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PRZETWARZANIE DANYCH KONTEKSTOWYCH W CHMURZE PUBLICZNEJ ORAZ SYSTEMACH BRZEGOWYCH

Streszczenie. Wymiana i udostępnianie danych są podstawą rozwoju gospodarki opartej na danych. Jest ona niezbędna w automatyzacji procesów przemysłowych, a także w rozwiązaniach stosowanych w inteligentnych miastach, rolnictwie oraz inteligentnych domach. W niniejszym artykule przedstawiamy model przetwarzania danych kontekstowych, który może być wykorzystany w środowiskach Chmury Publicznej oraz na urządzeniach brzegowych, umożliwiając ustandaryzowaną komunikację między usługami, które tworzą inteligentne rozwiązania.

CONTEXT DATA PROCESSING IN PUBLIC CLOUD AND EDGE

Summary. Data sharing and exchange are the primary enablers of the data economy and process automation in industrial solutions, as well as in smart applications used in smart cities, smart agriculture, and smart home domains. In this paper, we present a context data processing model that can be hosted in Public Cloud and Edge environments, enabling seamless communication between the services that comprise smart solutions.

1. Industry 4.0 revolution

People have a natural tendency to order things and to number ages of development in all domains. In internet development they coined web 1.0, 2.0, and 3.0. In industry development we distinguish three revolutions, related to the invention of steam power (1.0), assembly line (2.0), and digitalization (3.0).

What is the forth? It is the era of interconnecting things (IIoT in particular), application of AI in manufacturing, and a couple more disruptive technologies which are also revolutionizing our daily life embedded in Smart Apps and AI assistants. The term Industry 4.0 was coined in Germany in 2011 and popularized by Klaus Schwab (World Economic Forum Founder and Executive Chairman). The 4th era technologies supporting the intelligent factory are:

- Robotics,
- Artificial Intelligence,
- Quantum Computing,
- Industrial Internet of Things,
- Decentralized decision making,

- 5G wireless technologies,
- Autonomous vehicles

In fact, it is a huge set of emerging technologies, not just one breakthrough technology. Moreover, the previous industry revolution period (3.0) overlaps with the 4.0 revolution age. As Industry 3.0 is seen as the Information age (focused on analysis), Industry 4.0 is the imagination age (focused on creativity).

2. FIWARE framework analysis

Let's deep dive into some technologies supporting smart plants, smart homes, smart cities [5], etc..

To enable all those breakthrough technologies to really make a difference, the fundamental need is the interconnection of devices and services, creating a real digital continuum, which breaks information silos. To make it reality we need standardized interfaces, APIs, for data exchange.

One of the possible solutions is FIWARE framework, an open source platform for building smart solutions. It can be used in Smart City, Industry, or Agri-food use cases. It defines a standard HTTP API, Context Broker, that allows an application, for example, to read the value of a temperature sensor placed on a street lamp just by calling the GET method on a particular endpoint, or with a simple PUT method to turn on watering on farmland.

Besides the core component, Context Broker, FIWARE foundation developed bunch of open source components called Generic Enablers [3] that support the development of smart solutions providing building blocks for all the required functions, like context management, data processing, analysis, visualization, authorization, etc.

