

Activités de robotique portuaire au CRISTAL OMCRI4CP (Open Mobile Cloud Robotics for Connected Ports)

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Journée technique 2RM

Robotique Mobile

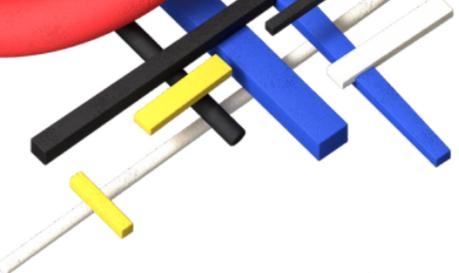
Toulouse, LAAS, le 19 octobre 2021

Présenté par Mamadou Sarifou DIALLO et Gérald Dherbomez



Sommaire

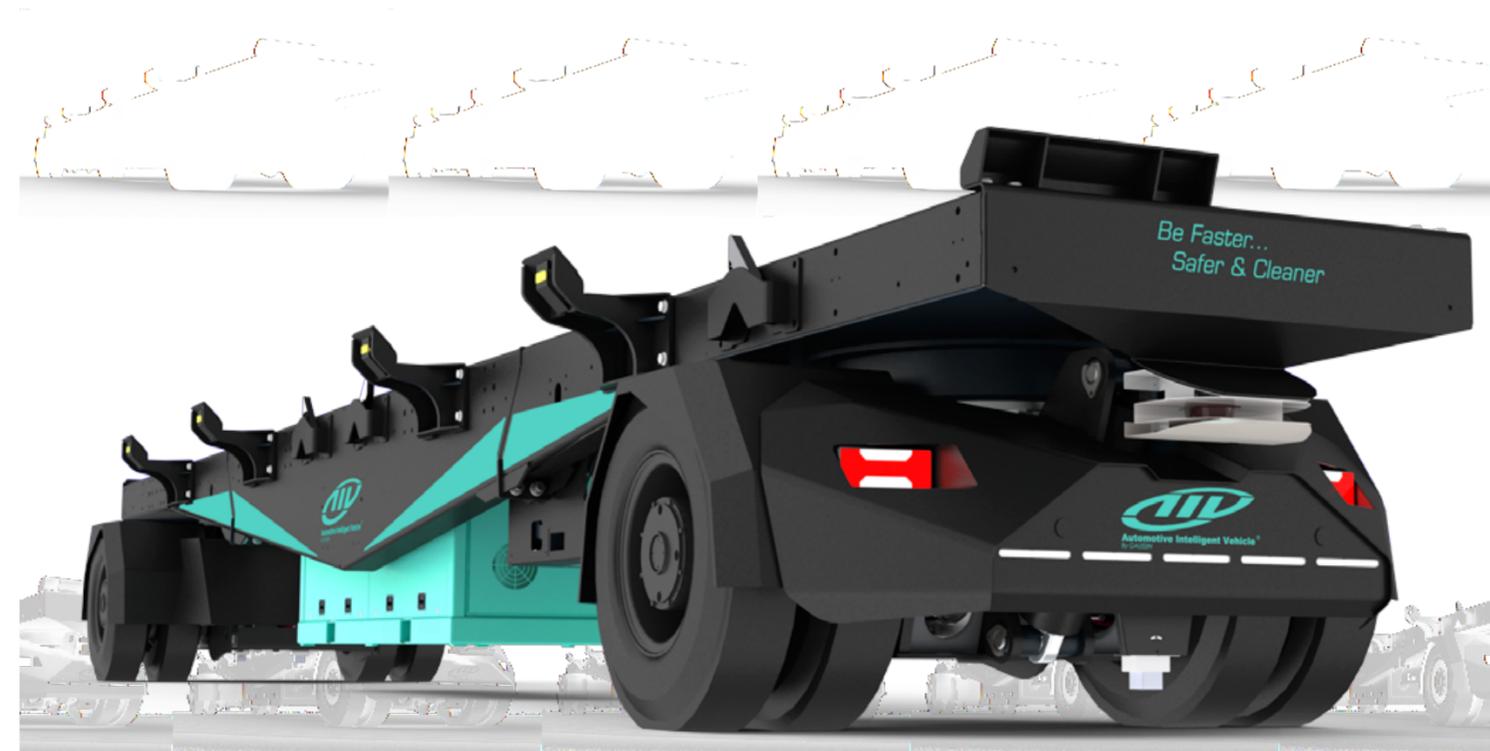
- 01 Historique des activités de recherche en robotique portuaire à CRISAL
- 02 Présentation du projet OMCRI4CP
- 03 Réalisations techniques
- 04 Perspectives et synthèse



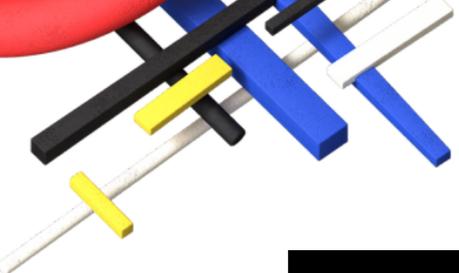
Historique robotique portuaire à CRIStAL

Projet européen Intrade 2009 - 2013 :

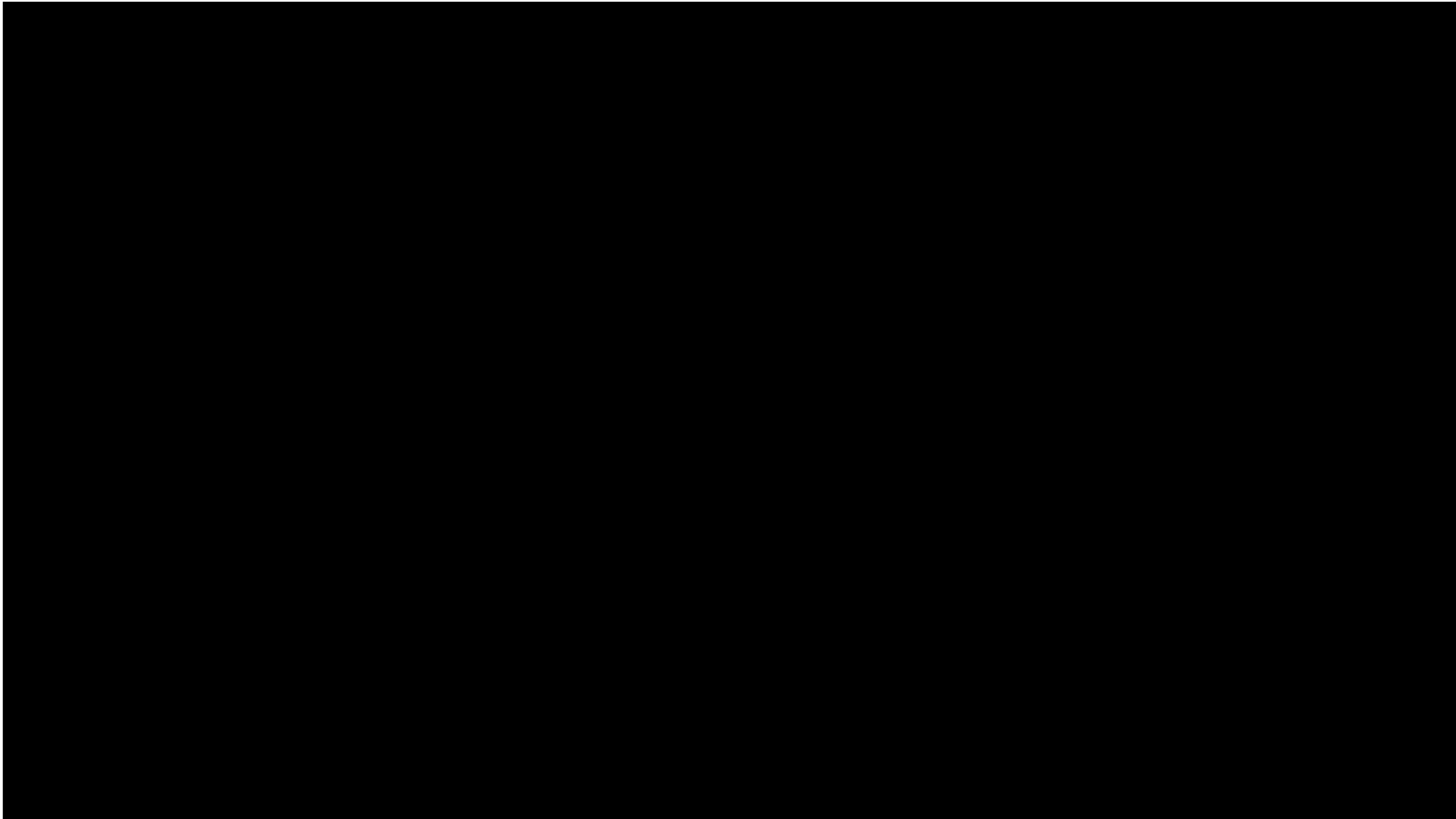
- Développement du Robutainer (robot porte container de 12m de long)
- Expérimentations sur plusieurs ports européens



