Instructions and guidelines for the D1 Template

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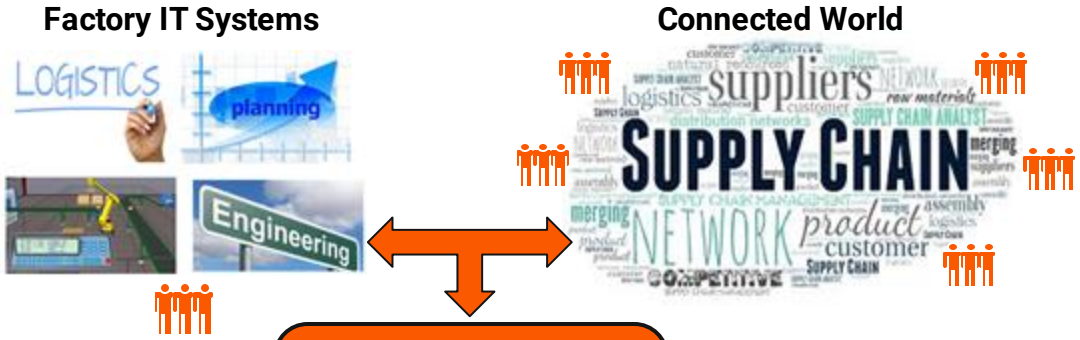