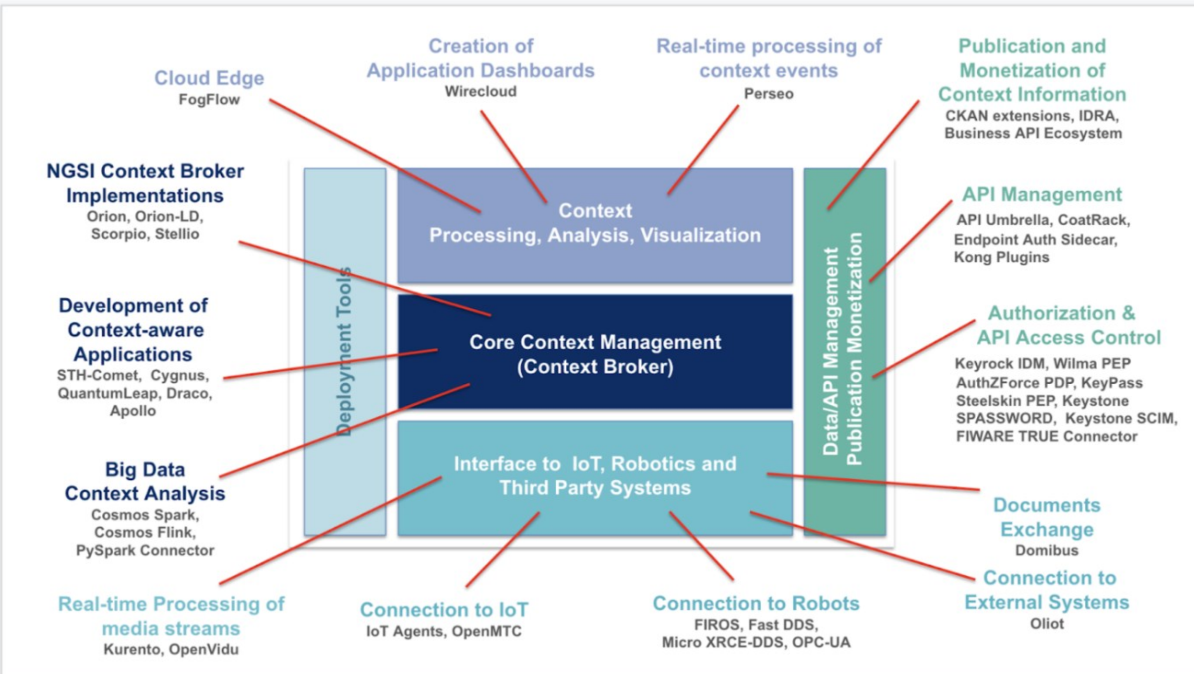

Fig. 1. Generic Enablers. Source: [FIWARE]

The Context Broker component [6] used for context data management implements ETSI standard NGSI-LD (Next Generation Service Interfaces Linked Data) that describes capabilities to provide, consume and subscribe to context information. This information model enables modeling of context information using attributes: properties and relationships of context entities ("digital twins"), representing real-world assets.