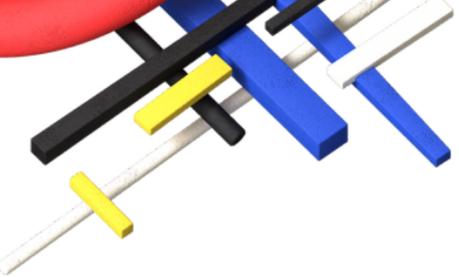
Projet PIA PSPC VASCO (2014-2019) avec Gaussin, BA Systèmes et LS2N pour industrialiser le prototype



Vidéo du Robutainer



<https://www.youtube.com/watch?v=49vqrl1O0N8>



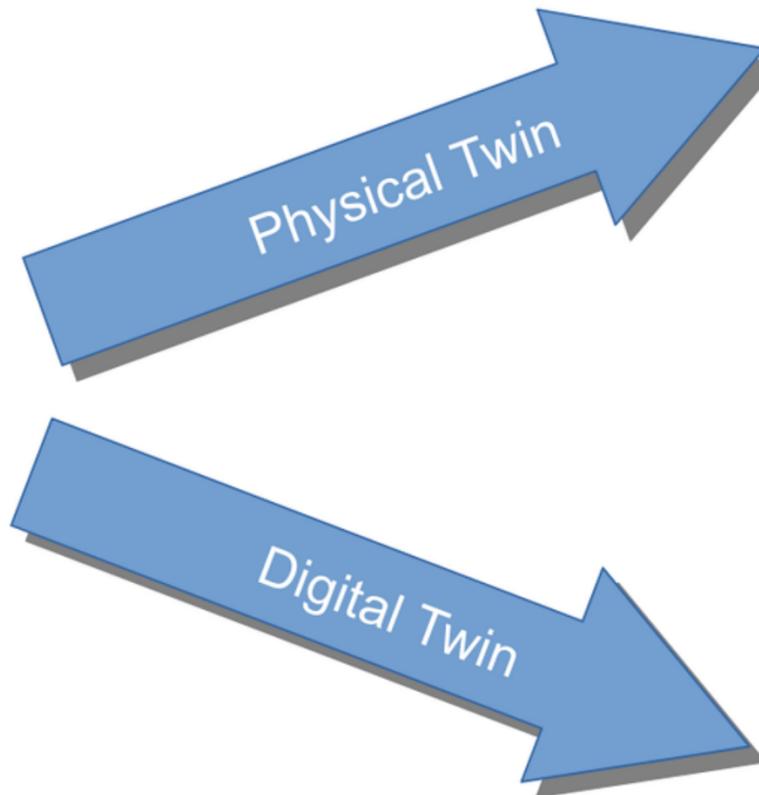
SPEED project (2018-2022)

Projet européen dont l'objectif est de développer l'écosystème des ports de commerce intelligents via la numérisation/robotisation (IoT & Data Science)

<https://www.smartportsecosystem.com/>



• *Real port environment*

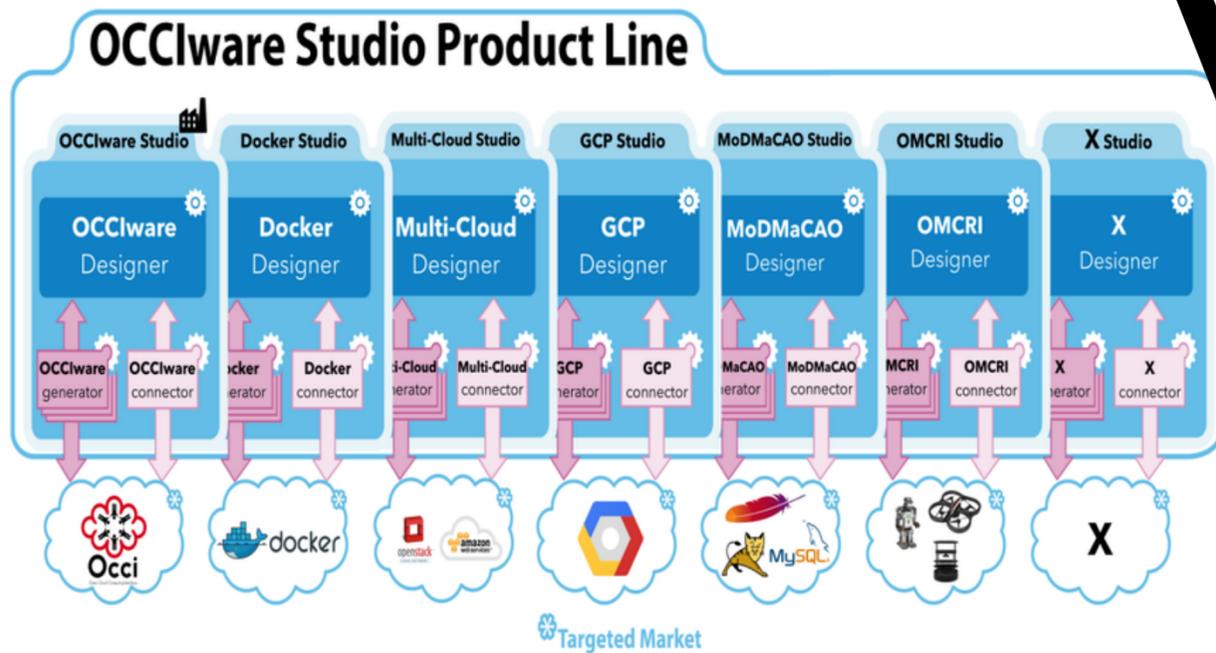


OMCRI4CP (Open Mobile Cloud Robotics Interface for Connected Ports)

Contexte scientifique

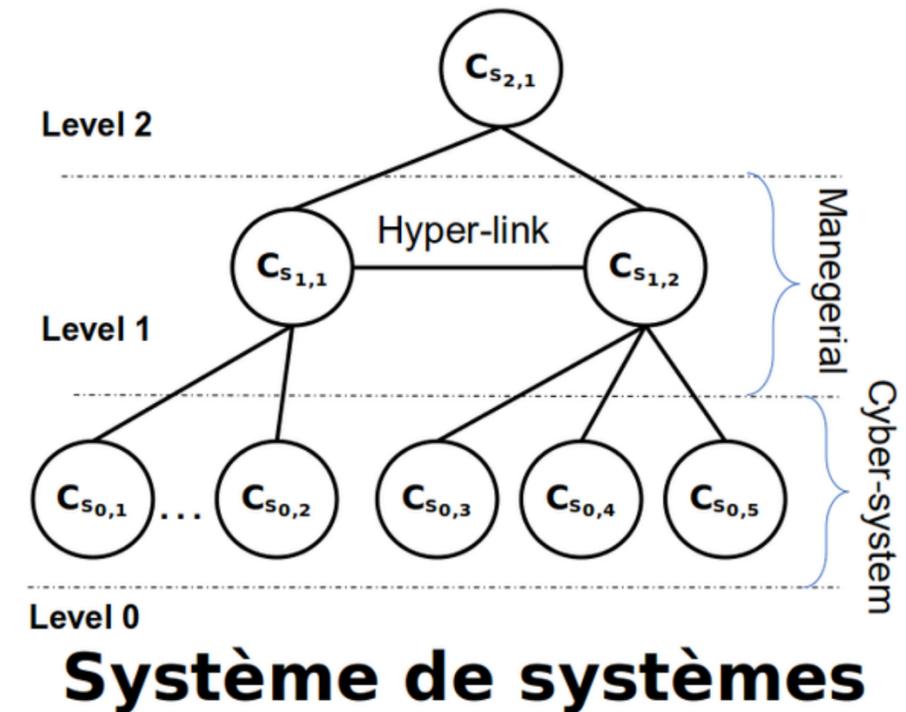
Equipe GL - SPIRALS

Génie Logiciel
Systemes distribués
Cloud Computing



Equipe TOPSYS - SOFTe

Automatique
Systeme de systemes robotiques
Ports intelligents et connectés



Service
Java + EMF (Eclipse Modeling Framework)
Modélisation dans OMCRI - Robot as a
Service

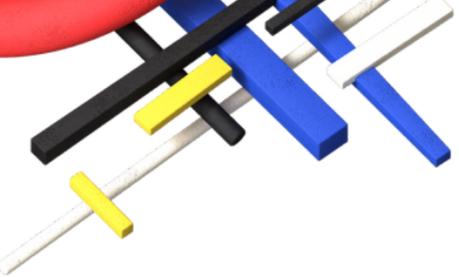
Définition des couches managériales
du SoS
Contrôle des objets connectés via ROS

OMCRI4CP

<https://github.com/occiware>

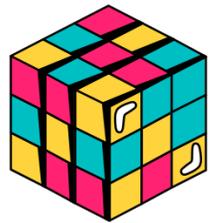
A decorative graphic on the left side of the slide consists of various 3D geometric shapes in different colors (red, blue, green, yellow, black, white) and orientations, including rectangular prisms, cylinders, and a curved yellow shape at the top. The shapes are arranged in a cluster that appears to be partially overlapping the main content area.

