PSI3542 SISTEMAS EMBARCADOS PARA IOT 2019

PROF. SERGIO TAKEO KOFUJI

PSI-EPUSP

AULA 02 – 06/08/2019

INTRODUÇÃO À DISCIPLINA

INTERNET DAS COISAS

Recaptulação

Aplicações de IoT

SMART ENERGY

SMART CITIES

SMART HEALTH

SMART TRANSPORT

internet of things

SMART LIVING

SMART HOMES

SMART INDUSTRY

SMART AGRICULTURE

ANIMAL TRACKING

FUTURE FARMS
small and smart

SURVEY DRONES

Aerial drones survey the fields, mapping weeds, yield and soil variation. This enables precise application of inputs, mapping spread of pernicious weed blackgrass could increasing Wheat yields by 2-5%.

FLEET OF AGRIBOTS

A herd of specialised agribots tend to crops, weeding, fertilising and harvesting. Robots capable of microdot application of fertiliser reduce fertiliser cost by 99.9%.

FARMING DATA

The farm generates vast quantities of rich and varied data. This is stored in the cloud. Data can be used as digital evidence reducing time spent completing grant applications or carrying out farm inspections saving on average £5,500 per farm per year.

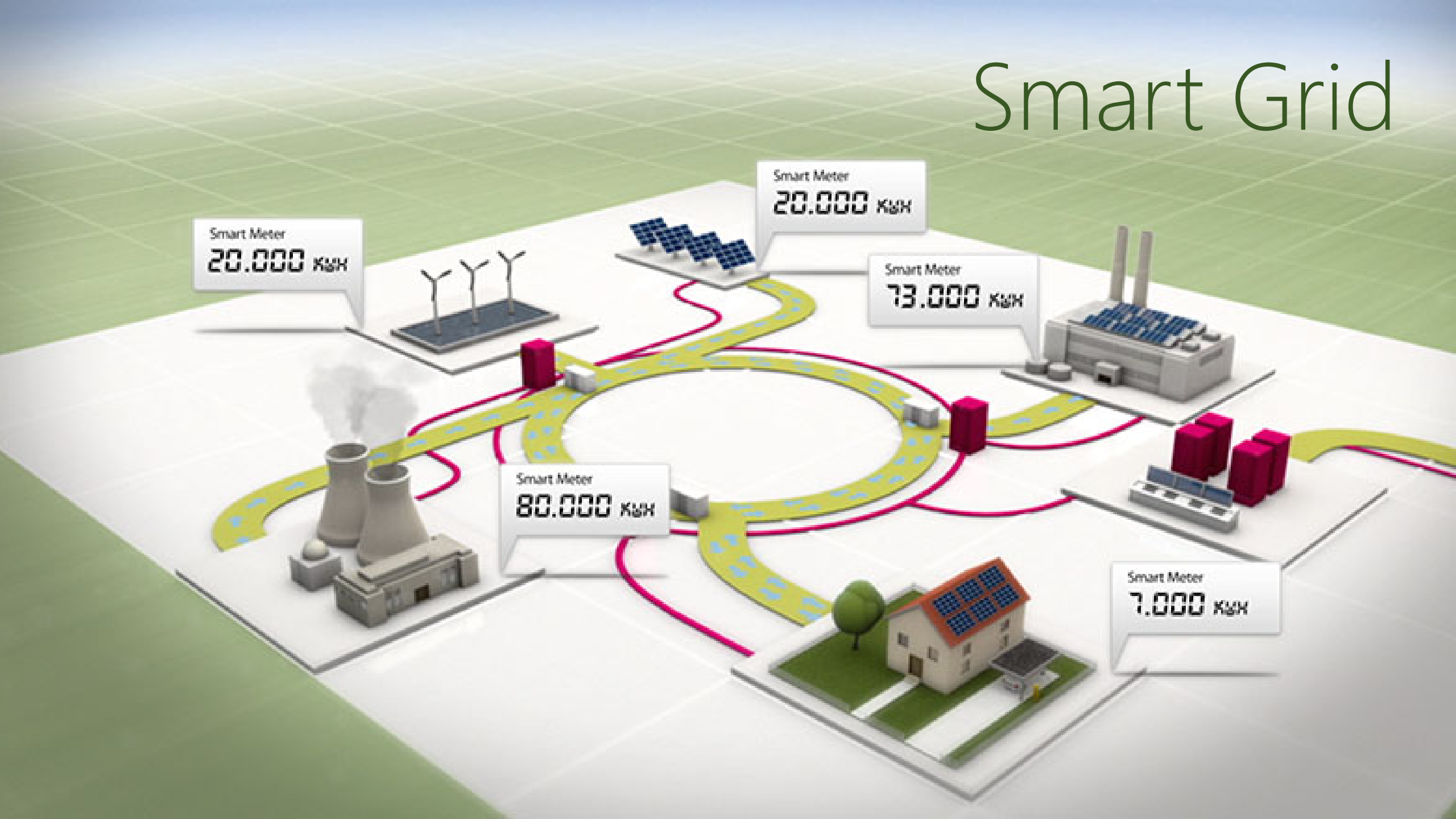
TEXTING COWS

Sensors attached to livestock allowing monitoring of animal health and wellbeing. They can send texts to alert farmers when a cow goes into labour or develops infection increasing herd survival and increasing milk yields by 10%.

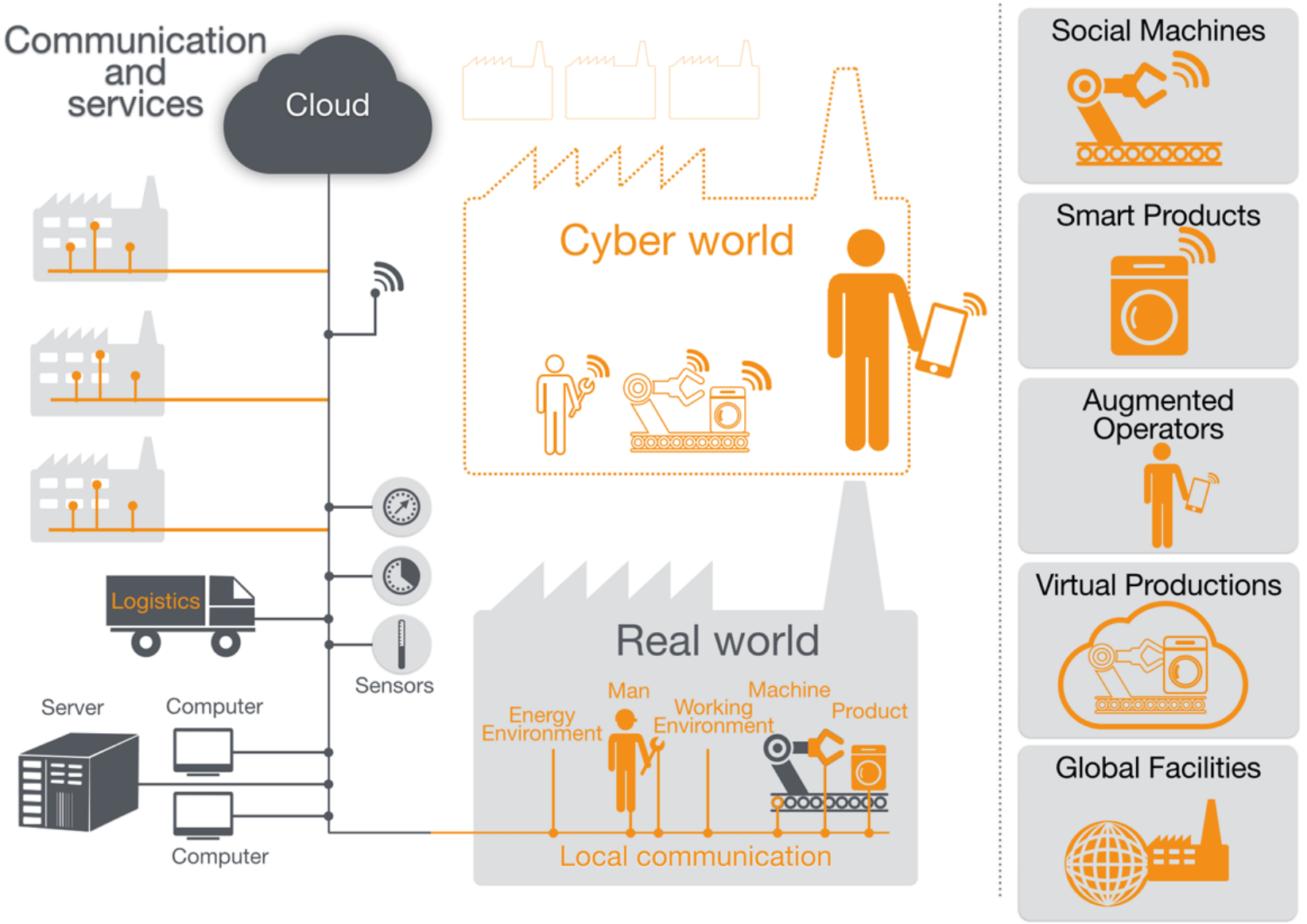
SMART TRACTORS

GPS controlled steering and optimised route planning reduces soil erosion, saving fuel costs by 10%.