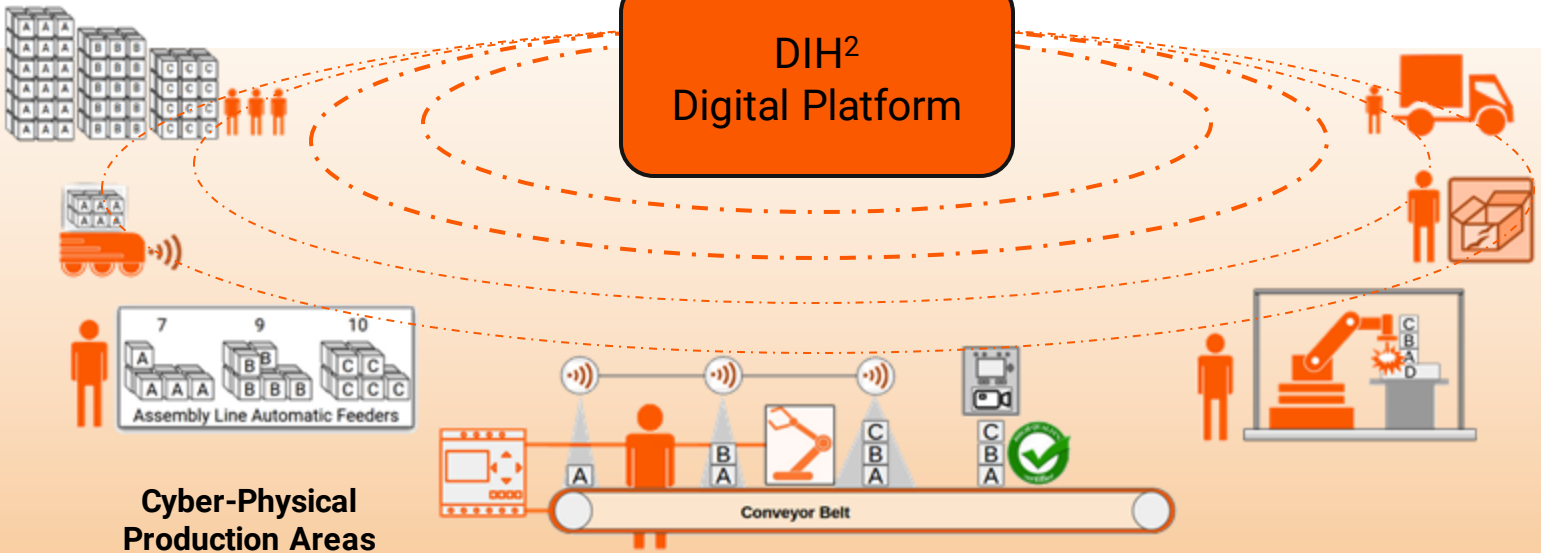
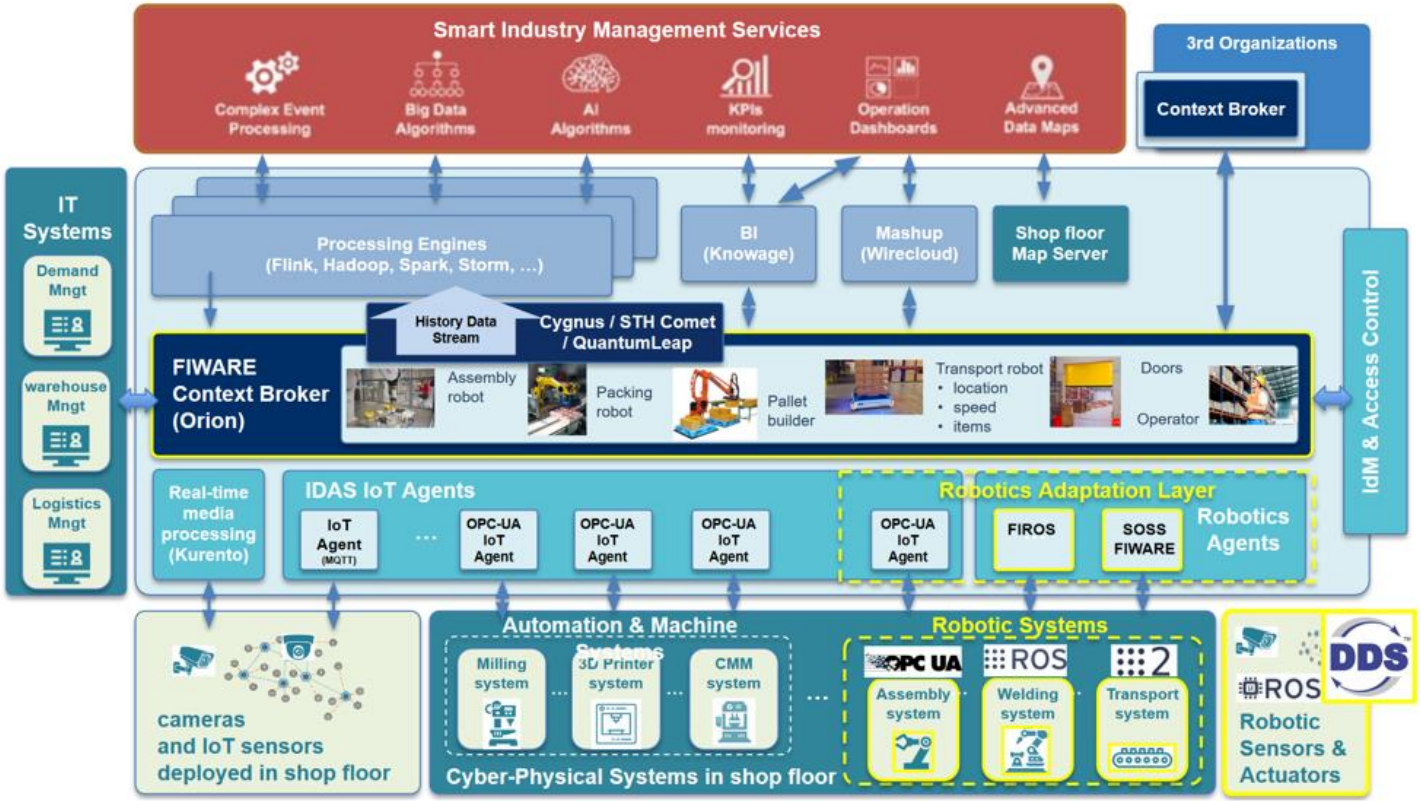
Complex Use Case: Robotics for Agile Production