Architecture du démonstrateur OMCRI4CP



Objectifs du stage

OMCRI4CP : Open Mobile Cloud Robotics Interface for Connected Ports



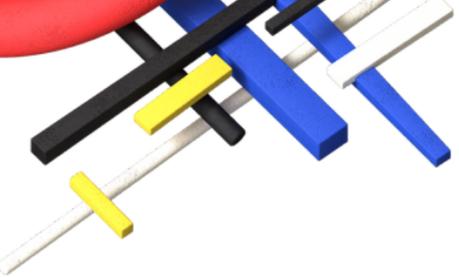
Contribution au Projet Européen SPEED (Smart Ports Ecosystem of the European 2 Seas Region) Belgique - France - Pays Bas - Royaume Uni



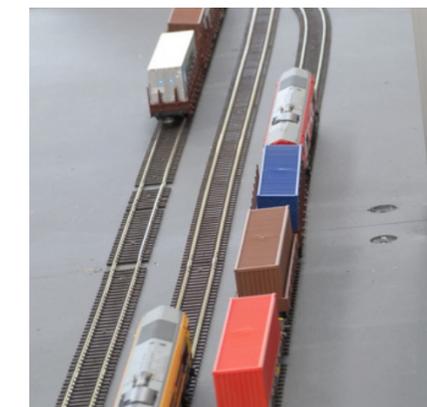
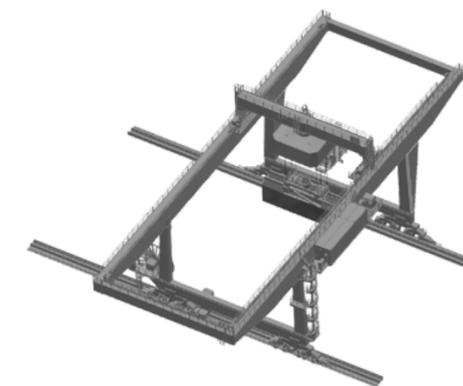
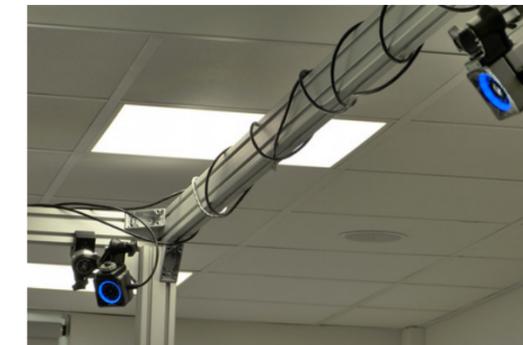
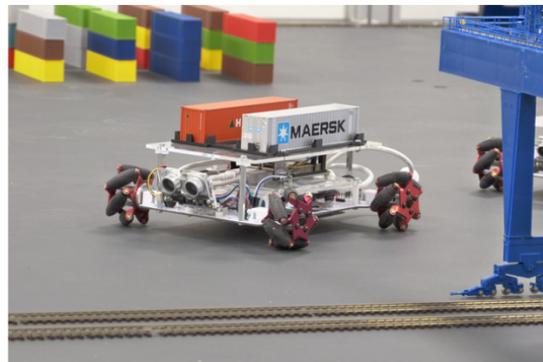
Mise en place d'un démonstrateur portuaire connecté et robotisé au laboratoire



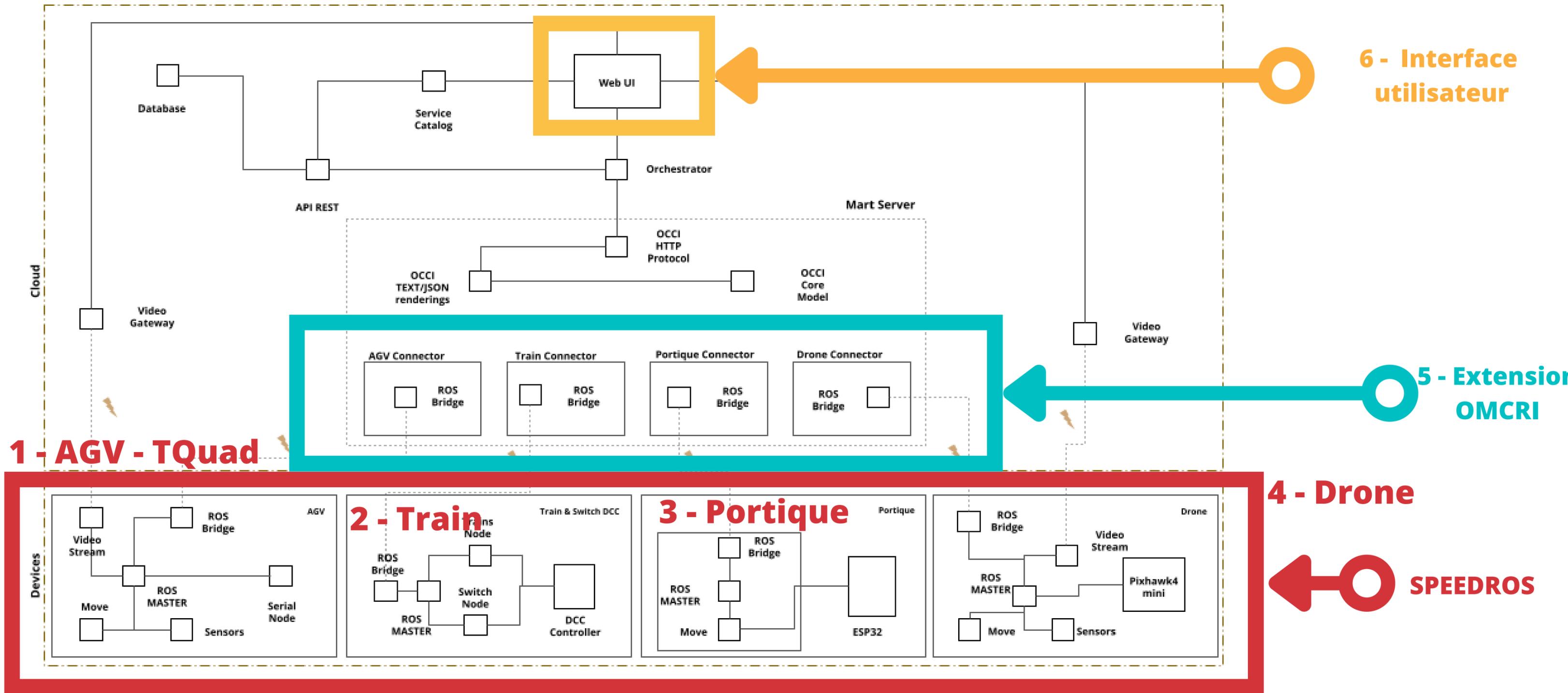
Mise en place d'une application robotique basée sur le principe de robotique cloud pour la plateforme portuaire

