Arquitetura de alta disponibilidade e escalabilidade para o processamento de dados de contexto baseadas no FIWARE

Outubro, 2023

Escola Politécnica da USP

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PCS3888 - Aspectos Gerenciais e Estratégicos em Internet das Coisas

Prof. Dr. Carlos Eduardo Cugnasca
Prof. Dr. Moacyr Martucci Jr.
Prof. Dr. Sergio Takeo Kofuji

Universidade de São Paulo
AVEIRO TECH CITY living lab
AVEIRO CÂMARA MUNICIPAL
30 YEARS instituto de telecomunicações
universidade de aveiro
FIWARE

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Formação Acadêmica

Pós-doutorado
Universidade de Aveiro (UA) - Portugal
2023 - em andamento

Doutorado em Engenharia Elétrica
Escola Politécnica da Universidade de São Paulo - USP / UFRN / UA
2015 - 2022

Mestrado em Engenharia Elétrica
Escola Politécnica da Universidade de São Paulo - USP
2004 - 2006

Bacharelado em Pedagogia
Universidade do Sul de Santa Catarina - UNISUL
2009 - 2012

Licenciatura em Computação
Centro Universitário Belas Artes de São Paulo - Belas Artes
2003 - 2004

Tecnologia em Materiais, Processos e Componentes Eletrônicos
Faculdade de Tecnologia de São Paulo - FATEC São Paulo
1995 - 1998

Atuação Profissional

FACULDADE ENGENHEIRO SALVADOR ARENA — 2007

Fatec São Caetano do Sul Antonio Russo — 2012

alura FIAP — 2014

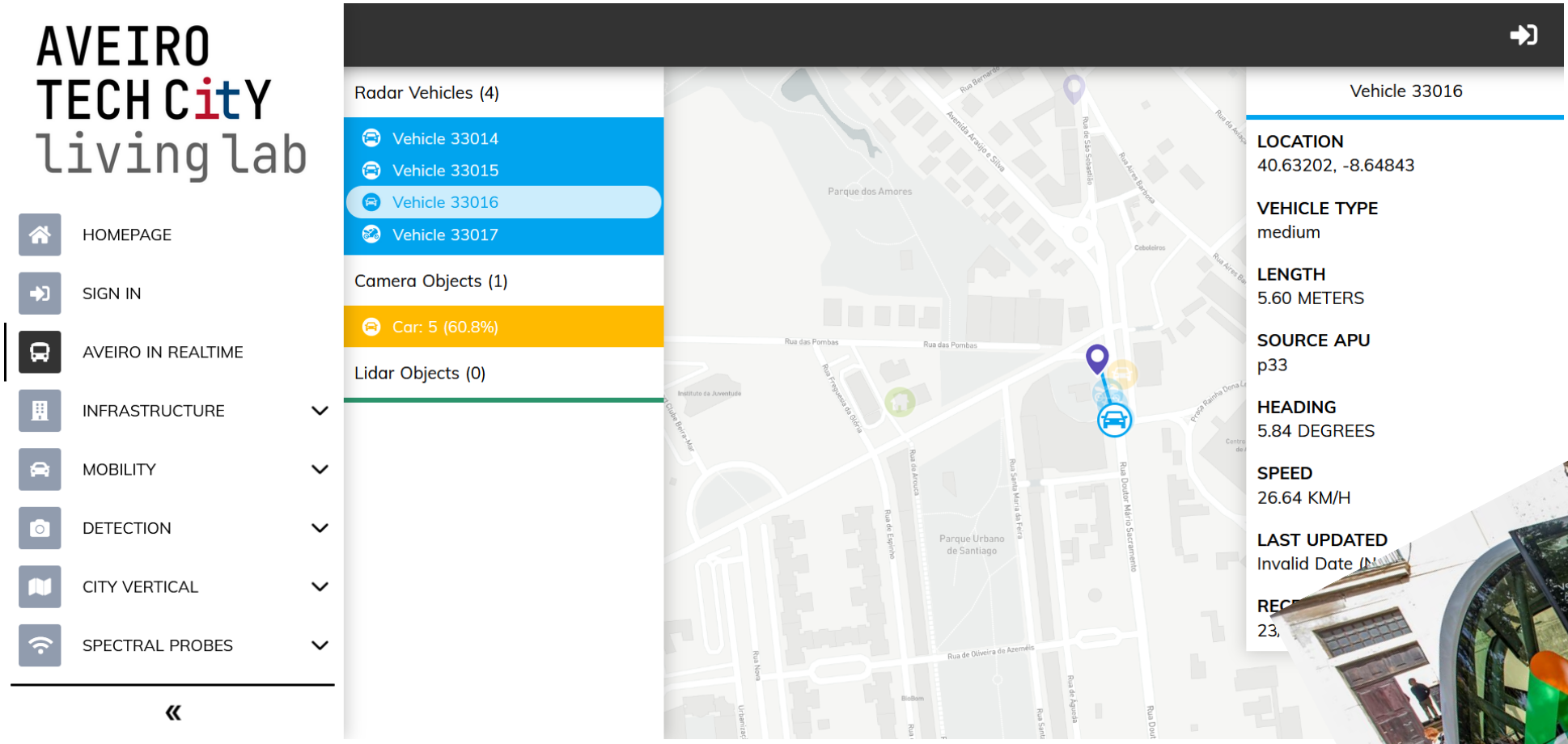
INEP — 2011

USP UNIVERSIDADE DE SÃO PAULO — 2018

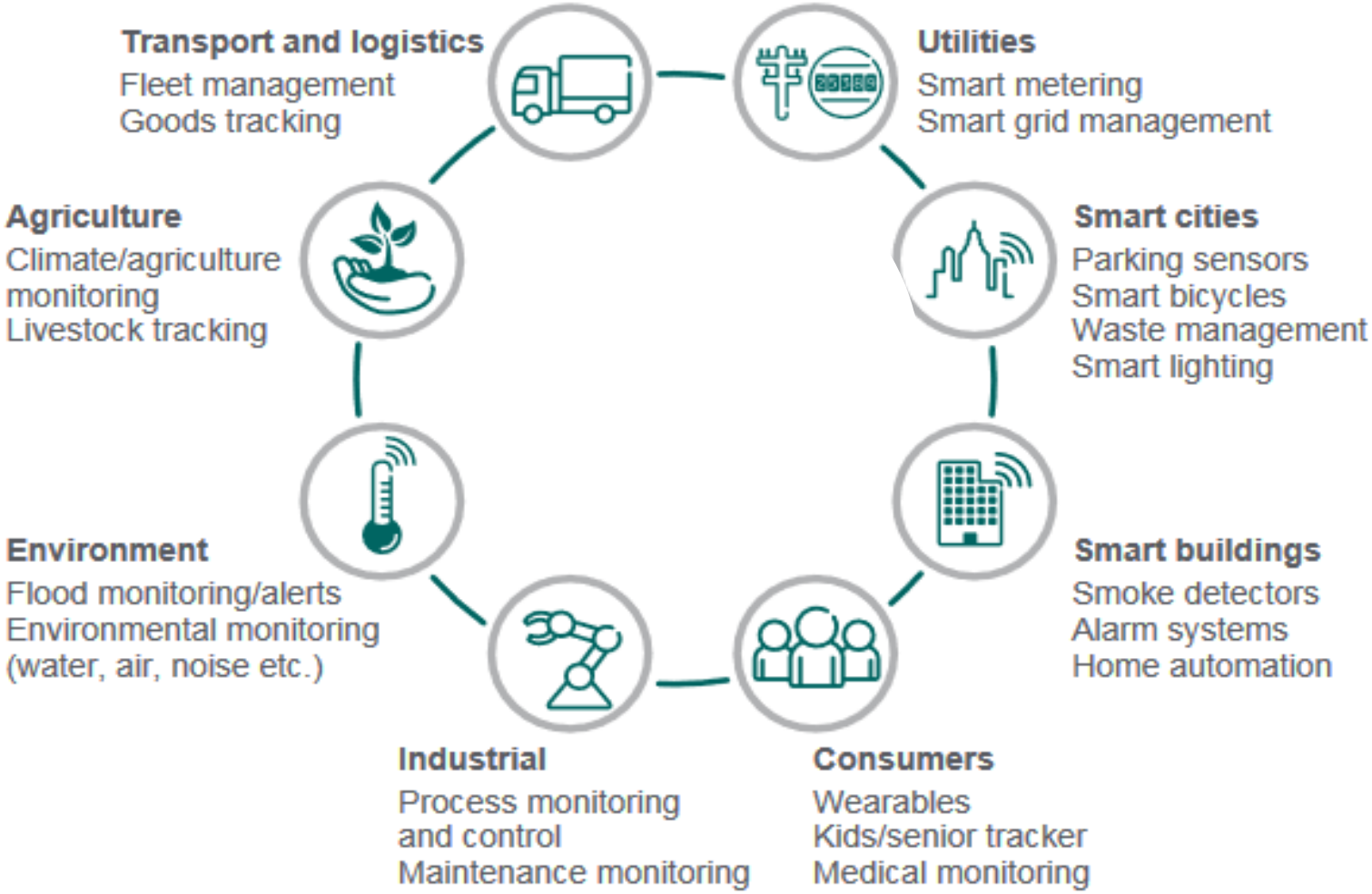
FIWARE FOUNDATION — 2018

Tema: Arquitetura de alta disponibilidade e escalabilidade para o processamento de dados de contexto baseadas na estrutura FIWARE

Estudo de Caso: ATCLL (Aveiro Tech City Living Lab)



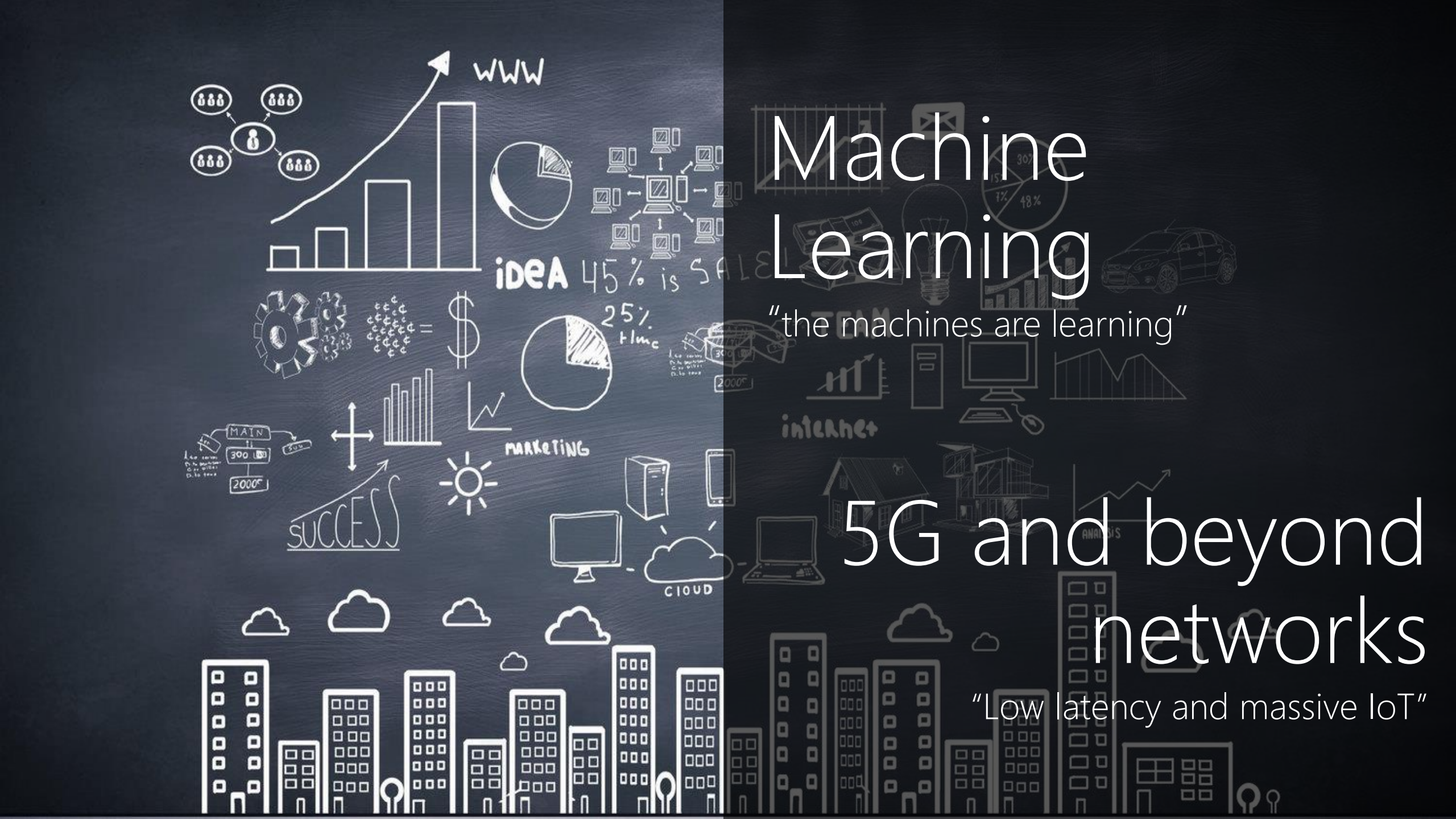
Ambientes Inteligentes



Source: Ericsson White Paper Uen 284 23-3278 - 2016

Smart Environments

enabling technologies

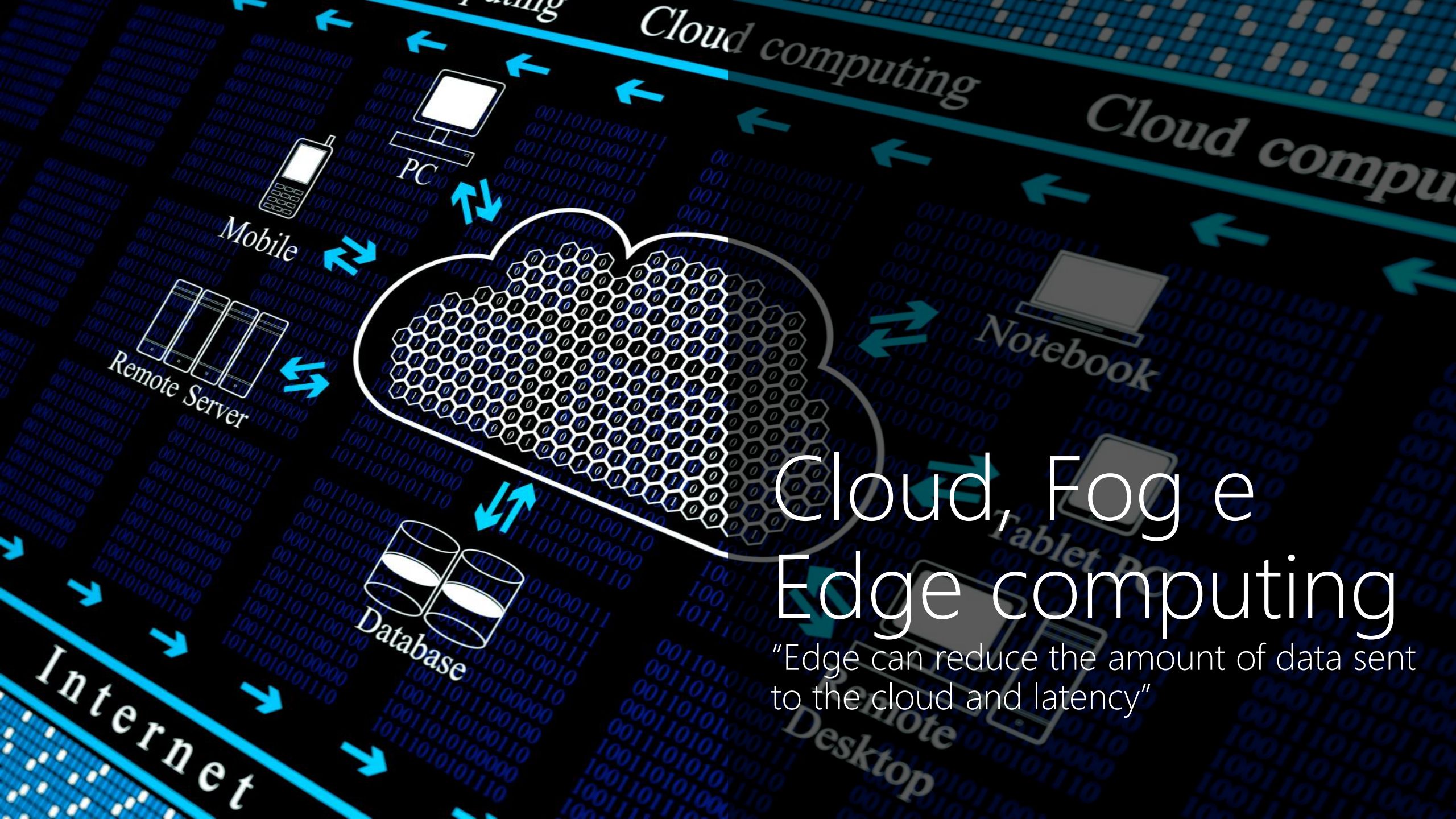


Machine Learning

"the machines are learning"

5G and beyond networks

"Low latency and massive IoT"



Cloud, Fog e Edge computing

"Edge can reduce the amount of data sent to the cloud and latency"

Internet of Things

"Everything is connecting to the Internet!"

Cidades inteligentes podem ser compreendidas como um ambiente físico no qual as tecnologias de comunicação e informação desaparecem à medida que são incorporadas em objetos e ambientes físicos.

STEVENTON, Alan; WRIGHT, Steve. **Intelligent spaces: The application of pervasive ICT**. Springer Science & Business Media, 2010.

AVEIRO TECH CitY living lab

- HOMEPAGE
- SIGN IN
- AVEIRO IN REALTIME
- INFRASTRUCTURE
- MOBILITY
- DETECTION
- CITY VERTICAL
- SPECTRAL PROBES

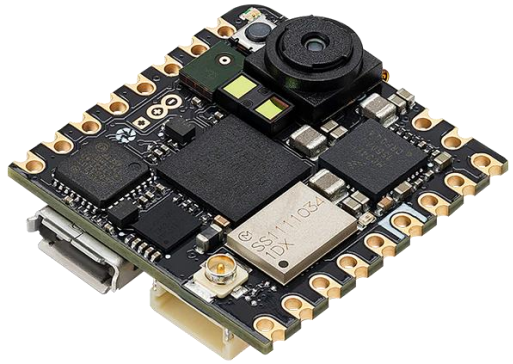
The technological lab (Aveiro Tech City Living Lab) is an advanced large scale infrastructure, spanned all over the city of Aveiro, at the service of researchers, digital industries, start-ups, scaleups, R&D centres, entrepreneurs and other stakeholders interested in developing, testing or demonstrating concepts, products or services. This infrastructure integrates people, through their mobile phones, sensors and vehicles, such as automobiles, bicycles in the city and "moliceiros" in the Aveiro Lagoon, aerial and aquatic drones.

