PAVING THE WAY FOR A DATA-DRIVEN INDUSTRY DIGITALISATION

FIWARE

>>> DATA IS DRIVING INDUSTRIE 4.0

In a **Smart Factory**, machines, smart sensors and robotic platforms on the shop floor generate data for monitoring, maintenance, and basic management of the production line. However, much of this data remains in information silos within the factory. A higher integration of context data from many different data sources can improve efficiency and speed up production processes.

Smart Factories can better exploit data from customers, suppliers, and partners nearby or around the globe. Non-manufacturing context data (e.g. from fleets, traffic and weather during product delivery) can be used to optimize inbound and outbound processes.

The trustworthy data exchange across systems and organizations, together with the definition of open standard APIs and information models enabling portability and interoperability of applications, become key drivers of **Industrie 4.0** and its evolution.

FIWARE, the open source software of choice for building smart solutions, is working on reference architectures and information models to help manufacturing companies in their digital transformation.

❯ ❯ ❯ FIWARE AN OPEN SOURCE TECHNOLOGY AND ECOSYSTEM

❯ **Driving standards and breaking up information silos**. All interactions with the FIWARE Context Broker occur through the FIWARE NGSI API, a public and royalty-free API for managing context information at scale. NGSI has been adopted as the de-facto standard for context management by the relevant organisations.

❯ **Simplifying IoT Data Management**. FIWARE allows developers to merge IoT data with data from other relevant sources through a well defined RESTful API - a simple task for any web developer, reducing both the time and cost of development for smart solutions.

❯ **Transforming Big Data into knowledge**. Data Analytics and Artificial Intelligence are used for process support and automation.

❯ **Enabling the Data Economy**. Your data is an asset. FIWARE transforms this asset into value.

❯ **Unleashing the potential of right-time Open Data**. Current real-time data from the world around you and persistent historic data are both made available via the FIWARE Context Broker and the FIWARE NGSI API**.**

❯ **Ensuring Data Sovereignty**. FIWARE enables you to define appropriate levels of access to your data based on Industrial Data Space concepts - you decide what others are allowed to do with your data and when.

❯ ❯ ❯ FIWARE FOR INDUSTRY: SMART INDUSTRY APPLICATIONS

❯ Building a smart manufacturing platform, based on standards and other open source components, that supports real-time, high-value applications for manufacturers to optimize production systems and value chains.

❯ Creating a reference architecture, compliant with existing industry architectures such as the **Reference Architecture Model Industrie 4.0, the Industrial Data Space Reference Architecture** or **the Industrial Internet Consortium Reference Architecture** which are capable of transforming the industrial sector into a networked, data-driven environment.

❯ Breaking the information silos and unleashing the potential of context data from the Internet of Things and different systems, which can be exploited together using Big Data and Artificial Intelligence services on the Cloud to achieve higher degrees of efficiency and automation.