Smart Grid


Smart Meter
20.000 KWH
Smart Meter
20.000 KWH
Smart Meter
73.000 KWH
Smart Meter
80.000 KWH
Smart Meter
7.000 KWH

Indústria 4.0



Energia e Recursos Hídricos

Water

Integrar-se com uma variedade de fontes de dados para acompanhar os esforços de conservação e obter insights para melhorar as operações existentes.

CITY GOVERNMENT

UTILITY INDUSTRY

RESEARCH

Use dados praticamente em tempo real sobre eventos climáticos para antecipar as mudanças na disponibilidade de recursos ou necessidades.

Lake

Aquifer

Gerenciar fontes de água e de energia a partir de um local remoto, controle de fluxo e uso definido por processos automatizados.

THIRD-PARTY PROVIDERS

Aumentar a visibilidade das instalações de ativos e melhorar o desempenho com dashboards e análise de dados de desempenho.

Utilização de dados históricos para prever necessidades e colaborar com os fornecedores de água de terceiros para atender à demanda.

Proporcionar aos cidadãos uma maior visibilidade do consumo de recursos residenciais e da comunidade, para conduzir os esforços na conservação.

City Leaders

Utilizar dados para descobrir insights que impulsionam a mudança política, melhorar os procedimentos e aumentar o serviço aos cidadãos.

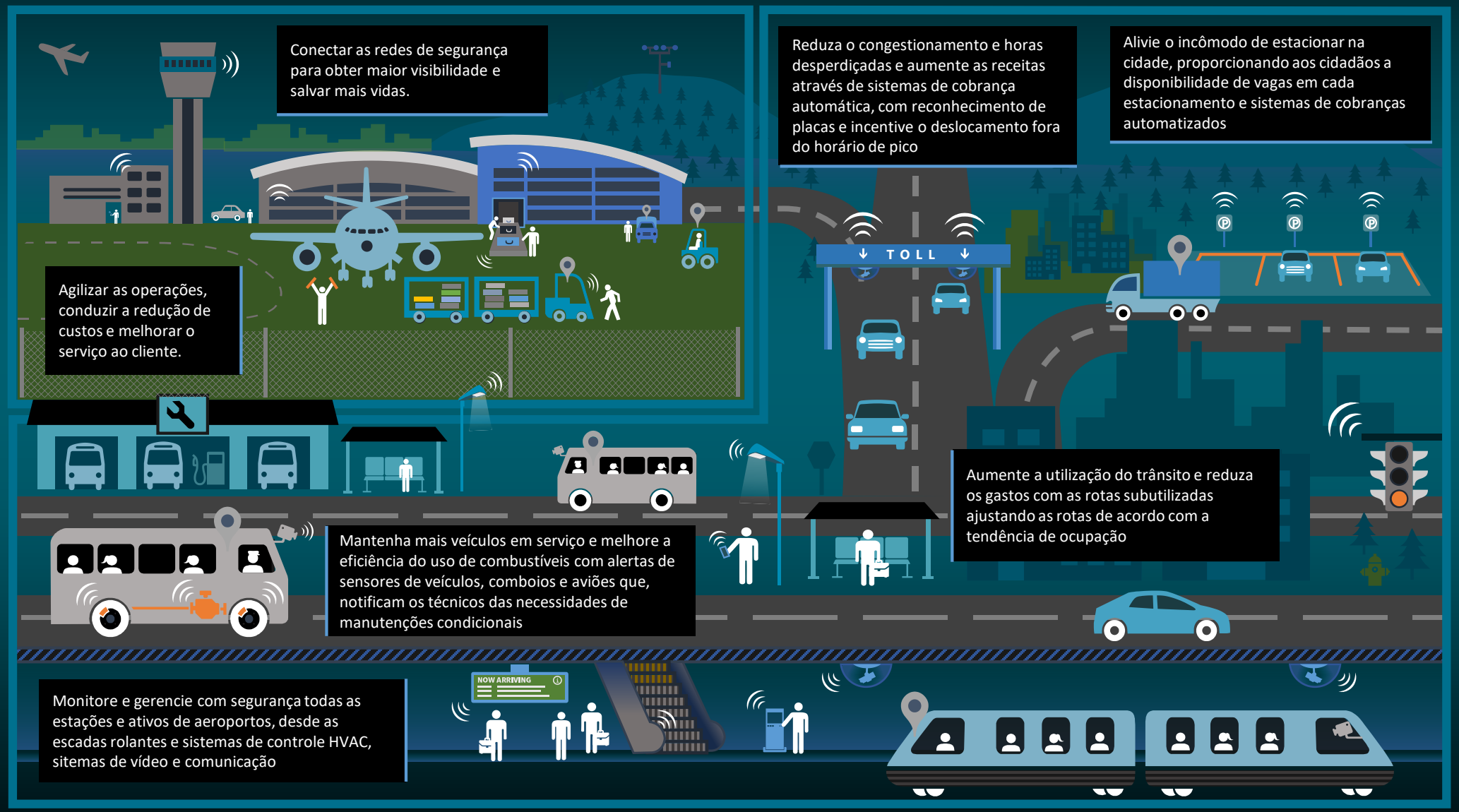
Worker

Acompanhar os esforços de conservação e melhorar a precisão da cobrança com a leitura de medidores de água com mais freqüência.

Citizen

Colaborar com os cidadãos interessados com relatórios de consumo individuais e da sua região.

Sistemas de Transporte Inteligente



City Manager

Alivie o congestionamento para salvar horas desperdiçadas e recursos, aumente a consciência ambiental para ter um ar mais limpo e uma menor emissão de carbono

Fleet Manager

Monitore frotas de forma centralizada e reduza os custos de manutenção por meio da análise de dados de todo o sistema

Citizen

Proporcionar aos cidadãos uma melhor experiencia no trânsito fornecendo informações digitais dos serviços em dispositivos móveis

Saúde

PATIENT HOME

Monitorar a condição dos pacientes com o uso de dispositivos médicos que alertam a equipe sobre os cuidados no momento em os eventos ocorrem.

Transforme o veículo em um ambiente inteligente que monitora os indicadores de saúde.

HOSPITAL

Permita uma experiência interativa entre pacientes e equipes de cuidados médicos afim de reduzir os tempos de resposta e forneça acesso remoto aos dados mais recentes dos pacientes.

Conecte os dados do paciente de uma forma mais contextual, com isso, os dados mais recentes do pacientes são exibidos automaticamente em dispositivos com base em sua localização e função.

Combine dados de várias fontes para descobrir insights que permitem uma jornada aprimorada do paciente, maior eficiência operacional e melhor gestão de risco.

Tornar os dados pacientes visíveis e acionáveis quase em tempo real, permitindo uma melhor tomada de decisão, melhor coordenação e redução de erros.

OUTPATIENT FACILITY

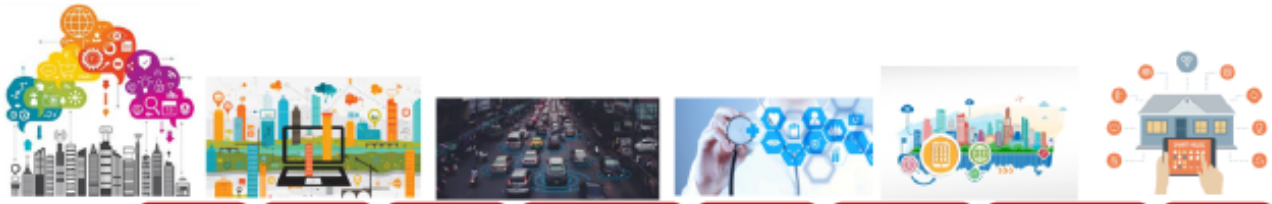
Tornar os dados do paciente acessíveis de um ponto central, permitindo uma visão holística da jornada do paciente, assim, os provedores de saúde podem otimizar cada interação com o paciente.

HEALTHCARE ECOSYSTEM

Integre dados de fontes existentes e não-tradicionais para obter uma análise de grande volume de dados, permitindo assim a transformação do processo de inovação da saúde.