A Internet das Coisas (IoT) pode ser compreendida como um conjunto de tecnologias de comunicação, processamento e armazenamento em grande escala capazes de interconectar dispositivos e objetos à Internet, os quais, por meio de transdutores e atuadores, adquirem a capacidade de integrar o mundo físico e virtual.

*R. Khan, S. U. Khan, R. Zaheer, and S. Khan, "**Future internet: the internet of things architecture, possible applications and key challenges**", in Frontiers of Information Technology (FIT), 2012 10th International Conference on. IEEE, 2012, pp. 257–260.*

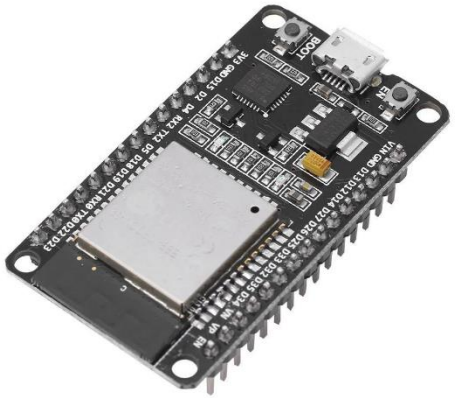
Hardware para prototipação em IoT

Single Board - Rasp 4



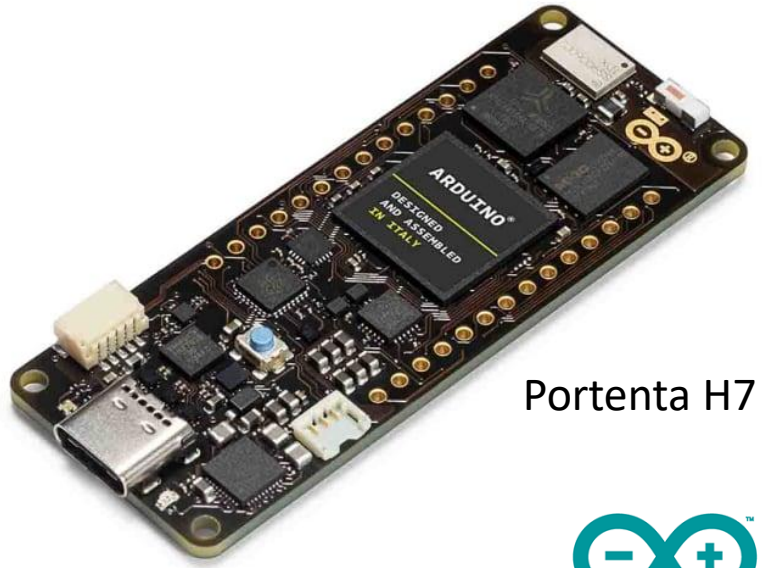
Nicla

OPTA



ESP 32

Arduino Uno R4 Wi-Fi

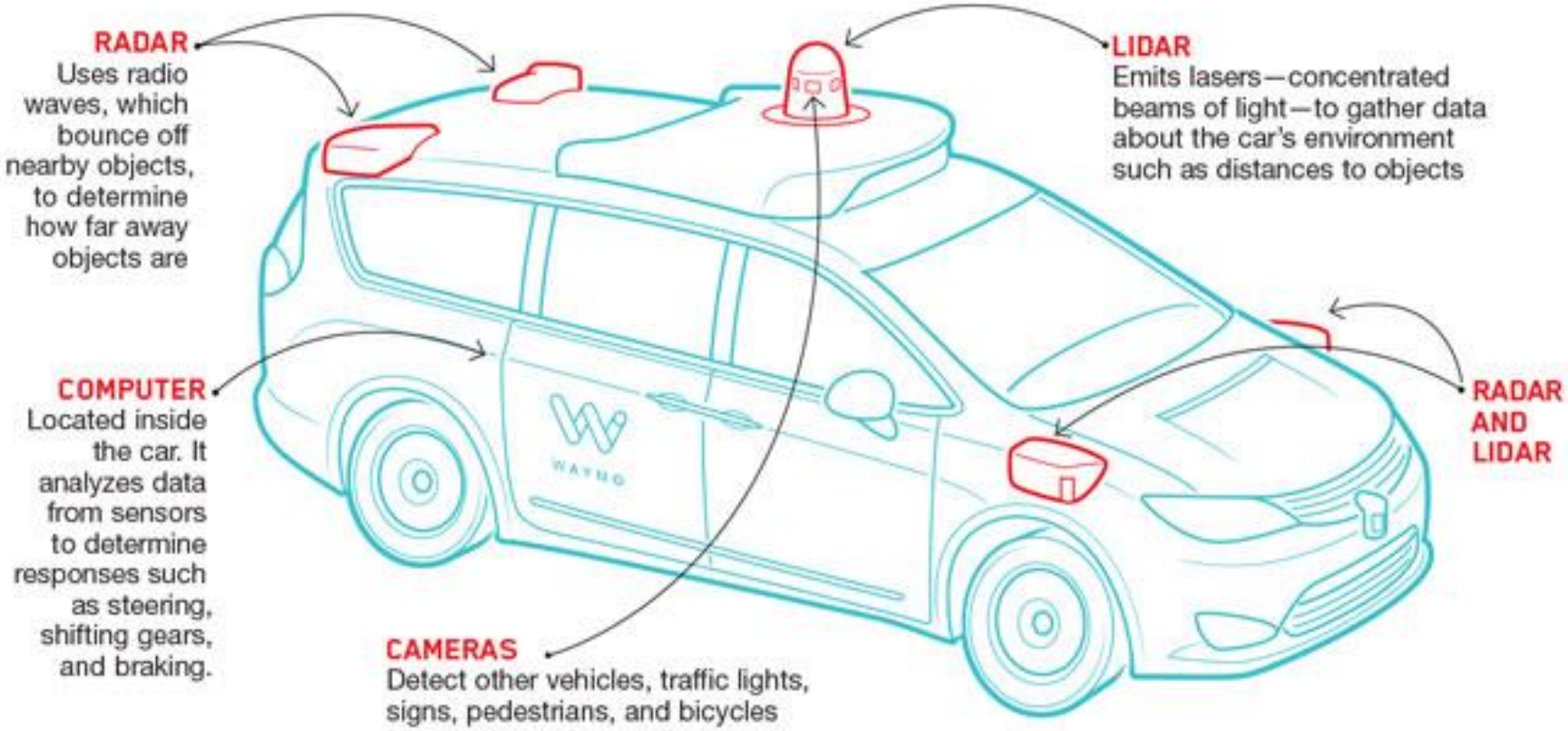


Portenta H7

ARDUINO

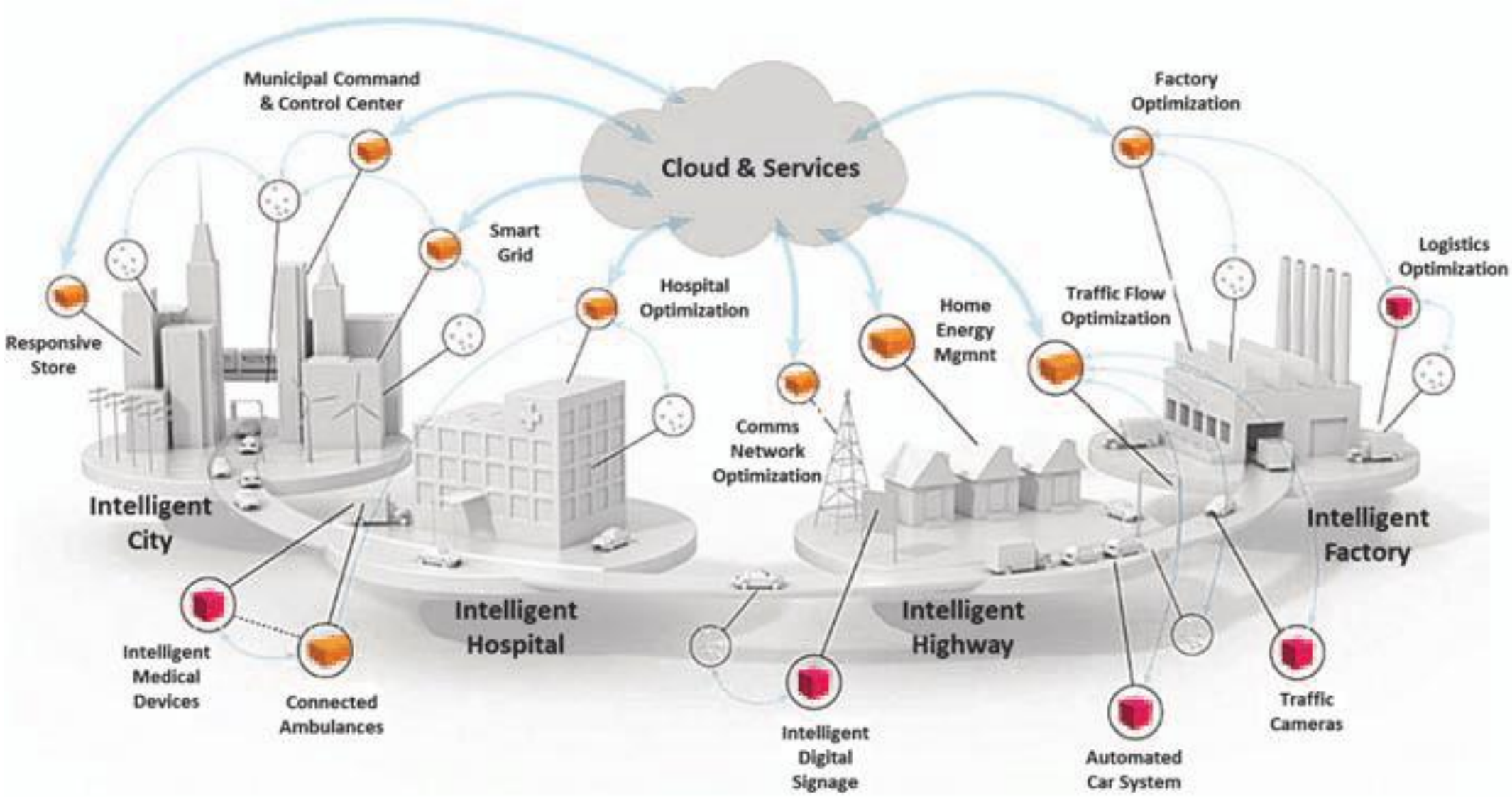
Sensores e Atuadores

stay at home!

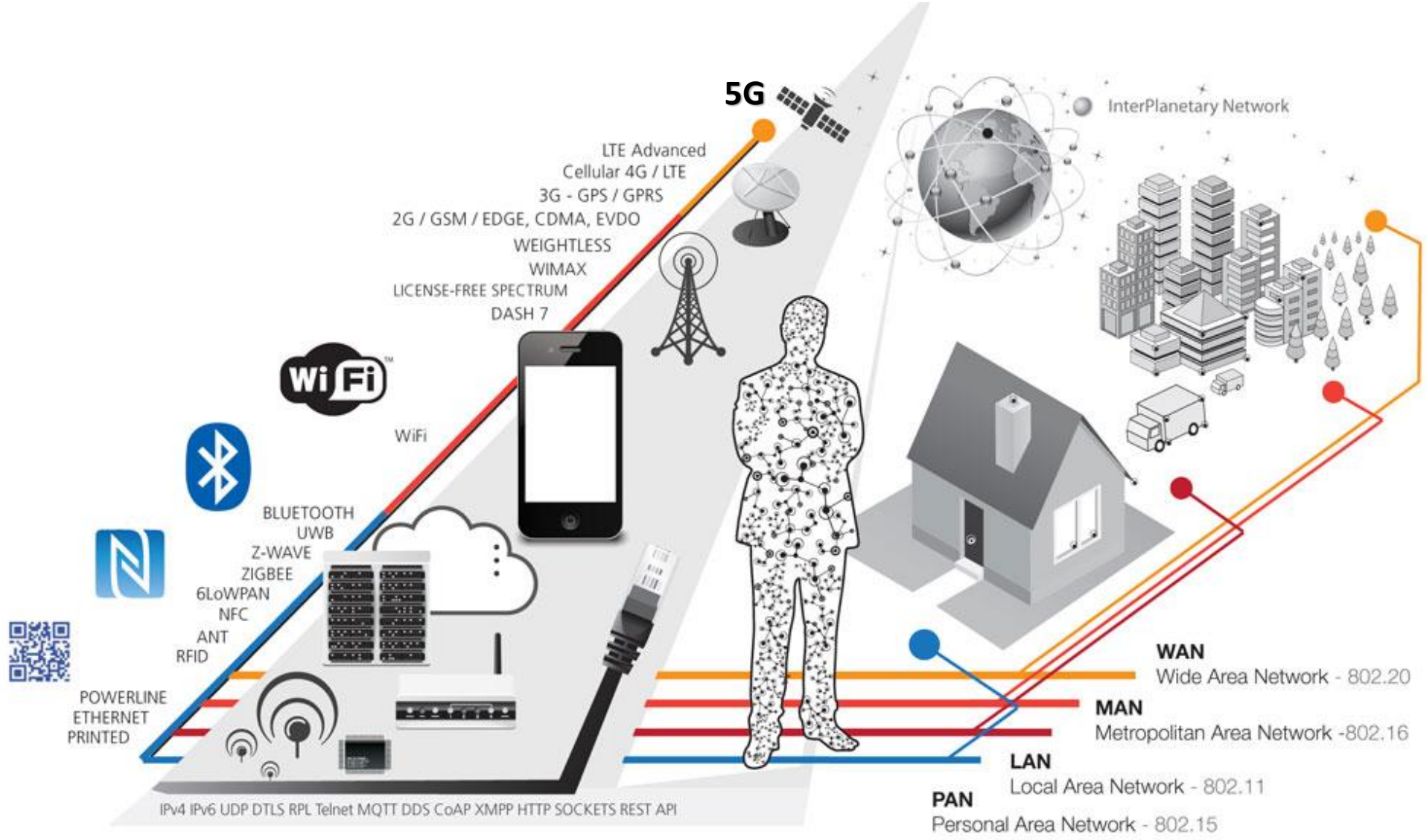


WAYMO

As informações são transmitidas para a nuvem



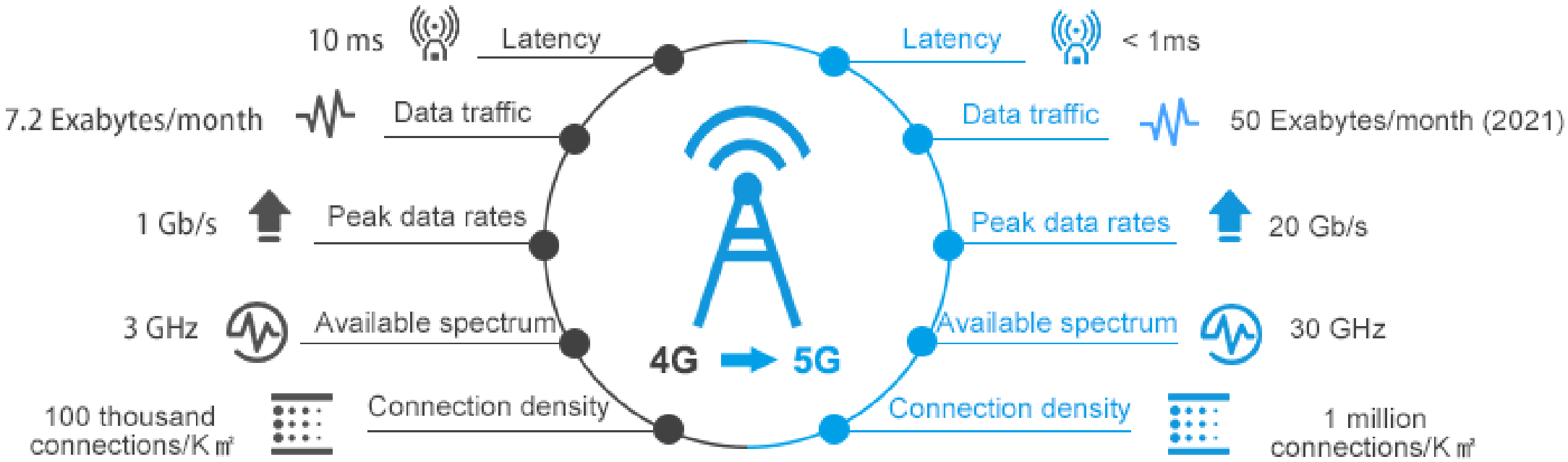
Tecnologias



LoRaWAN

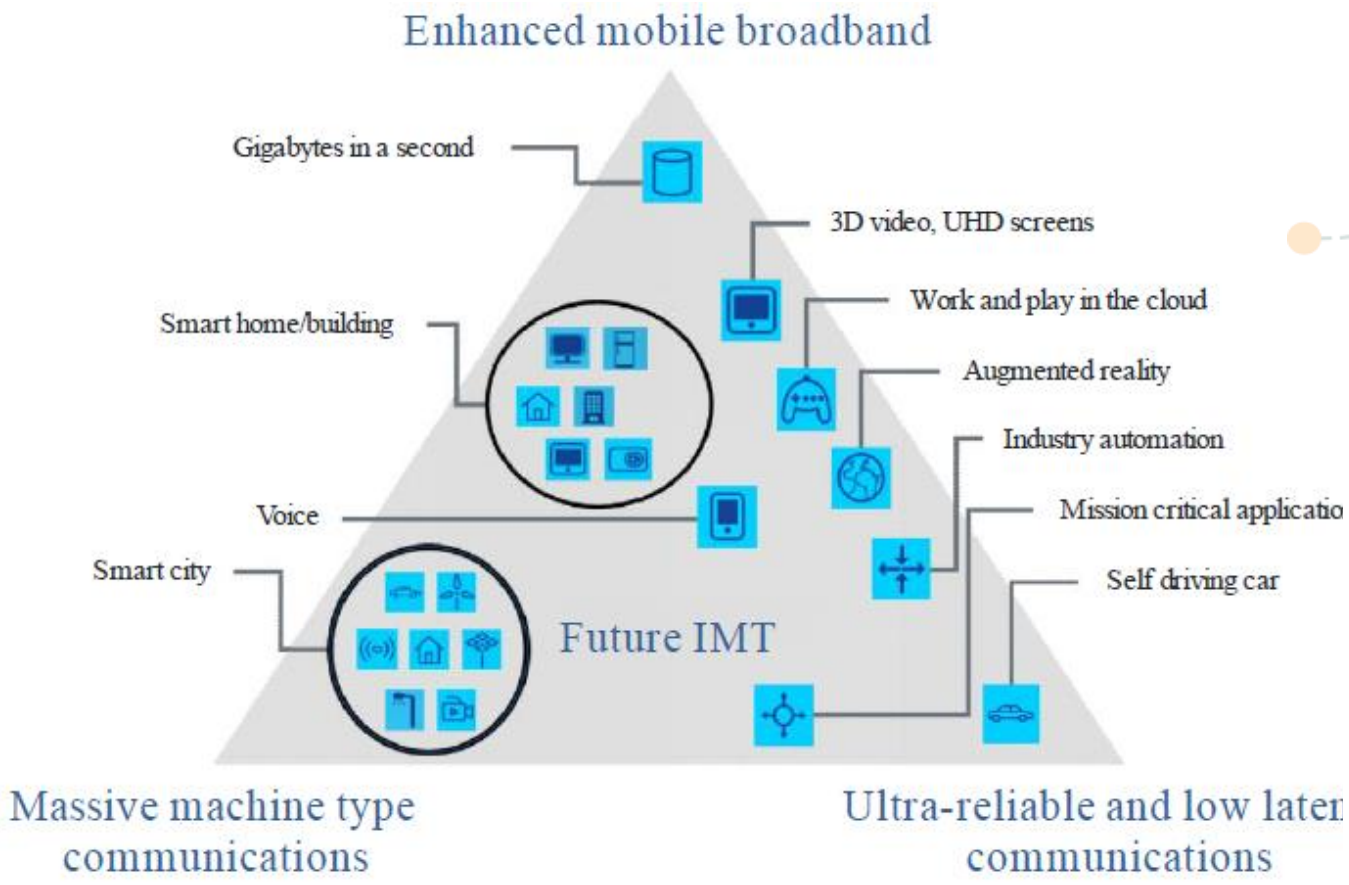
LoRa
LIGHTING PANEL CONTROL AND MONITORING UNIT
LoRaWAN™ GATEWAY
IP COMMUNICATION
inteliLIGHT® LAMP CONTROLLER
inteliLIGHT® StreetLight Control Software in the cloud or on the local server
MUNICIPAL WIRELESS NETWORK
ELECTRICAL VEHICLE CHARGERS
CITY SENSORS
TRAFFIC MONITORING
SECURITY INFRASTRUCTURE
NEAR ZERO STREET LIGHTING ENERGY COST

