# IoT Technologies – Technological Trends

Research made under Beacon Südtirol - Alto Adige (CUP:B31H17000060001) project

SFSCon - Bolzano/Bozen 15th November 2019

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# About Me

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**Electronics Engineer and ICT professional with over 10 Years of experience in management and designing in the Engineering and R&D department of the Gruppo FOS.**
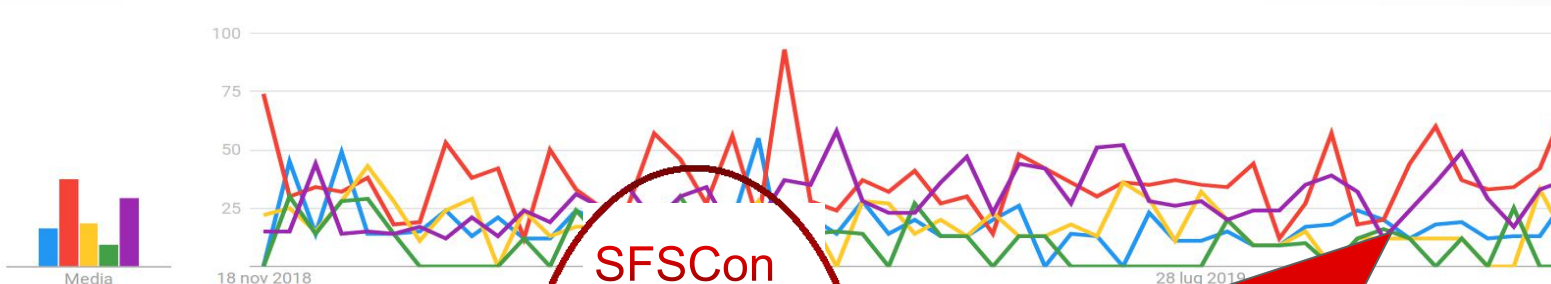
**IoT expert, managed various R&D projects, WEB projects and software projects for energy efficiency and intelligent monitoring systems.**

# IoT Trends - SFScon Effect
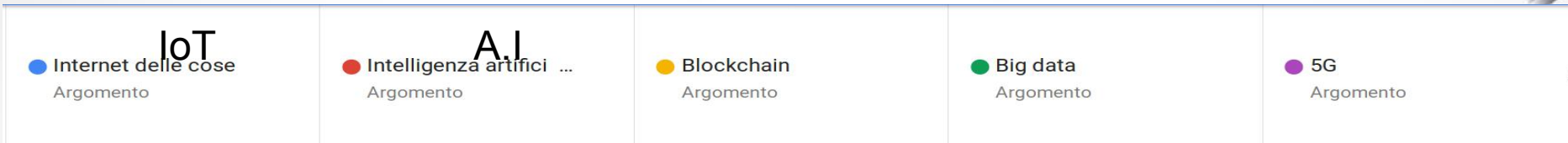
# Why did this study?

How we can chose where spend our time? Where the technology will drive us? Which technology will be the future of our life? What is the Internet of Things? What is the real growth of this technologies? Why everywere and everyone tell IoT is a revolution, a new Internet ....?..

**What did wi try to do?**
To know - To understand - To forecast - To create - To organize - To define - To select ....

The studies wanted to obtain the analysis of the state of technological art, aimed at identifying the current and possibly future technologies of the Internet of Things (IoT) paradigms.

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# Our Work

- Understanding the general IoT technological Trends

- Defining the technological state of the art of the IoT

- Understanding the IoT State of the Art in South Tirol and its IoT trends

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# What is IoT?

- The Internet of Things is a concept, a paradigm and not a technology, but it is embodied in the technology of things.

- Developing IoT applications does not just mean creating systems to connect devices in a network but it is something much more complex.