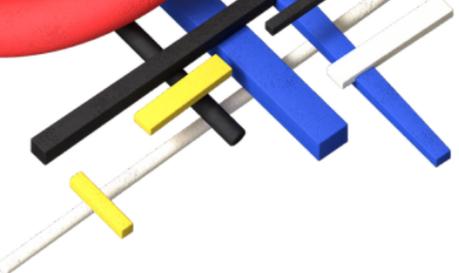


La plateforme portuaire du projet SPEED

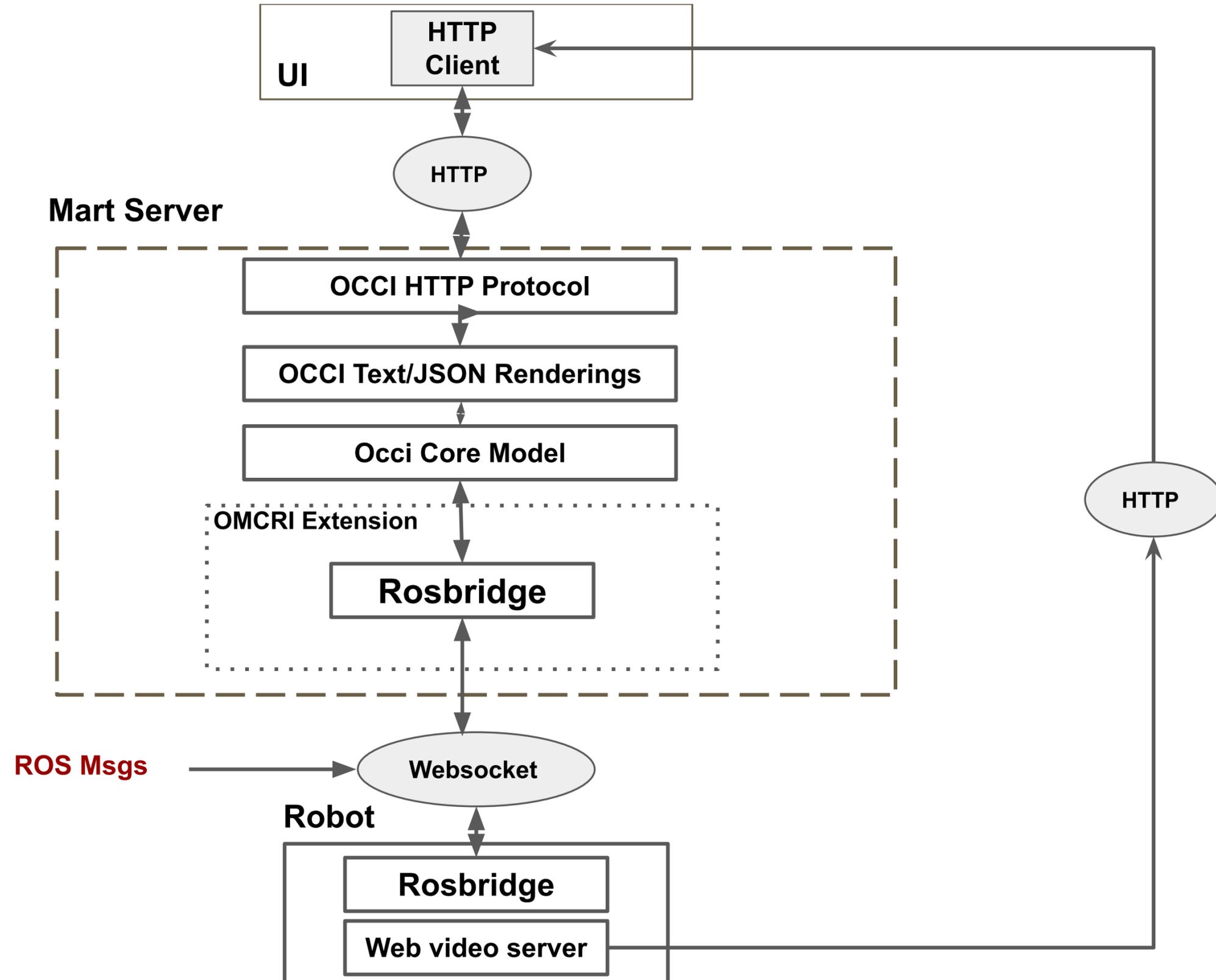


Architecture logicielle de la plateforme OMCRI4CP





Architecture conceptuelle de la plateforme OMCRI4CP



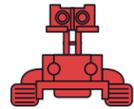
Description des composants matériels et logiciels

OMCRI4CP



Robot Mobile : T-Quads

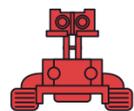
1 - AGV - TQuad



Robot mobile à roues holonomes développé par 3sigma



Raspberry Pi, Arduino, Capteurs (*IMU, Ultrasons, Camera, etc*)