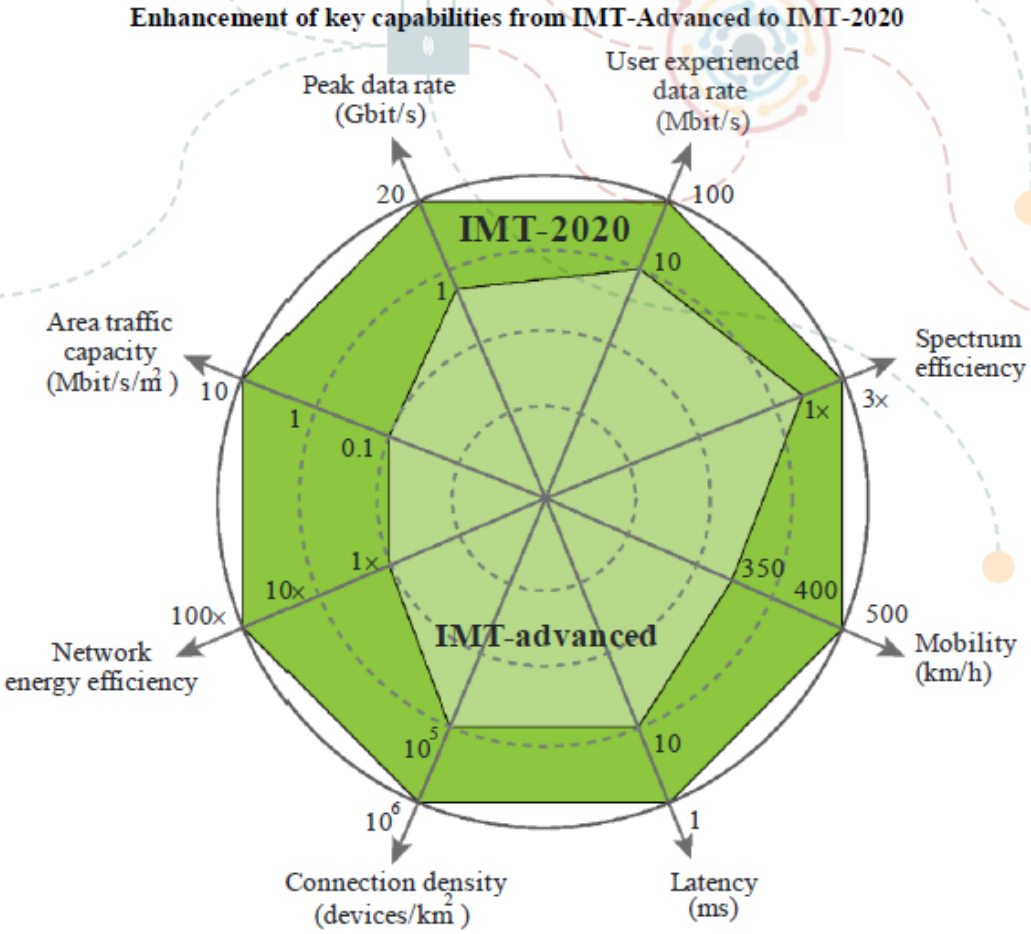
5G Requisitos



Comparing 4G and 5G

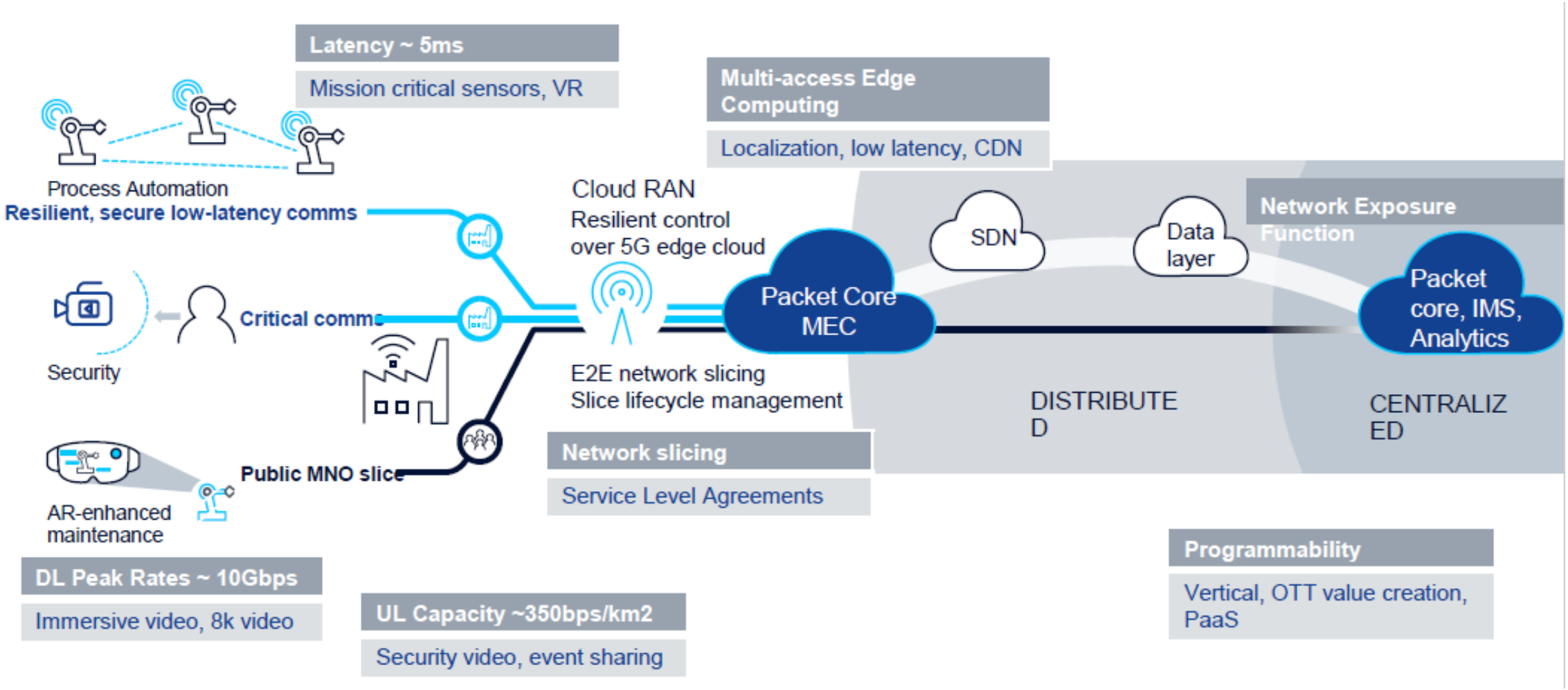
5G Requisitos



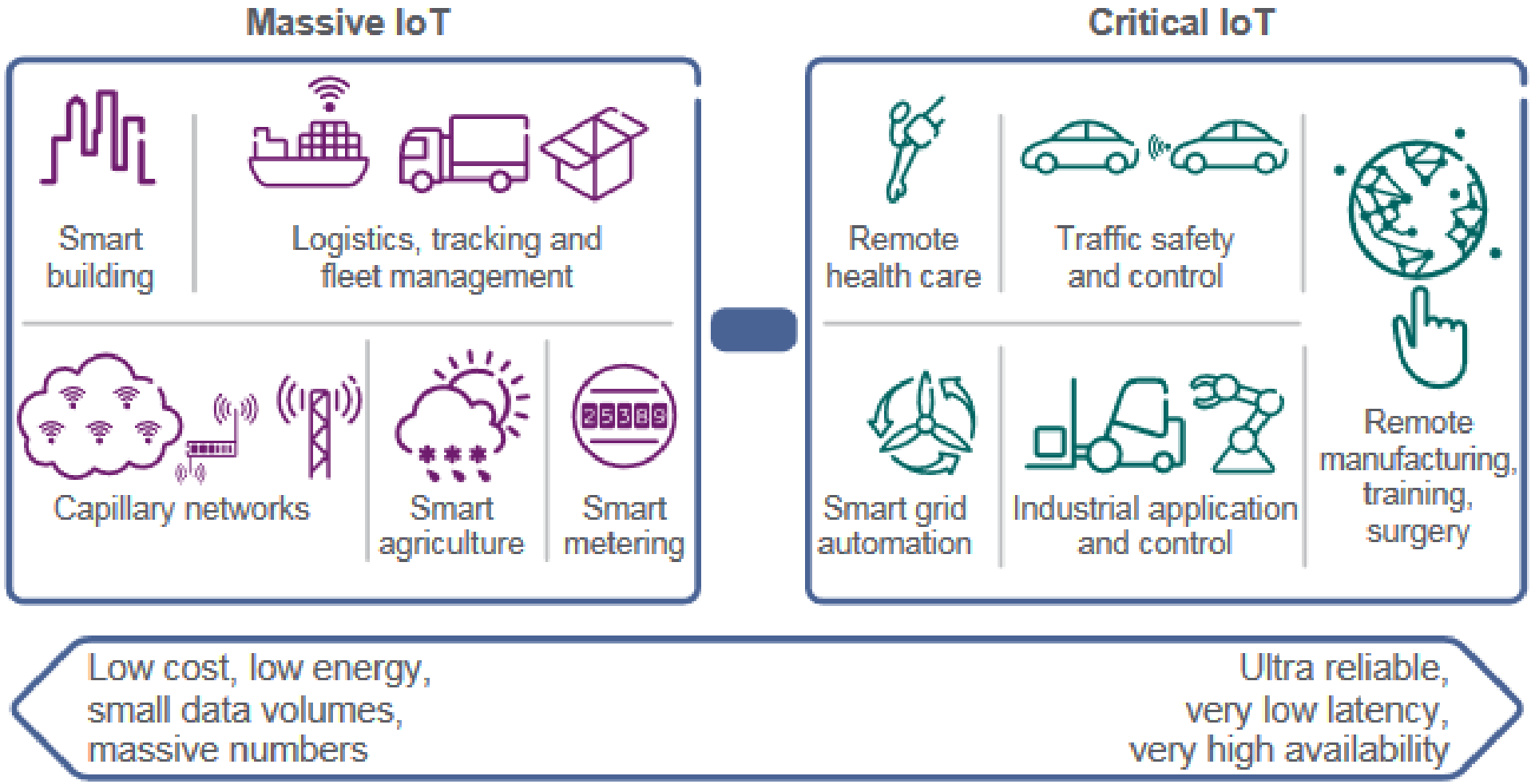


Fonte (ITU-R, 2015)