Segurança Pública e Defesa Civil


COST EFFECTIVE
SENSOR NETWORK
EMBEDDED SYSTEM
SECURITY & PRIVACY
SOFTWARE
DATA & SIGNAL PROCESSING
COMMUNICATION
INTEROPERABILITY
CLOUD COMPUTING
NETWORK TECHNOLOGY
IDENTIFICATION
FUTURE INTERNET
NETWORK MANAGMENT
DATA MANAGMENT
PROTOCOL/ STANDARDS
SYSTEM INTEGRATION
NANOELECTRONICS
HARDWARE
DISCOVERY SERVICES
POWER & ENERGY STORAGE
SEMICODUCTOR ELECTRONICS
INTERNET of THINGS



SMART LIVING | SMART CITIES | SMART ENERGY | SMART TRANSPORT | SMART HEALTH | SMART INDUSTRY | SMART BUILDINGS | SMART HOMES

APPLICATION LAYER

- IOT APPLICATIONS

SERVICE SUPPORT & APPLICATION SUPPORT LAYER

- VIRTUAL ENTITY
- VIRTUAL ENTITY & IOT SERVICE MANAGMENT
- VIRTUAL ENTITY SERVICE
- IOT BUSINESS PROCESS MANAGMENT
- BUSINESS PROCESS EXECUTION
- BUSINESS PROCESS MODELING
- MANGMENT CAPABILITIES
- GENERIC/SPECIFIC MANAGMENT
- DEVICE MANAGER
- QOS MANAGER
- SECURITY
- AUTHENTICATION
- IDENTITY MANGMT
- ACEESS CONTROL
- ENCRYPTION
- DATA MANGMENT
- DATA GOVERNENCE
- DATA QUALITY MANGMT
- DATA MINING
- ANLYTICS PLATFORM
- IN MOTION ANALITICS
- PREDICTIVE ANALITICS
- STATISTICAL ANALITICS

NETWORK / COMMUNICATION LAYER

- NETWORKING CAPABILITY
- TRANSPORT CAPABILITY
- GATEWAY NETWORK
  - WI-FI
  - GSM/GPRS
  - LTE
  - ETHERNET
- GATEWAY
  - EMEDDED & SIGNALPROSESSOR
  - OS
  - SIM MODULE
  - MICROCONTROLLER

SMART DEVICE / SENSOR LAYER

- SENSOR NETWORKS
  - WI-FI
  - ZigBee
  - ETHERNET
  - BLUETOOTH
  - UWB
  - WIRED
- SENSORS
  - ANALOG
  - DIGITAL
  - RFID
  - ELECTRO-MECH
  - PHOTO-ELECTRIC
  - GPS
  - SOLID STATE
  - INFRA-RED
  - GYROSCOPE
  - ELECTRO-CHEMICAL
- WSN
- devices

TECHNOLOGY	FUTURE DEVELOPMENT	RESEARCH NEEDS
Hardware Devices	•Nanotechnology •Miniaturization of chipsets •Ultra low power circuits	•Low cost modular devices •Ultra low power EPROM/FRAM •Autonomous circuits
SENSOR	•Smart sensors (bio-chemical) •More sensors (tiny sensors) •Low power sensors •Wireless sensor network for sensor connectivity	•Self powering sensors • Intelligence of sensors
Communication Technology	•On chip antennas •Wide spectrum and spectrum aware protocols •Unified protocol over wide Spectrum •Multi-functional reconfigurable chips	•Protocols for interoperability •Multi-protocol chips •Gateway convergence •On chip networks •Longer range (higher frequencies – tenths of GHz) •5G developments
Network Technology	•Self aware and self organizing networks •Self-learning, self-repairing networks •IPv6- enabled scalability •Ubiquitous IPv6-based IoT deployment	•Grid/Cloud network •Software defined networks •Service based network •Need based network
Software and algorithms	•Goal oriented software •Distributed intelligence, problem solving •User oriented software	•Context aware software •Evolving software •Self reusable software •Autonomous things: •Self configurable •Self healing •Self management
Data and Signal Processing Technology	•Context aware data processing and data responses •Cognitive processing and optimization •IoT complex data analysis •IoT intelligent data visualization •Energy, frequency spectrum aware data processing	•Common sensor ontology •Distributed energy efficient data processing •Autonomous computing
Discovery and Search Engine Technologies	•Automatic route tagging and identification management centers •On demand service discovery/integration	•Scalable Discovery services for connecting things with services
Security & Privacy Technologies	•User centric context-aware privacy and privacy policies •Privacy aware data processing •Security and privacy profiles selection based on security and privacy need	•Low cost, secure and high performance identification/ authentication devices •Decentralized approaches to privacy by information localization

Aula02- Objetivos de Aprendizado

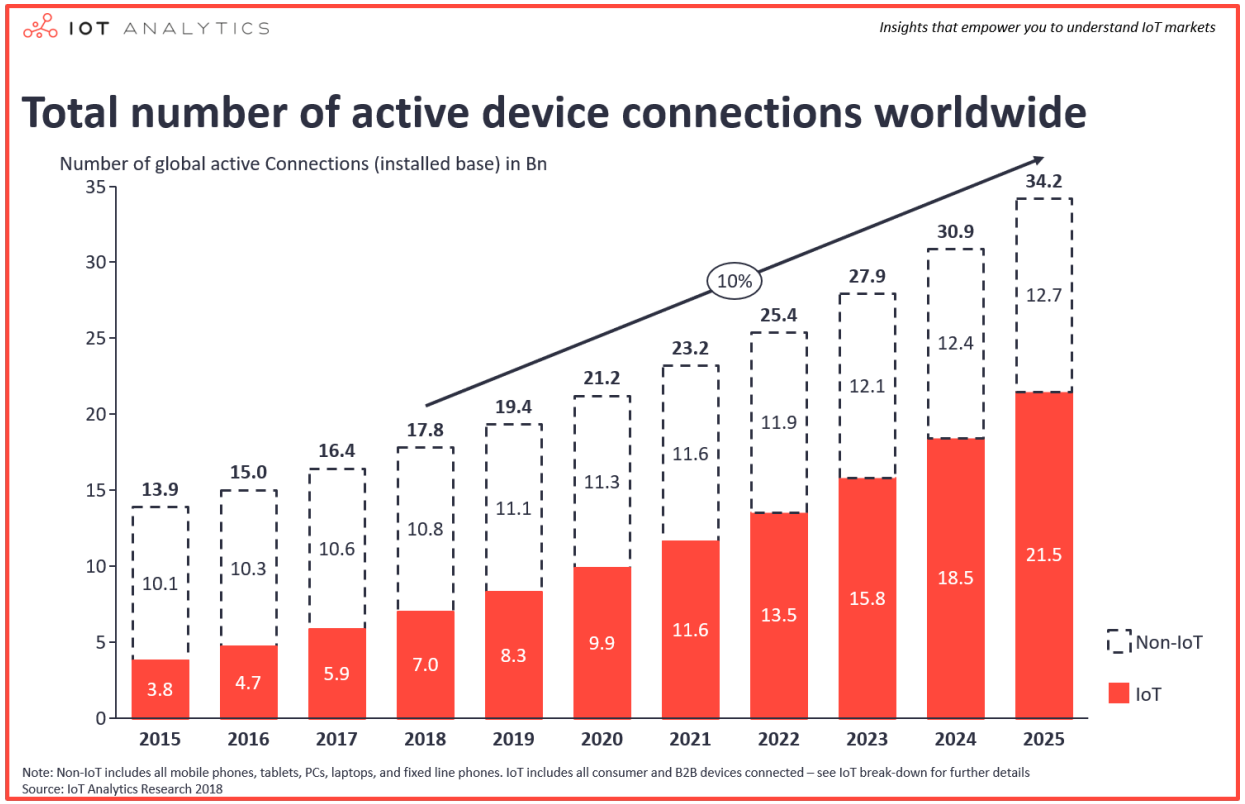
O aluno deve conhecer os dispositivos de IoT, tipos, formas de Comunicação e plataformas de Dashboards.