- IoT is an internet of People to people, People to machine, machine to machine, interacting through internet.[1]

**"Internet of Things (IoT)"** is a description of an idea that **can be seen as a single term.**

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1 - Internet ofThings-IOT: Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges Keyur K Patel ad All

# Internet of Things (IoT): some Definitions

- *The IoT is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.* (Gartner)

- *An IoT is a network that connects uniquely identifiable "Things" to the Internet. The "Things" have sensing/actuation and potential programmability capabilities. Through the exploitation of unique identification and sensing, information about the "Thing" can be collected and the state of the 'Thing' can be changed from anywhere, anytime, by anything.(IEEE for Small environment scenario)*

- ***IoT envisions a self-configuring, adaptive, complex network that interconnects 'things' to the Internet through the use of standard communication protocols. The interconnected things have physical or virtual representation in the digital world, sensing/actuation capability, a programmability feature and are uniquely identifiable. The representation contains information including the thing's identity, status, location or any other business, social or privately relevant information. The things offer services, with or without human intervention, through the exploitation of unique identification, data capture and communication, and actuation capability. The service is exploited through the use of intelligent interfaces and is made available anywhere, anytime, and for anything taking security into consideration.(IEEE for Large environment scenario)***

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# Internet of Things

- The Internet of Things is one of the necessary components for the new industrial revolution.

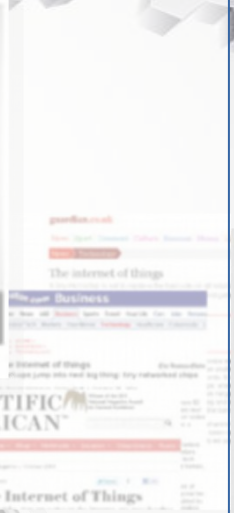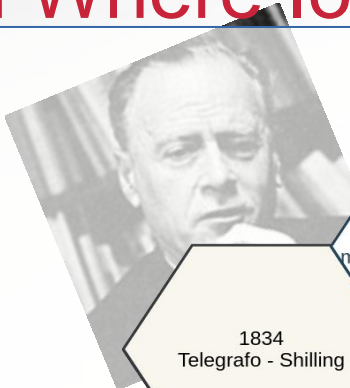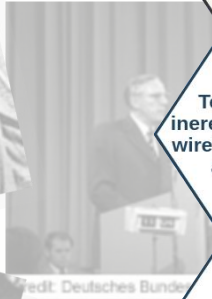- Every "thing" will be connected to a network, absolutly reachable and integrated in a context .

## The vision of the IoT can be consumer or industry oriented.

In this technological study, the concept of IoT and IIoT (Industrial Internet of Things) are not clearly distinguished.

In the consumer-oriented concept the focal points are the people.
The IIoT creates opportunities for companies (Industry 4.0).