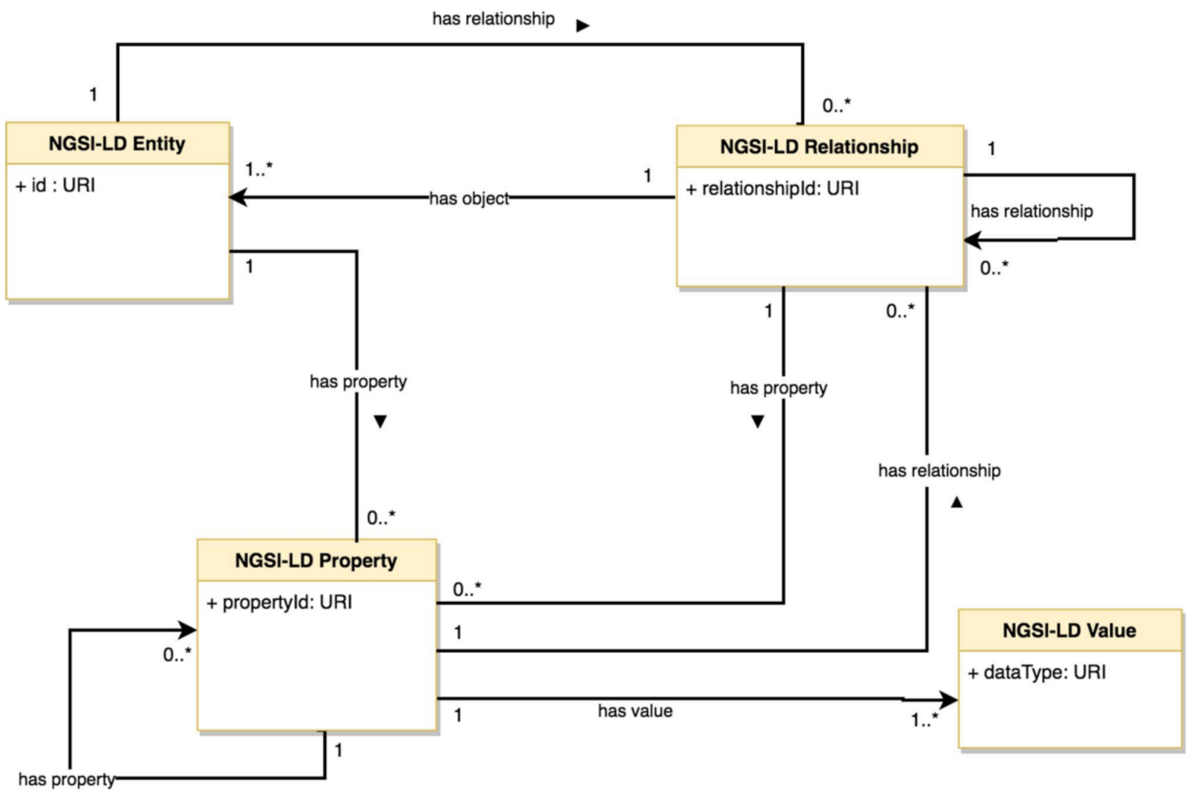

Fig. 2. Next Generation Service Interfaces Linked Data. Source: [ETSI]

Using inheritance the meta model can be extended by derived classes and corresponding domain models can be created that match different use cases. An example below depicts domain modeling consisting of four entities: “Parking”, “Street”, “Gate” and “Car”, which are connected with relationships and have properties (e.g. operation space, has opening, has state, reliability).

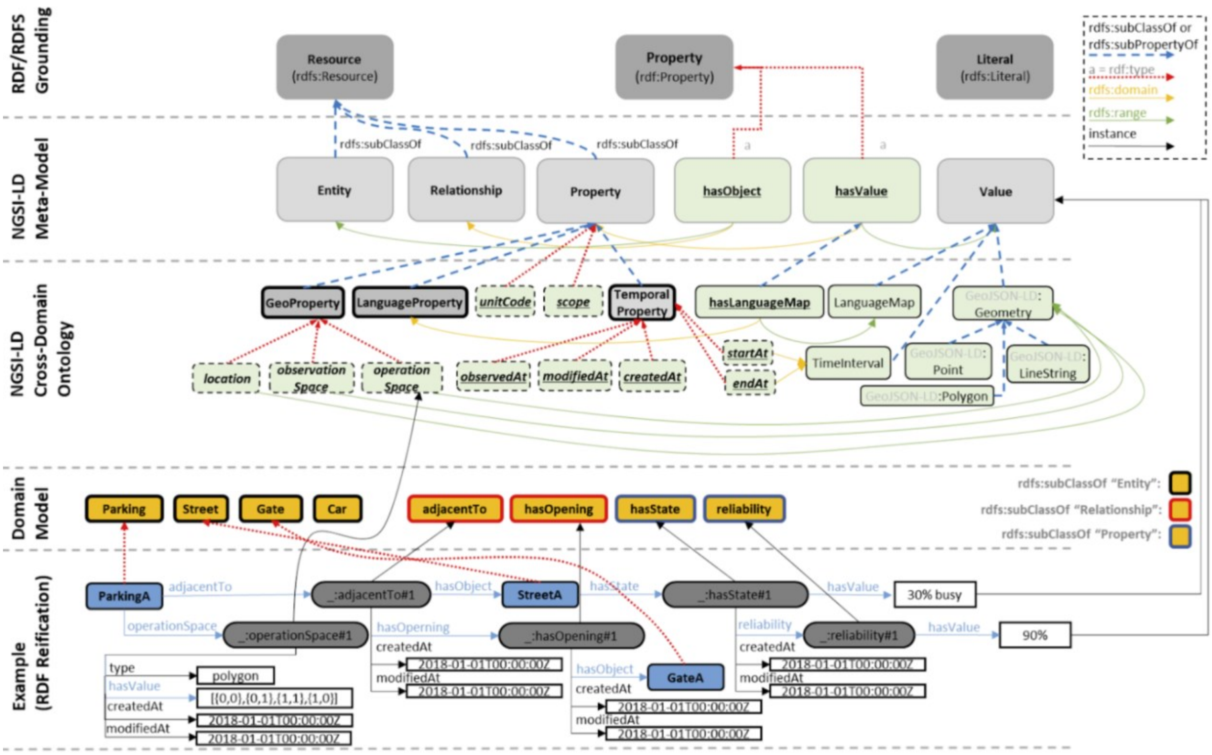

Fig. 3. Cross-Domain Ontology and instantiation. Source: [ETSI]

Using the above model we can represent example entities connected by relationships that reflects real world objects. In below example graph view a "Vehicle" entity ("urn:ngsi-id:Vehicle:A4567") parked by a "Person" on "Off Street Parking" monitored by a "Camera".