5G – Network Slicing with SDN and NFV

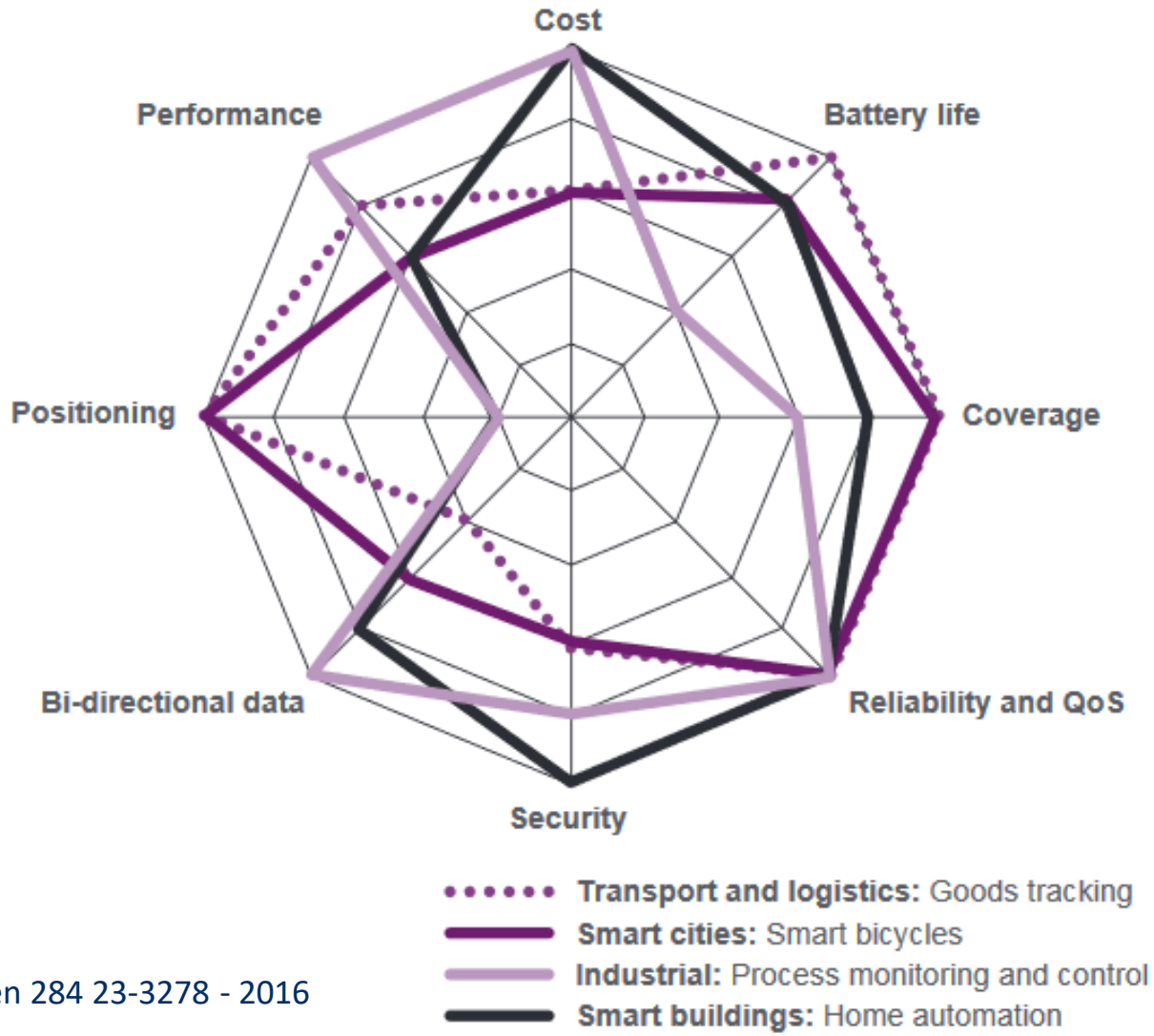


Aplicações de IoT Massivas e Críticas



Source: Ericsson White Paper Uen 284 23-3278 - 2016

Requisitos



Source: Ericsson White Paper Uen 284 23-3278 - 2016

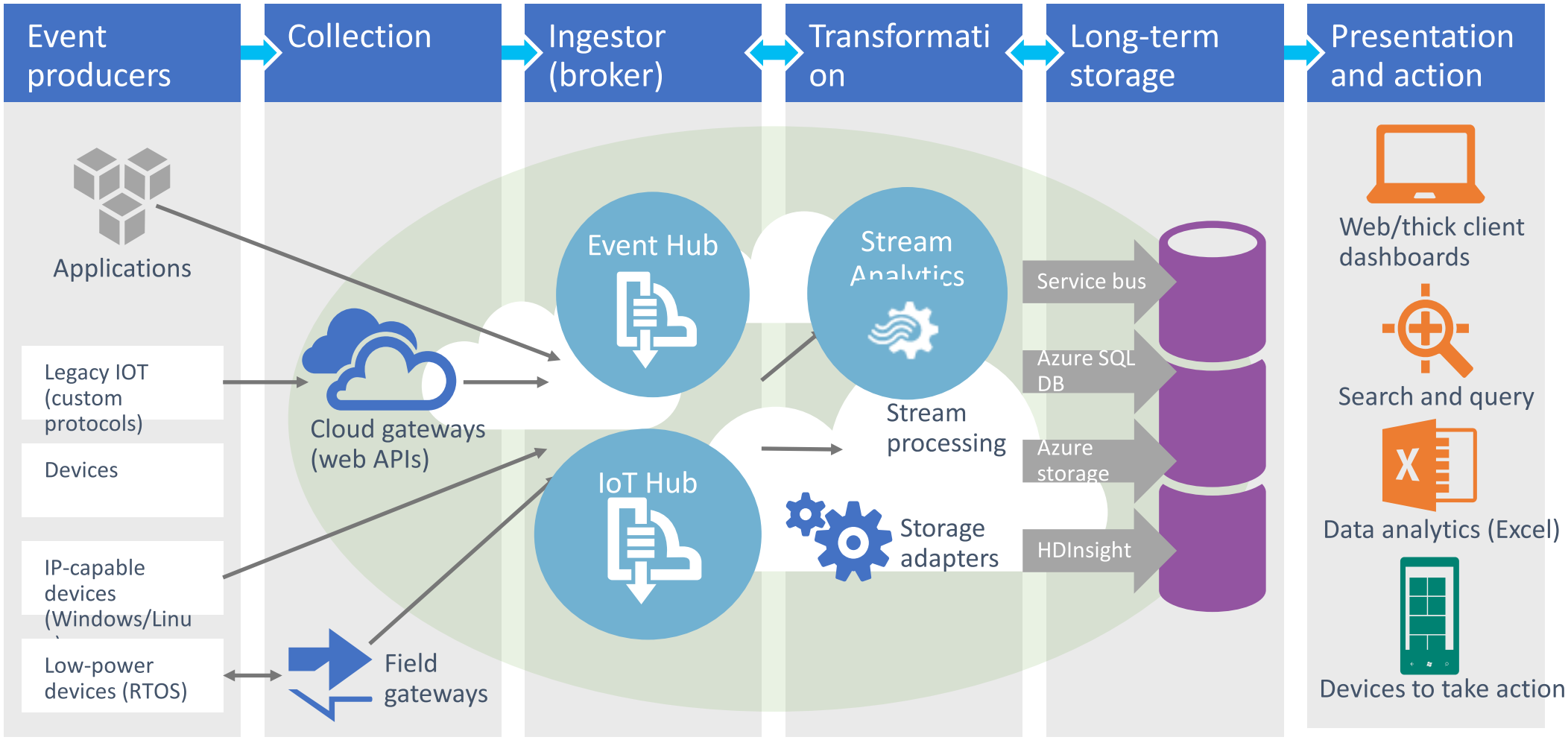
IBM Cloud

Windows Azure

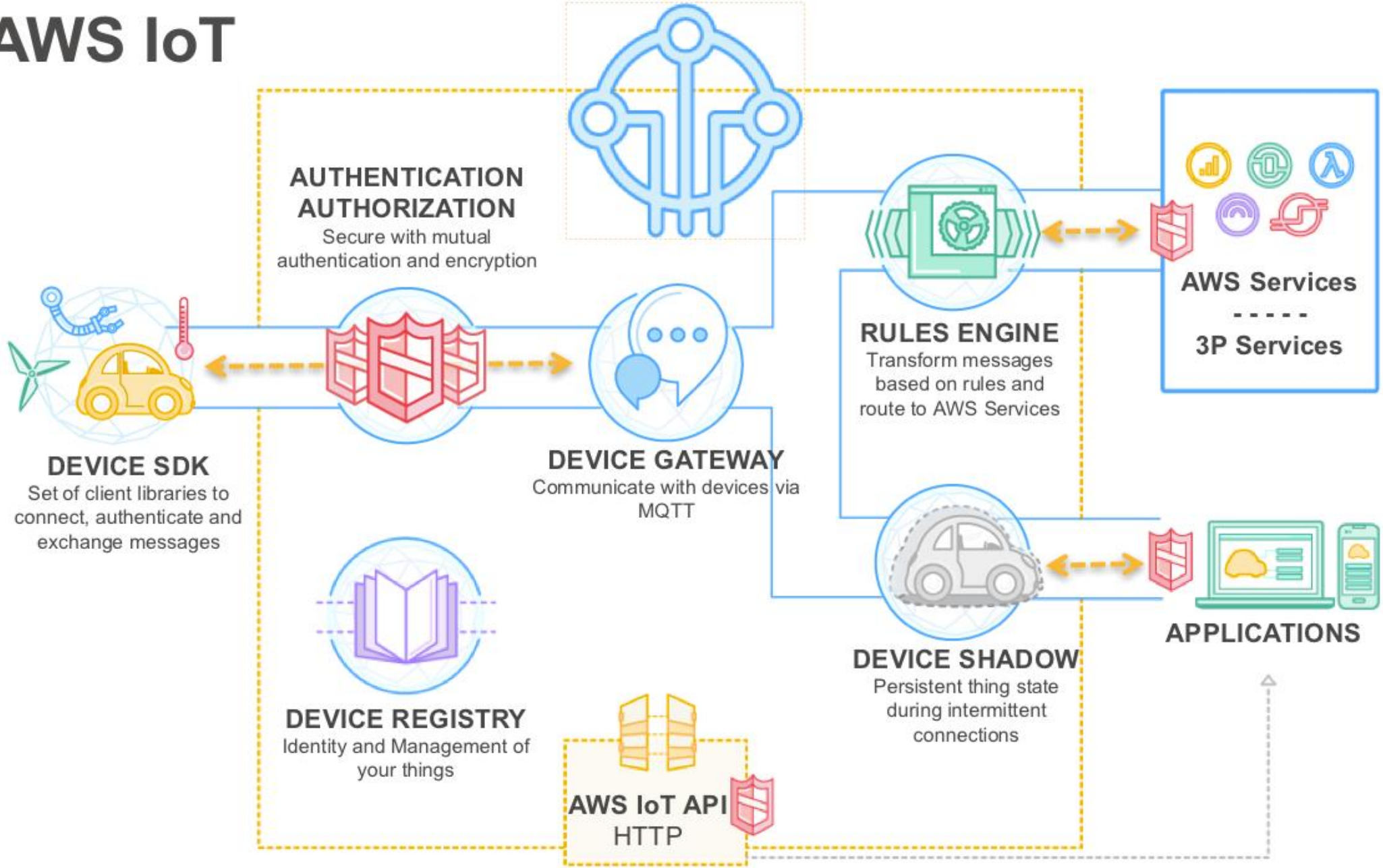
amazon
web services™

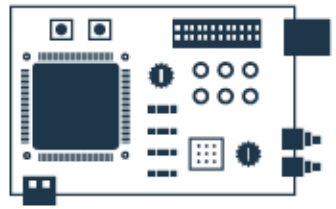
Google

Microsoft Azure



AWS IoT


AUTHENTICATION
AUTHORIZATION
Secure with mutual authentication and encryption
RULES ENGINE
Transform messages based on rules and route to AWS Services
AWS Services
- - - - -
3P Services
DEVICE SDK
Set of client libraries to connect, authenticate and exchange messages
DEVICE GATEWAY
Communicate with devices via MQTT
DEVICE REGISTRY
Identity and Management of your things
DEVICE SHADOW
Persistent thing state during intermittent connections
APPLICATIONS
AWS IoT API
HTTP



Your device or gateway

We start with your device, be it a sensor, a gateway or something else.
To find out how to get it connected, search our recipes.

MQTT

Your device data is sent securely up to the cloud using
the open, lightweight MQTT messaging protocol.

IBM Watson IoT Platform

This is the hub of all things IBM IoT. This is where you can
setup and manage your connected devices so that your
apps can access their live and historical data.

REST & Real-time APIs

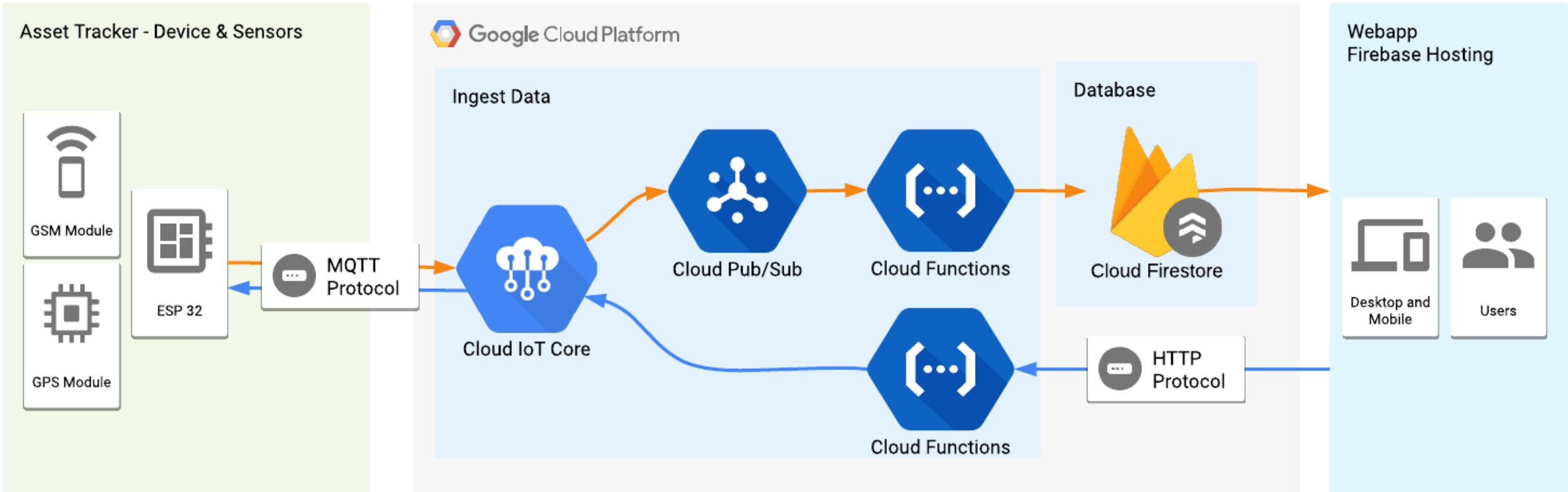
Use our secure APIs to connect your apps
with the data coming from your devices.

Your application and analytics

Create applications within IBM Bluemix, another cloud,
or your own servers to interpret the data you now have access to!

Google

Device to Cloud



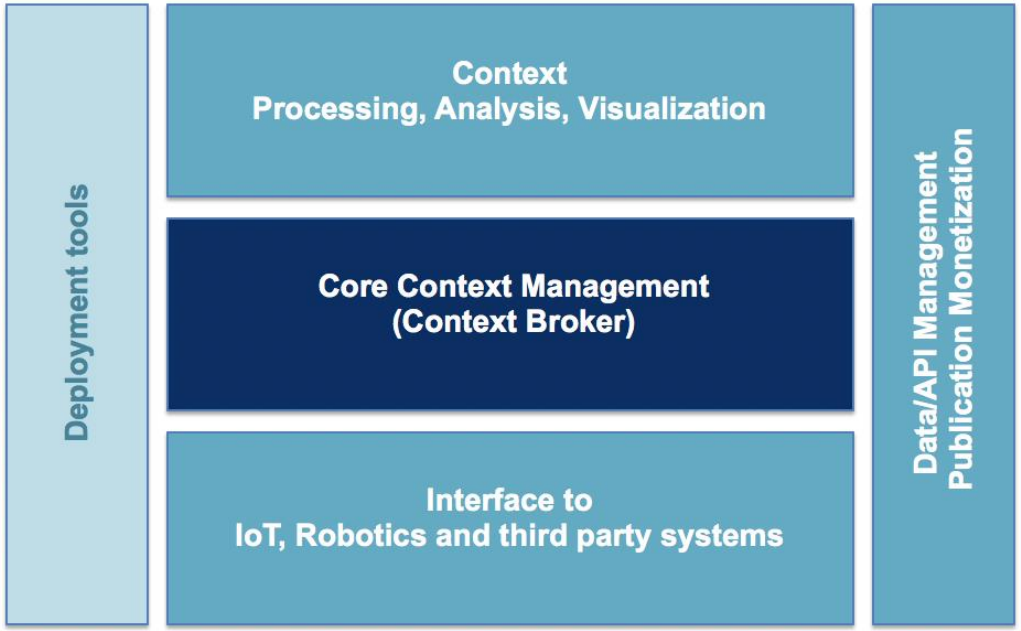
Cloud to Device

FIWARE
Open APIs for Open Minds

www.fiware.org

The Open Source platform for our smart digital future.

FIWARE



O FIWARE é uma plataforma aberta que pode ser utilizada para suportar aplicações de IoT e Ambientes Inteligentes, apresenta uma arquitetura modular e padronizada para coletar, processar, armazenar e compartilhar informações de contexto em tempo de execução.

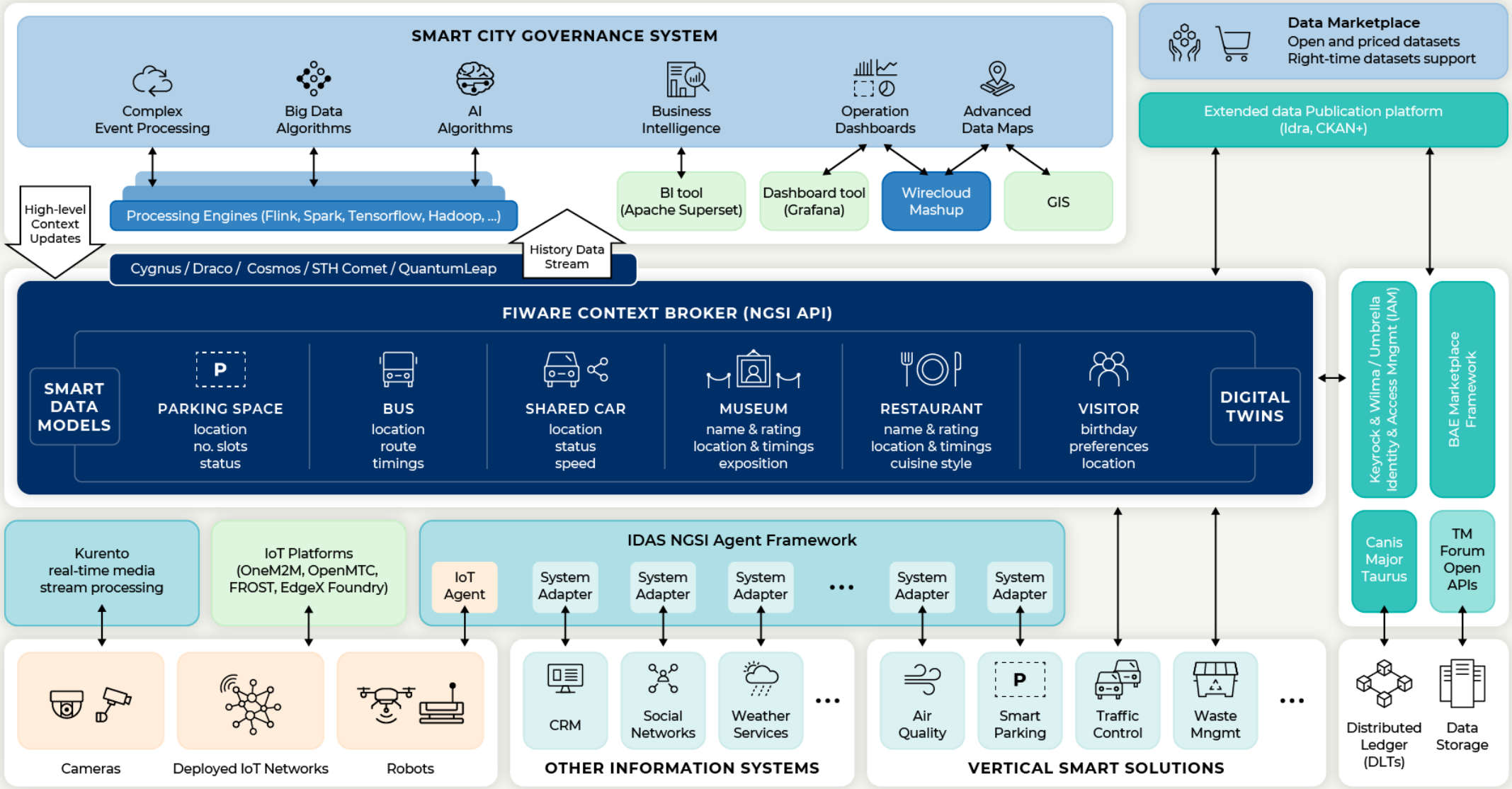
Oferece recursos avançados e sua implementação utiliza tecnologias e padrões abertos.