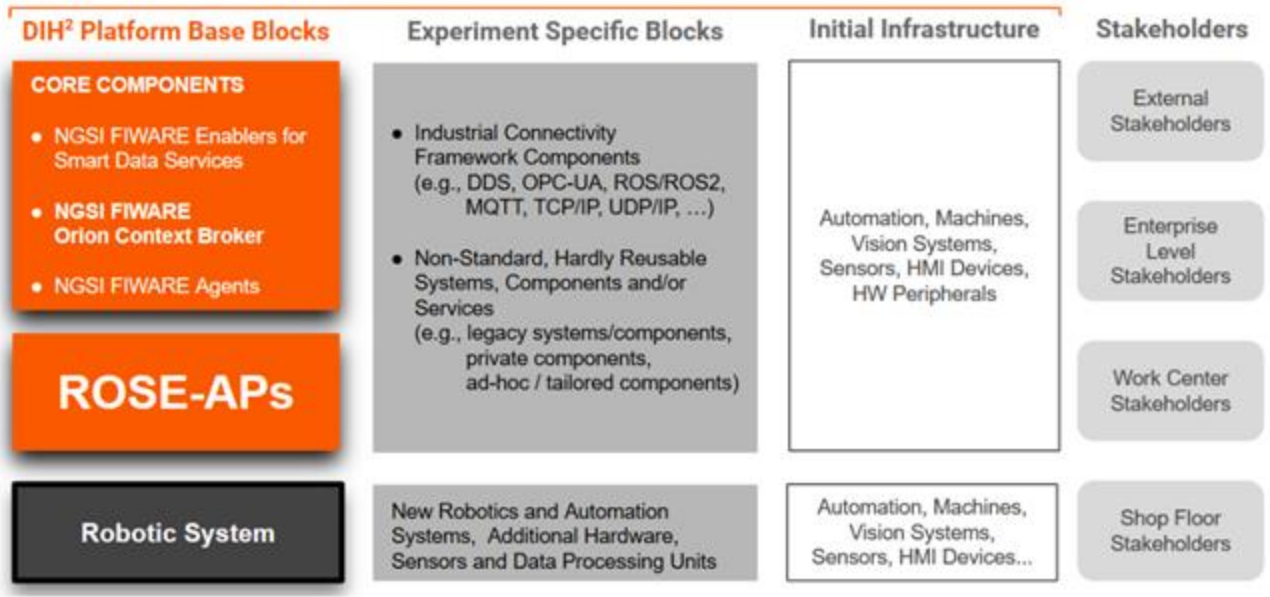




FIWARE Reference Architecture (System of Systems)



TTE Solution: Building Blocks



Key Contributions of the TTEs: ROSE-AP Blocks

Image Source: Wikimedia Commons, the free media repository

TTE Solution → ROSE-APs
Type 1. CPS Smart Agents

Context Broker

FIWARE NGSI ORION

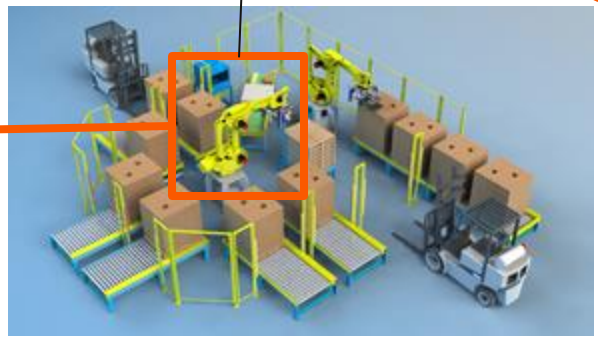
ROSE-AP Example (Type 1):
Standard Palletizer Smart Agent

High-Level Robot APIs

Native / Legacy Robot Middlewares, Programming Tools, Dev. environments...