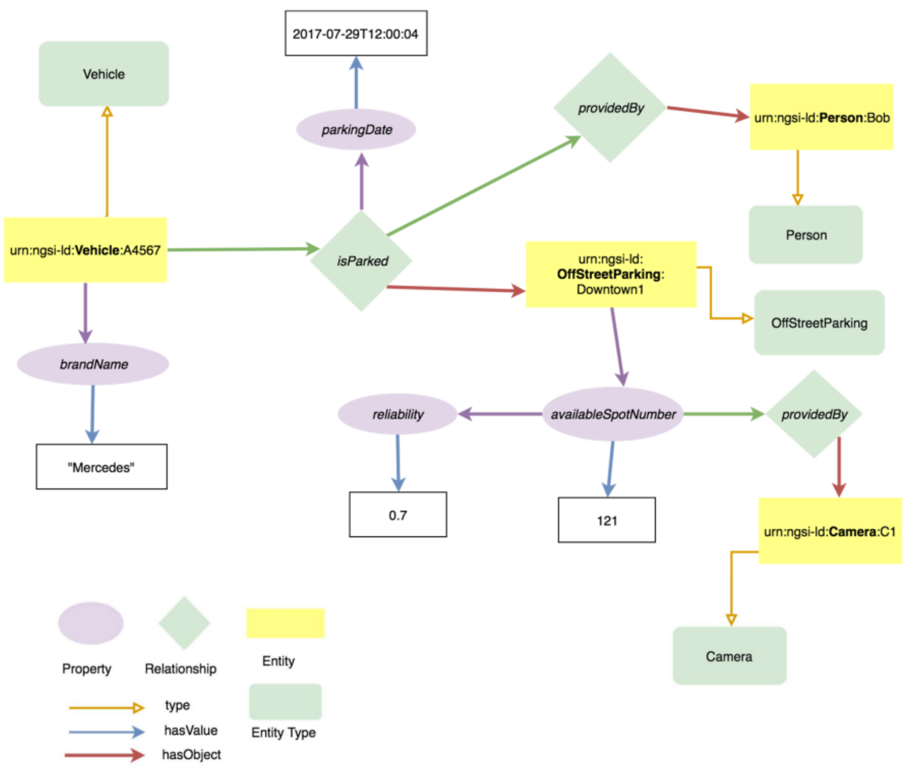

Fig. 4. Property graph example. Source: [ETSI]

Next required functionality is a query language. NGSI-LD information model also also meets this requirement by defining the syntax allowing query of a data. Let'a have a look in couple examples.
Below query is encoded as an HTTP query string:

"?type=Vehicle&q=speed>50;brandName!=Mercedes"

It returns entities that are vehicles of the Mercedes brand that exceed a speed of 50. The query language supports also geographic properties. Data consumer can, for example, limit the maximum distance of objects by using below syntax:

"georel=near;maxDistance==2000
geometry=Point
coordinates=[8,40]
geoproperty=observationSpace"

Finally, thanks to this virtual modeling the digital service can reflect physical objects in the Context Registry and easily access and modify its states from smart apps via the federated brokers (either central or distributed) that point to the right context source (e.g. IoT device). Because NGSI-LD is a standardized international model, it guarantees interoperability. Not surprisingly, it is also placed inside the IDS Connector component [7], described in International Data Spaces reference architecture model. Both reference architecture models, developed by FIWARE and IDSA, assume data usage control which provides data sovereignty for data providers and owners.