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# When and Where IoT Born

# IoT Architecture - IoT Technological Landescape
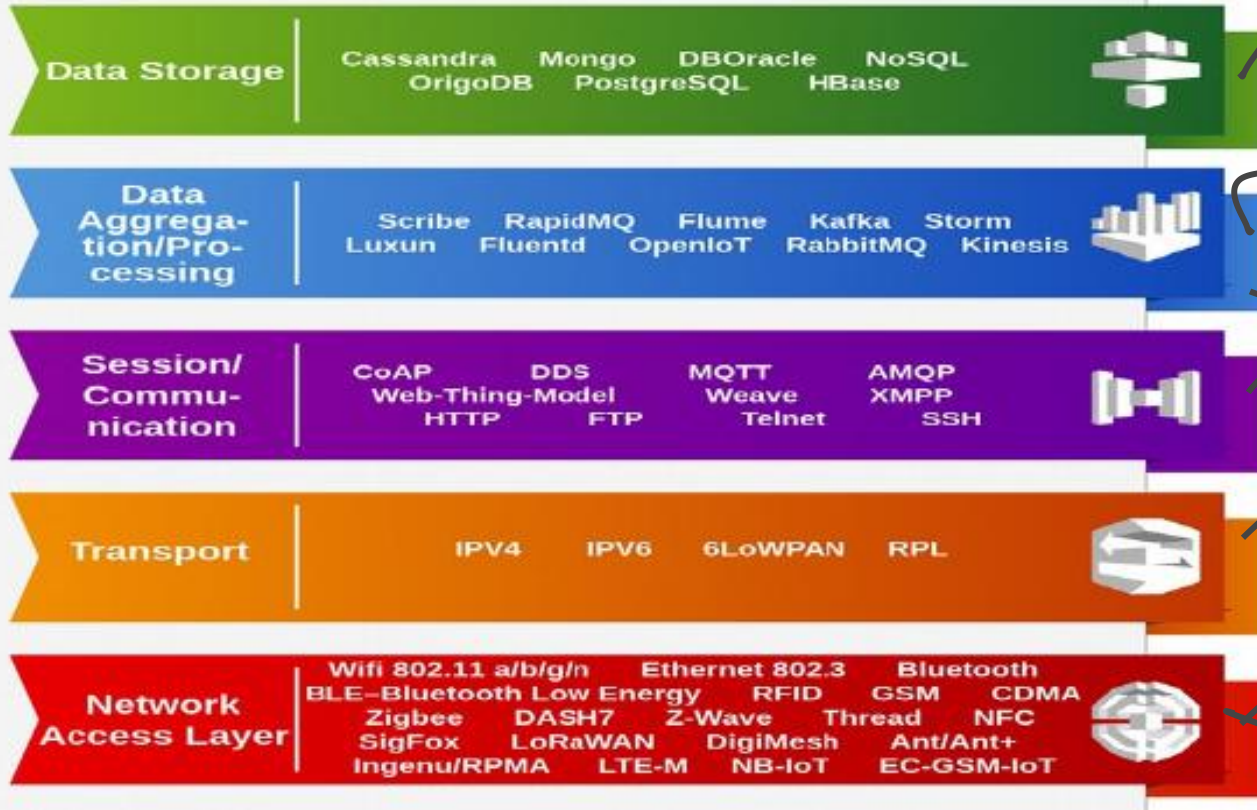
# IoT Architecture - Link Protocol Layer
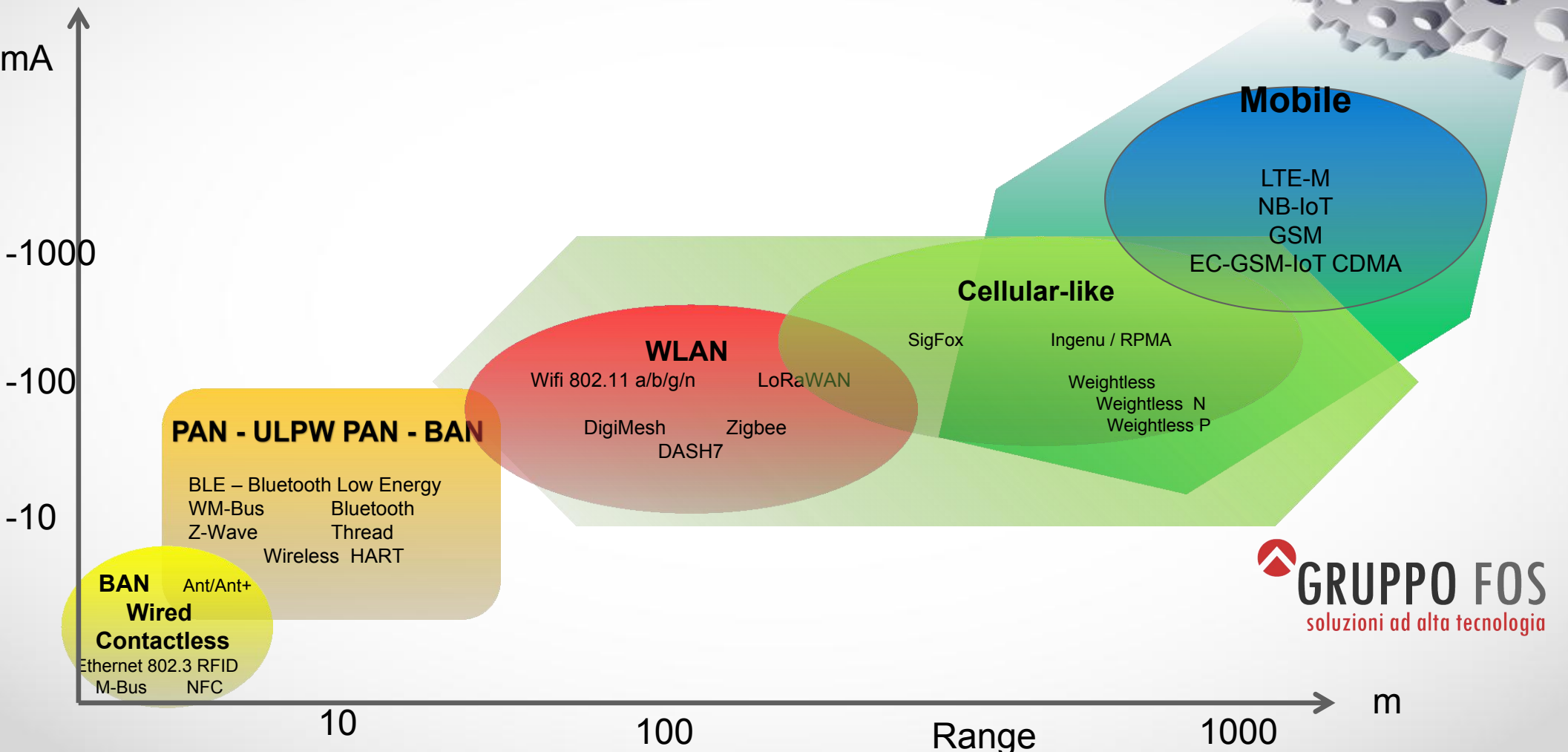