Utiliser comme AGV (Automated Guided Vehicles) pour transporter les conteneurs



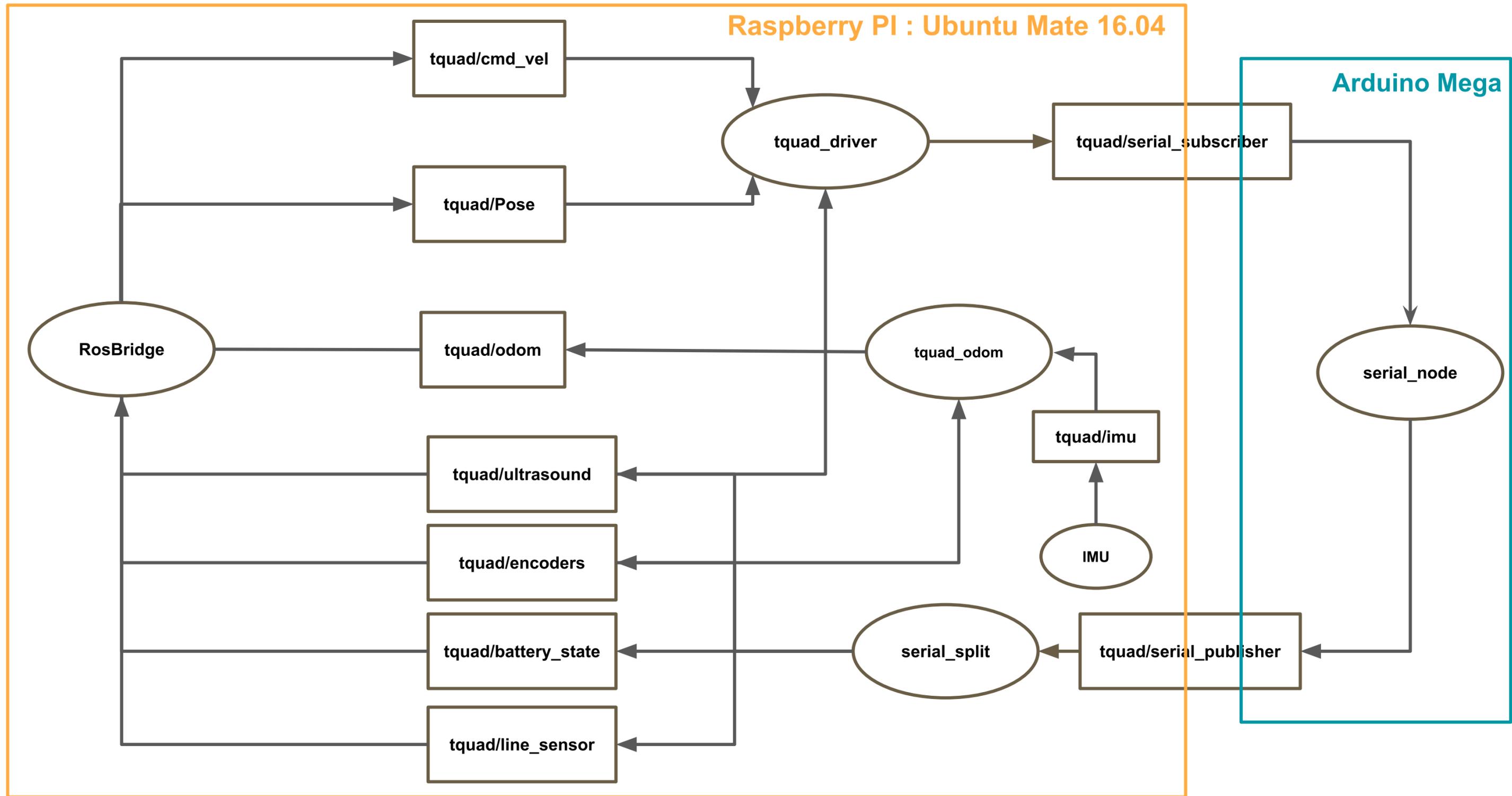
Liens utiles

<https://www.robot-tquad.com/fr/>

<https://github.com/CRISAL-PADR/SpeedRos>



Architecture logicielle des T-Quads



Trains & Switchs DCC



Train à l'échelle H0



Station de commande & Booster

- *Raspberry Pi*
- *Régulateur de tension*
- *Un pont en H*



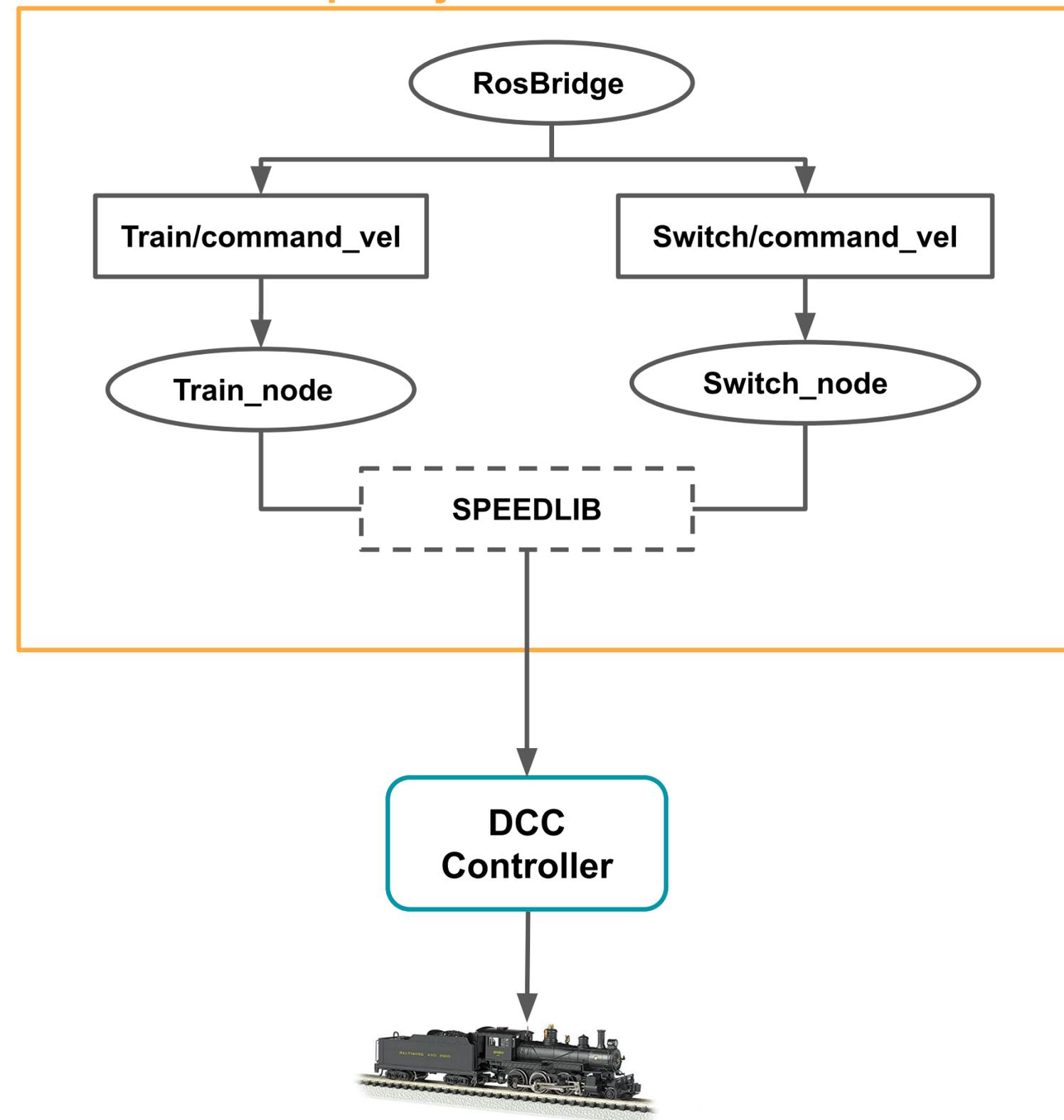
Liens utiles

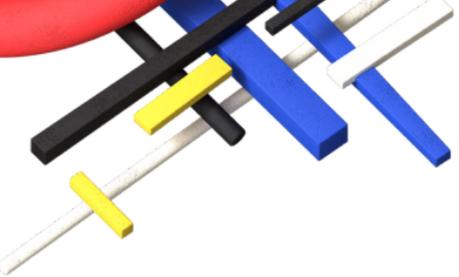
<https://github.com/CRISAL-PADR/Speed>

<https://github.com/CRISAL-PADR/SpeedRos>

<https://cristal-padrspeed.readthedocs.io/en/latest/index.html>

Raspberry PI : Ubuntu mate 16.04





Portiques



Portique du fabricant Faller



ESP32

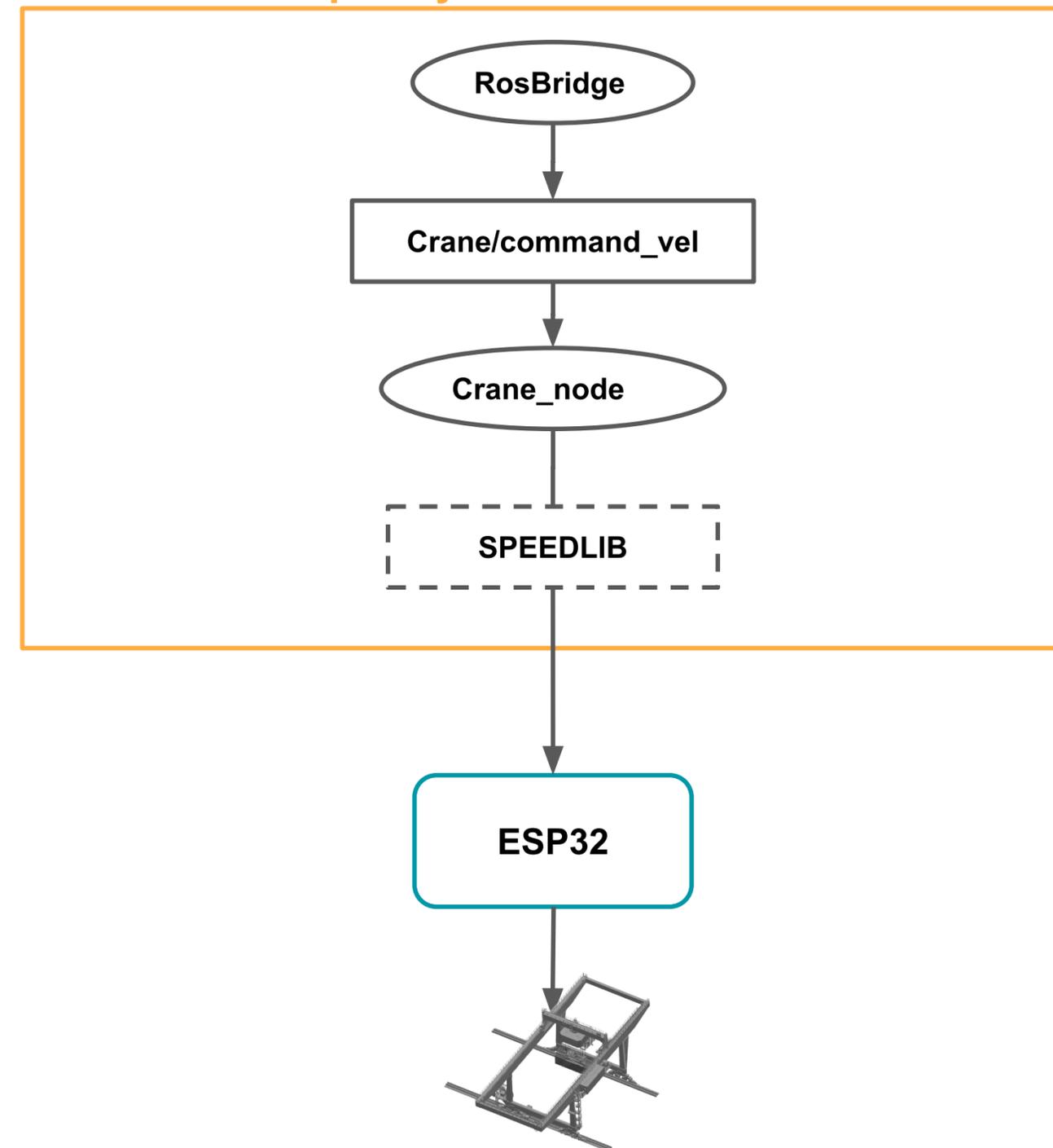


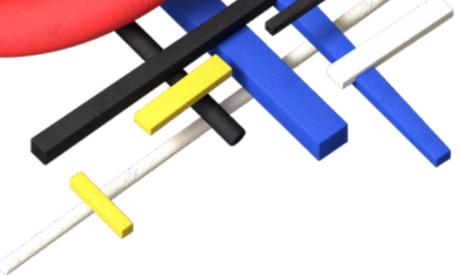
Liens utiles

<https://www.faller.de/fr/fr/Accueil.html>

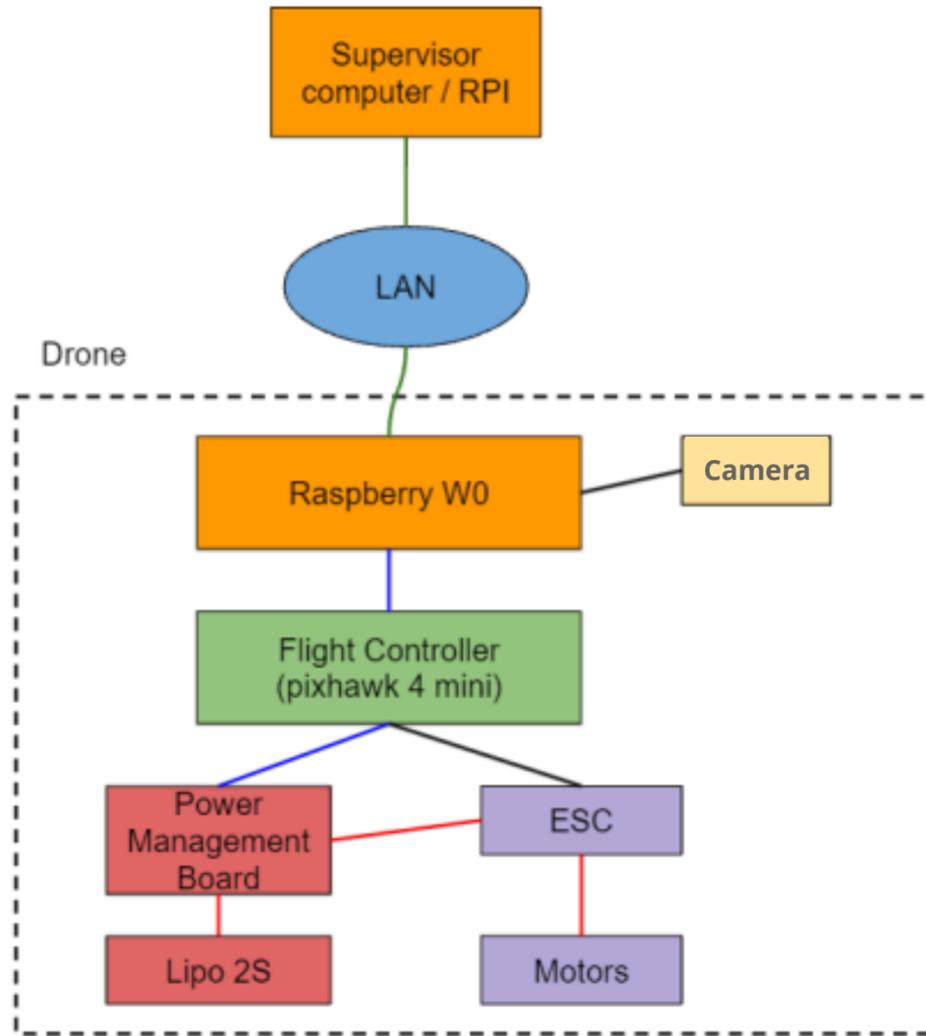
<https://github.com/CRISAL-PADR/SpeedRos>