Dispositivos Sensores e Atuadores

Smartphone como Dispositivo IOT

Freeboard

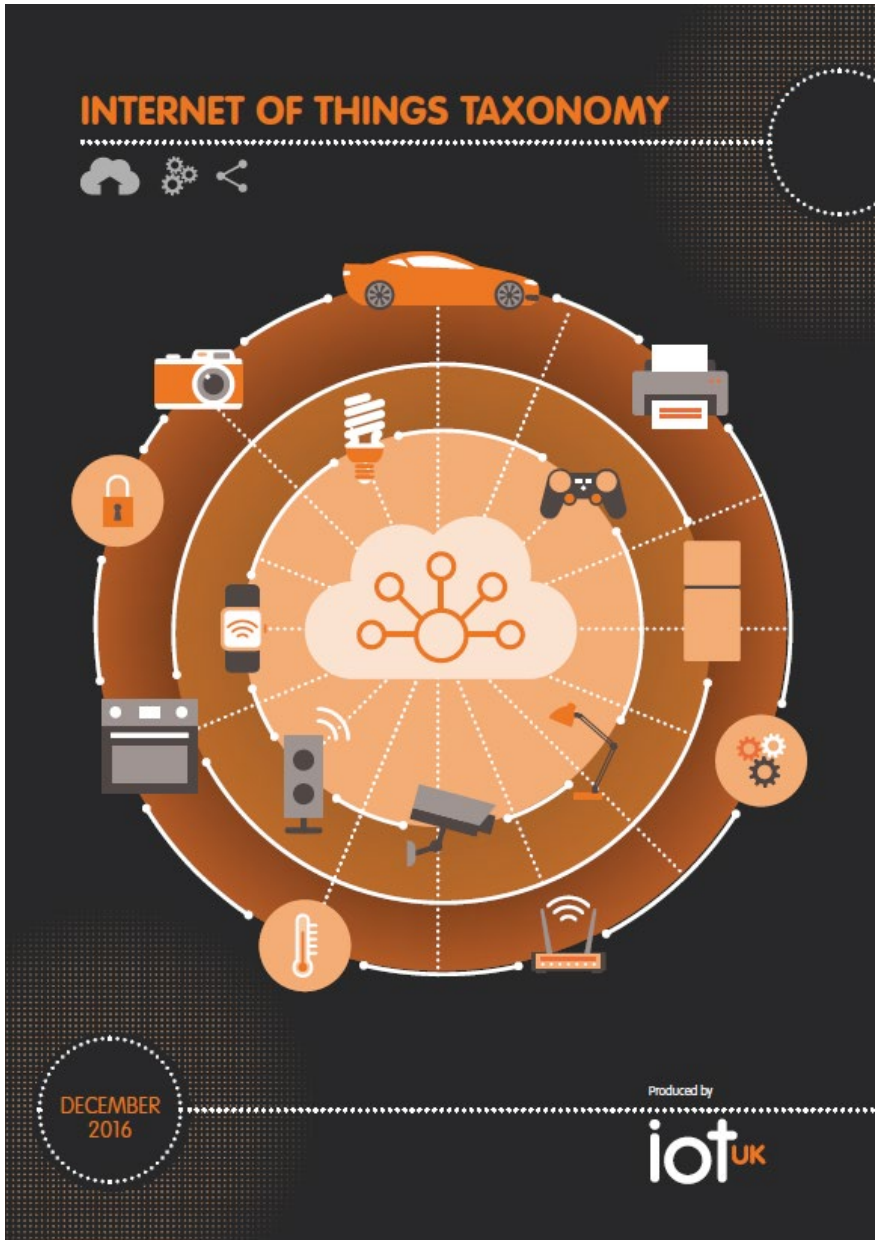
Pratica



- https://www.softwaretestinghelp.com/iot-devices/
- Numero de dispositivos IoT em 2018/2019
- https://iot-analytics.com/state-of-the-iot-update-q1-q2-2018-number-of-iot-devices-now-7b/

Dispositivos IOT

Taxonomia - https://iotuk.org.uk/wp-content/uploads/2017/01/IOT-Taxonomy-Report.pdf



Classificação de Sistemas (Projetos) de IOT

Complexidade Técnica

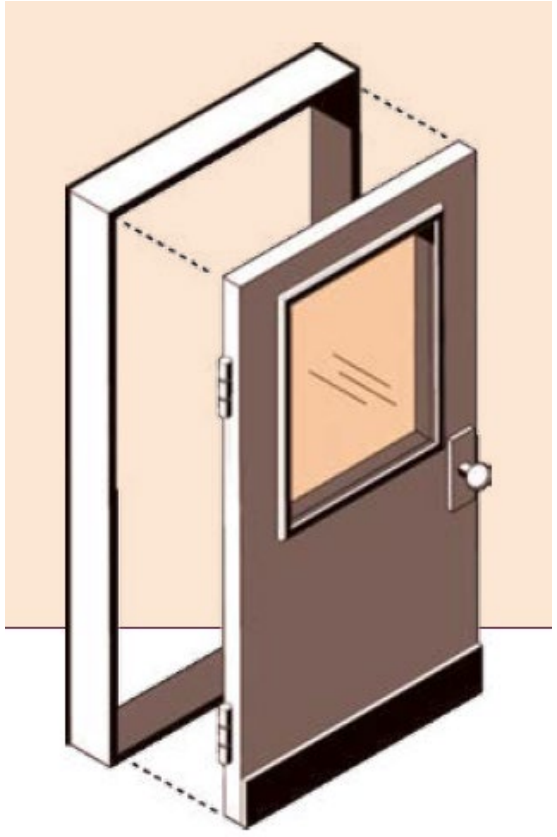
Safety, Security, Privacy

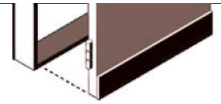
Data Sharing


SECURITY
RETAIL
SOCIETY
HEALTHCARE
HOME
ENERGY
MOBILITY
H

TCom Level	Description	Examples
0	Dumb/passive objects. Not connected, identified or monitored	Any unconnected, unidentified object
1	Identifiable dumb/passive objects with a virtual existence that can meaningfully be counted/ tracked by online systems	RFID Tags, barcoded or QR-coded objects
2	Connected objects. Objects linked to an IP network, with some means of reading, programming or controlling them. These should be counted as elements within the IoT universe, but they are often underused assets.	Printers, doorbells, IP connected fire alarms or security systems
3	Connected broadly homogeneous objects in a simple integrated system, whether the benefit of that system accrues to the end user or the system provider	Networks of multiple temperature sensors within a single building or campus. Environmental monitoring networks, wearable devices (such as Fitbit or other wellness technologies)
4	Connected heterogeneous objects in a single, integrated system. This involves taking data from a variety of sensors of different types, all deployed for the same end user or organisation to help improve processes, make better decisions or change outcomes.	The deployment of a range of sensors in a care home or hospital or the combination of parking, traffic volume and traffic control data in an urban road management system
5	Different objects deployed across multiple interconnected systems for multiple organisations, in multiple locations, all within a similar domain. System supports analysis of aggregated data derived from all deployment locations.	Partnering university campuses' security cameras, fire alarms, temperature sensors, access control systems and energy monitoring systems integrated into a single unified control and monitoring solution
6	As for TCom 5, but where multiple domains are connected. This involves gathering data from a variety of sensor types, across a variety of systems and ecosystems, and creating combined views of the data that offer new sources of value (economic or social) or where there is a high degree of automation across homogeneous systems	Smart cities where multiple organisations, or different city departments and their partners, have built applications that draw on diverse sets of data from multiple sources to develop or improve services. Such applications might include the adjustment of street lighting in response to incoming data on night-time police activity levels, or the adjustment of traffic lights in response to real-time data sources about local environment data, or current people movement data based on mobile phone location data. Or, in the second case, the automated adjustment of environmental controls across a service provider's care estate based on real-time data feeds from sensors deployed in those settings.
7	As for TCom 6, but involving both multiple ecosystems and a high degree of automation	A smart city solution drawing data from multiple providers and sources, which is then used for automated traffic control and routing of emergency services, or the automated adjustment of traffic lights based on real-time mobile phone location data

Exemplo



TCOM 0	Door	
TCOM 1	Identifiable door	The door is being made at factory X in Sweden, by company Y, using wood from source Z, and was at this stage in the supply chain
TCOM 2	Single door with networked alarm	A door has been opened
TCOM 3	One of many interconnected remotely controllable alarmed doors in building-wide alarm solution	Several doors have been opened - close and lock them all
TCOM 4	One of many devices (connected doors, fire alarms, cameras, temperature sensors, personnel tags) comprising a complete integrated building access and alarm solution	Cameras and temperature sensors confirm a fire in stock room. Open all fire doors and sound alarm
TCOM 5	Many doors and other devices within multiple interconnected building access and alarm solutions across multiple properties	Security door has been opened in campus building, and expensive equipment moved. Doors used and location tracking show the equipment has been hidden in building nearby. Route security to ...
TCOM 6	Sophisticated emergency services solution taking building data (temperature, access control, people location) and external environment data (location of emergency services teams, skill sets of available people, people flows, traffic flows, weather, visibility data) to enable sophisticated emergency coordination decision-making	Fire in stock room near identified chemicals. Open all external fire doors. Seal stock room door. Use traffic system to route traffic away. Provide camera feed to emergency services. Request services of nearest qualified emergency personnel.
TCOM 7	As TCom 6 but response actions all undertaken automatically (ie without human intervention or approval)	Fire in stock room near identified chemicals. All external fire doors automatically opened. Stock room door auto-sealed. Traffic control system automatically routes traffic away. Appropriate emergency personnel automatically contacted.