Low-Level Robot APIs

Palletizer Application



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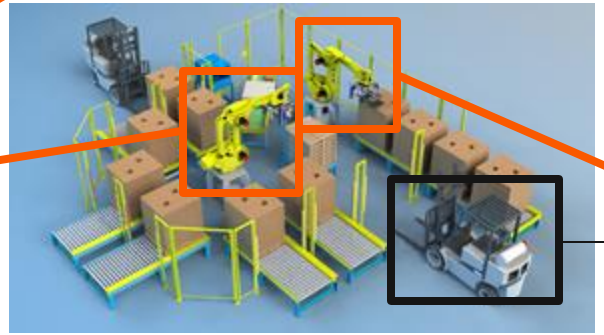
TTE Solution → ROSE-APs
Type 2: Smart Solutions (I)

ROSE-AP Example (Type 2.1): Smart Vertical Solution
- **Robotized Palletization Management**

Context Broker

FIWARE NGSI ORION

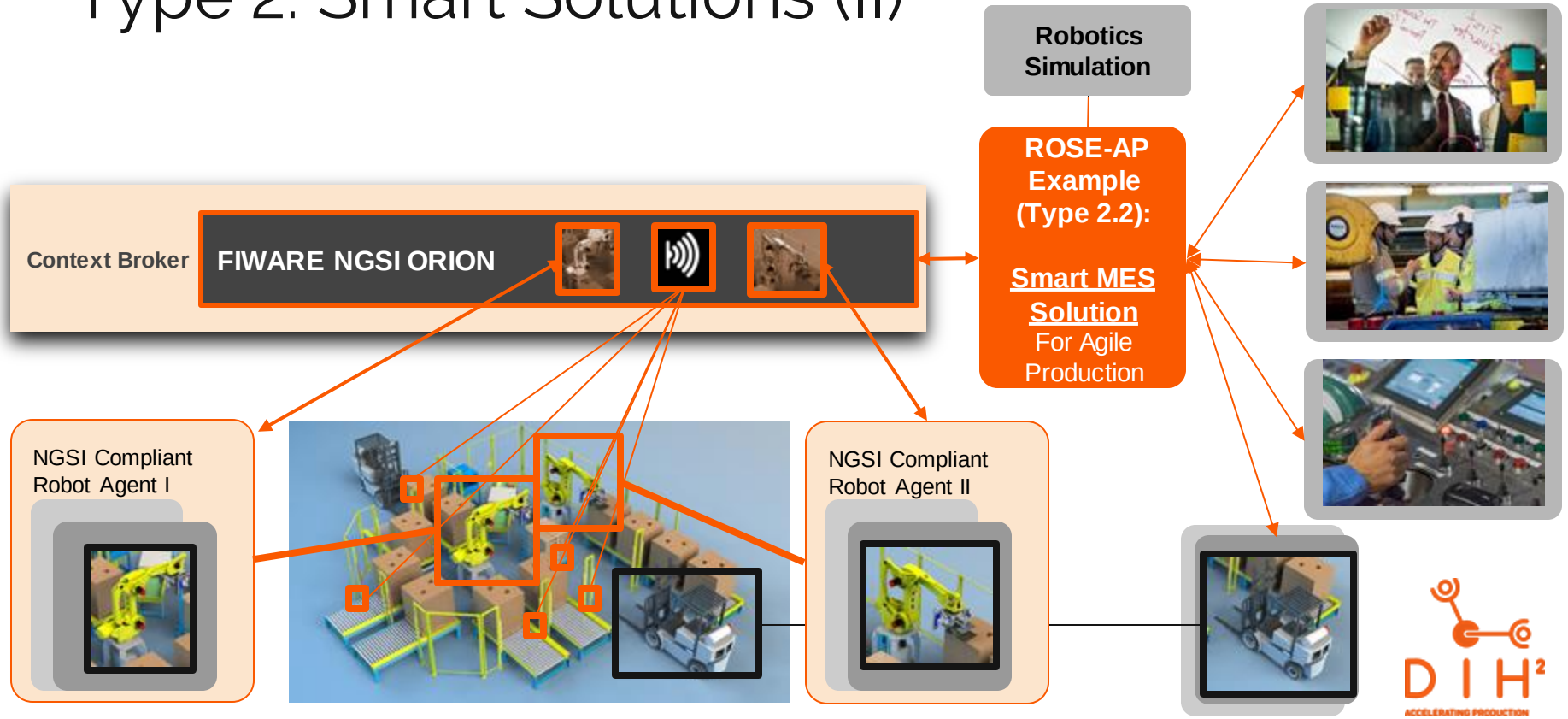
NGSI Compliant Robot Agent I



NGSI Compliant Robot Agent II

MES/ERP Applications

TTE Solution → ROSE-APs
Type 2: Smart Solutions (II)