Raspberry PI : Ubuntu mate 16.04





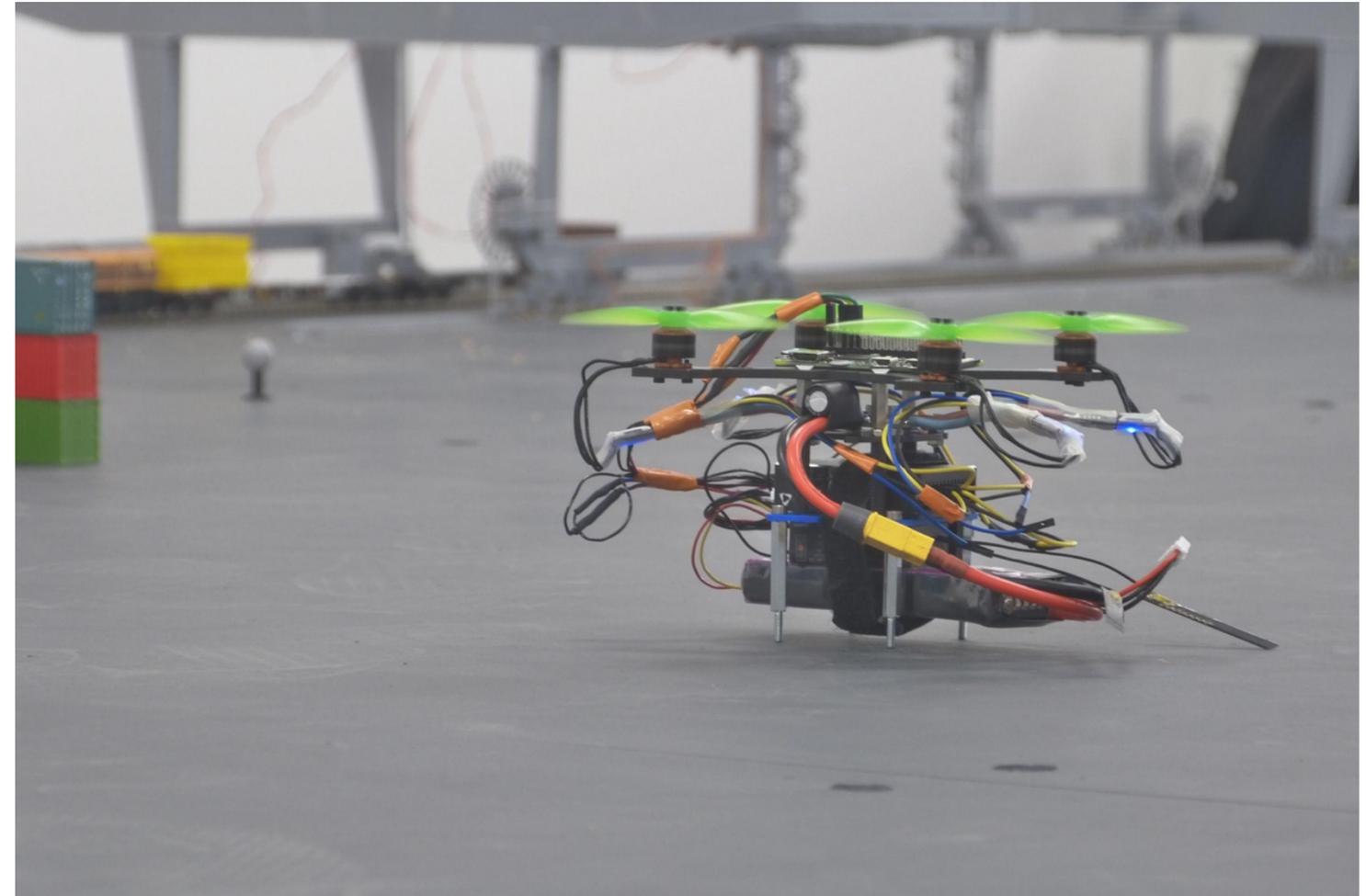
Mini drone open source et open hardware



Legend :

red link : power link
green line : network link
blue line : uart, serial link
black line : pin link (rpi,pwm)

blue : network
red : power
orange : computer
green : flight controller
purple : motors components
yellow : sensors



Implémentation des extensions



Sur-couche d'application pour accéder aux robots à partir du cloud



OMCRI & JAVA & Eclipse IDE

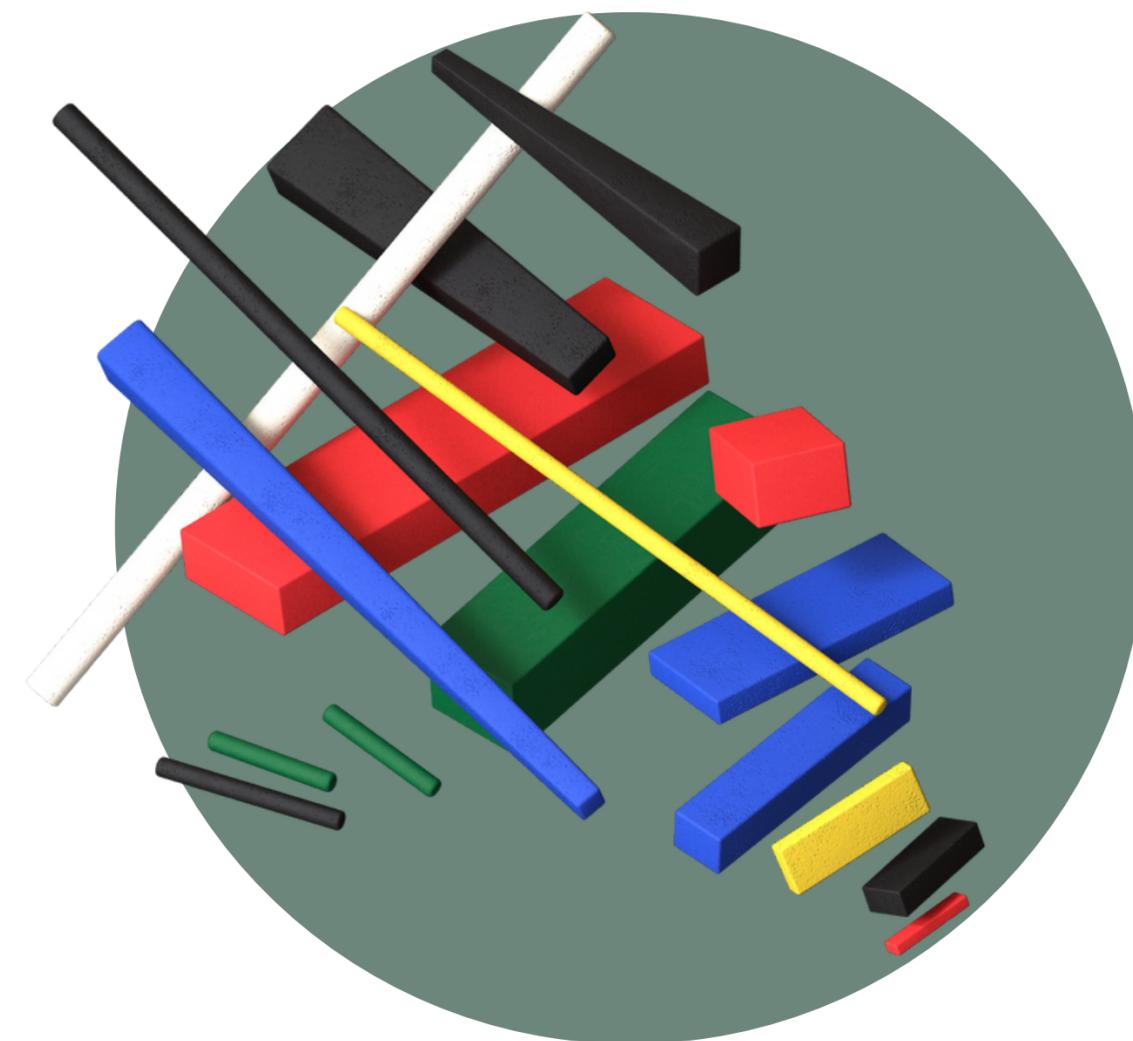


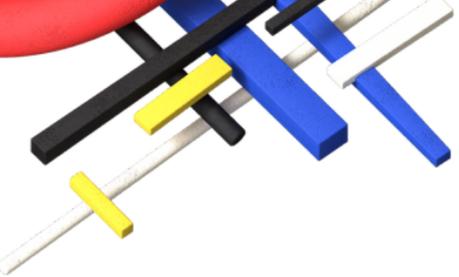
Chaque type d'équipement dispose d'une extension (représentation objet) qui décrit l'ensemble de ses fonctions.