**mA**

**Mobile**

LTE-M
NB-IoT
GSM
EC-GSM-IoT CDMA

-1000

**Cellular-like**

SigFox        Ingenu / RPMA

-100

**WLAN**

Wifi 802.11 a/b/g/n        LoRaWAN

Weightless
Weightless N
Weightless P

**PAN - ULPW PAN - BAN**

DigiMesh        Zigbee
DASH7

BLE – Bluetooth Low Energy
WM-Bus        Bluetooth
Z-Wave        Thread
Wireless  HART

-10

**BAN**  Ant/Ant+
**Wired
Contactless**

Ethernet 802.3 RFID
M-Bus        NFC

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10        100        **Range**        1000        **m**

# IoT Architecture - IoT Technological Landescape
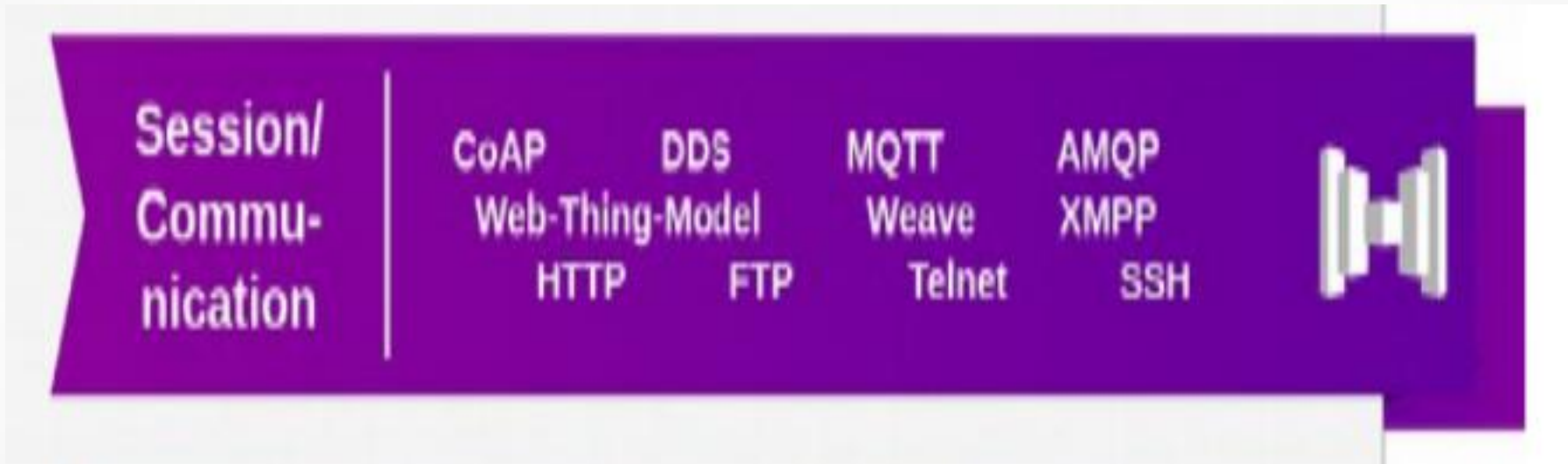
# IoT Architecture - IoT Technological Landescape