TTE Solution → ROSE-APs
Type 3: IT System Smart Agents

Smart Vertical Solution
(e.g. smart pick & palletize)

Smart
MES

Smart
IT System
Agent

Warehouse

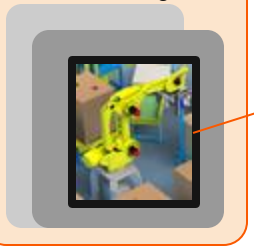
Smart
IT System
Agent

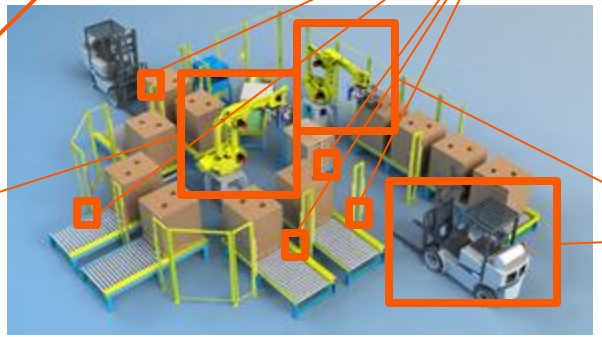
Demand
Planning

Context Broker

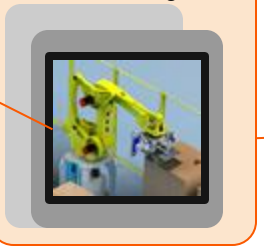
FIWARE NGSI ORION

Smart CPS Agent

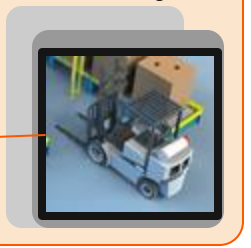




Smart CPS Agent



Smart CPS Agent



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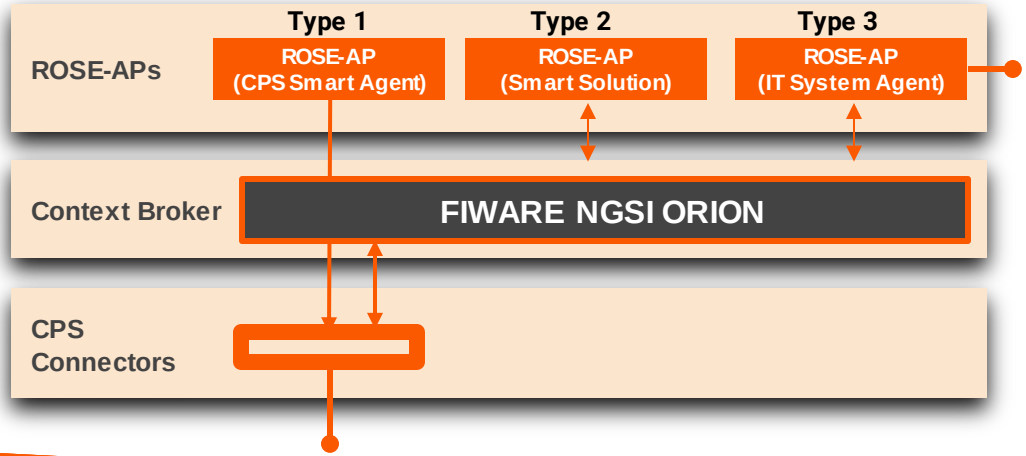
Summary of ROSE-AP Types

A ROSE-AP is a standardised, NGSI Compliant App/Components, with concrete value for a relevant cluster of stakeholders. They materialise a relevant part of an agile production use cases in a replicable and scalable way for one or more manufacturing domains.