System Security Level

SSL	Description	Examples
0	No data involved, no control of the system	
1	No sensitive data involved, no control of the objects in the system	Wireless doorbell
2	System provides anonymous, aggregated statistics, no control of the system	Remote temperature sensors
3	System generates sensitive data or supports some degree of remote control of the system objects	Biometric data, door actuation mechanisms
4	System generates sensitive data, supports some degree of remote control of the system objects and connects with external systems	Integrated facilities management systems, tele-health monitoring, security and safety systems

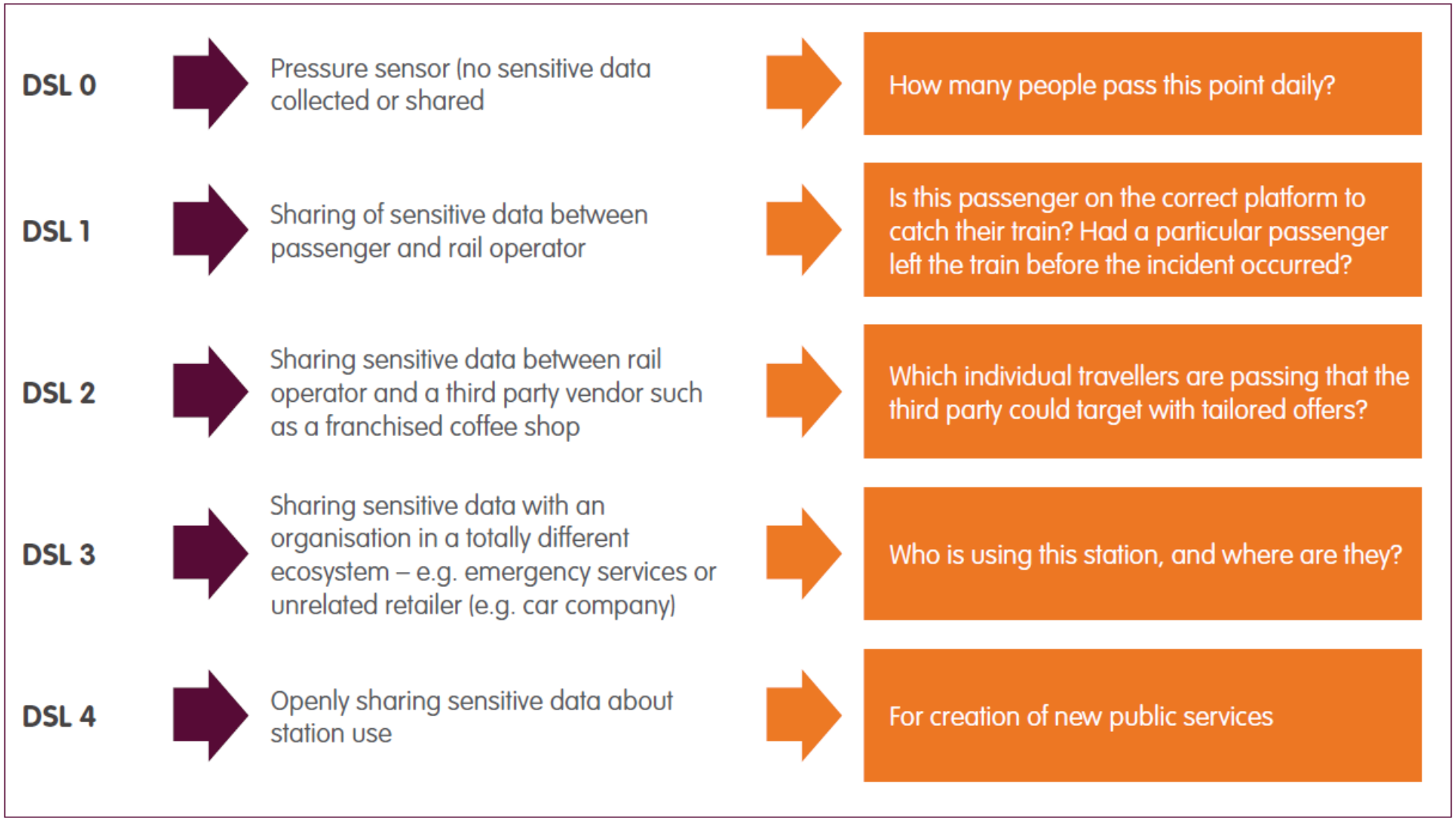
Figure 2 – Illustration of increasing system sensitivity of an IoT deployment

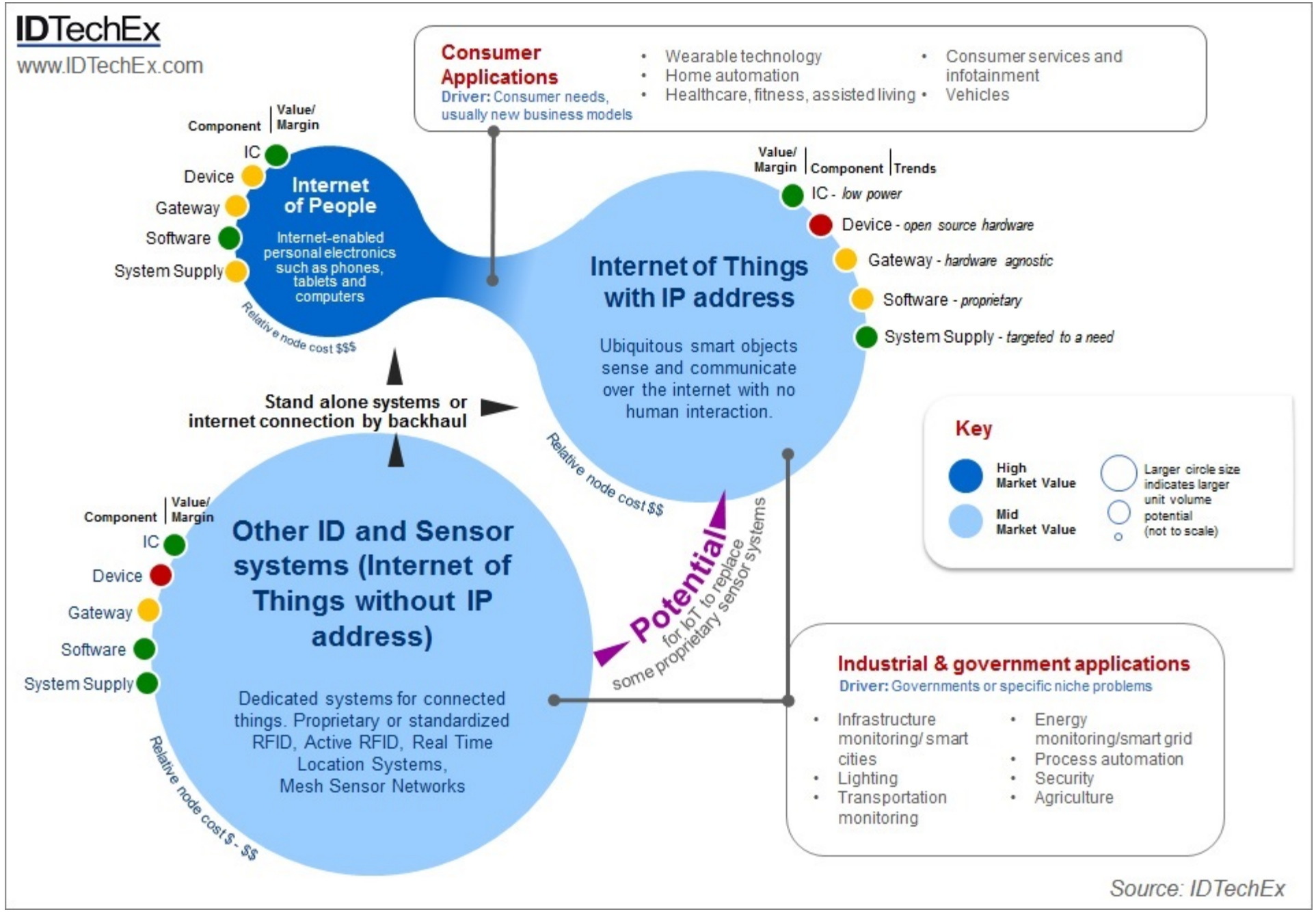
SSL 0	Car	
SSL 1	Car with seat sensor	Is anyone in the car?
SSL 2	Car with camera; or car with sensor and control	Who is in the car? Or, if someone is in the car, turn on air conditioning
SSL 3	Car with camera and control	Monitor who is in the driving seat. Prevent engine from starting if the driver is too young or has no valid licence
SSL 4	Car with camera, multiple sensors, controls, links to wider systems	Monitor the health of the car's driver. Assume automatic control of the vehicle if the driver becomes ill or distracted; alter traffic lights and bring car to a safe stop.