❯ Using a **data-driven** approach through the decoupling of industrial processes while warranting sovereignty on a strategic asset: data.
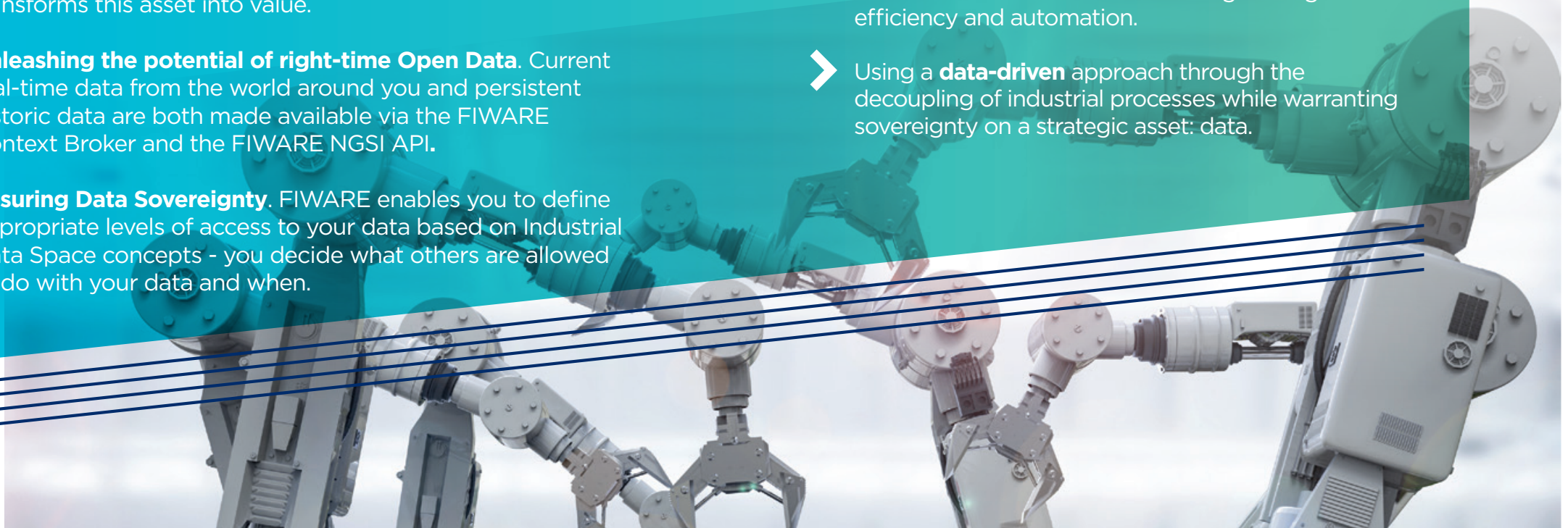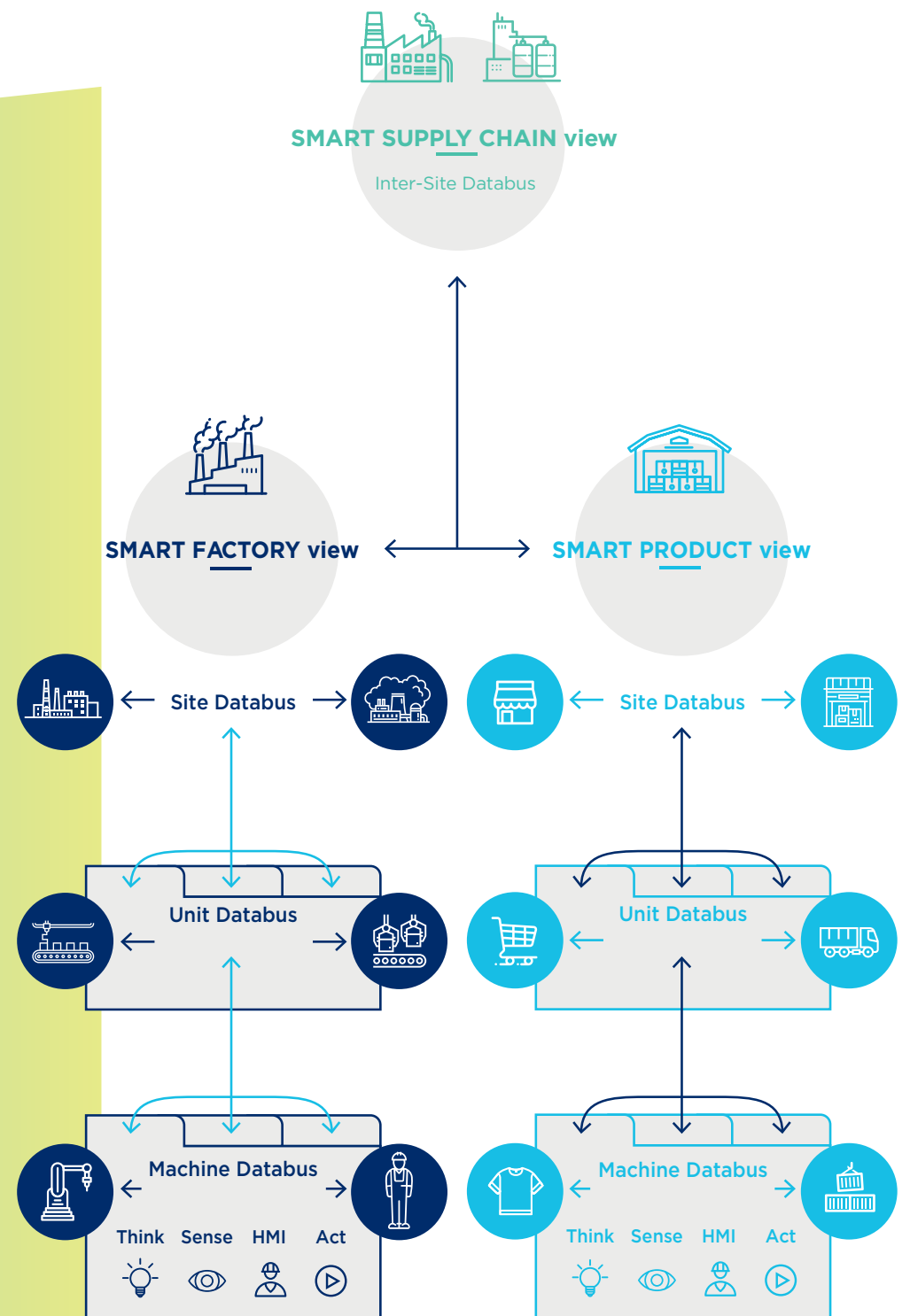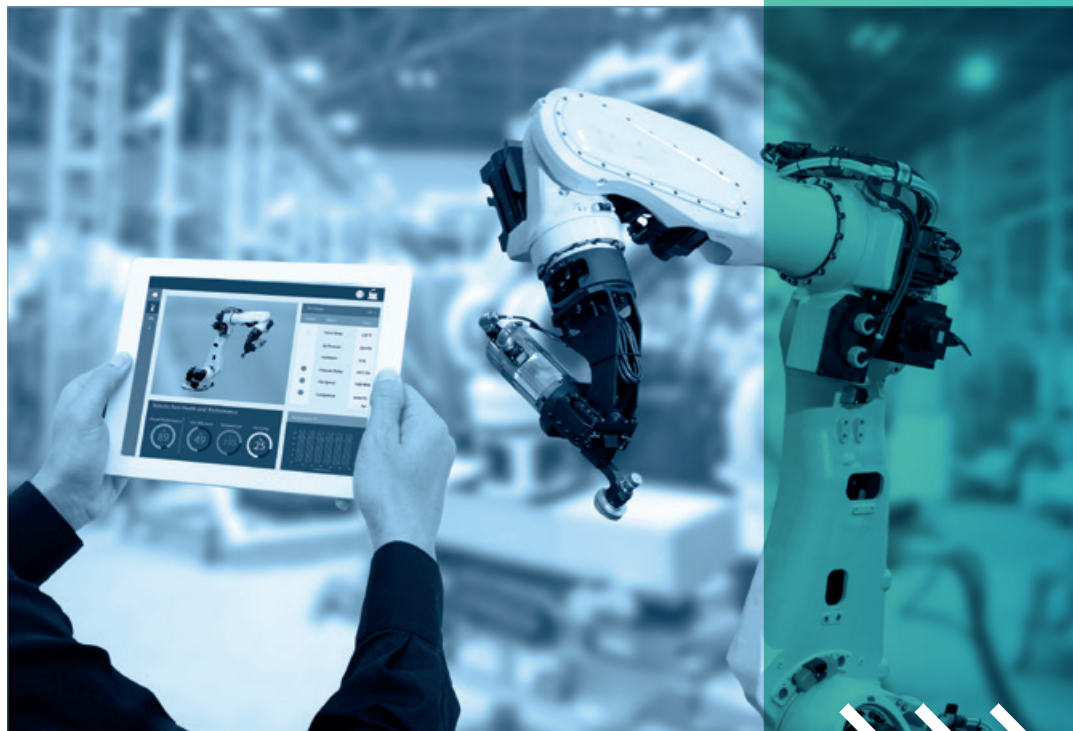
› › › A REFERENCE ARCHITECTURE FOR INDUSTRIE 4.0

