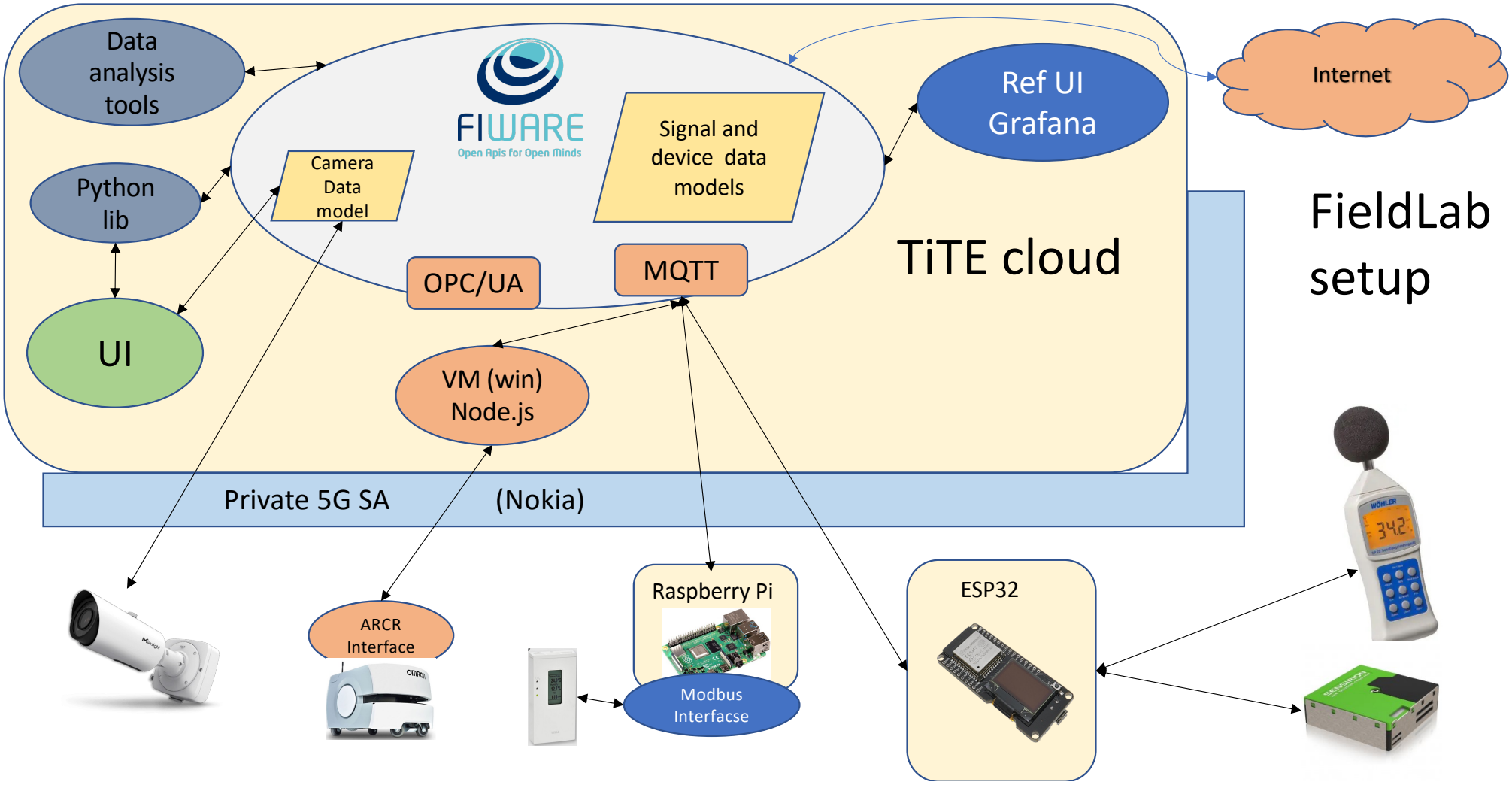
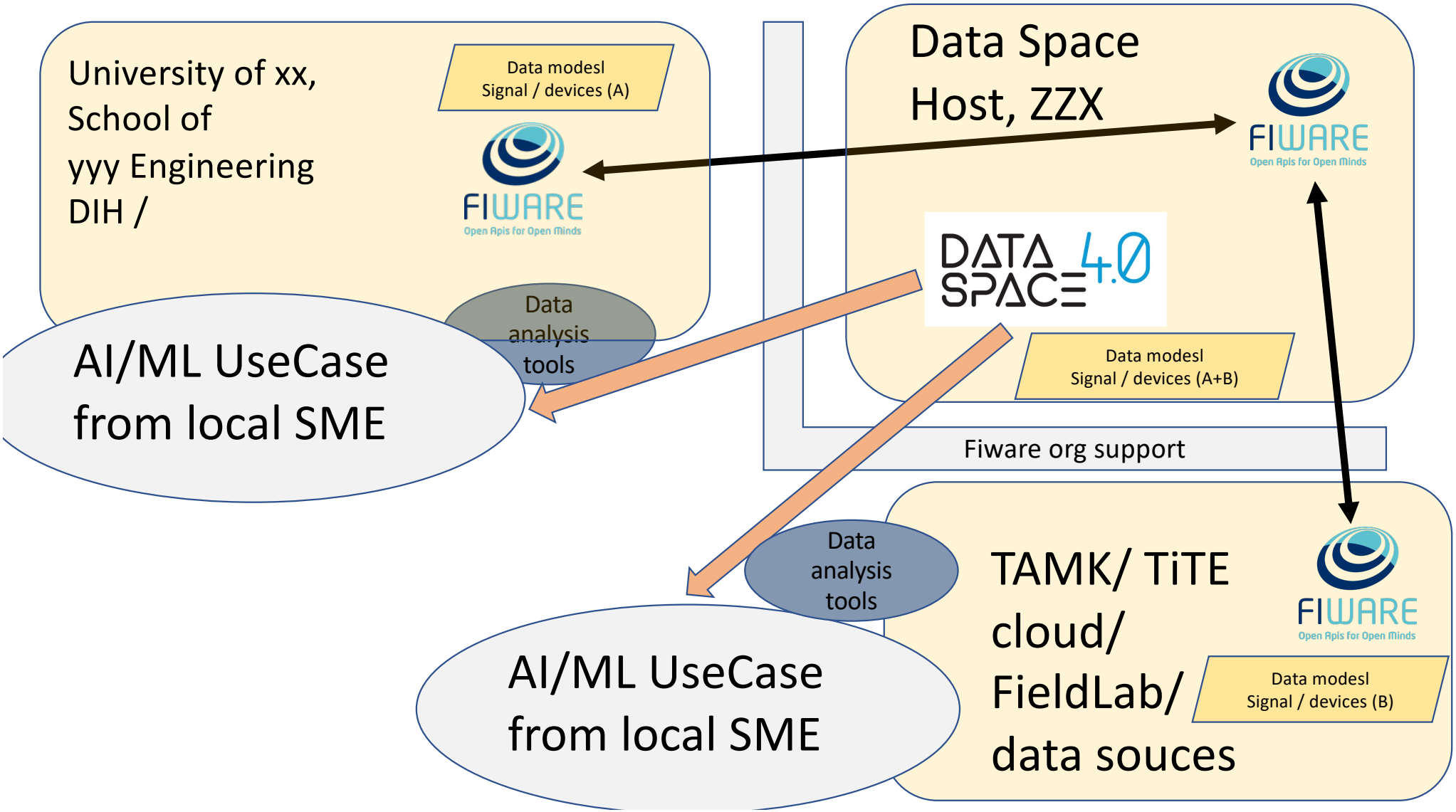


Fiware/dataspace/datamodel/3D-robot manufacturing and post processing use case



Flab – FIWARE – 5G – 4.0 testbed – IoT/ Data/ AI