On the one hand, **Agent ROSE-APs** aim to provide a smart integration of robots, machines, sensors, and heterogeneous IT systems with the NGSI ORION Context Broker.

On the other hand, **Smart Solution ROSE-APs** leverage the data that the NGSI ORION Context Broker makes available to materialise an agile production concept/service in a robust, reusable, and scalable way.

ROSE-AP Types:

1. Base Type (I) → CPS Smart Agents
2. Base Type (II) → Smart Solutions
3. Base Type (III) → IT System Agents

**Other ROSE-AP Types → Try to fit your ROSE-AP description into one of the aforementioned patterns. If you consider that it does not perfectly match one you can describe it as a hybrid pattern based on the three base types. If you can't describe your ROSE-AP according to these patterns, please send an email to francisco.melendez@fiware.org with a short description of what you are thinking to contribute as a ROSE-AP. If email support is not enough, we can agree on a convenient date and time slot for a one-to-one call.*

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Key Instructions to fill the D1 Template

- Describe a technical solution that aims to increase the agility of your initial production context.
- The solution can extend the initial infrastructure with both HW and SW.
- No limits on the number and type of capabilities for the new features. However, due to the scope of this Open Call there are some **mandatory requirements** they must cover:
  - The solution must gravitate around the **DIH^2 Digital Platform**, which means that at least one robot along with other equipment like sensors, machines and IT systems will be integrated with the FIWARE Context Broker instance that runs at VTT facilities.
  - At least one of the new features added must be defined as a **ROSE-AP**, which stands for "Robotics Open Standard Enablers for Agile Production"
  - Therefore, at least one **robotic system** must be a core part of the proposed solution.
  - Specify the main **stakeholders** to/from which your ROSE-AP(s) deliver/receive value.

ROSE-AP Stakeholders

Industrie 4.0 → RAMI 4.0 Hierarchy Levels

Inter-site IIoT Levels: ● External Party ● Enterprise end-point	Elements: IT Systems and Services associated with ERP systems , business and supply chain management,, logistics …
Intra-Factory IIoT Levels: ● Work Center ● Station	Elements: IT Systems and Services associated with ERP systems, SCADA, MES, Simulations, Advanced Planning and Scheduling, Intra-Logistics…
Cyber Physical Level: ● Control Device ● Field Device	Elements: - Robots - Industrial Automation, Machines, Tools, Sensors, Human-Machine Interfaces, products

The application scope for ROSE-APs is large. In fact, they can target any manufacturing problem where robotics systems play a relevant role. Thus, **the range of possible stakeholders of ROSE-APs includes several and highly heterogeneous profiles.**

On the left, the hierarchy levels specified in the Reference Architecture Model for Industrie 4.0 (RAMI 4.0) are listed along with examples of the typical systems that are deployed / operate at each level. **The role of the ROSE-AP should be clearly linked to an increase in the agility of a production process that is associated with a subset of these hierarchy levels and system elements**.

The stakeholders of the ROSE-AP are a relevant cluster of organisations, parties, teams, and/or individuals that will derive benefit from the aforementioned role.

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DIH²

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D1 Requirements Specification

<< Name of the experiment>>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824964