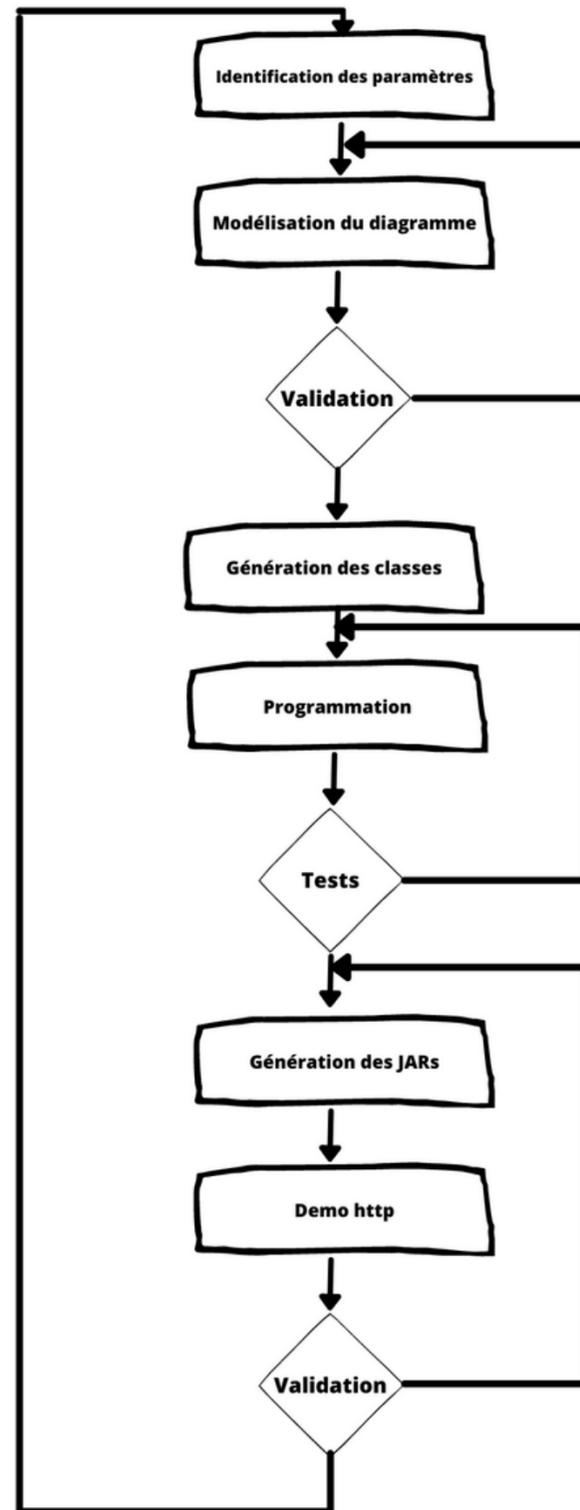
Liens utiles

<https://github.com/sarifou/cloudrobotics>

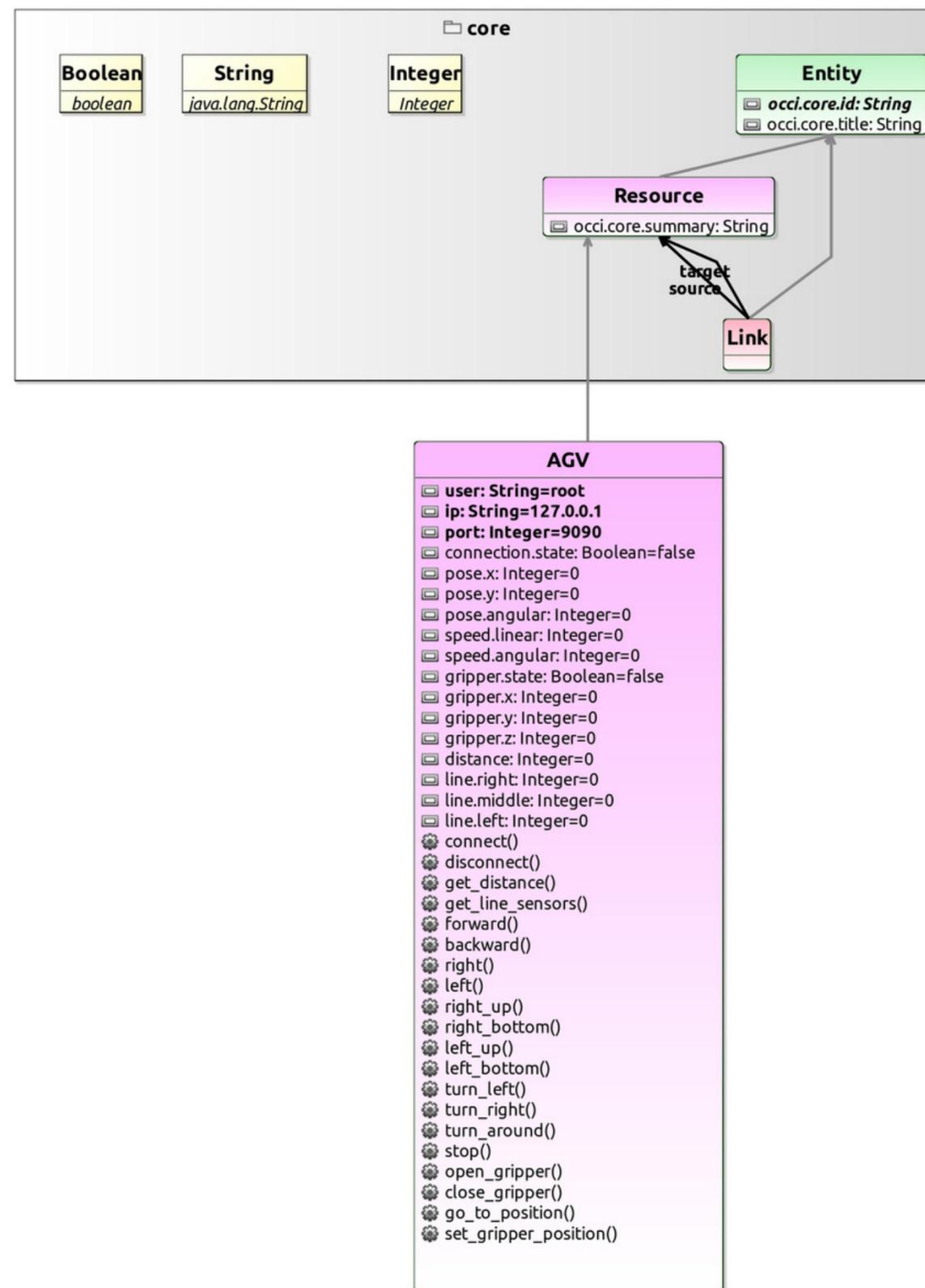


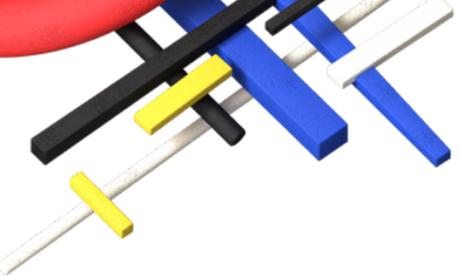


Cycle de développement d'une extension



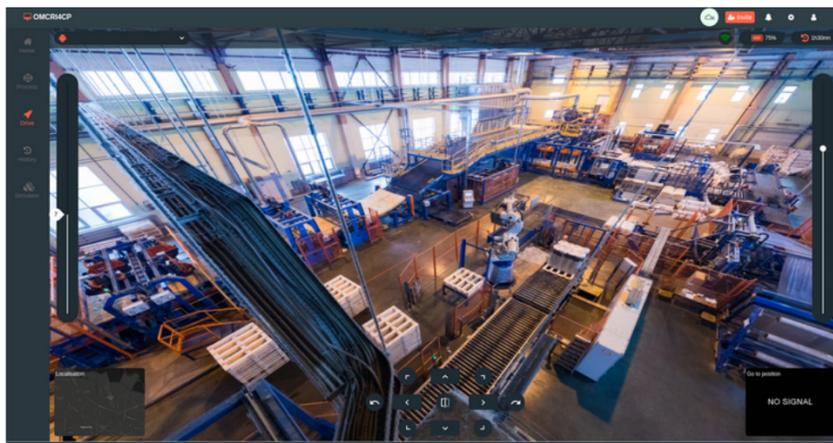
Exemple d'extension





Interface utilisateur

6 - Interface utilisateur



OMCRI4CP

Home

Active Process: 10 / 15 (75%)

Active Robots: 10 / 15 (75%)

Active Sites: 10 / 15 (75%)

Active Process: 10 / 15 (75%)

Train	Active	Total	AGV	Active	Total	Drone	Active	Total	Crane	Active	Total
train 1	100%	auto	AGV 1	100%	auto	Drone 1	25%	tele	Crane 1	100%	auto
train 2	67%	auto	AGV 1	75%	tele	Drone 1	75%	tele	Crane 1	100%	auto
train 3	10%	auto	AGV 1	25%	tele	Drone 1	100%	auto	Crane 1	100%	auto

OMCRI4CP

Commands

Speed: [Slider]

Train: [Stop] [Reverse]

Direction: [Forward] [Reverse]

Accessories

Light: [On/Off]

Horn: [On/Off]

Train noise: [On/Off]

Wagon noise: [On/Off]

Switches: Site 1, Site 2, Site 3, Site 4

OMCRI4CP

Container bridge-crane

Speed: [Slider]

Chassis: [Slider]

Travelling crab: [Slider]

Spreader: [Slider]

Additional functions:

Primary board: [On/Off]

Pin 18: [On/Off]

Secondary board: [On/Off]

Pin 4 & 5: [On/Off]

Pin 18: [On/Off]

PUT http://localhost:8080/port/trainestdera

Params Authorization Headers (8) **Body** Pre-request Script Tests Settings

none form-data x-www-form-urlencoded raw binary GraphQL JSON

```

1  {
2    "title": "TrainTest",
3    "summary": "Train test",
4    "kind": "http://cristal.org/omcri4cp/train#train",
5    "attributes": {
6      "user": "cherif",
7      "number": 1,
8      "ip": "127.0.0.1",
9      "name": "DCC1",
10     "port": 9090
11   }
12 }