| | Device Management | | | | Business Processes | | | | Analytics | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Business Apps** | Asset Mgt. Device Provisioning Device Registration Remote Control | Firmware Mgt. | | | Efficiency gain Support | Marketing / Sales | | | AI Data Analysis | Machine Learning DataMining Visualizzation Eng. | |
| **Business Model** | | Open | Indirect | Integratec | Cloud | On demar | On Premise | Platform | Direct | Closed | |
| **Data Storage / Retieval** | | | | Hadoop | HBase | Cassandra | MongoDB | Postgress | | | |
| **Data Aggregation / Processing** | | | Scribe | RapidQM | Flume | Kafka | Storm | Luxun | Fluentd | | |
| **Session /Communication** | Coap | DDS | XMPP | HTTP | Telnet | MQTT | DDS | AMQP | FTP | SSH | NATS |
| **Transport** | | | | IPv4 | 6LoWPAN | IPV6 | RPL | | | | |
| **Link Protocol Layer** | BLE Sigfox | Bluetooth INGENU | RFID LTE | Wifi 802.1 NB-IoT | Zigbee | CDMA | GSM | Ethernet 80 | 802.14.4e | DASH7 | LoRa/LoRaWan |
| **Connectrivity** | | ODB2 | PLC | RS-232 | RS-485 | Modbus | Wireless | USB | SPI | RJ45 | |
| | Device | | | | | | Smart Gateways | | | | |
| | Sensors | | | | | | | | | | |

Security and Privacy

Figura 8: Panorama dei protocolli per l'IoT dei dispositivi al mercato

# Potential Economic Impact of IoT

**Table 1.2. Potential economic impact of Internet of Things in 2025[12]**

| | Size in 2025[1] $ billion, adjusted to 2015 dollars Total = $3.9 trillion–11.1 trillion | Major applications |
|---|---|---|
| ▣)) Human | 170–1,590 | Monitoring and managing illness, improving wellness |
| 🏠 Home | 200–350 | Energy management, safety and security, chore automation, usage-based design of appliances |
| 🏪 Retail environments | 410–1,160 | Automated checkout, layout optimization, smart CRM, in-store personalized promotions, inventory shrinkage prevention |
| 🖥 Offices | 70–150 | Organizational redesign and worker monitoring, augmented reality for training, energy monitoring, building security |
| 🏭 Factories | 1,210–3,700 | Operations optimization, predictive maintenance, inventory optimization, health and safety |
| ⚓ Worksites | 160–930 | Operations optimization, equipment maintenance, health and safety, IoT-enabled R&D |
| 🚗 Vehicles | 210–740 | Condition-based maintenance, reduced insurance |
| 🏙 Cities | 930–1,660 | Public safety and health, traffic control, resource management |
| 🚢 Outside | 560–850 | Logistics routing, autonomous cars and trucks, navigation |

Legend: ■ Low estimate □ High estimate

[1] Includes sized applications only.
*Note: Numbers may not sum due to rounding.*

Figura 3: Previsione dell'impatto economico dell'IoT nel 2025

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# IoT Trends - since 2018

- 2011 IoT take a place in a GARTNER Hype Cycle
- 2014 IoT arise the "Peak of Inflated Expectation"
- 2018 IoT platforms are in the first part of the discendent line