Data Sharing Level

DSL	Description	Examples
0	No data is shared	Simple point-to-point monitoring systems such as consumer weather stations and wireless doorbells
1	Basic sharing between two parties: agreed sharing of sensitive data between the customer/buyer/user and the seller or provider (whether that seller or provider operates in the commercial or public sector)	Cloud-based security systems, remote cameras, home monitoring systems
2	Third person sharing: sharing of sensitive data between the seller or provider and unrelated third parties in a commercial context.	Person tracking information to support targeted marketing offers
3	Multi-domain and third-party sharing: sharing of sensitive data between the customer/buyer/user and multiple sellers or providers involved in delivering services, where those providers come from different ecosystems (including the commercial and public sectors)	The aggregation of parking, traffic and environmental data in an urban traffic management application
4	Open access to sensitive data, including data generated through use of public finance or infrastructure	Integration of multiple security systems in a public safety context

Figure 3 – How the degree of data sharing can influence the complexity of deploying an IoT solution




IDTechEx
www.IDTechEx.com
Consumer Applications
Driver: Consumer needs, usually new business models
• Wearable technology
• Home automation
• Healthcare, fitness, assisted living
• Consumer services and infotainment
• Vehicles
Component
Value/ Margin
IC
Device
Gateway
Software
System Supply
Internet of People
Internet-enabled personal electronics such as phones, tablets and computers
Relative node cost $$$
Value/ Margin
Component
Trends
IC - low power
Device - open source hardware
Gateway - hardware agnostic
Software - proprietary
System Supply - targeted to a need
Internet of Things with IP address
Ubiquitous smart objects sense and communicate over the internet with no human interaction.
Relative node cost $$
Stand alone systems or internet connection by backhaul
Component
Value/ Margin
IC
Device
Gateway
Software
System Supply
Other ID and Sensor systems (Internet of Things without IP address)
Dedicated systems for connected things. Proprietary or standardized RFID, Active RFID, Real Time Location Systems, Mesh Sensor Networks
Relative node cost $ - $$
Potential
for IoT to replace some proprietary sensor systems
Key
High Market Value
Mid Market Value
Larger circle size indicates larger unit volume potential (not to scale)
Industrial & government applications
Driver: Governments or specific niche problems
• Infrastructure monitoring/ smart cities
• Lighting
• Transportation monitoring
• Energy monitoring/smart grid
• Process automation
• Security
• Agriculture
Source: IDTechEx

Classificação de Dispositivos IoT Sensores

- https://journal-bcs.springeropen.com/articles/10.1186/s13173-019-0085-7/tables/3
- An IoT sensor and scenario survey for data researchers. Cleber M. de Morais, Djamel Sadok, Judith Keln. 2019.

Category	Description
Ambient	This refers to sensors that gather data from the environment or the space around them.
Motion	This is used to perceive motion of people or things in a context (as in accelerometers and gyroscopes).
Electric	This category holds the sensors that are applied to electricity grids.
Biosensor	The biosensors are worn by humans or animals. They return vital signs and/or biological information about one subject.
Identification	This represents a semantic or identity of another thing to the IoT system. The most common items in this classification are RFID and NFC tags and their readers.
Position	This is related to identifying an object's position in a global scale (as with GPS) or in a local scale (as in small beacon position).
Presence	This captures the presence of a person, an animal, or object in a space and registers it in the system. The most common solution is the PIR sensor.
Machine vision	This family of sensors captures images that will be processed by a computer to produce information.
Interaction	These types of sensors are devices that are human-activated to trigger an event, such as a button or a lever.
Acoustic	Such sensors are activated by soundwaves, producing data from the ambient sound change.
Force/load	The force/load sensors are activated by external forces, capturing the deformation or the intensity of those forces to the system.
Hydraulic	These are applied in the water system to measure and control the flow.
Chemical	Chemical sensors are capable of detecting chemical substance(s) in the air or water.
Object information	This specific category includes sensors with similar functions to the previous categories. They differ in that their application is confined to a specific object. The object information is the result of a small context application of a sensor. For instance, a temperature sensor used inside a machine provides object information which is different from an ambient temperature sensor.

Classificação de Sensores IoT

- An Application Domain-Based Taxonomy for IoT Sensors. Vitor ROZSAa, Marta DENISCZWICZa, Moisés DUTRAa,1, Parisa GHODOUSb, Catarina FERREIRA DA SILVAb, Nader MOAYERIc, Frédérique BIENNIERd and Nicolas FIGAYe. 2016

Sensores – Tipos e Sub-Tipos

Type	**Motion**	**Position**	**Environment**	**Mass Measurement**	**Biosensor**
Subtype	Movement	Orientation	Temperature	Volume	Blood
	Velocity	Inclination	Humidity	Pressure	Organ
	Inertia	Proximity	Luminance	Density	Mental
	Vibration	Presence	Acoustic	Deformation	Tissue
	Acceleration	Location	Radiation	Viscosity	
	Rotation		Gas	Flow	
			Magnetic Field	Load	
			Weather	Moisture	
			Chemical	Shock	
			Electrical	Contact	
			Color	Strain	
			EMF^2	Corrosion	
				Electrical Conductivity	
				Oxygen	

Domain	Industrial			Smart Cities			Healthcare	
Area	**Agriculture**	**Logistic**	**Plant Floor**	**Transport**	**Buildings**	**Environment**	**Monitoring**	**Management**
Sensor (subtype)	Chemical Conductivity Gas Humidity Location Luminance Moisture Pressure Temperature Weather	Gas Humidity Inclination Location Luminance Pressure Shock Temperature Vibration	Acoustic Chemical Contact Gas Humidity Inclination Inertial Location Luminance Moisture Movement Orientation Presence Temperature Vibration Volume Weather	Acceleration Acoustic Contact Gas Inclination Load Luminance Magnetic Field Moisture Movement Oxygen Presence Pressure Proximity Shock Temperature Velocity Volume	Acceleration Acoustic Color Deformation Flow Gas Humidity Inclination Luminance Magnetic Field Movement Orientation Presence Pressure Proximity Temperature Vibration	Acoustic Chemical Conductivity Corrosion Density EMF Flow Gas Humidity Load Location Luminance Moisture Movement Pressure Proximity Strain Temperature Volume Weather	Acceleration Blood Emotion Gas Humidity Inclination Movement Organ Orientation Presence Pressure Radiation Temperature Tissue Vibration	Acceleration Location Luminance Pressure Temperature

Figure 1. Taxonomy of IoT sensors.

Segundo o Mercado

- Consumer, Industrial, Commercial

Sensores

Grove - Digital Light Sensor

Grove - Light Sensor

Grove - Temperature and Humidity Sensor

Grove - Barometer Sensor

Grove - Dust Sensor

Grove - Gas Sensor

Grove - Temperature Sensor

Grove - Air Quality Sensor

Grove - Temperature and Humidity Sensor Pro

Grove - Gas Sensor(O_2)

Sensores

Grove - 3-Axis Digital Compass

Grove - 3-Axis Digital Accelerometer(±1.5g)

Grove - 3-Axis Digital Gyro

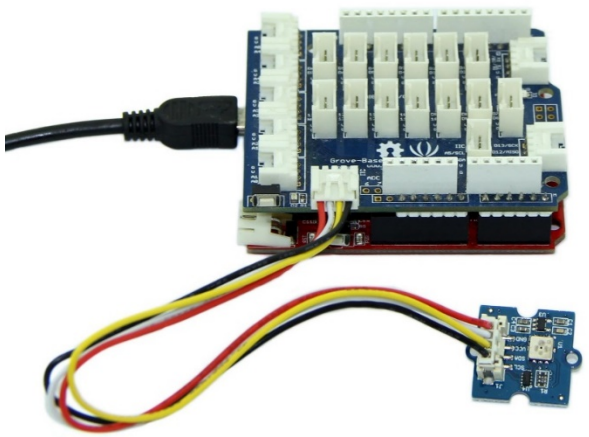
Grove - Collision Sensor

Grove - 3-Axis Analog Accelerometer

Grove - 3-Axis Digital Accelerometer(±16g)

Grove - 6-Axis Accelerometer and Compass V1.0

Grove - Single Axis Analog Gyro



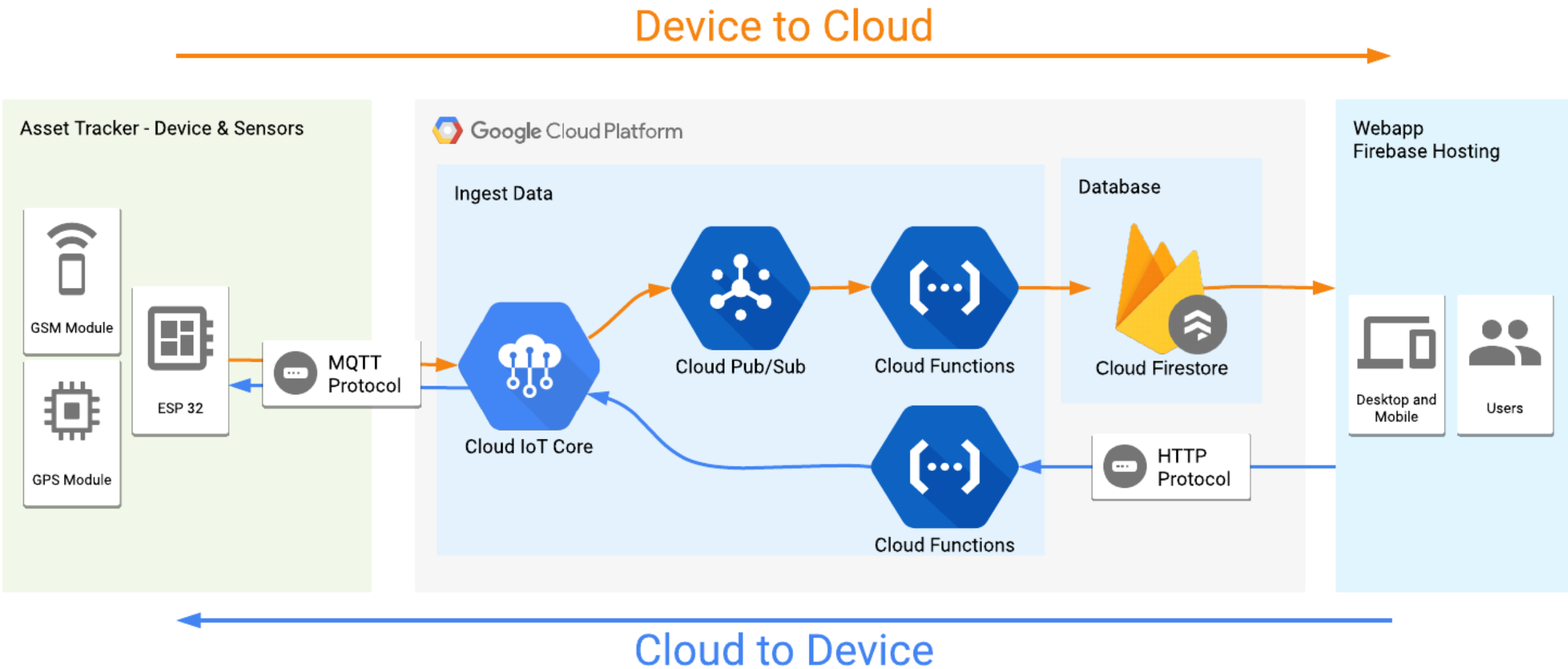
Como coletar e apresentar os dados coletados dos sensors?