The data-driven implementation of the Industrial Internet Reference Architecture (IIRA) uses four data bus layers where data exchange and sharing processes are taking place and where FIWARE technology can be used in key scenarios:

› A Machine Data Bus is the real world data exchange, active on the factory shop floor, in the operations of a product or in transportation and logistics.

› A Unit Data Bus uses dedicated edge/fog data gateways as a bridge between real and digital worlds. Here, a cloud-edge programming system can process the data stream through a series of distributed components, using the **FIWARE NGSI** API to harmonize access to data published using many different data formats.

› A Site Data Bus implements the data exchange in a single administrative domain, be it a company, an IT department, a plant or a fleet of vehicles. This would make use of **FIWARE Context Broker** technology for managing the entire lifecycle of context information including updates, queries, registrations, and subscriptions.

› An Inter-site Data Bus materializes B2B data exchange and sharing of data between business processes distributed across at least two different administrative domains. **FIWARE Context Broker** technology can also be used for this purpose.

SMART SUPPLY CHAIN view

Inter-Site Databus

SMART FACTORY view

SMART PRODUCT view

Site Databus

Unit Databus

Machine Databus

Think Sense HMI Act

>>> FIWARE AND INTERNATIONAL DATA SPACES: A SHARED VISION

The Industrial Data Space (IDS) addresses a key topic in the evolution of Industrie 4.0: how companies and institutions can build a space where data is shared in a decentralised manner so that each organization can use available data to improve their processes as well as govern and monetize data exported to third parties.

For this, International Data Spaces Association (IDSA) is creating a reference architecture to implement secure and trustworthy data exchanges where data providers keep control over the use of their data ("data sovereignty"). It also addresses interoperability with many different data types used in global supply chains.

FIWARE and IDSA are working together on the first open source implementation of the IDS Reference Architecture. Its main component is the IDS Connector which, based on the **FIWARE Context Broker** and other complementary FIWARE technologies, manages all aspects related to the publication of and the access to data.

Both the IDS and FIWARE platforms are listed as promising digital industrial platforms build on European strength in a recent report published by the European Union on the progress of the Digitising European Industry (DEI) initiative.