Italian Google trends of IoT compared to other emerging technologies From 2011 to 2018
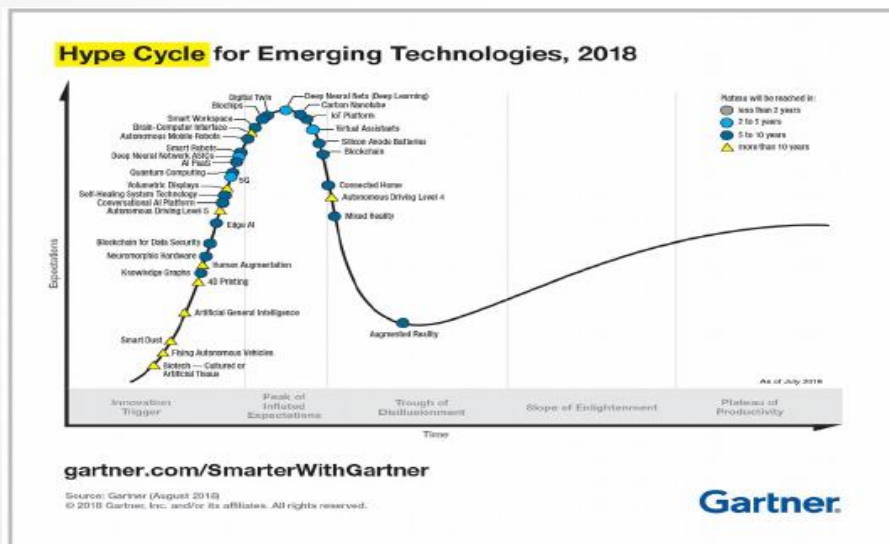


Figura1:
Gartner 2018 hype cycle of emerging technologies (Source Gartner Inc.)
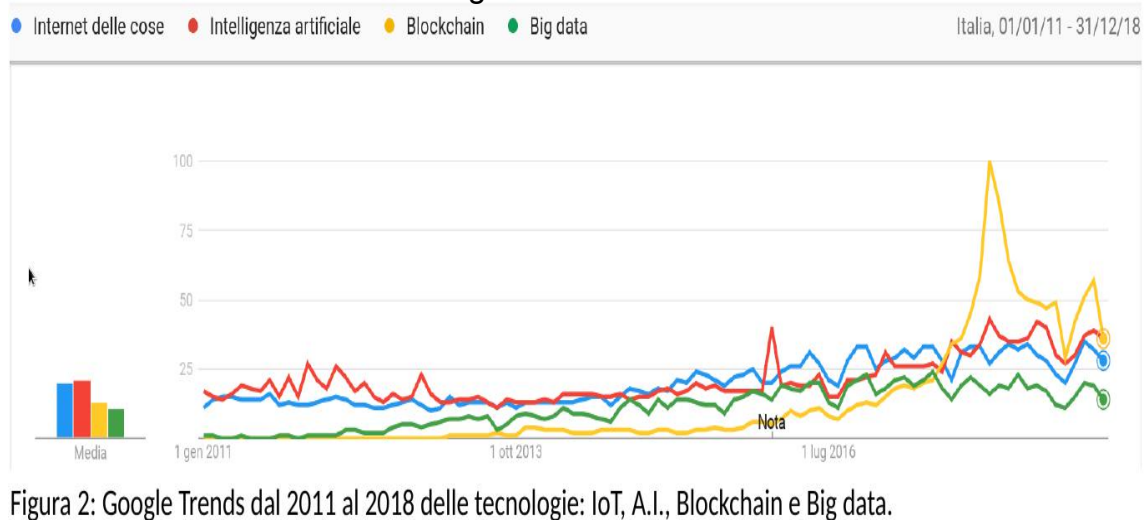


Figura 2: Google Trends dal 2011 al 2018 delle tecnologie: IoT, A.I., Blockchain e Big data.

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# IoT Trends - in the last Year