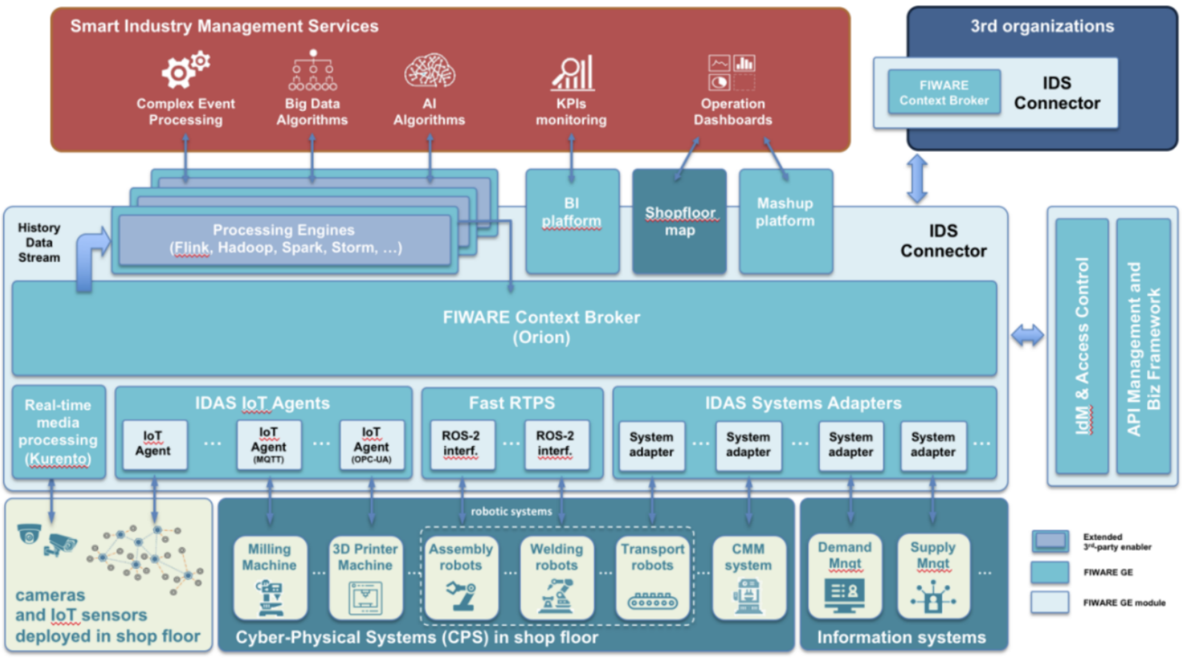

Fig. 5. FIWARE reference architecture. Source: [FIWARE]

3. Edge Computing

Adopting Edge Computing brings many benefits like: lower latency, lower data bandwidth required, higher data confidentiality and finally autonomy of processing.
But on the other hand we struggle with some challenges like: limited compute power, diverse infrastructure, heavy operation conditions (e.g. no air conditioning or shocks), limited scalability etc..

Depending on your use case you can decide to leverage general purpose public cloud extension services and K8s orchestrator to manage your Edge workloads or go into IoT specific frameworks and develop apps dedicated to run on Edge hardware.

One of the leaders in Edge Computing Solutions [2] is Eviden. Offerings includ full stack hardware and software, based on the BullSequana servers and Computer Vision Platform. One of the products that can be hosted both in the cloud or Edge environment is the Urban Data Platform (UDP) [1] which can host a number of Smart Services (e.g. smart city, smart agriculture, smart buildings and many others). The UDP platform is built on top of the FIWARE framework [4] described above which facilitates communication between IoT devices and can be used to enforce data sovereignty which is very important aspect of data exchange as well.

4. Conclusions

A number of international organizations are working on the standardization of data exchange and sharing, as well as implementing solutions, both commercial and open-source. The solution we propose the FIWARE Context Broker – which is part of curated framework of open-source platform components designed to accelerate the development of smart solutions - is utilized in hundreds of use cases across the domains of industry, agrifood, cities and many others. Context Information Management Framework - NGSI API, a standardized API allows data to be read or modified, on IoT devices like sensors and other endpoints using standard HTTP methods. This enables application developers to focus on higher-level application logic, abstracting the communication layer by reusing standard software components. This concept allows smart solutions to communicate seamlessly via a standard API using a shared data space. This approach seems to define a solid foundation for the development of sustainable smart applications across many industries.

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