› › › IDS Connector implementation using FIWARE
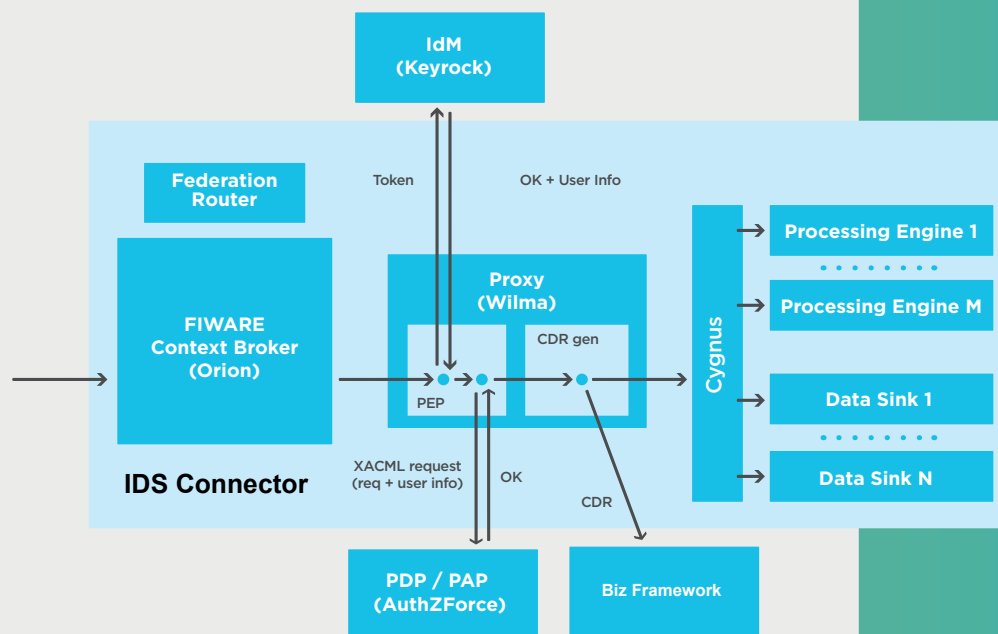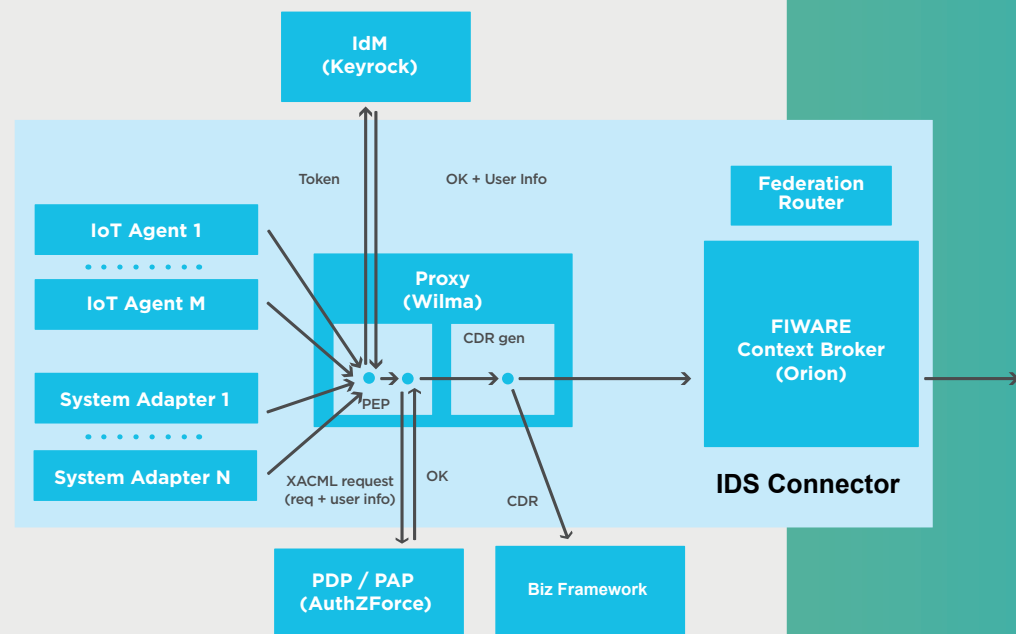
The core communication component of an IDS Connector implemented using FIWARE is the FIWARE Context Broker component (Orion).
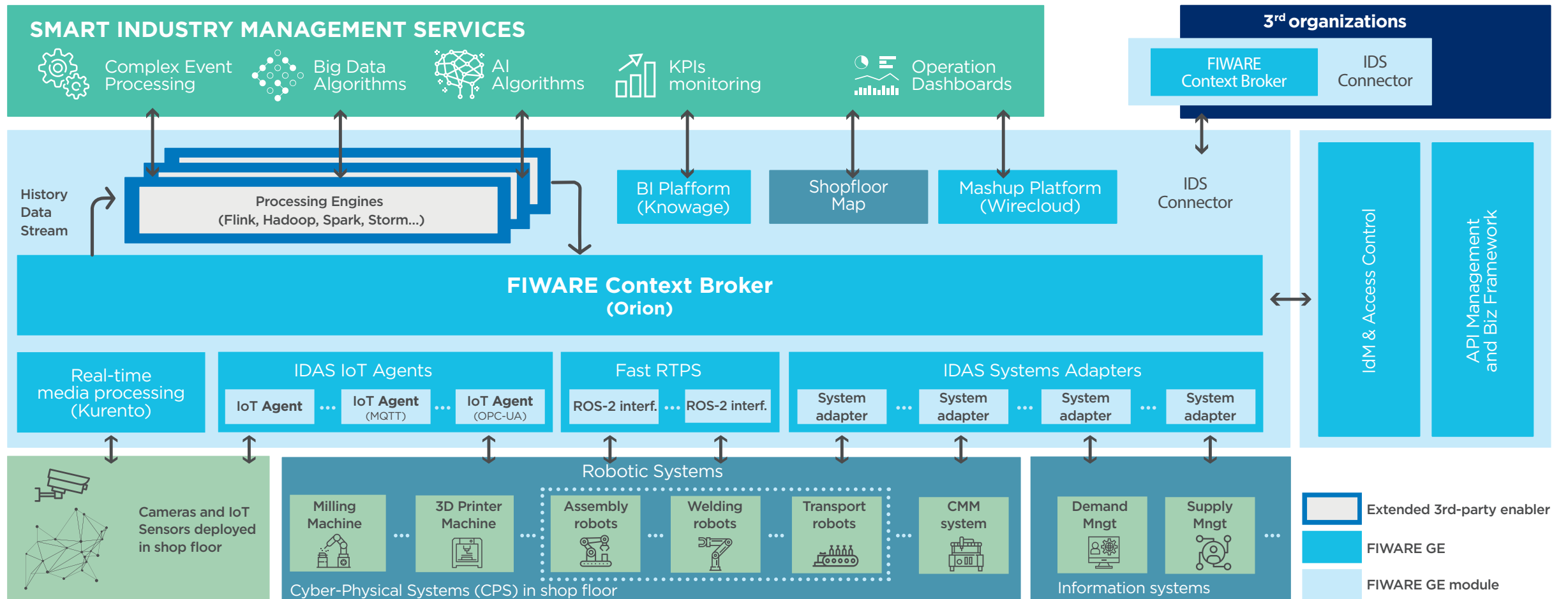
Orion Context Broker comes together with components enabling:

› enforcement of data usage control policies: Wilma (PEP)

› federation with Context Brokers associated to remote IDS Connectors

› accounting of interactions (requests, notifications): Wilma (CDR gen)

› connection with alternative processing engines or data sinks: Cygnus

Tools enable the automated deployment of data system adapters or data processing engines and configure connections to preserve defined policies.

Authorization and Access Control components adhere to widely accepted open standards (XACML: PEP + PDP/PAP) while automated deployment tools rely on latest developments with Docker or Kubernetes.

Diagram (top)

IdM (Keyrock)

Token — OK + User Info

IoT Agent 1
· · · · · · ·
IoT Agent M

System Adapter 1
· · · · · · ·
System Adapter N

Proxy (Wilma)
PEP
CDR gen

Federation Router

FIWARE Context Broker (Orion)

IDS Connector

XACML request (req + user info) — OK — CDR

PDP / PAP (AuthZForce)

Biz Framework

Diagram (bottom)

IdM (Keyrock)

Token — OK + User Info

Federation Router

FIWARE Context Broker (Orion)

IDS Connector

Proxy (Wilma)
PEP
CDR gen

Cygnus

Processing Engine 1
· · · · · · ·
Processing Engine M

Data Sink 1
· · · · · · ·
Data Sink N

XACML request (req + user info) — OK — CDR

PDP / PAP (AuthZForce)

Biz Framework

>>> REFERENCE ARCHITECTURE OF SMART INDUSTRY SOLUTIONS POWERED BY FIWARE

SMART INDUSTRY MANAGEMENT SERVICES

- Complex Event Processing
- Big Data Algorithms
- AI Algorithms
- KPIs monitoring
- Operation Dashboards

3rd organizations
- FIWARE Context Broker
- IDS Connector

History Data Stream

Processing Engines (Flink, Hadoop, Spark, Storm…)

BI Plafform (Knowage)

Shopfloor Map

Mashup Platform (Wirecloud)

IDS Connector

FIWARE Context Broker (Orion)

IdM & Access Control

API Management and Biz Framework

Real-time media processing (Kurento)

IDAS IoT Agents
- IoT Agent
- … IoT Agent (MQTT)
- … IoT Agent (OPC-UA)

Fast RTPS
- ROS-2 interf.
- … ROS-2 interf.

IDAS Systems Adapters
- System adapter
- … System adapter
- … System adapter
- … System adapter

Cameras and IoT Sensors deployed in shop floor

Robotic Systems
- Milling Machine
- … 3D Printer Machine
- … Assembly robots
- … Welding robots
- … Transport robots
- … CMM system

Cyber-Physical Systems (CPS) in shop floor

Information systems
- Demand Mngt
- Supply Mngt
- …

Legend:
- Extended 3rd-party enabler
- FIWARE GE
- FIWARE GE module

- Orion integrates information from robots, other machines and sensors in the shop floor as well as information systems, breaking information silos.

- IDAS IoT Agents connect to sensors, handling multiple IoT protocols (MQTT, CoAP/OMA-LWM2M, OneM2M,…). OPC-UA IoT Agents bring alignment with RAMI 4.0.

- Kurento transforms media streams from cameras into valuable context information.

- ROS-2 robots are interfaced using Fast RTPS, adopted as default communication middleware in ROS-2.

- Tailor-made system adapters cope with rest of shop floor machines and information systems.

- History data is processed using different processing engines (e.g., Hadoop or Flink) to extract insights or derive smart actions. Complex Event Processing, Advanced AI or machine learning functions can be implemented on top of Apache Flink.

- Operational dashboards are based on the Wirecloud web mashup framework.

- Knowage enables KPIs monitoring, Reporting and BI functions.

❯❯❯ USE CASE
Zero Defect Manufacturing

❯❯❯ Paving the way for the future data-driven industrial digitalization

The Swiss mechanical engineering company **Georg Fischer AG** and the **Innovalia Group** show how the maintenance of Milling and Coordinate Measuring Machines (CMMs) can be improved by exchanging plant data.