In 2019 IoT disappear from GARTNER Hype Cycle for Emerging Technologies.
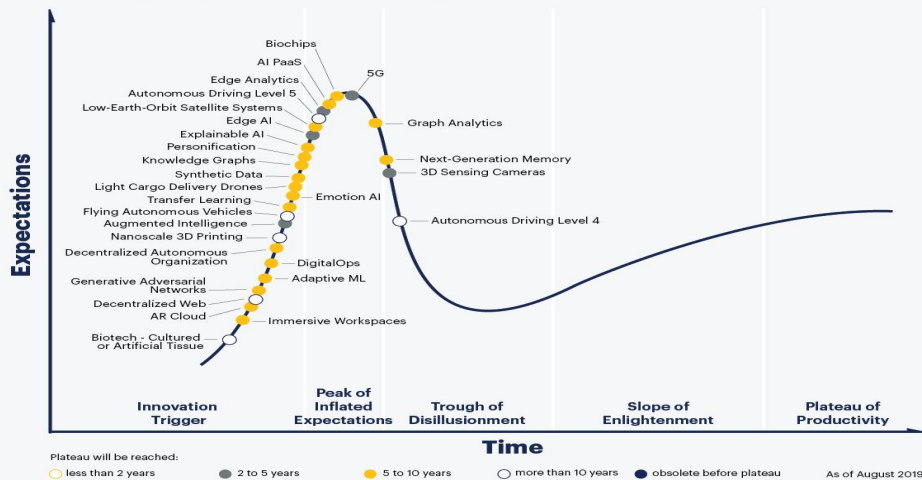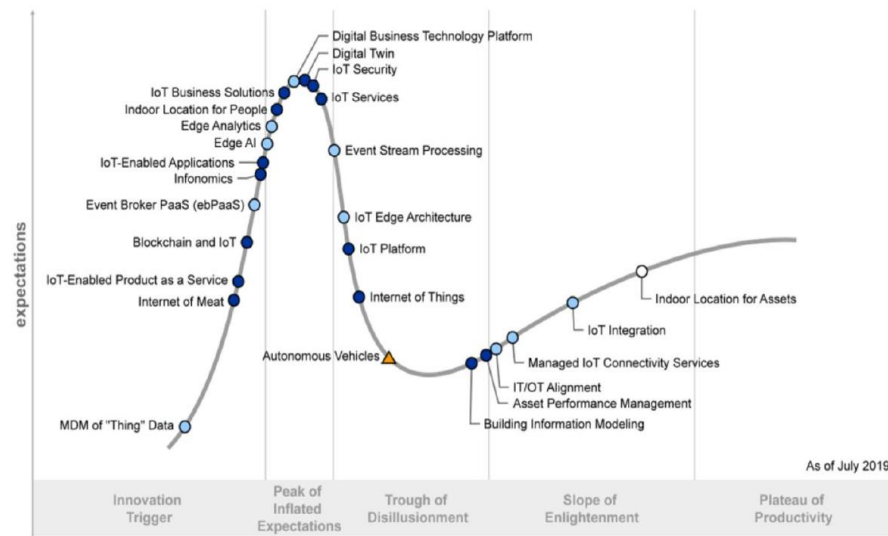