FIWARE

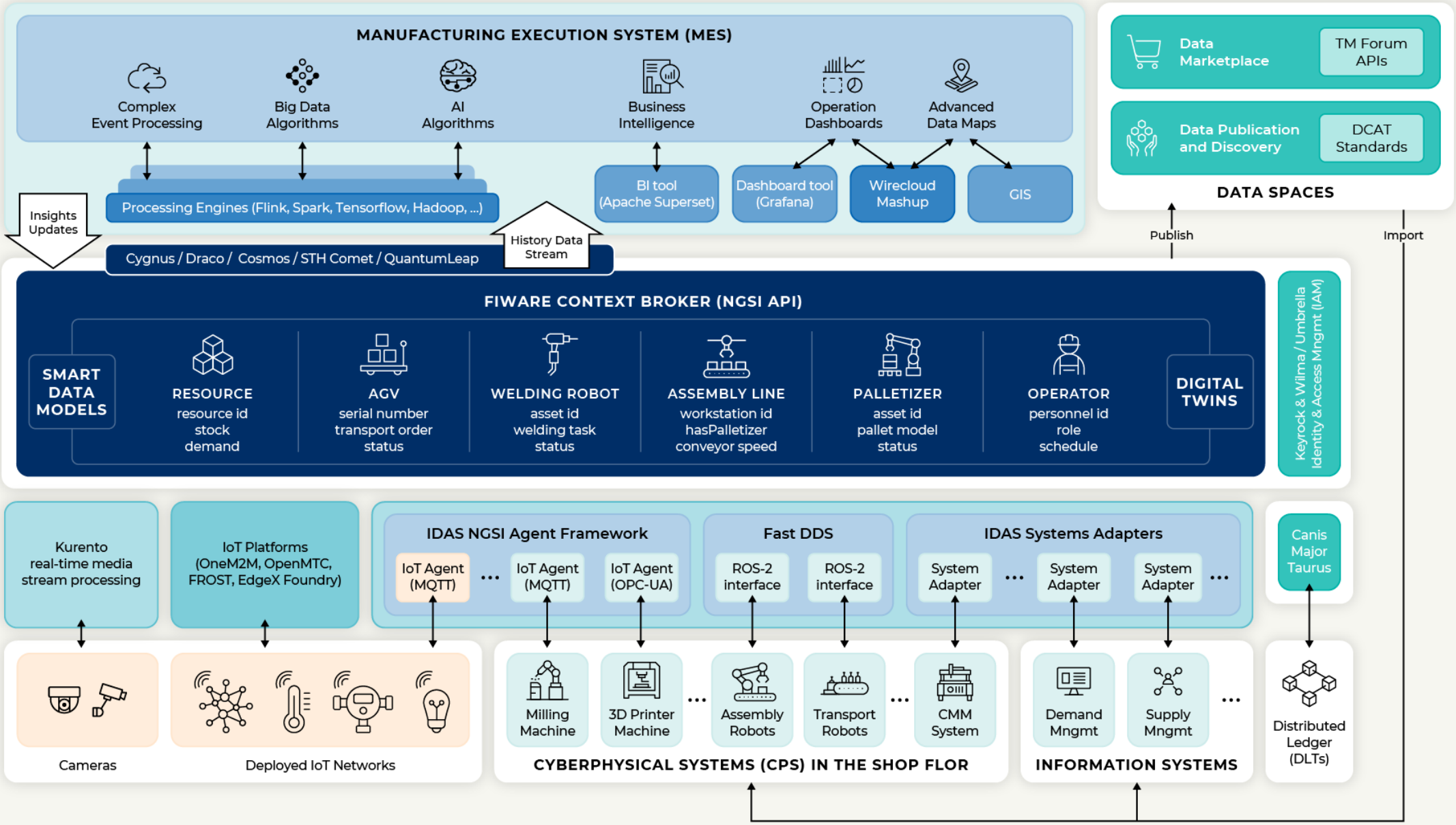
Marketplace

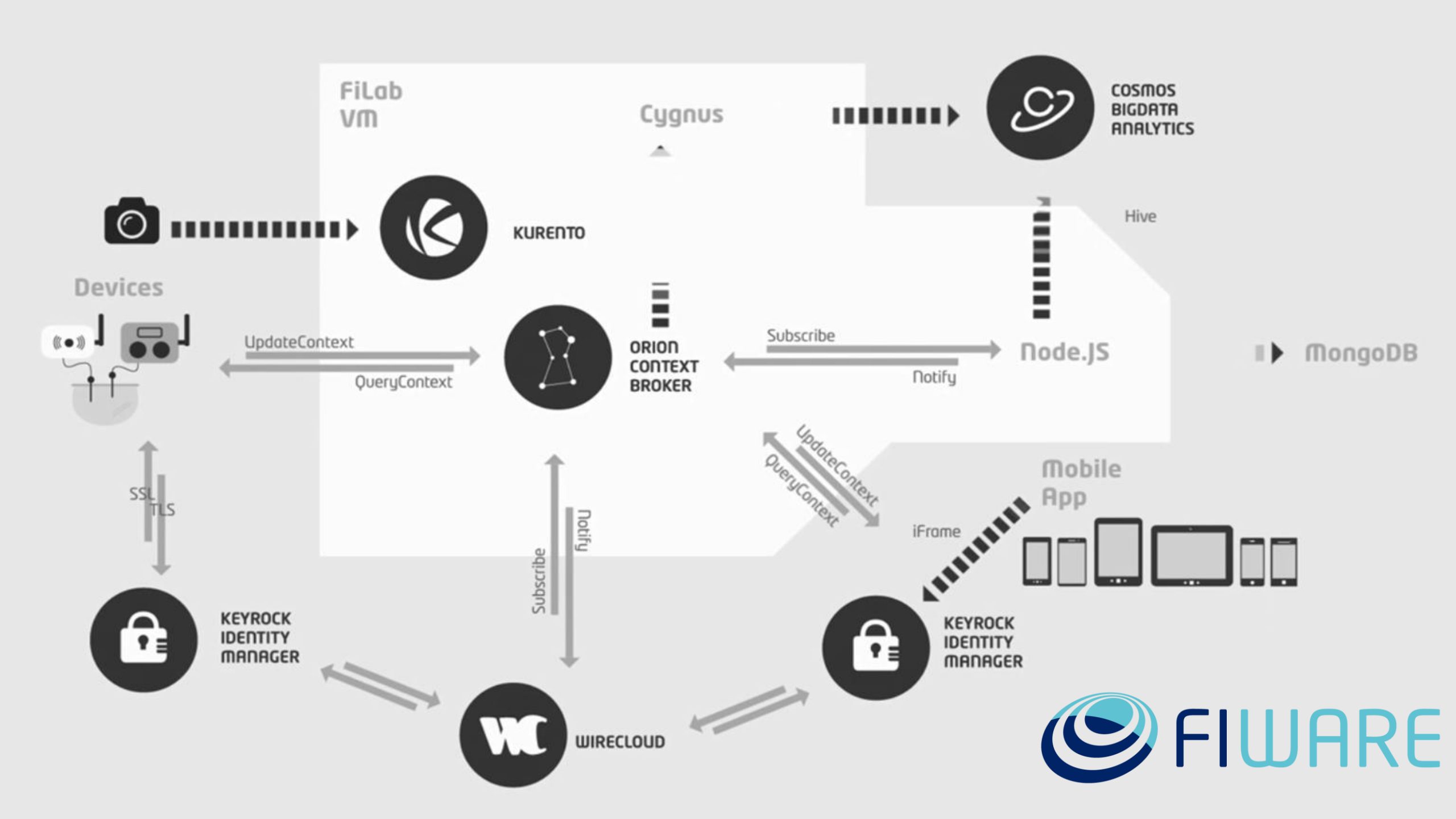
FIWARE

The FIWARE Smart Cities Reference Architecture

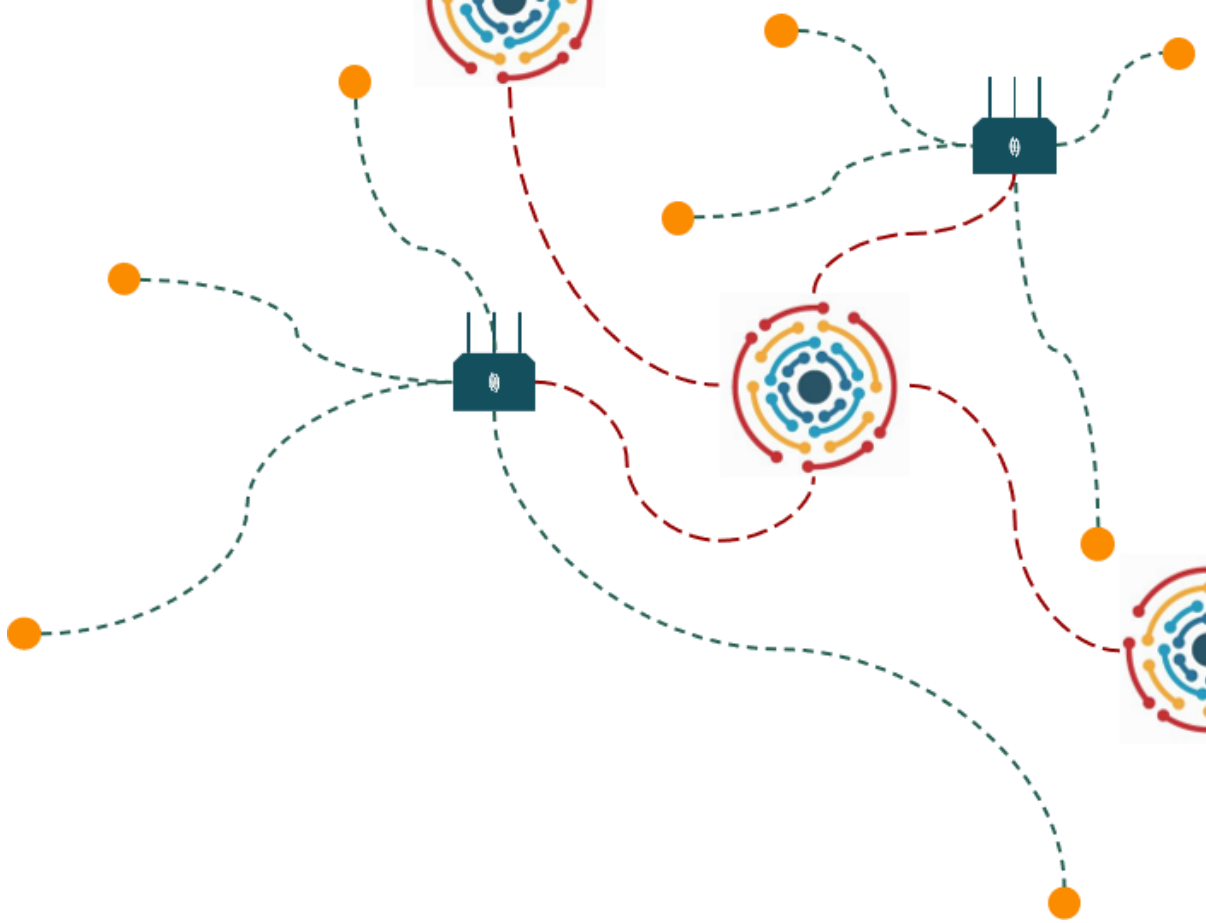


The FIWARE Smart Industry Reference Architecture




FiLab
VM
Cygnus
COSMOS
BIGDATA
ANALYTICS
KURENTO
Hive
Devices
UpdateContext
QueryContext
ORION
CONTEXT
BROKER
Subscribe
Notify
Node.JS
MongoDB
SSL
TLS
Subscribe
Notify
UpdateContext
QueryContext
Mobile
App
iFrame
KEYROCK
IDENTITY
MANAGER
KEYROCK
IDENTITY
MANAGER
WIRECLOUD
FIWARE

This is FIWARE!