Each of the two machines can improve operation and maintenance by using the data produced by the other machine. The data exchange happens via an IDS Connector, making use of the FIWARE Context Broker.

Both machines work synchronously and exploit data shared from each other for a better performance.

The factory can be sure that the data provided to the machine manufacturers is only used for defined purposes and is not shared with the competition. In turn, each machine manufacturer has certainty that only the licensed data is used by the other manufacturer for the agreed purposes.

INTERNATIONAL DATA SPACES ASSOCIATION

FIWARE
Open APIs for Open Minds

innovalia METROLOGY
Quality Control Cloud

Quality Control

FIWARE Context Broker

IDS CONNECTOR

+GF+
Predictive Maintenance System Milling Machine

Big Data Analysis

FIWARE Context Broker

IDS CONNECTOR

IDS CONNECTOR

FIWARE Context Broker

+GF+ Milling machine

Innovalia Coordinate-measuring machine

+GF+

Innovalia

System Adapters
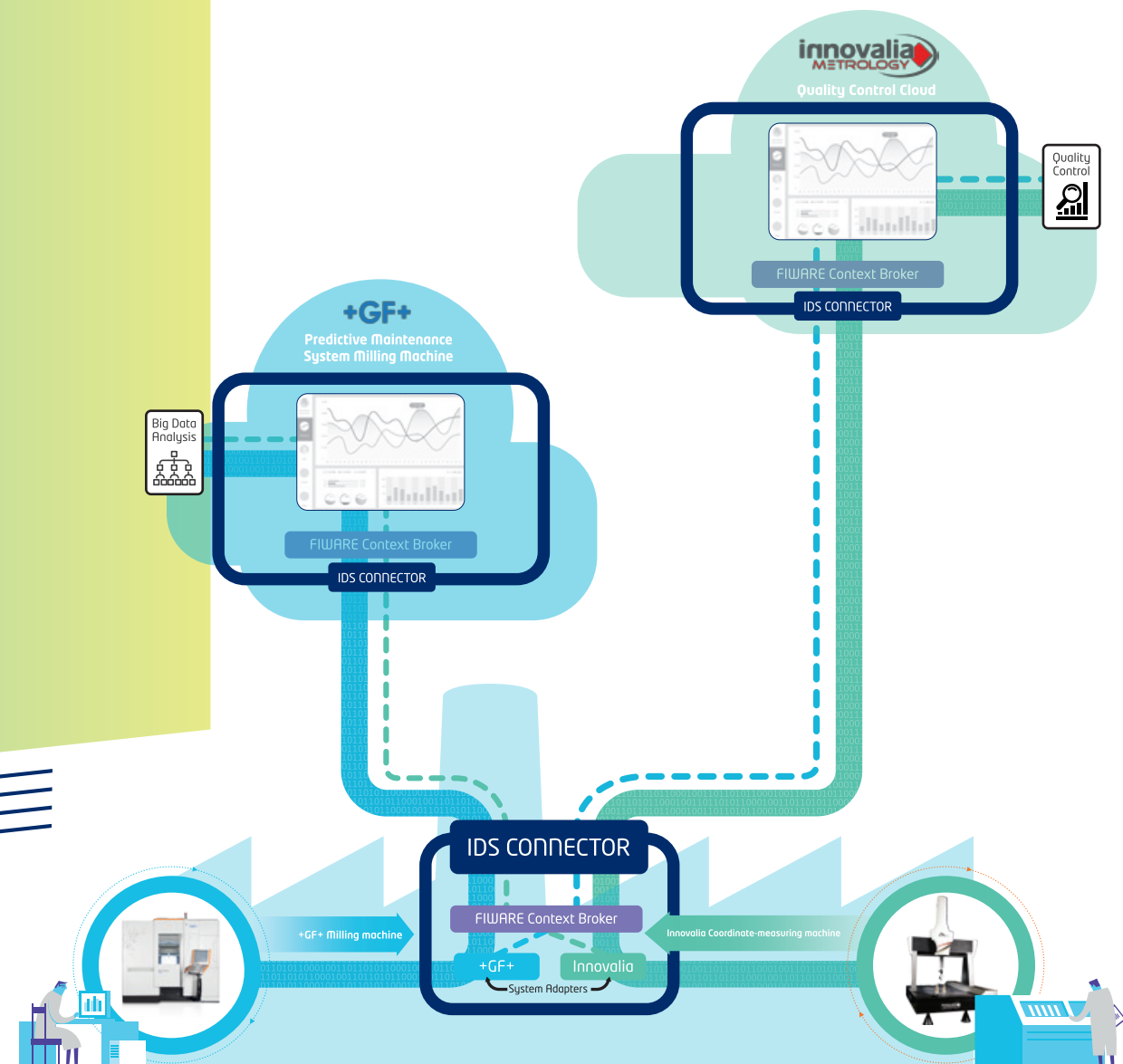
› › › USE CASE
Predictive Maintenance of Fleets

The core of this application is a platform developed by **Stratio Automotive** for the predictive maintenance of commercial vehicles.