- Platformas de IoT

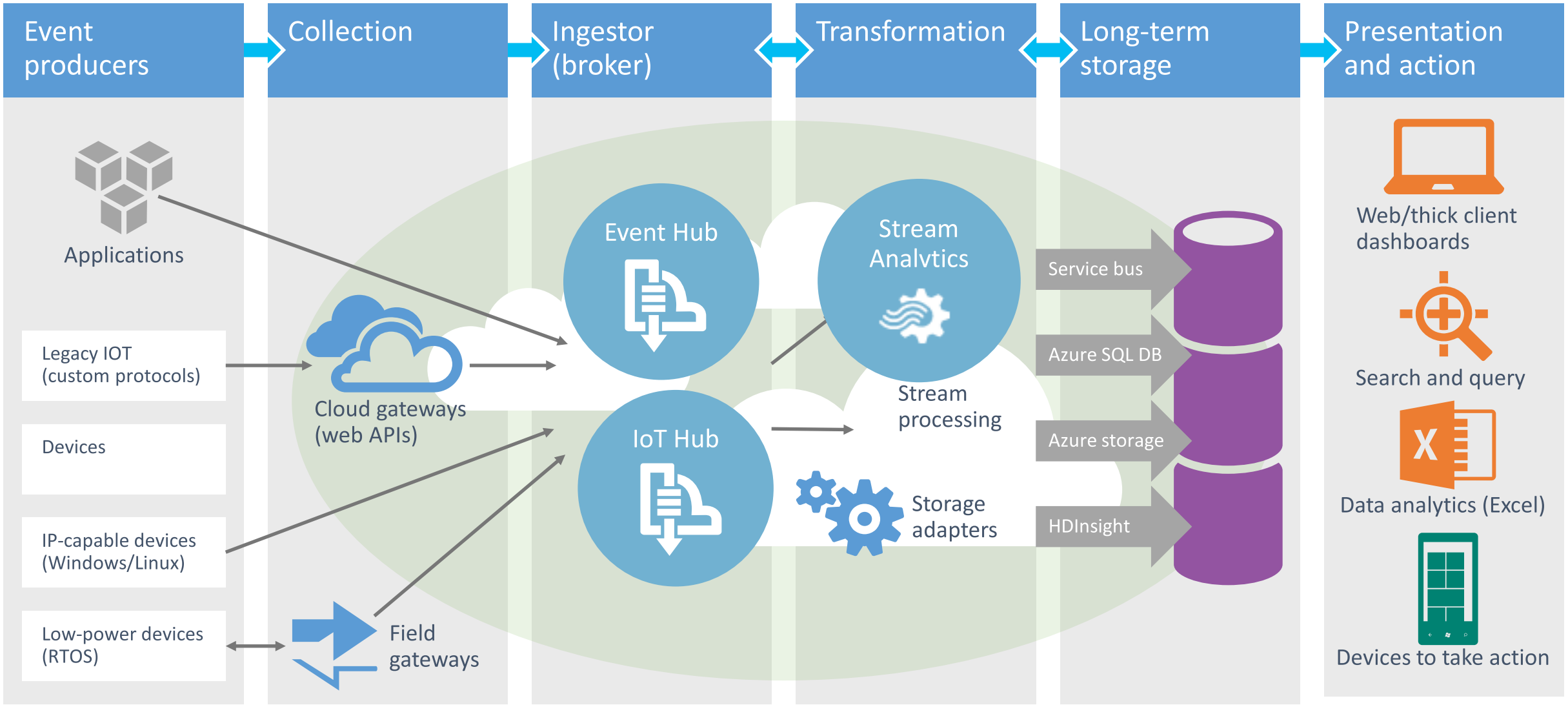
Principais Plataformas Comerciais para o Back-end IoT