Helix Multi-layered

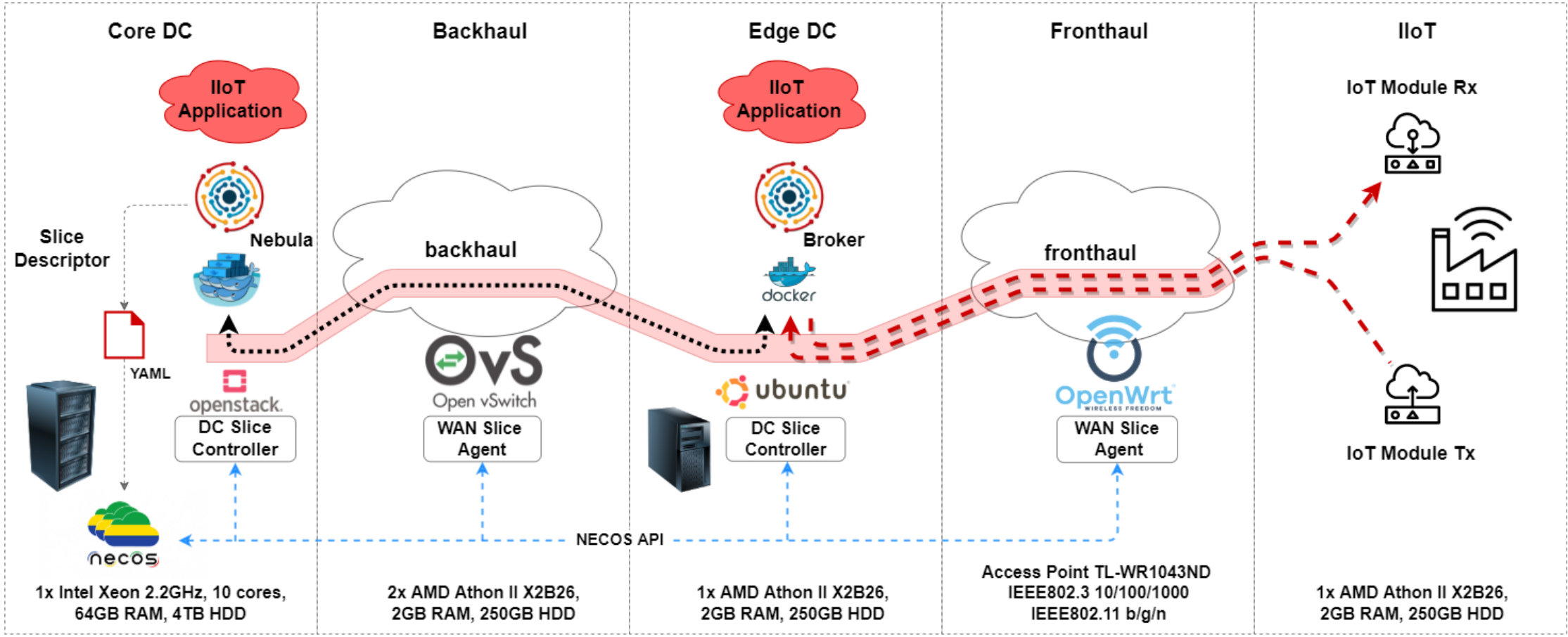
& NECOS

Universidade de São Paulo

UFRN UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

Helix Multi-layered

Integração Helix & NECOS



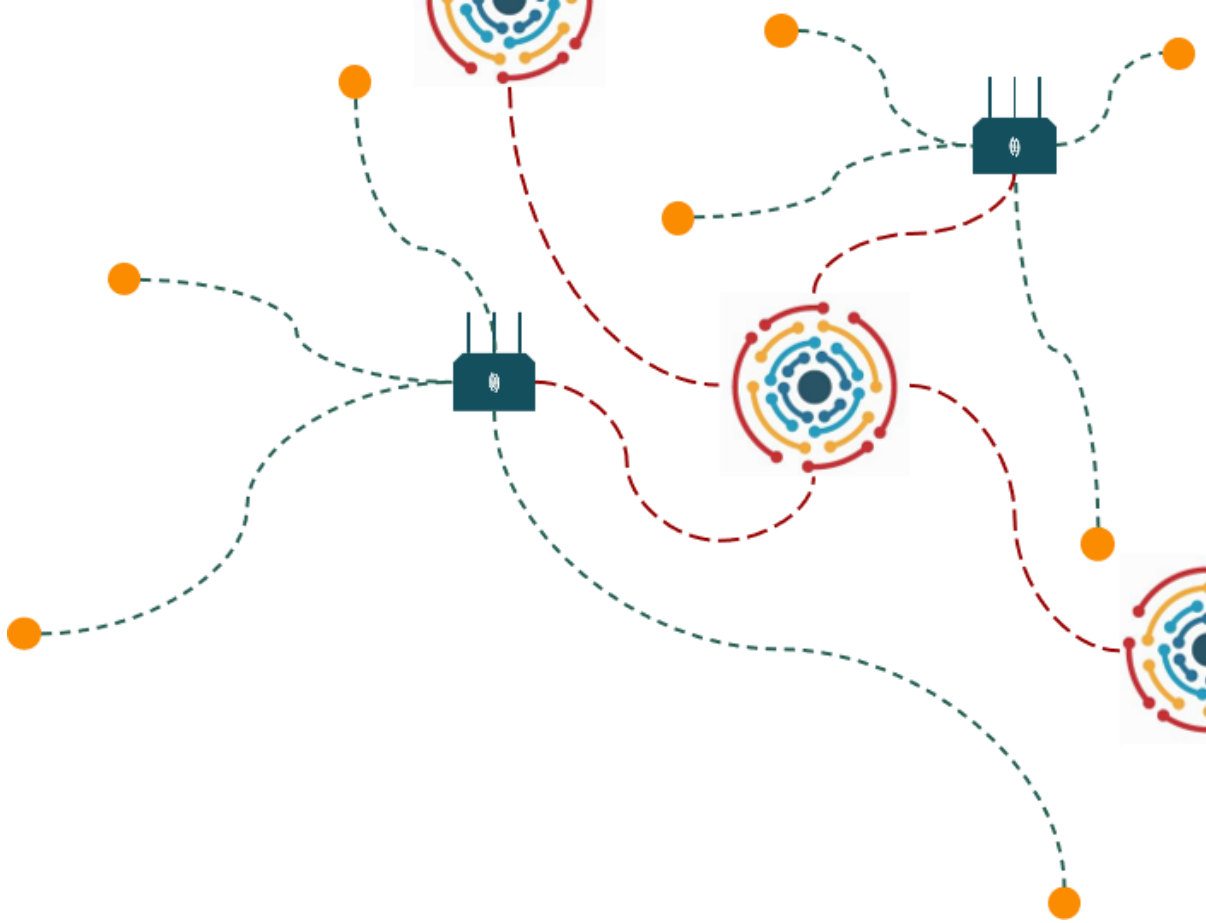
AVEIRO CÂMARA MUNICIPAL

TECH CiTY

instituto de telecomunicações

universidade de aveiro

USP Universidade de São Paulo



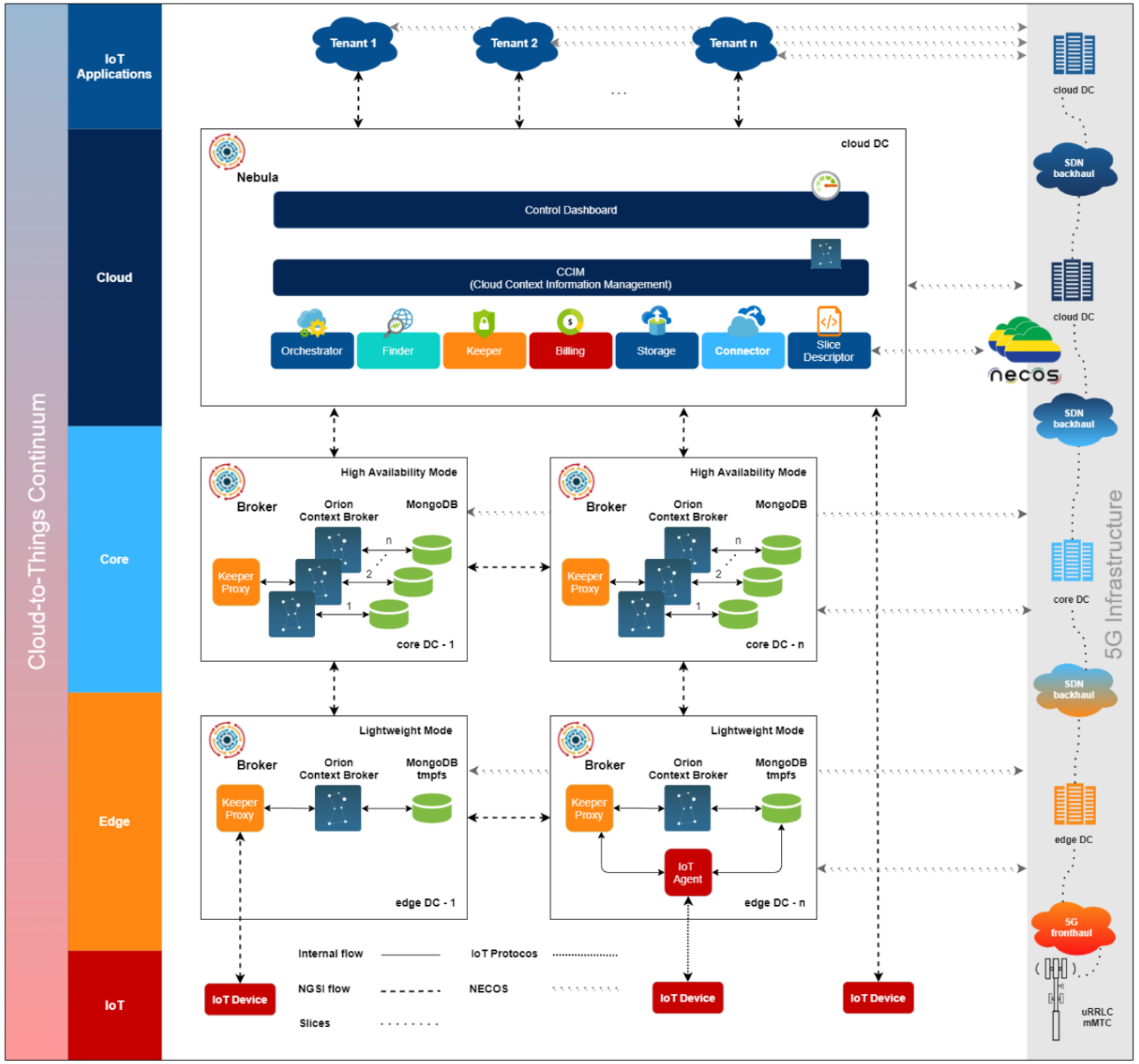
Helix Multi-layered

Real-world Testbed

AVEIRO TECH CiTY living lab

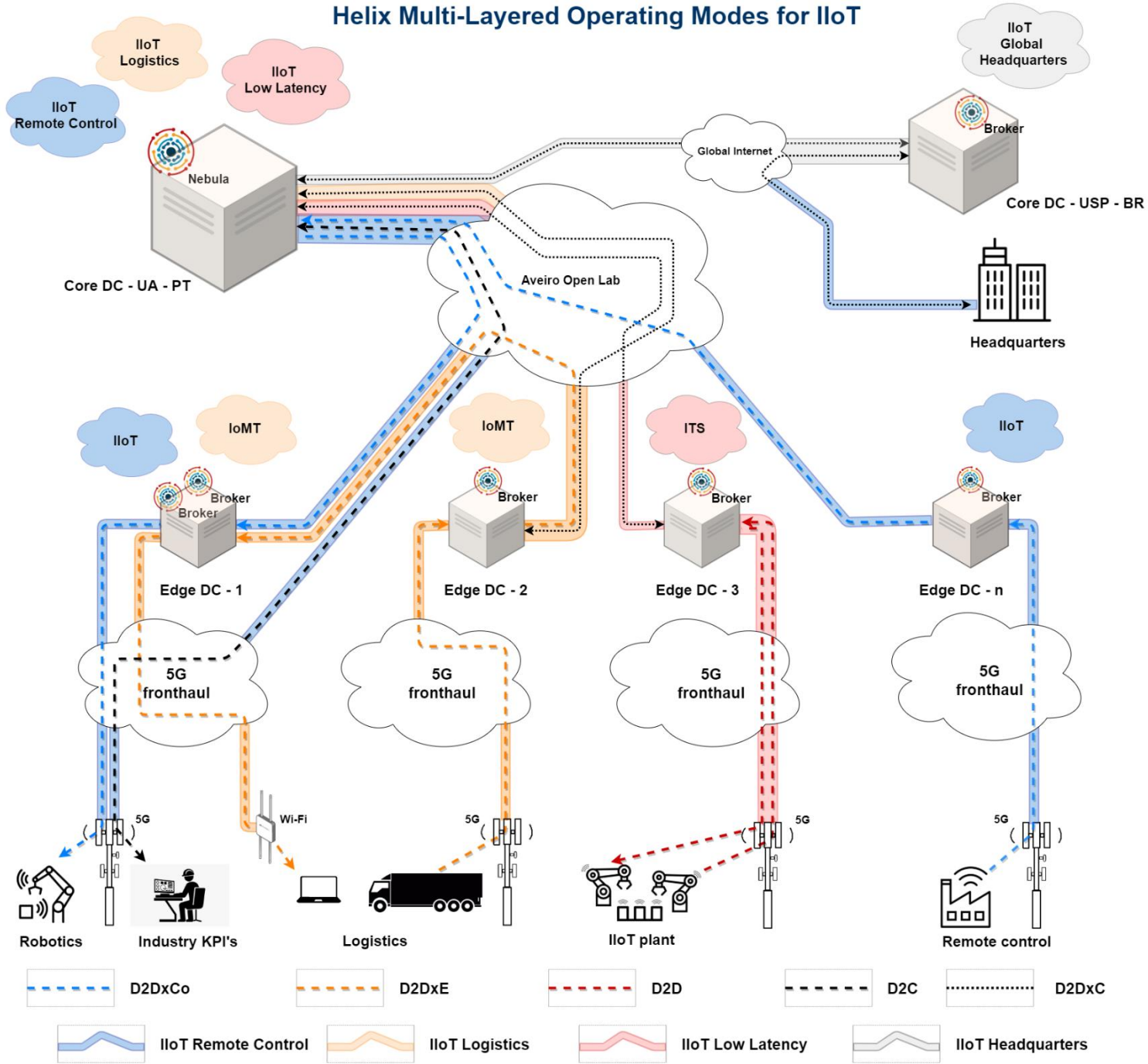
Helix

Multi-layered



Helix

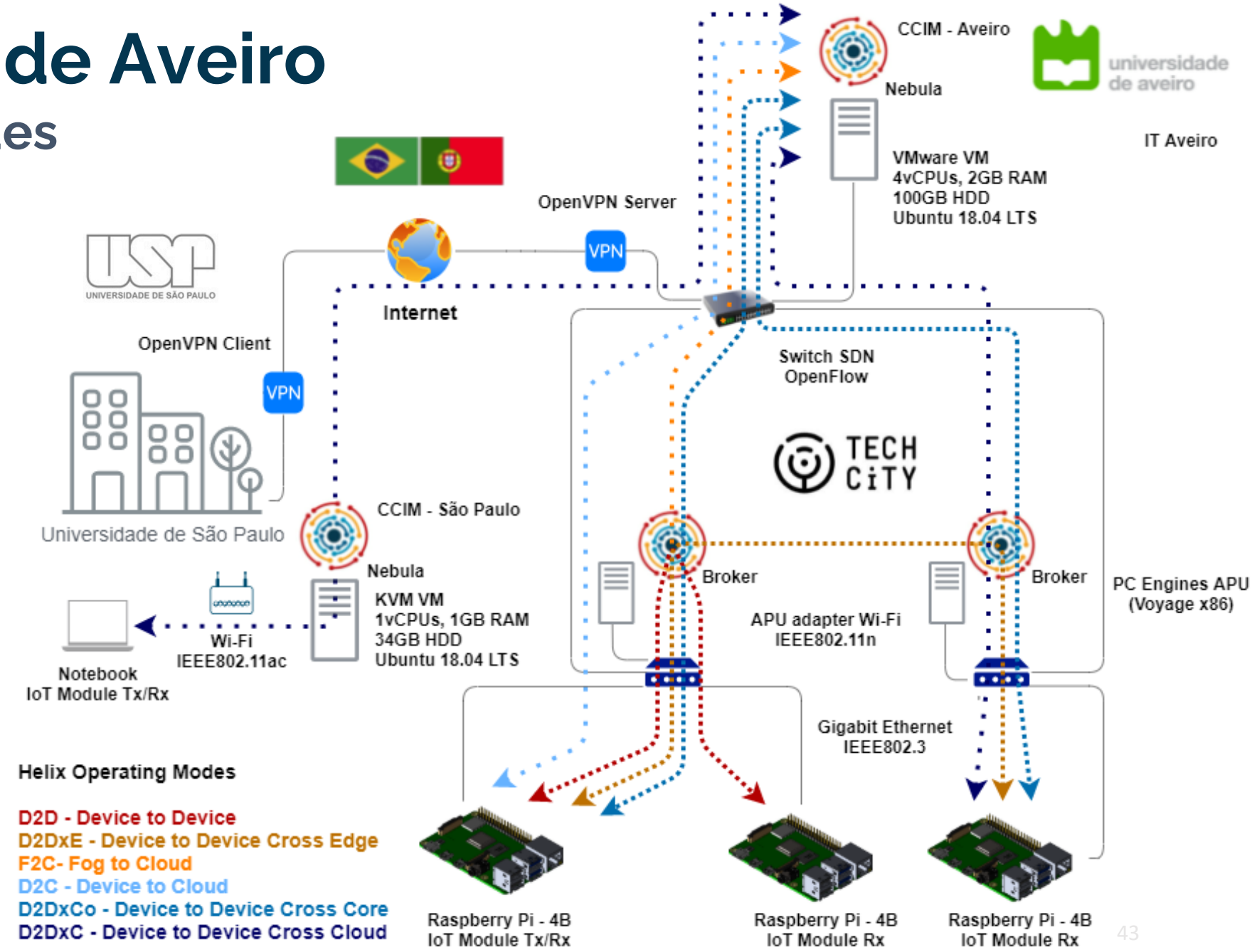
Multi-layered



Universidade de Aveiro

Laboratório de Redes

Bancada de Testes

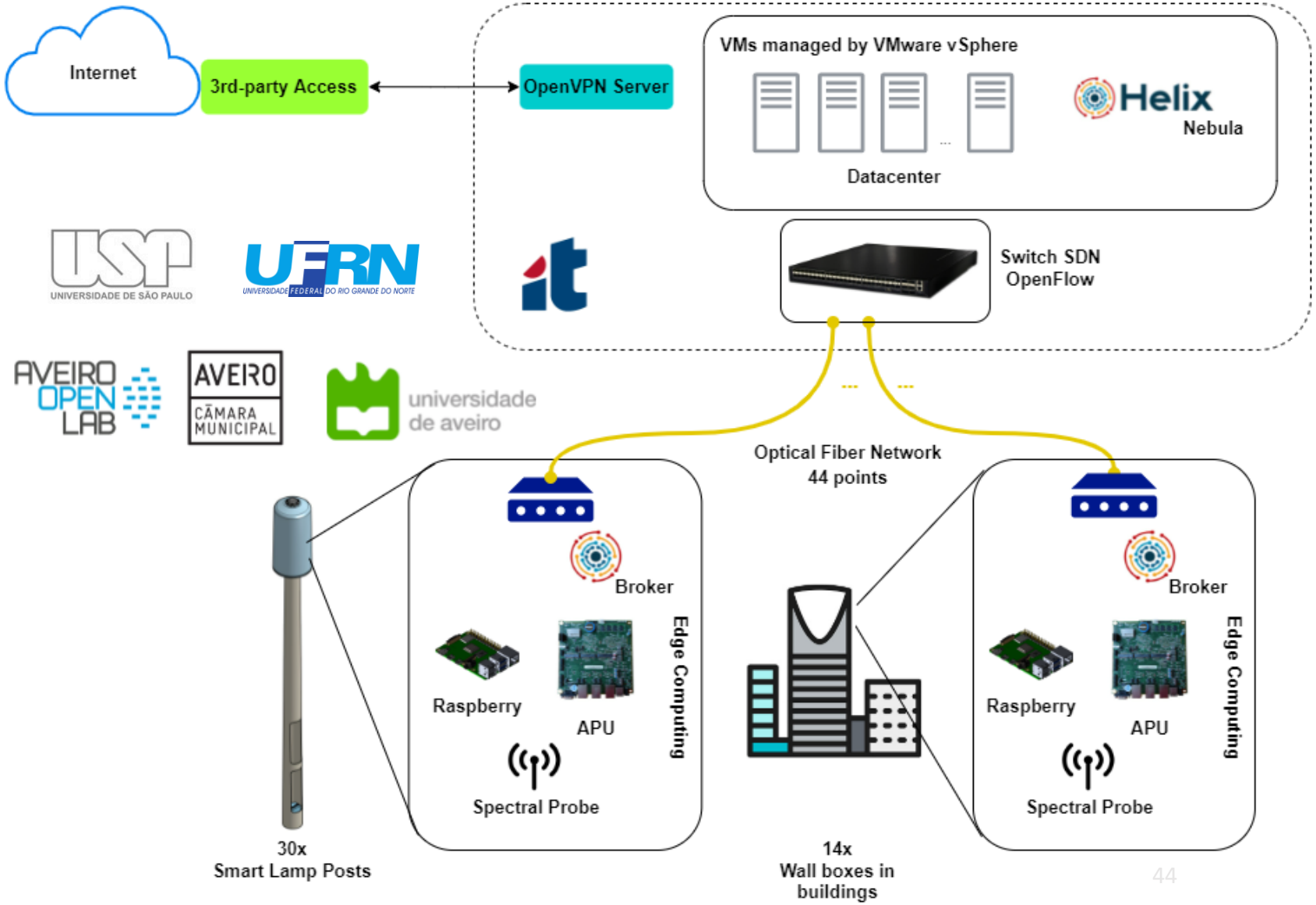


Aveiro Real-World Testbed

PoC – Spectral Probe

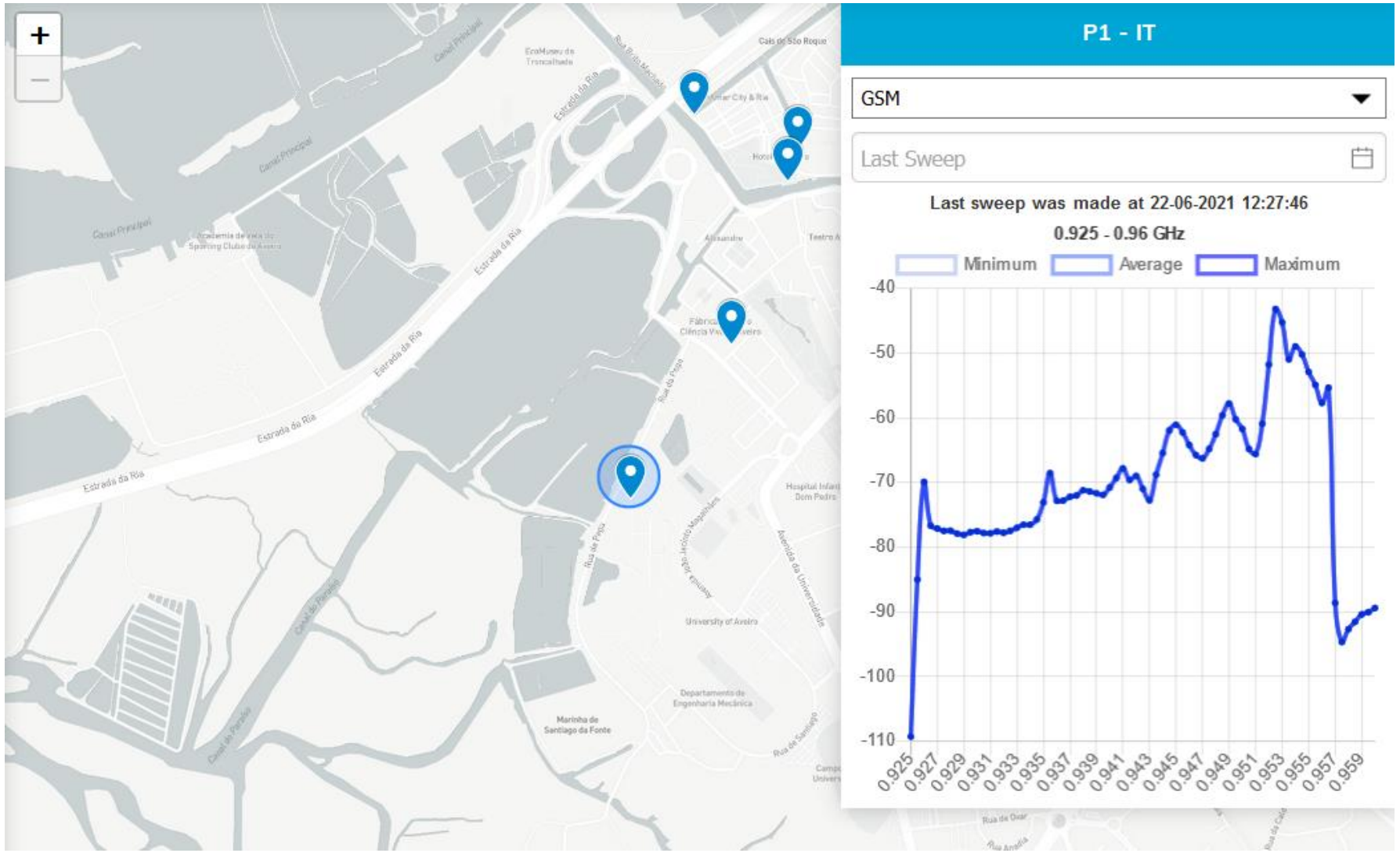
AVEIRO TECH CITY living lab

Postes Inteligentes



AVEIRO
TECH CitY
living lab

Spectral Probes

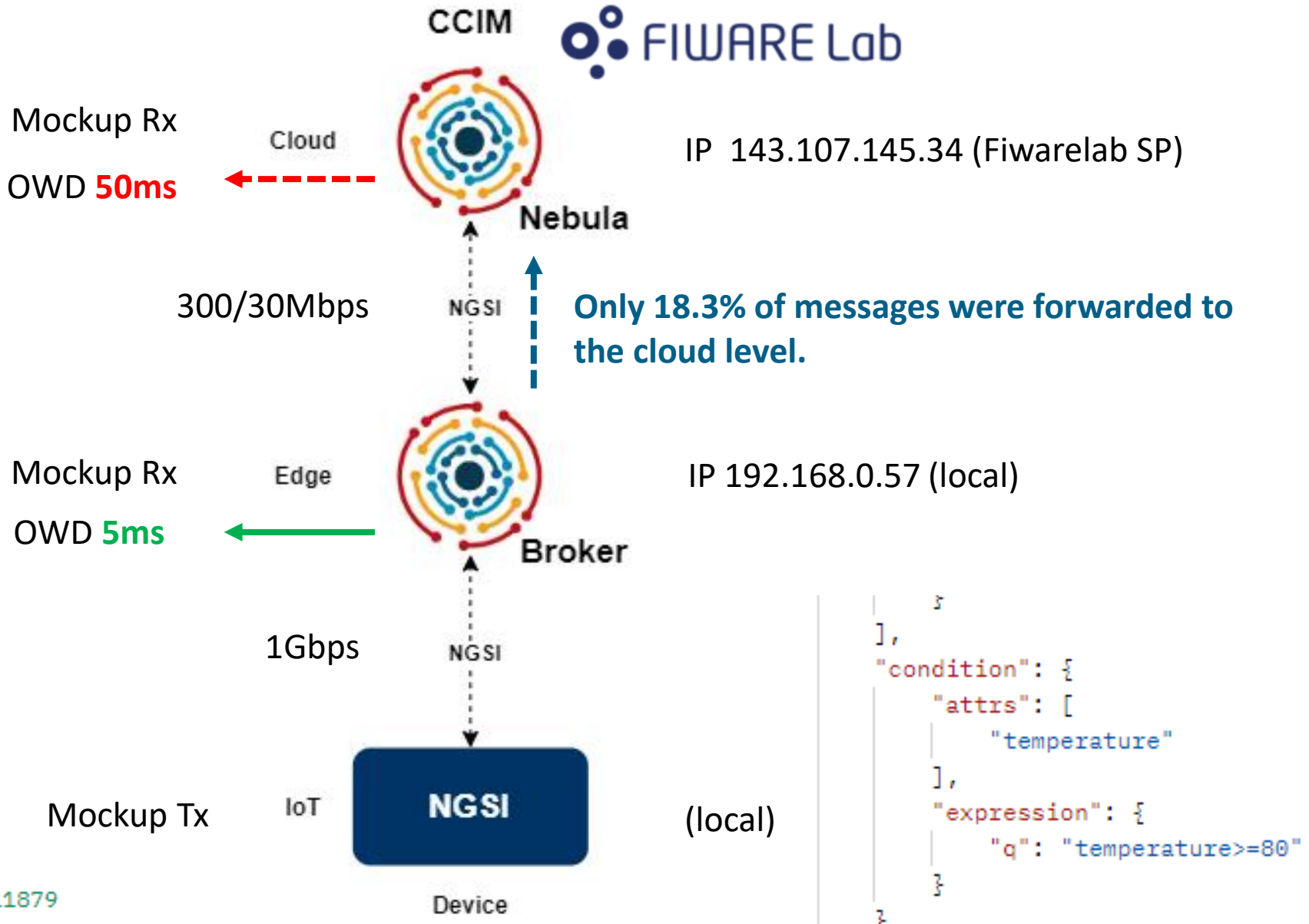


Helix

F2C Mode

OWD (One-Way Delay)

NTP (Network Time Protocol)




```
{
    "counters": {
        "jsonRequests": 1000,
        "noPayloadRequests": 4,
        "requests": {
            "entity": {
                "POST": 1000
            },
            "statistics": {
                "GET": 1
            }
        },
        "invalidRequests": 3,
        "notificationsSent": 183,
        "versionRequests": 0
    },
    "uptime_in_secs": 11879,
    "measuring_interval_in_secs": 11879
}
```

```
    }
],
"condition": {
    "attrs": [
        "temperature"
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    "expression": {
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    }
}
```
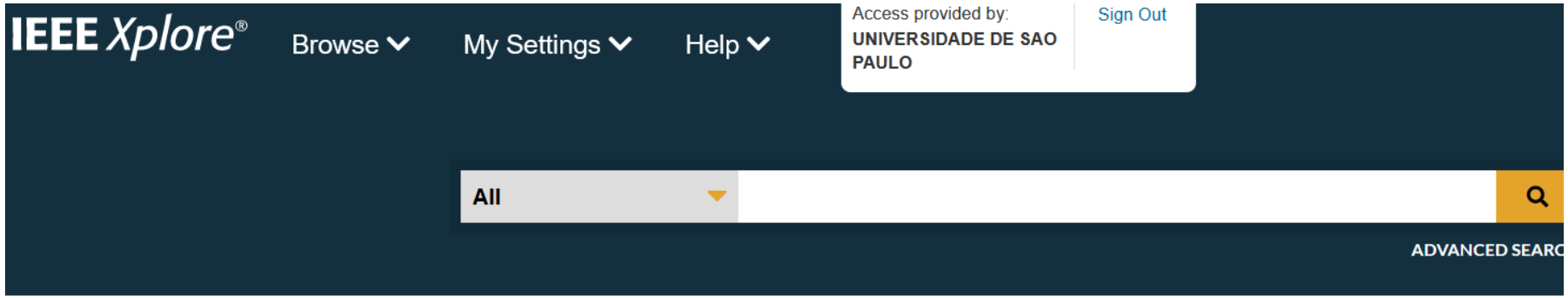

IEEE



Conferences > 2019 IEEE 1st Sustainable Cit...