By installing the Stratio Plug IoT device in buses or trucks, various variables from the vehicles are monitored and the predictive maintenance and availability of vehicle fleets is improved.

The Stratio system can use real-time traffic or environmental data published by smart cities to improve the algorithms used for predictive maintenance. In turn, the data from vehicles acting as mobile sensors can be exploited by the smart city systems to improve certain processes (e.g., road maintenance based on measurements of road conditions).

Deployed on an IDS-compliant infrastructure implemented with FIWARE, these data exchanges are secure and information is only accessed for agreed purposes.

In addition, data from vehicles may be published on a data marketplace supported by the city so it can be monetized when used by third-party developers. Innovative multi-side business models are enabled by the City which transforms into a Platform for open innovation.

› › › A reference architecture and a common standard for Industrie 4.0
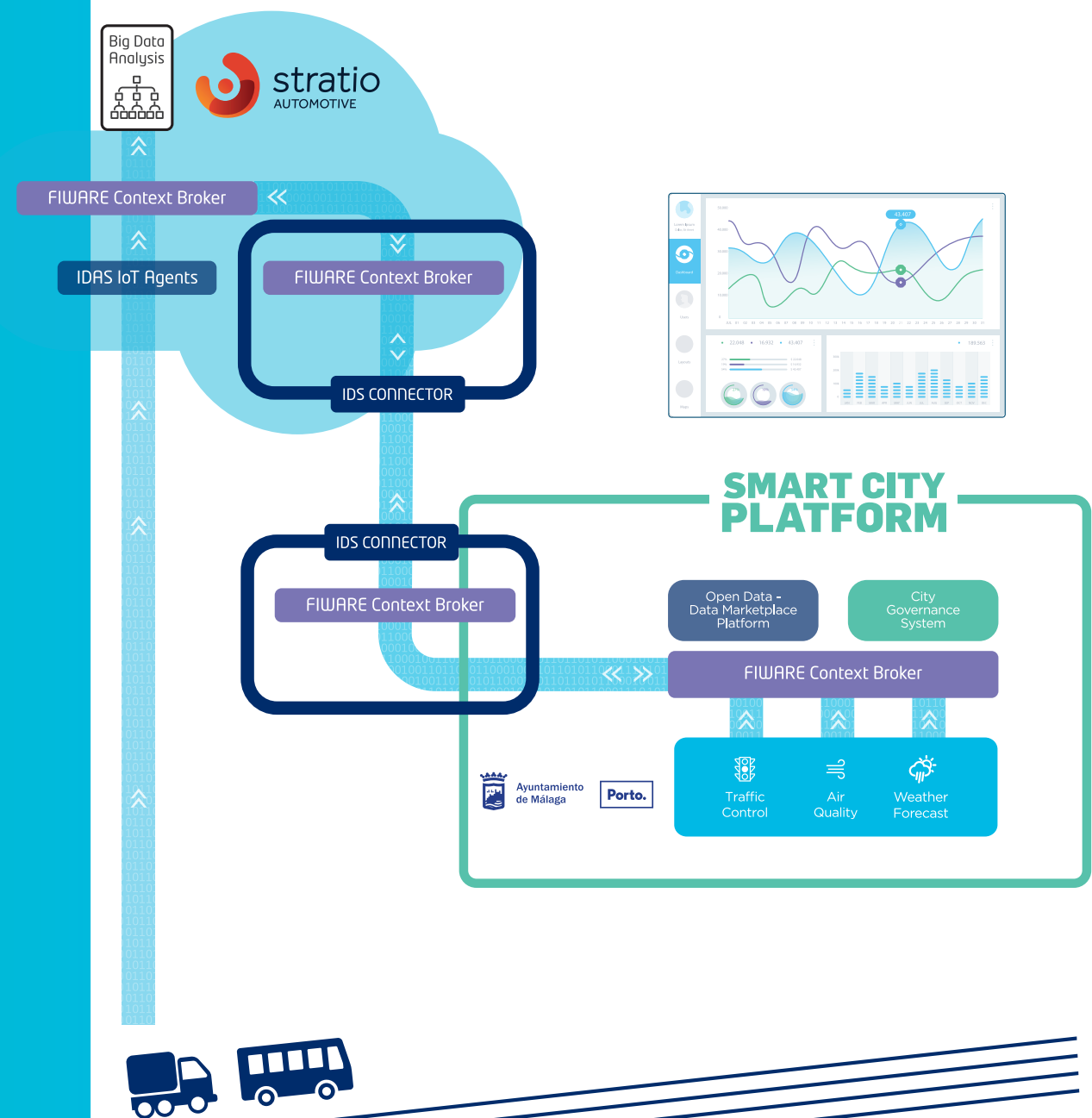
››› THE FIWARE OPC UA AGENT

The **FIWARE OPC UA** Agent is a flexible and configurable software component in the FIWARE architecture. It is able to exploit Industrial IoT Data in Motion streams coming from Smart Factories, together with other heterogeneous data sources from mobility, cities, the environment or meteorological data.