1. Use case

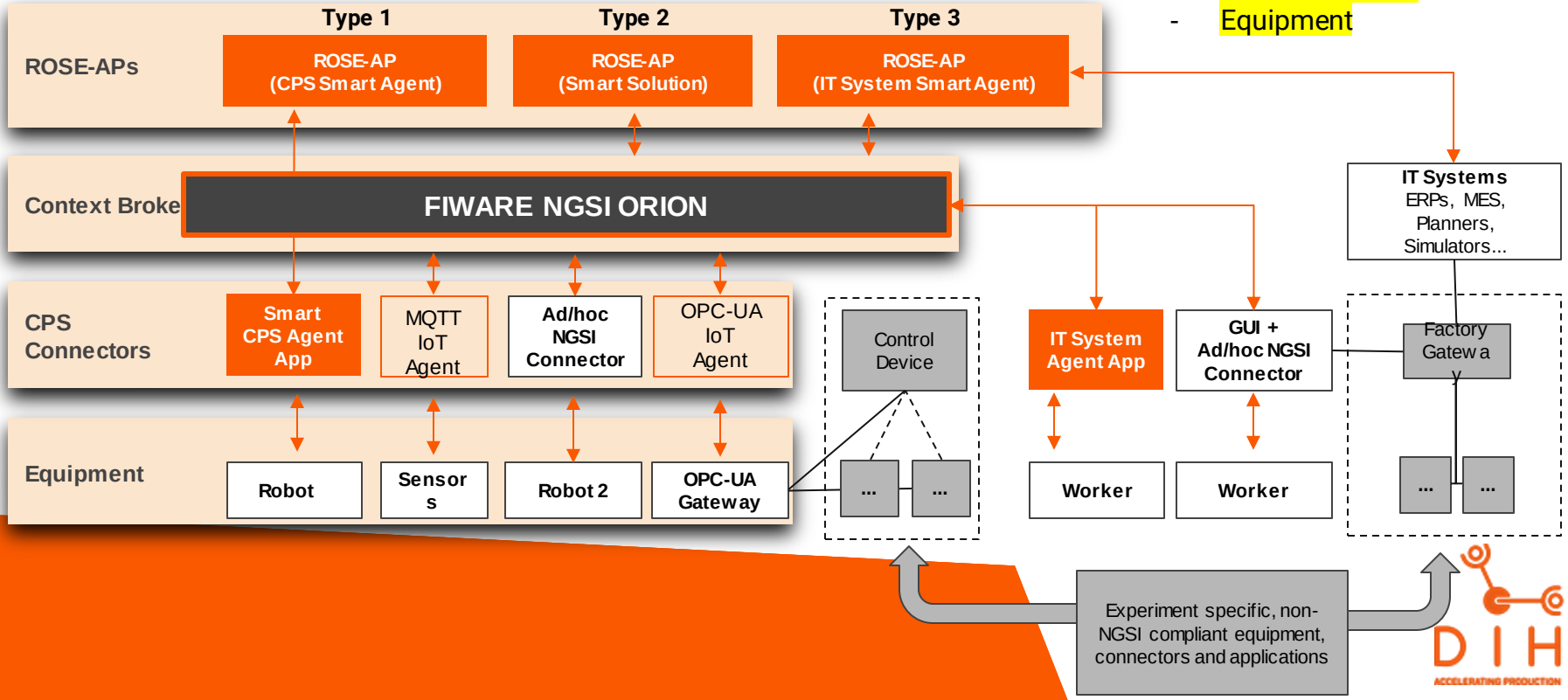
In this slide, **you are requested to provide a complete but concise description** of your use case.

- Use diagrams, figures and/or drawings with convenient annotations

2. System architecture

Please add, connect and fill out the names of the components and equipment in the following layers:

- ROSE-APs
- CPS Connectors
- Equipment



3. Robots to be Connected

- Feel free to use as many rows/tables/slides as you need to describe all the robots that will be connected to your system architecture during the experiment.
- Do not limit to the features in the table. Drop/add new ones at your convenience
- Delete this highlighted text

Robot Data
Example Inputs: • **Name and Unique identification number** • **Robot manufacturer / Robot model / Specifications Website**; • **Core Platform Type:** - **Transportation:** Box AGV, Forklift AGV, Towing AGV - **Arm: Type / Axes / Payload / Reach / Repeat / Weight** • **Onboard Sensors:** Odometry, battery capacity, load, camera, lidar, etc • **Actuators:** Tilt, lift, motors, grippers, extruders, paint gun, weld gun, etc. • **CAD data**: STL, DWG, etc. • **Picture** • **Battery Capacity:** hrs /plugged • **Autonomous capabilities:** Forking, charging, picking, placing, etc;
Robot Interfaces
API □ Native API Protocols / Controller SW / ROS/OPC-UA Compliant. **Accessible features** □ Made available either through its Native Network API or through a middleware SW controller **Data Exchange** □ Maximum Allowed Latency / Expected Size of data packets / Information Model