Helix SandBox: An Open Platform to Fast Prototype Smart Environments Applications

Publisher: IEEE Cite This PDF

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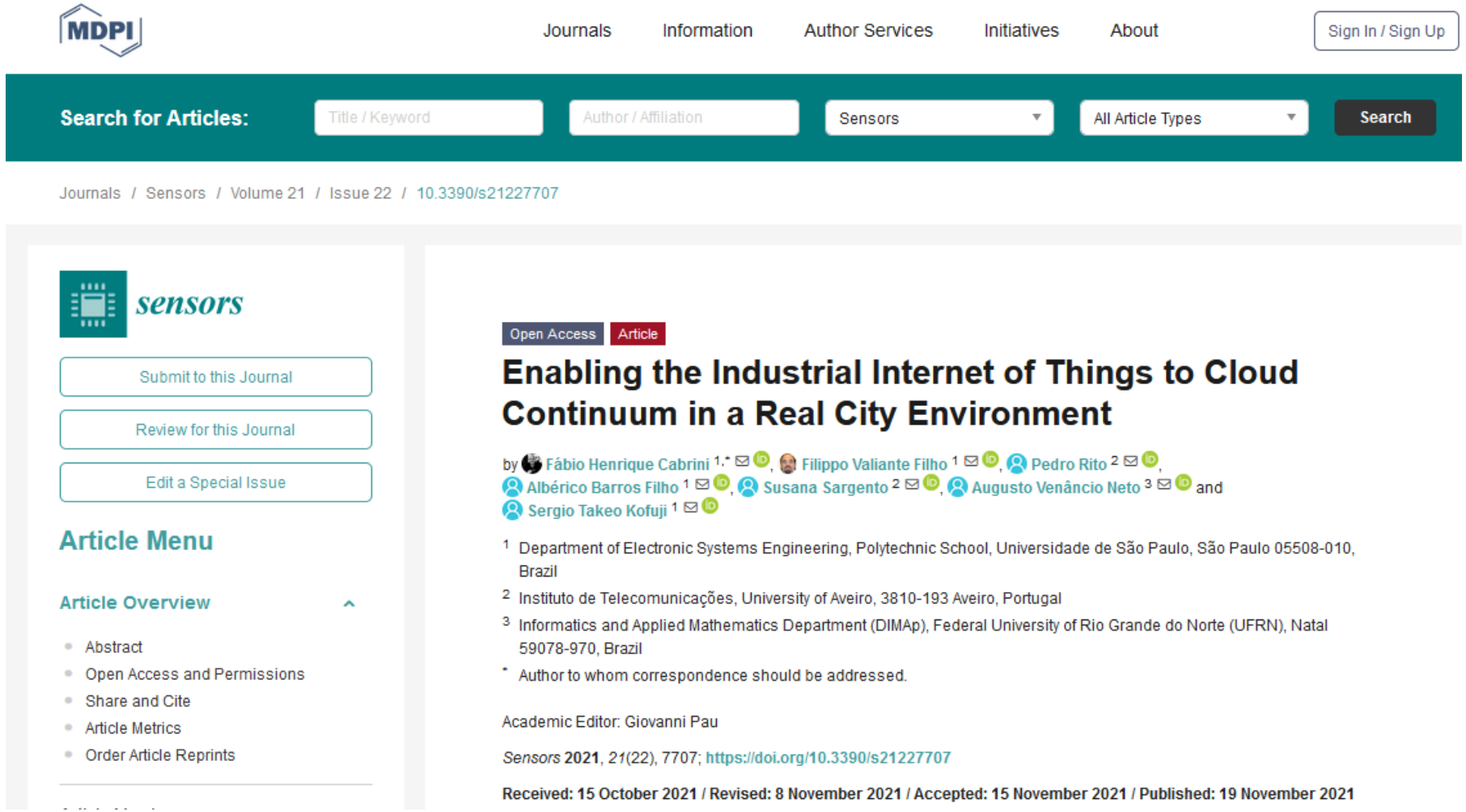
Sensors



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Helix Multi-layered: a context broker federation for an efficient cloud-to-things continuum

Fábio Henrique Cabrini, Albérico de Castro Barros Filho, Douglas Braz Maciel, Filippo Valiante Filho, Augusto José Venâncio Neto & Sergio Takeo Kofuji

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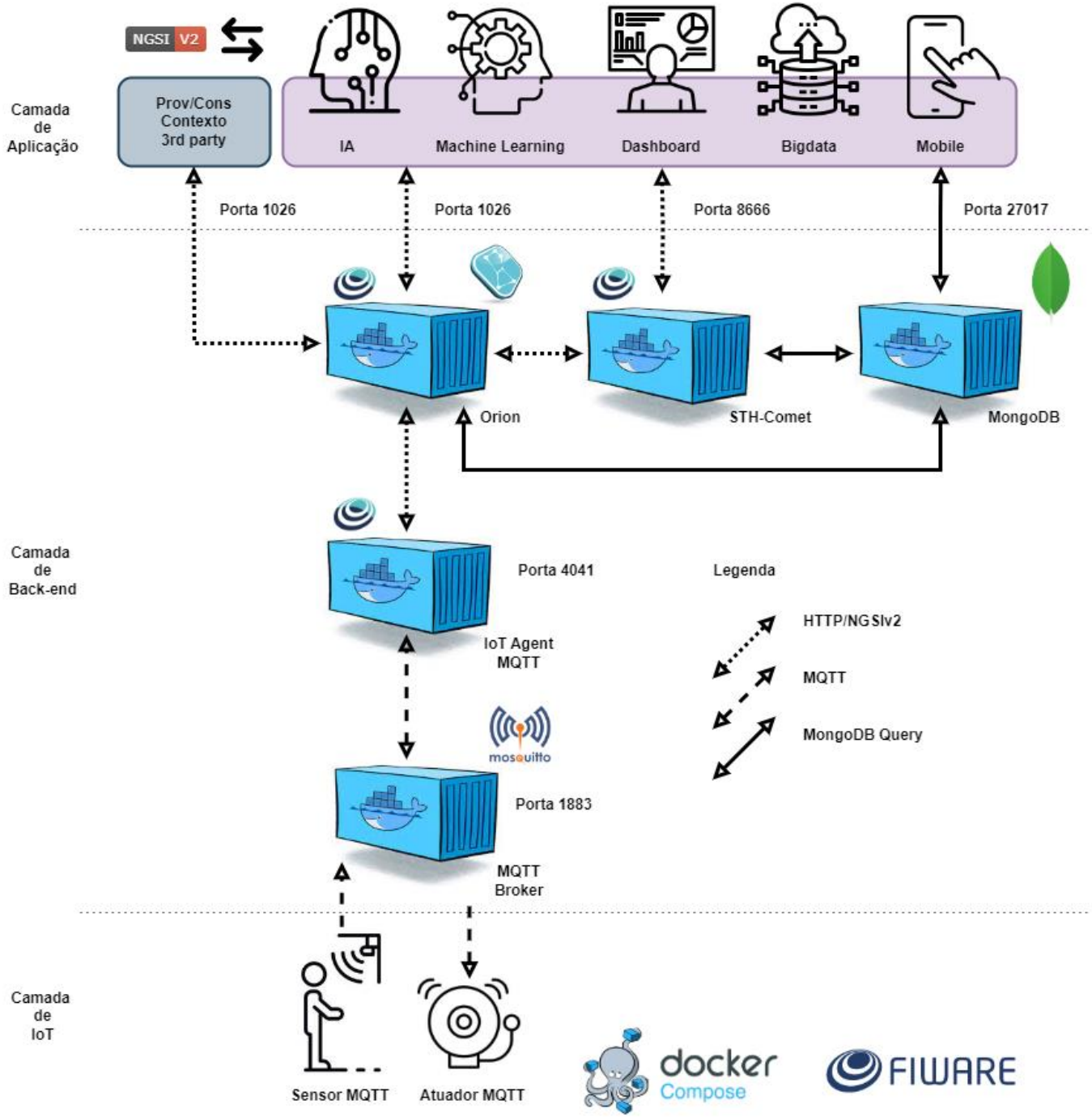
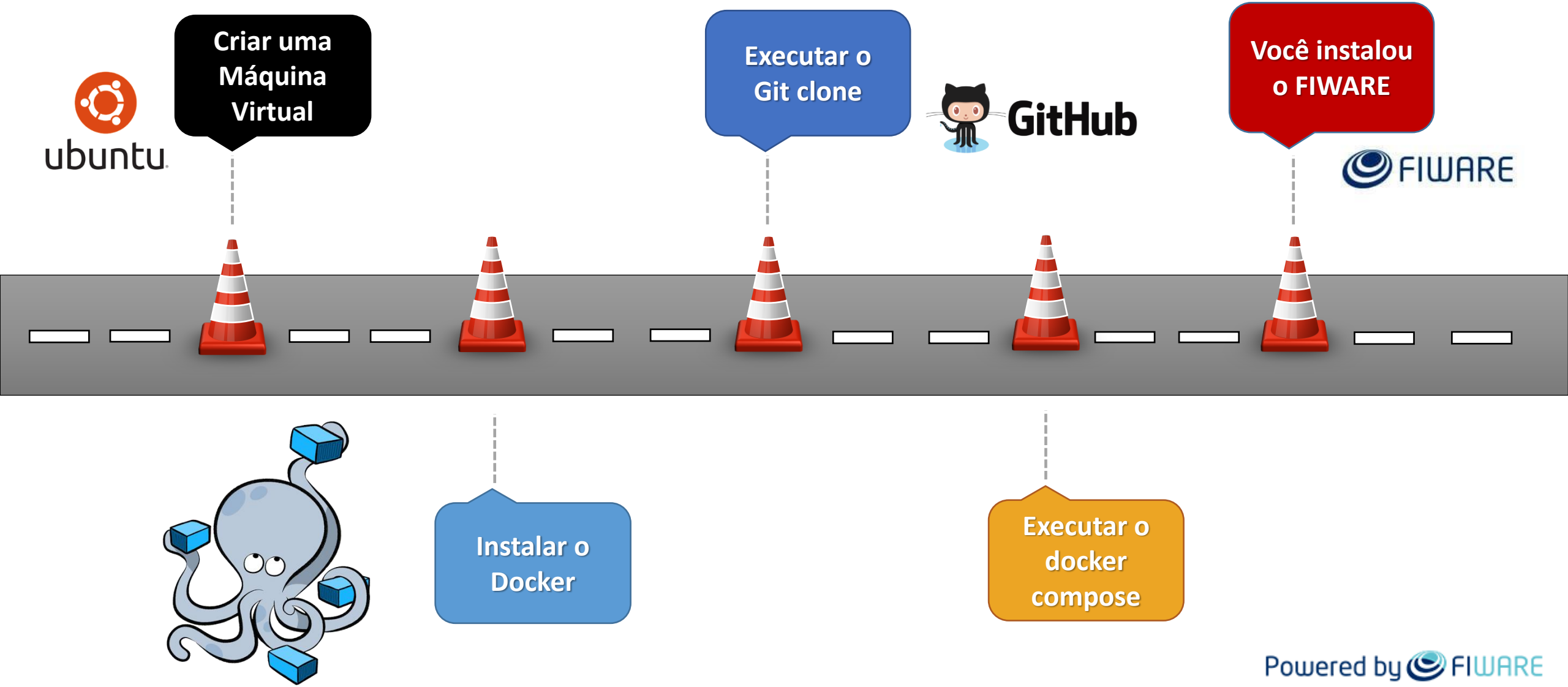
Hands-on