This software agent connects OPC UA servers with the **FIWARE Context Broker** using the **FIWARE NGSI** standard API. This way. It enables the development of advanced context-aware services and Artificial Intelligence applications such as Predictive Maintenance, Supply Chain Optimization, Advanced Production Planning and Scheduling or Distributed Plants Energy Management.

One application has been realized in a factory **Energy Management scenario** where real-time monitoring over several OPC sources has been integrated with IoT devices and factory legacy systems to support decision-making.

❯ ❯ ❯ THE
FIWARE
MARKETPLACE
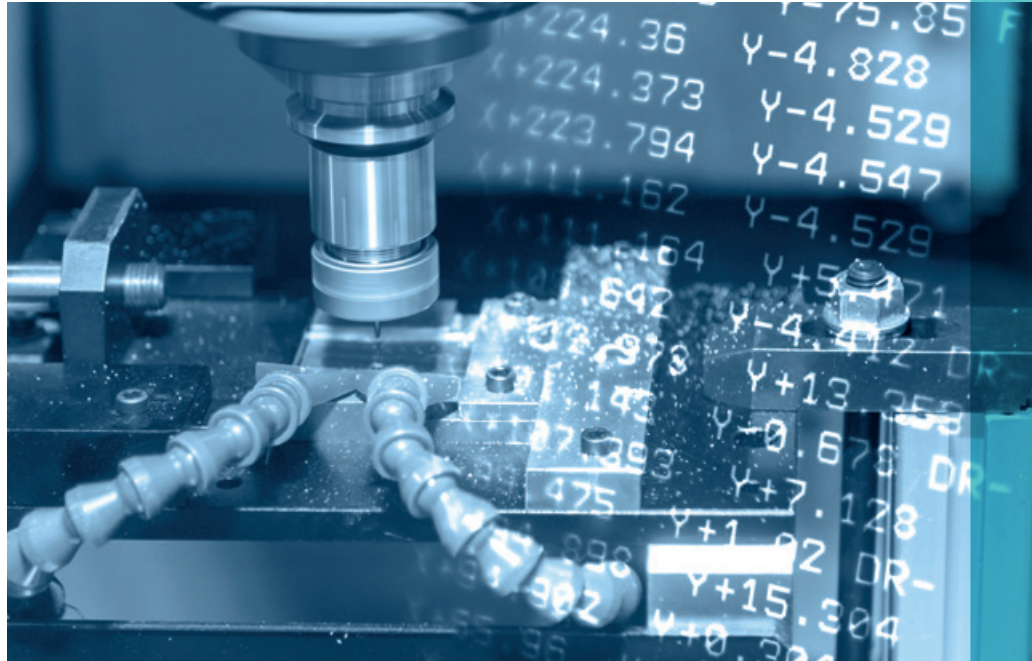
POWERED BY FIWARE

❯ **Smart Solutions** rely on FIWARE standards to manage context information at a large scale. They use the FIWARE technologies to gather and process context information coming from different and highly distributed sources.

❯ **FIWARE platform service providers** offer FIWARE as a Service on private and public clouds. Also, Platform Service Providers can deploy FIWARE platform instances on premises for their customers.

FIWARE-READY TECHNOLOGIES

❯ **FIWARE-ready IoT devices** come with easy-to-install drivers and instructions, accessible to end applications using the FIWARE NGSI standard.

❯ **FIWARE-ready software enablers** are base platform technologies, which can easily be integrated with FIWARE. This extends the basic capabilities of the platform with advanced added-value features

Check out: marketplace.fiware.org/join

The Marketplace is a global one-stop shop that gives access to a wide range of **Powered by FIWARE solutions and platforms**, **FIWARE-ready technologies**, as well as related training, coaching, consultancy, integration and services.

The Marketplace offers everyone in the **FIWARE Community** the platform to get more visible in front of their target customers or potential investors and partners.

FIWARE SERVICES

Online training material is available on the FIWARE Academy but many partners are offering tailored **training and coaching services**.

Finding the right experts offering **consultancy, integration or technical support services** is crucial in many projects. The FIWARE marketplace is helping to serve this need.

> The European Commission, under its **Connecting Europe Facility (CEF)** program, recently announced the adoption of FIWARE Context Broker technology as a CEF Building Block. The CEF program supports the development of digital infrastructures enabling a European Digital Single Market.

> **GSMA** has produced a Reference Architecture for IoT-enabled Big Data Ecosystem solutions where the FIWARE NGSI API is recommended.

> **ETSI** has launched an ISG (Industry Specifications Group) on cross-cutting Context Information Management (CIM) standards which identify OMA NGSI and FIWARE NGSI as starting points for the API specs.

> **TM Forum** has also agreed to adopt FIWARE NGSI as the basis for providing right-time access to context information. Combined with FIWARE Data Marketplace components and Open TM Forum Business APIs, it can transform cities into enablers of the Data Economy.

> **OASC (Open and Agile Smart Cities)** comprises more than 110 cities in 24 countries which have decided to adopt FIWARE NGSI as the basic API for right-time access to contextual data in the cities.

❯ ❯ ❯ GLOBAL ORGANIZATIONS ADOPTING FIWARE

BECOME A MEMBER OF THE FIWARE FOUNDATION

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FIWARE - the open source platform for our smart digital future.

fiware.org

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