4. Sensors to be Connected

- Feel free to use as many rows/slides as you need to describe all the sensors that will be connected to your system architecture during the experiment.
- Do not limit to the features in the table. Drop/add new ones at your convenience
- Delete this highlighted text

Sensor Data
Example Inputs: • **Name and Unique identification number** • **CAD data:** STL, DWG, etc.; • **Picture;** • **Type:** Pressure, temperature, velocity, etc. • **Units:** Pascal, oC, m/s, etc. • **Ranges:** …
Sensor Interfaces
API □ Native API Protocols | Controller SW | ROS/OPC-UA/MQTT/DDS Compliant. **Accessible features** □ Made available either through its Native Network API or through a middleware SW controller **Data Exchange** □ Maximum Allowed Latency / Expected Size of data packets / Information Model

5. Other Equipment to be Connected

- Feel free to use as many rows/slides as you need to describe the rest of the devices, machines, tools, systems, controllers, gateways, data processing units and/or smart products/assets that will be connected to your system architecture during the experiment.
- Use the set of features/characteristics that you consider convenient to describe the system.
- Delete this highlighted text

Equipment Data
Example Inputs: Device Description Features
Equipment Interfaces
Physical Link: Ethernet, Serial…; **Transport Protocol / Connectivity Framework:** HTTP, RTPS, MQTT, TCP, UDP, OPC-UA, DDS, MODBUS,... **API** □ Native API Protocols | Controller SW | ROS/OPC-UA/MQTT/DDS Compliant. **Accessible features** □ Made available either through its Native Network API or through a middleware SW controller **Data Exchange** □ Maximum Allowed Latency / Expected Size of data packets / Information Model

6. ROSE-AP requirements

Here describe each ROSE-AP and what are the functional requirements of these ROSE-AP.

- Feel free to use as many rows as you need to complete this section
- Delete this highlighted text

Label	Description of the Requirement	System/Services/Connectors Involved
Req-1		
Req-2		
...		

7. NGSI Connectors Requirements

Provide the set of NGSI interoperability requirements and specify the type of connector that will support this interoperability for either CPS Systems or Smart Data Services.
Connector types:

- **ROSE-AP: Samart CPS or IT Agent**
- Basic Instance of an existing **FIWARE Agent** (e.g., FIROS, OPC-UA, IoT Agent, ...) or
- Basic **Ad/hoc NGSI Connector**.

- Feel free to use as many rows/slides as you need to complete this Section 3.1
- Delete this highlighted text

Label	Description of the Requirement	Connector Type
NGSIC-1		
NGSIC-2		
...		

8. Other Connectors Requirements

Provide the set of interoperability requirements for those IT Systems, ERP/SCADA/MES systems, control devices, cyber-physical systems and/or services that are required for specific experiment purposes but **will not interoperate with the NGSI ORION Context broker**.
Specify the type of connector/interface that will support this interoperability.

Label	Description of the Requirement	Connector Type
OC-1		
OC-2		
...		

9. NGSI Smart Factory Services to be developed/deployed

Here provide a list of the main **services that your ROSE-AP of Type Smart Solution will deliver** to the manufacturing context **through the *interaction with / processing of* the NGSI ORION Context Broker Data**.

- Feel free to use as many rows as you need to complete this section
- Delete this highlighted text

Label	Name and Description of the Service	Service Provider / Consumer
NGSIS-1		
NGSIS-2		
…		

10. Other Factory Services to be developed/deployed

Here provide a list of **other ervices that your architecture will deliver** to the manufacturing context, **service integration with the NGSI ORION Context Broker WILL NOT EXIST**.

- Feel free to use as many rows as you need to complete this section
- Delete this highlighted text

Label	Name and Description of the Service	Service Provider / Consumer
ODS-1		
ODS-2		
...		

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