Arquitetura

FIWARE Descomplicado

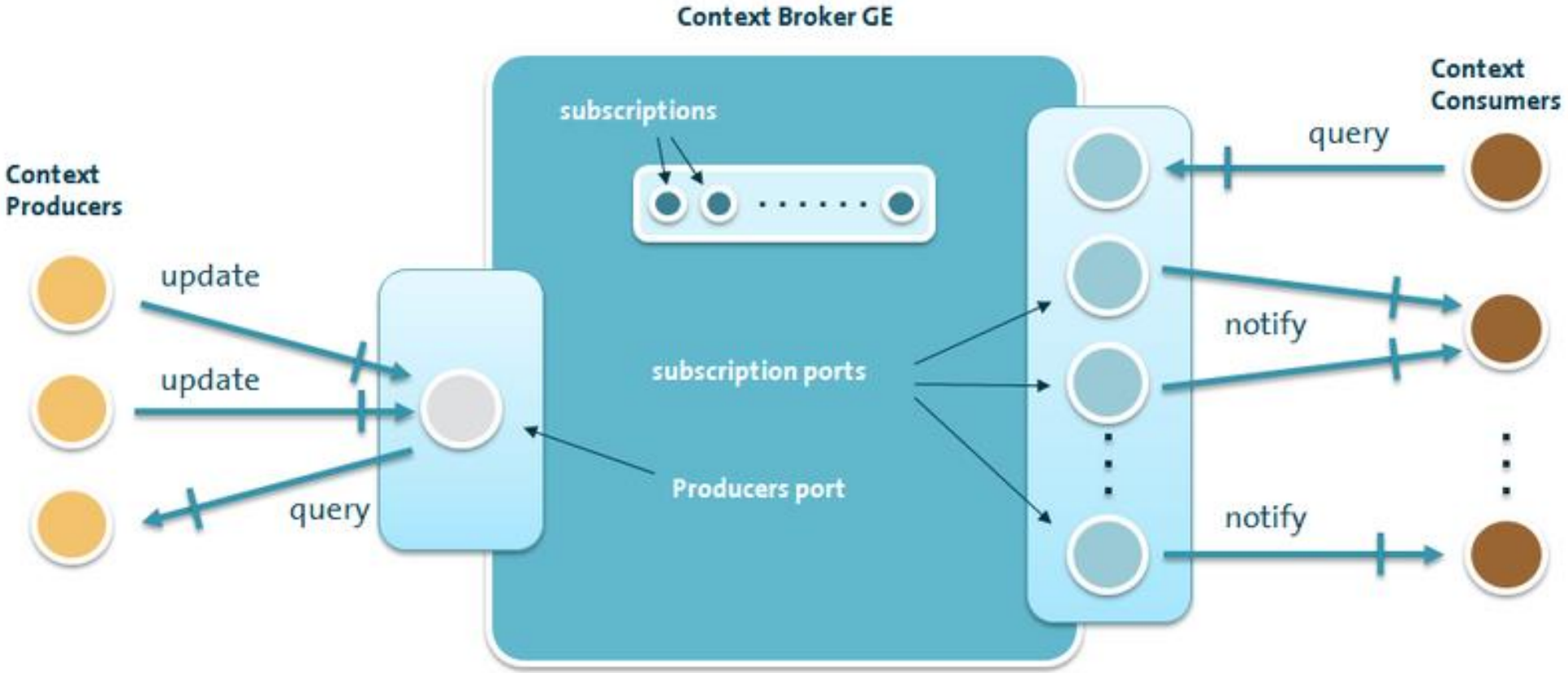


Roadmap



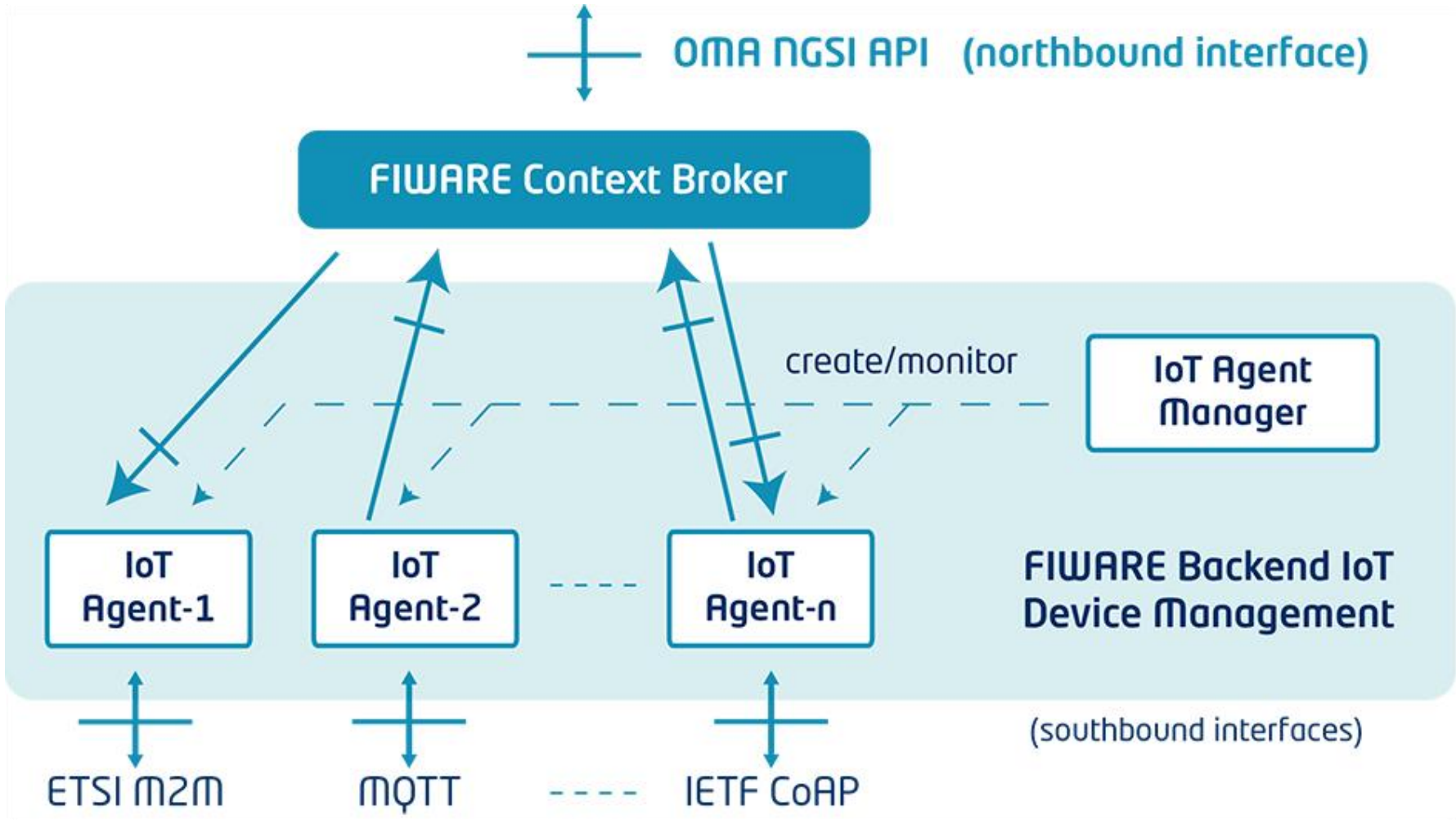
Powered by FIWARE

Orion Context Broker

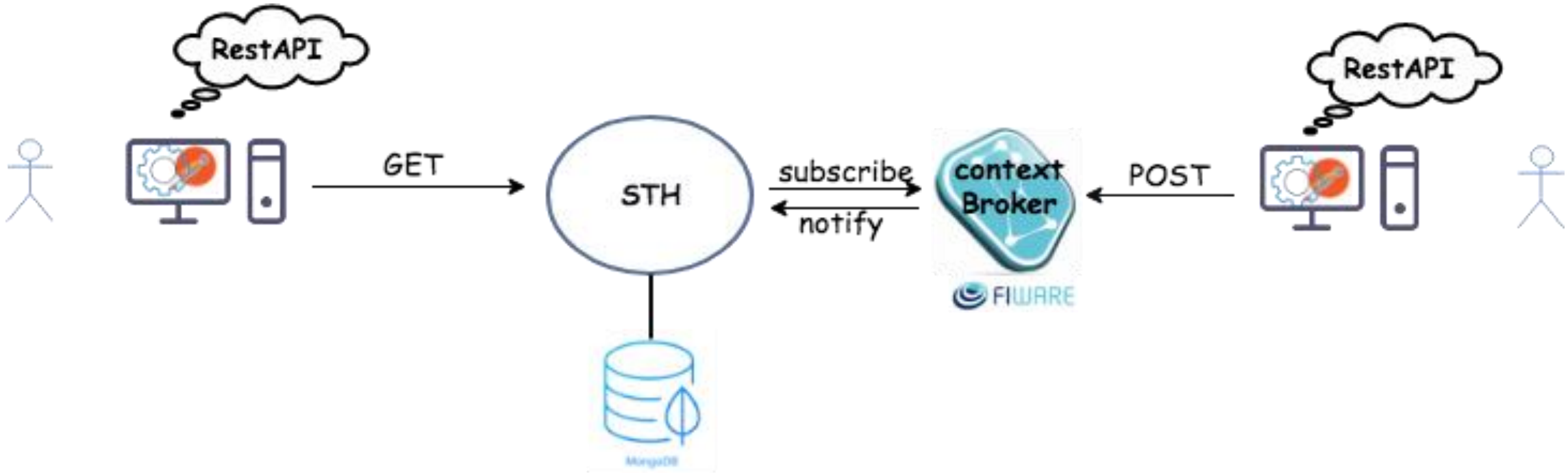


Powered by FIWARE

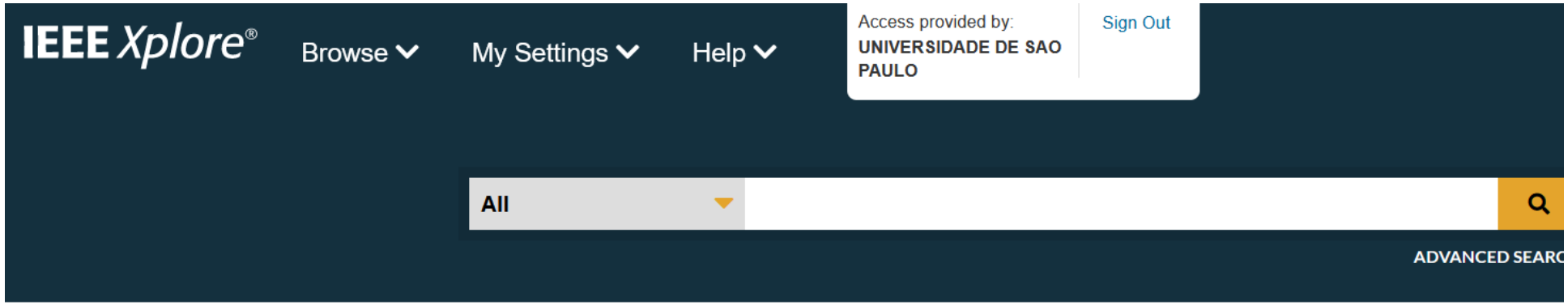
IoT Agents


OMA NGSI API (northbound interface)
FIWARE Context Broker
create/monitor
IoT Agent Manager
IoT Agent-1
IoT Agent-2
IoT Agent-n
FIWARE Backend IoT Device Management
(southbound interfaces)
ETSI M2M
MQTT
IETF CoAP

STH-Comet


RestAPI
GET
STH
subscribe
notify
context Broker
FIWARE
POST
RestAPI

IEEE



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Aveiro Tech City Living Lab: A Communication, Sensing, and Computing Platform for City Environments

Publisher: IEEE Cite This PDF

Pedro Rito ; Ana Almeida ; Andreia Figueiredo ; Christian Gomes ; Pedro Teixeira ; Rodrigo Rosma… All Authors

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Computer Networks

Computer Networks
Volume 213, 4 August 2022, 109027

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Gonçalo Vítor [a b], Pedro Rito [a], Susana Sargento [a b], Filipe Pinto [c]

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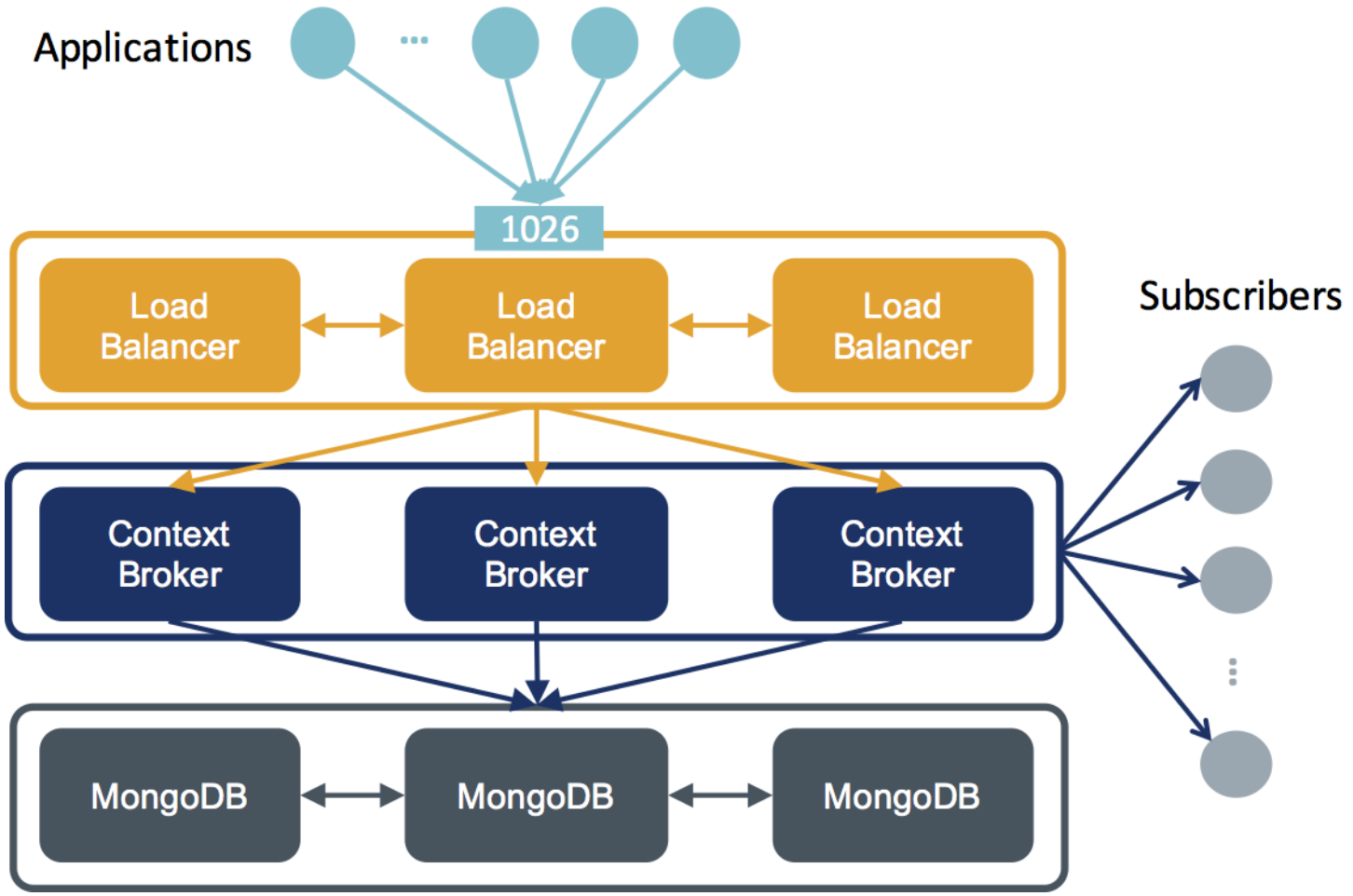
Arquitetura de alta disponibilidade



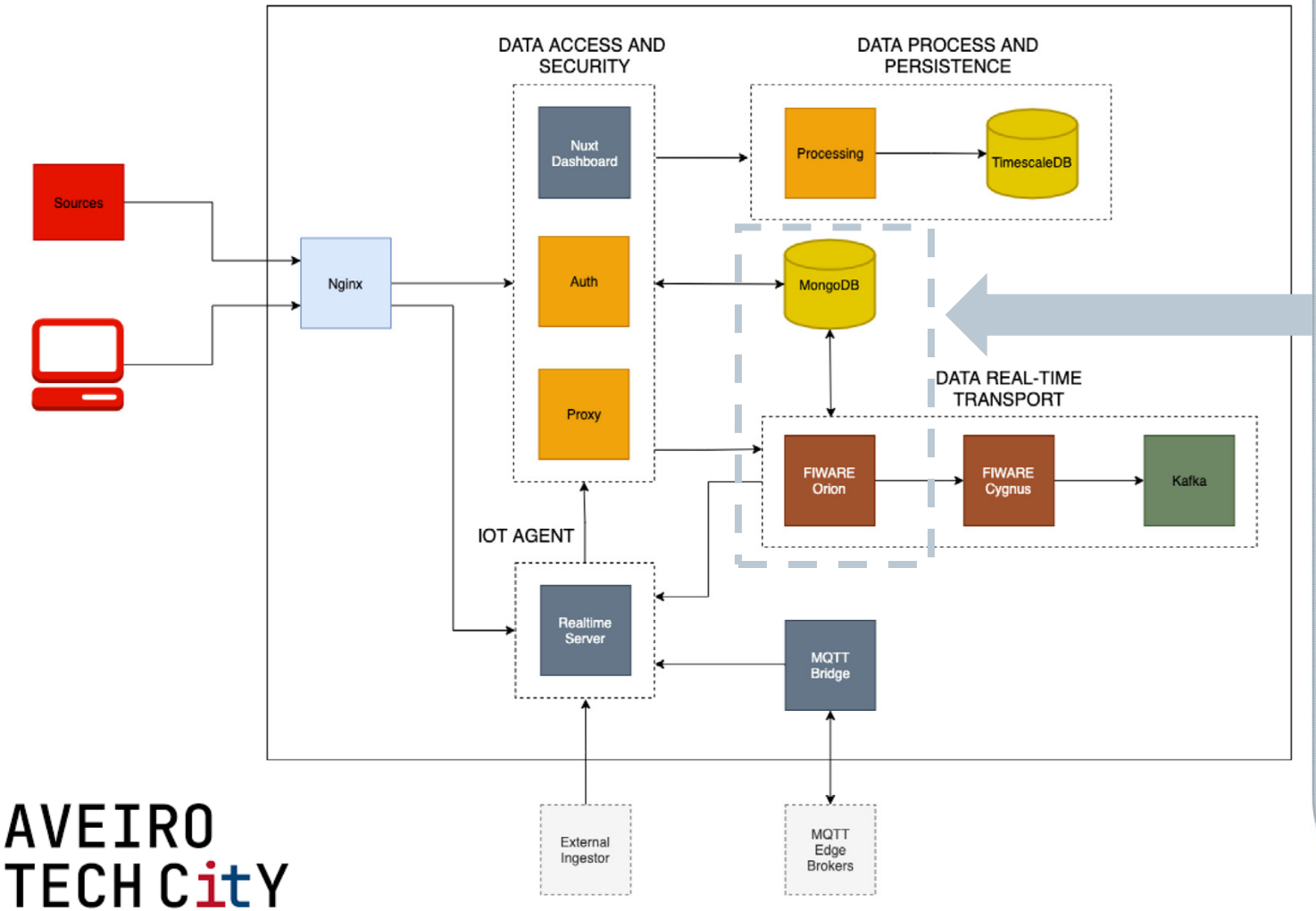
AVEIRO TECH CitY living lab

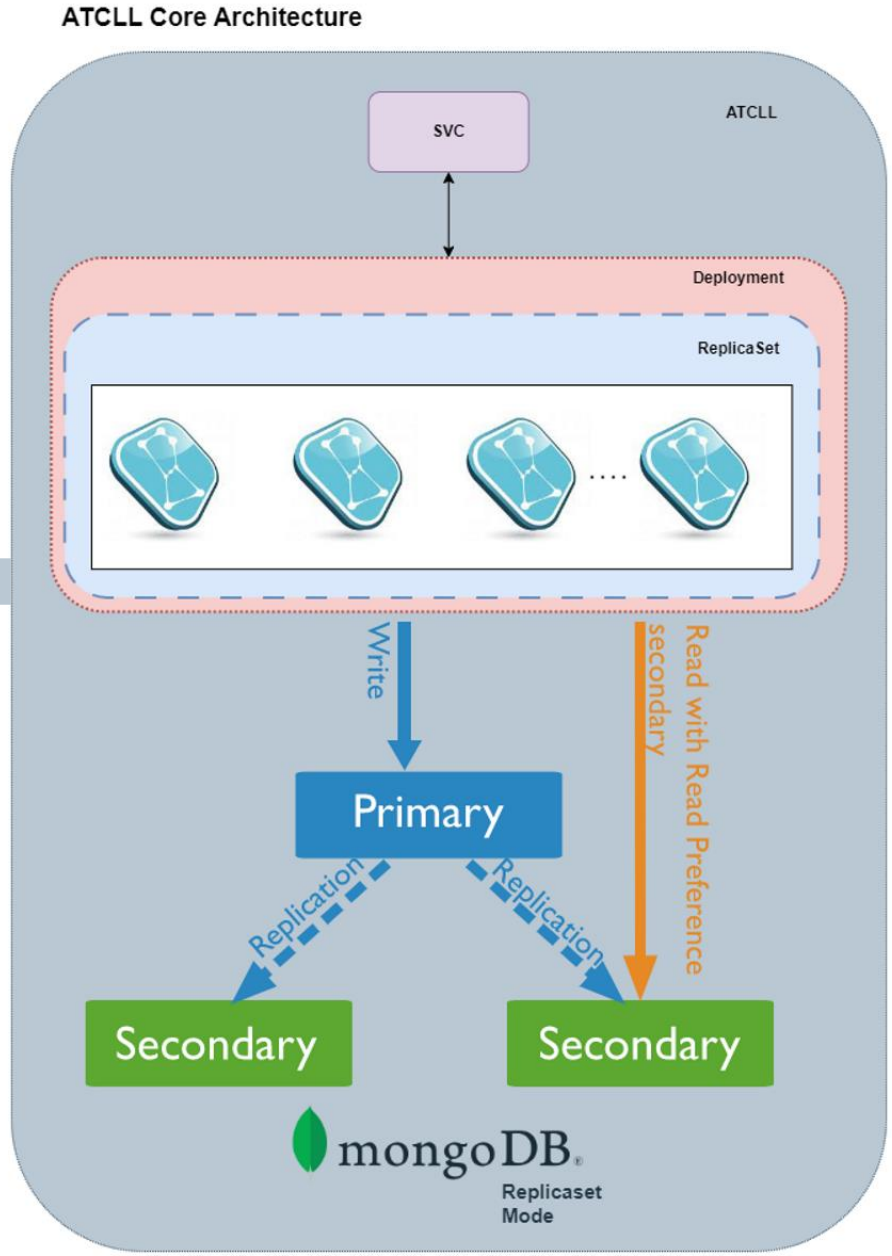
Context Broker: Orion-LD (Deployment k8s)
Service com LoadBalancer
Readnessprobe/livenessprobe
HPA - Horizontal Pod Autoscaler (uso de CPU)
Metric-Server

MongoDB: ReplicaSet Mode
Service com LoadBalancer
StatefulSet
StorageClass

kubernetes

Deployment K8S





AVEIRO TECH CITY living lab

Links

Fiware
https://www.fiware.org

Helix
https://gethelix.com.br

Helix GitHub
https://github.com/Helix-Platform/Sandbox-NG

K3D
https://k3d.io

MiniKube
https://minikube.sigs.k8s.io/docs/start/

Docker
https://www.docker.com/

Postman
https://www.postman.com/

FIWARE Descomplicado
https://github.com/fabiocabrini/fiware

Aveiro Tech City
https://www.aveirotechcity.pt/pt

Aveiro Tech City Living Lab (ATCLL)
https://aveiro-living-lab.it.pt/

Aveiro Helix Multi-layered
https://www.aveirotechcity.pt/pt/atividades/aveiro-tech-city-living-lab/projetos/helix-multi-layered

Obrigado!

fabio.cabrini@usp.br