```

OMCRI4CP

Process

New process

Receiver name: [Input]

Order description: [Input]

Start date: [Input]

Priority: [High]

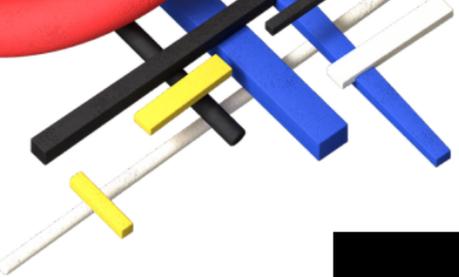
Submit

Traffic in this week

Last Orders

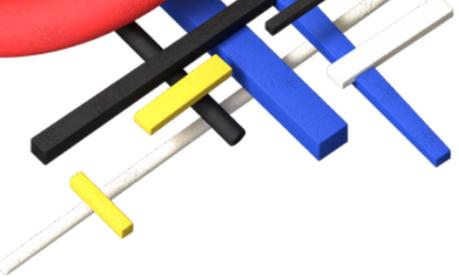
Order #	Receiver	Start Date	Priority	Status
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress
Order #123148	Receiver	July 8 2021	High	In progress

<https://github.com/sarifou/OMCRI4CPIInterface>

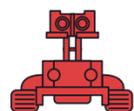


Demo de l'application robotique OMCRI4CP

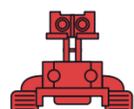
Open Mobile Cloud Robotics for Connected Ports Demo



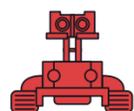
Futures évolutions : Orchestrateur



Application de RPA UIPath



Modélisation drag & drop

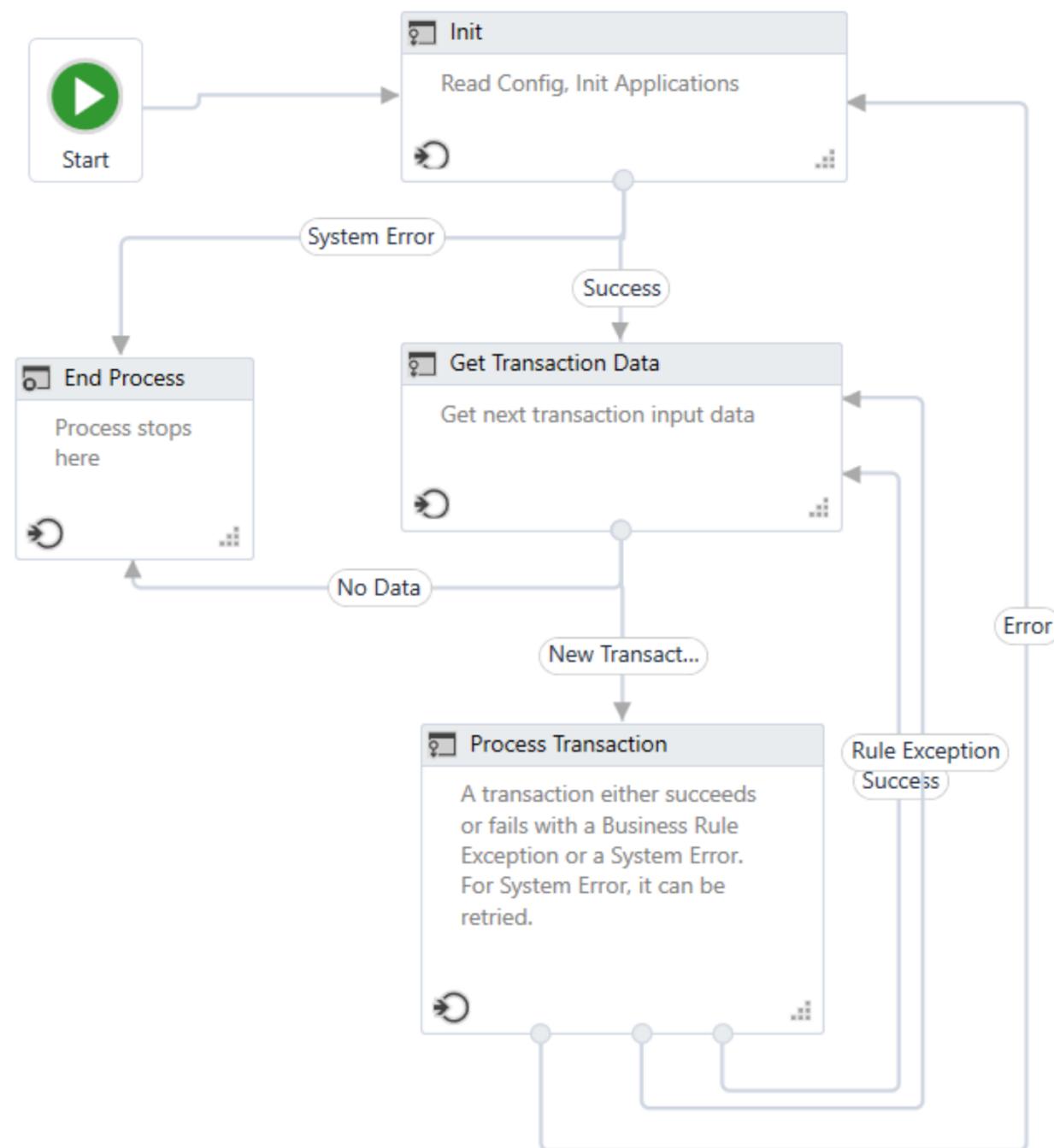


Définition des processus client

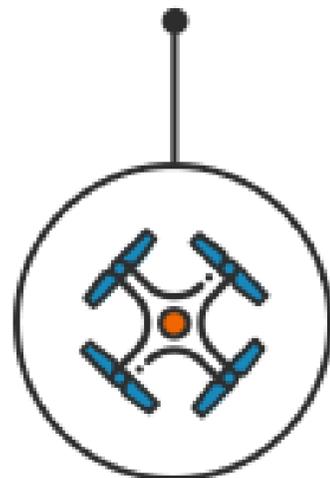
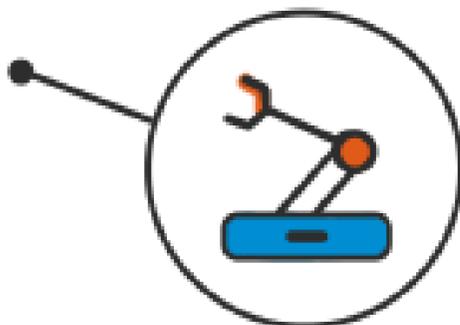
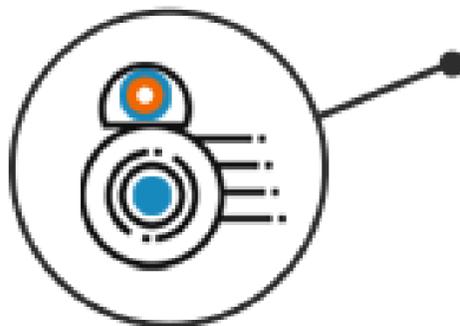
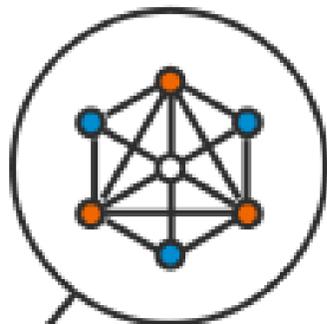
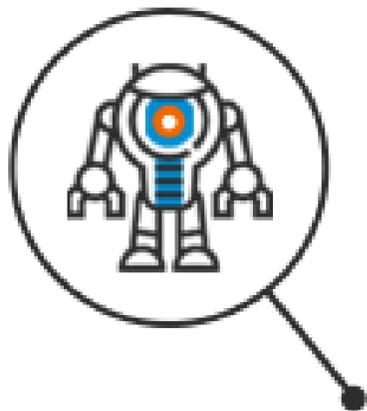
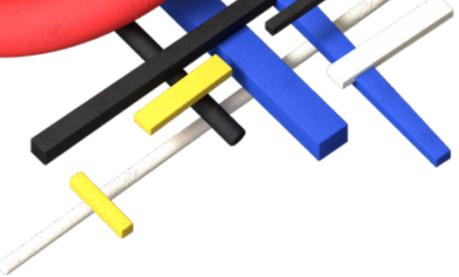


Liens utiles

<https://www.uipath.com/fr/>



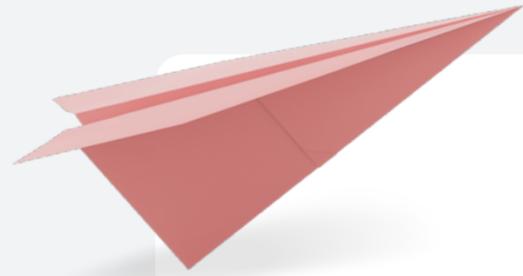
Conclusion



Opérationnel : Preuve de concept de démonstrateur cloud robotics (objets connectés, Edge computing et interface de contrôle dans les nuages)

Reste à faire :

- Dupliquer les objets
- Libérer le code du jumeau numérique sous Godot Engine
- Déployer l'application Cloud sur un serveur connecté à Internet
- Développer un scénario d'orchestration
- Ouverture du démonstrateur pour des tests par des partenaires



**Merci de votre
aimable attention**