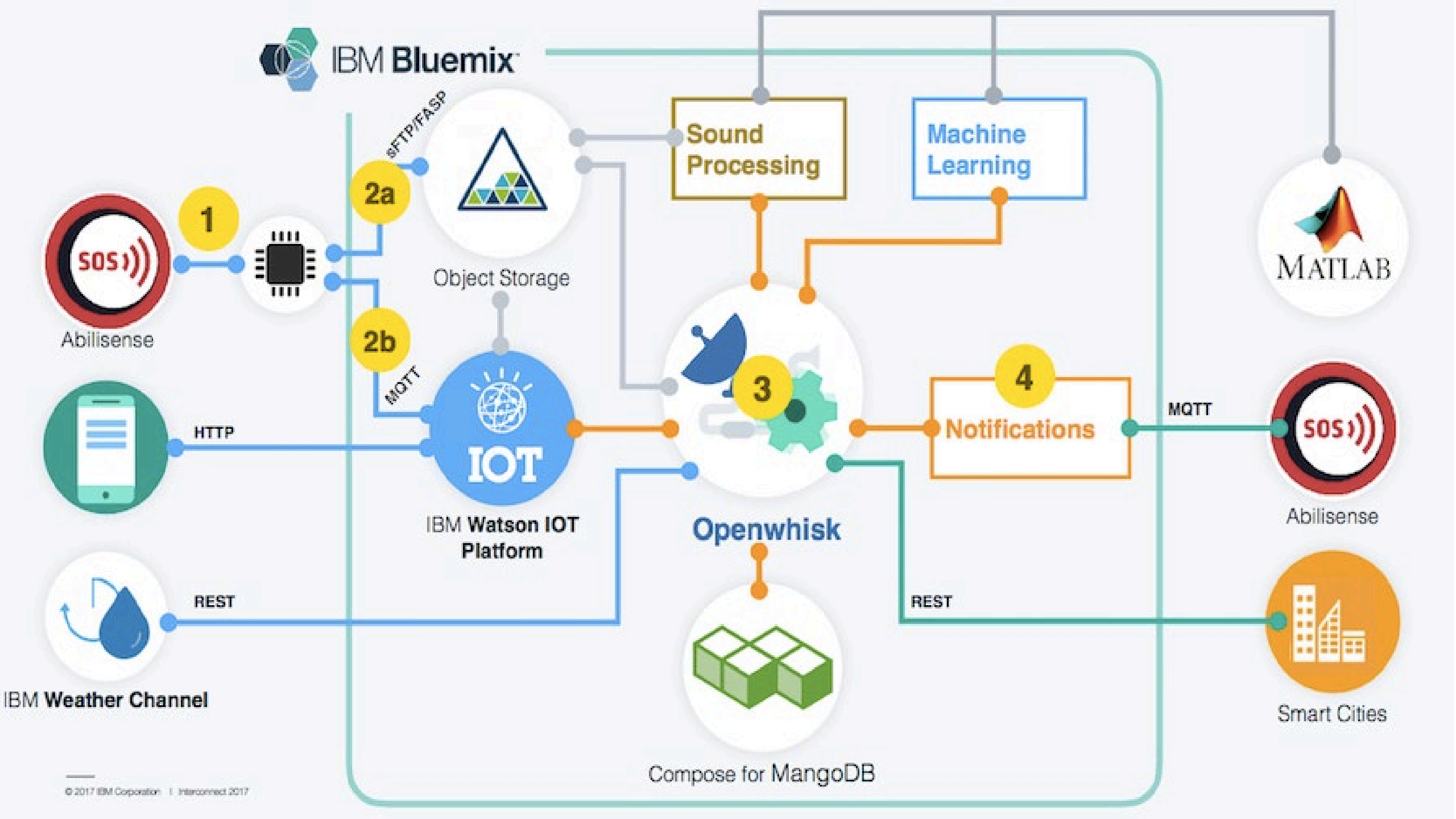
Microsoft Azure

Google Cloud Platform

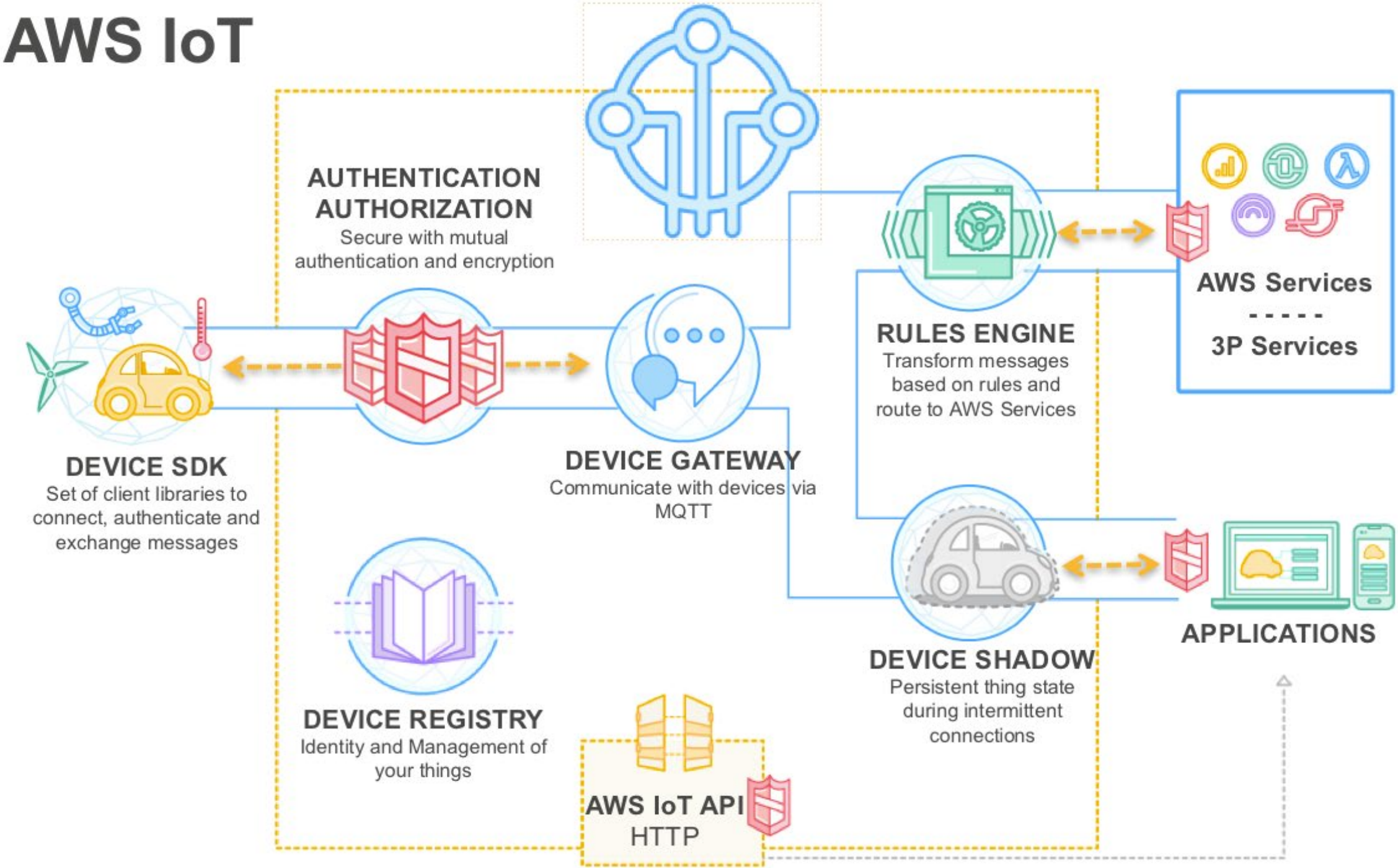


Microsoft Azure





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

Principais Plataformas Abertas para IoT

Parte Prática

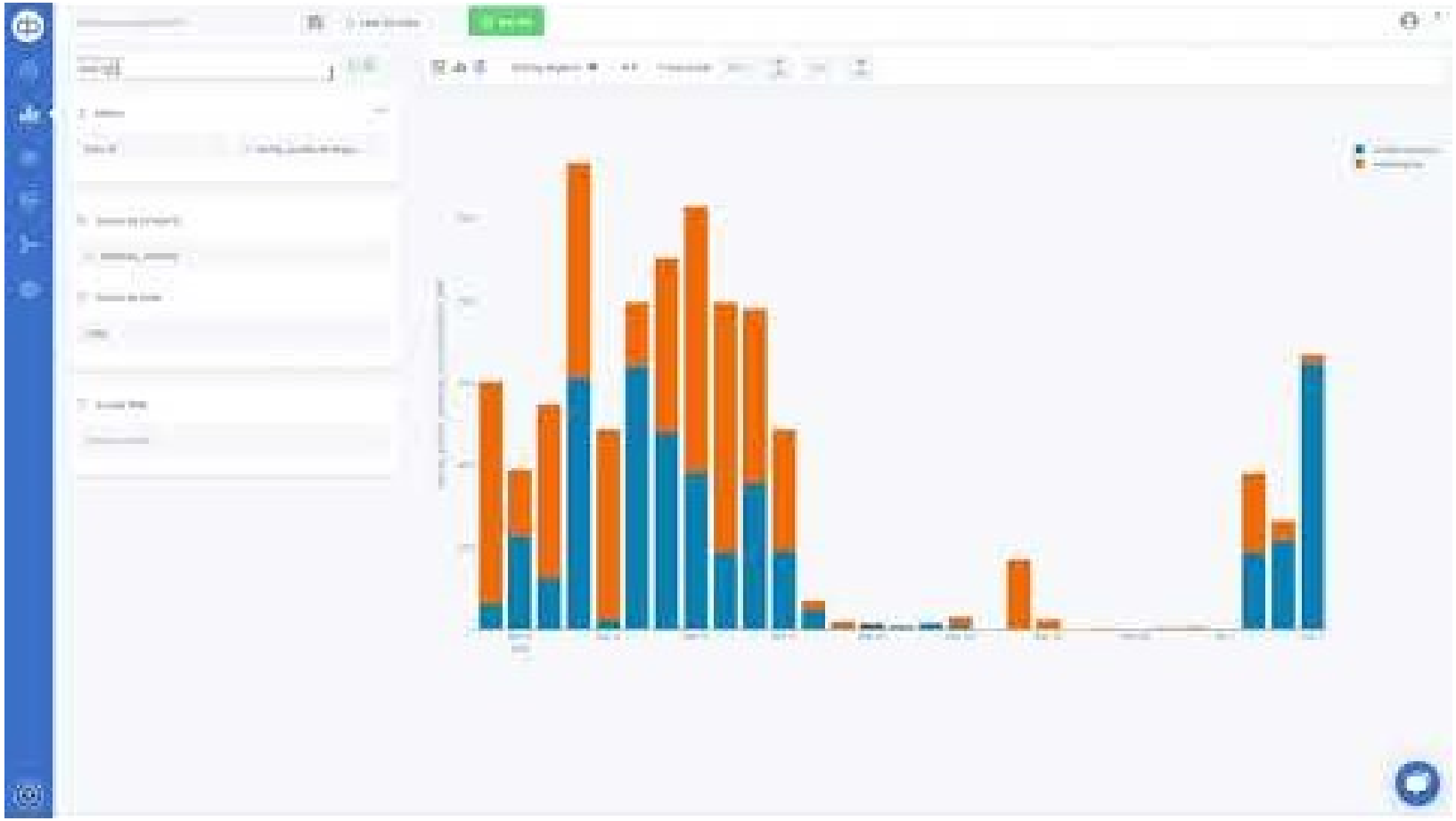
Plataformas/Ferramentas

- Dweet.io
- Freeboard.io

IoT DASHBOARD

- Definição
- Tipos
  - Open Source
  - Proprietários
- Exemplos Open Source
  - FreeBoard https://freeboard.io
  - ThigsBoard https://www.linode.com/docs/development/iot/install-thingsboard-iot-dashboard/
  - IotHook https://iothook.com/en/

Dashboard Video https://info.devicepilot.com/free-customiot-dashboards



FreeBoard https://freeboard.io

Roteiro

- Atraves do notebook, acesse o site freeboard.io
- Crie uma conta gratuita
- Siga o roteiro sugerido
- Atenção:
  - Voce pode utilizer o smartphone como dispositivo IoT. Para isso instale o APP dweet
  - Voce pode tambem utilizer o seu notebook como dispositivo IoT. Para isso, acesse o site dweet.io e crie um dispositivo
- Tire um screen-shot do dashboard e mande via SLACK com a identificacao do GRUPO (nome dos components)

Freeboard Cont…

DUVIDAS?

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