**Still have many different standards and approaches**

# IoT Trends - last Year
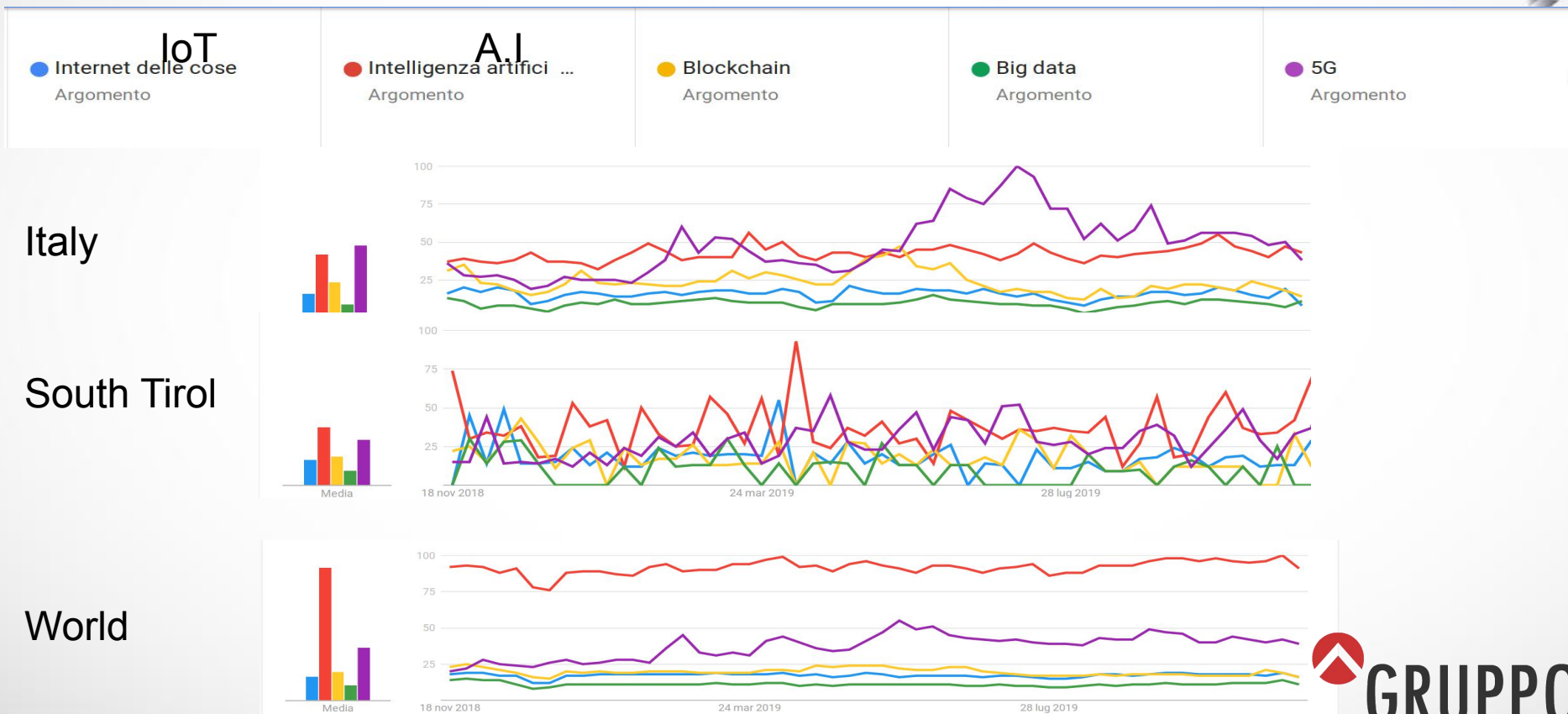
# Technological Trends in Italy

# Technological Trends in South Tirol. The most powerfull place in Italy



Origin: https://www.nettrotter.io/index.php/it/our-network-it/italy

# Technological Trends in South Tirol

# Thanks

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# IoT Landscape



MANY ALLIANCE AND CONSORTIUM, FRAGMENTED MARKET, MANY VENDORS, NO ONE DOMINATES

# IoT Architecture - Stack models comparative



Figura 9: Confronto tra i modelli di interconnessione IoT e Web con riferimento all'ISO/OSI

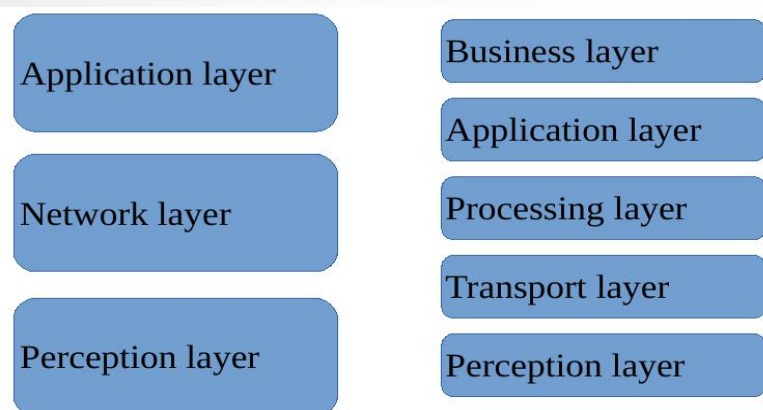# IoT Architecture - Stack models comparative



Figura 5: Architettura a 3 (A) e 5 (B) layer

| Application Layer | Authentication/Key Agreements | Privacy Protection |
|---|---|---|
| Support Layer | Secure Cloud Computing / Computing | Antivirus |
| Network Layer | Identity Authentication | Encryption Mechanism |
| Perception Layer | Encryption and Key Agreement | Sensor Data Protection |

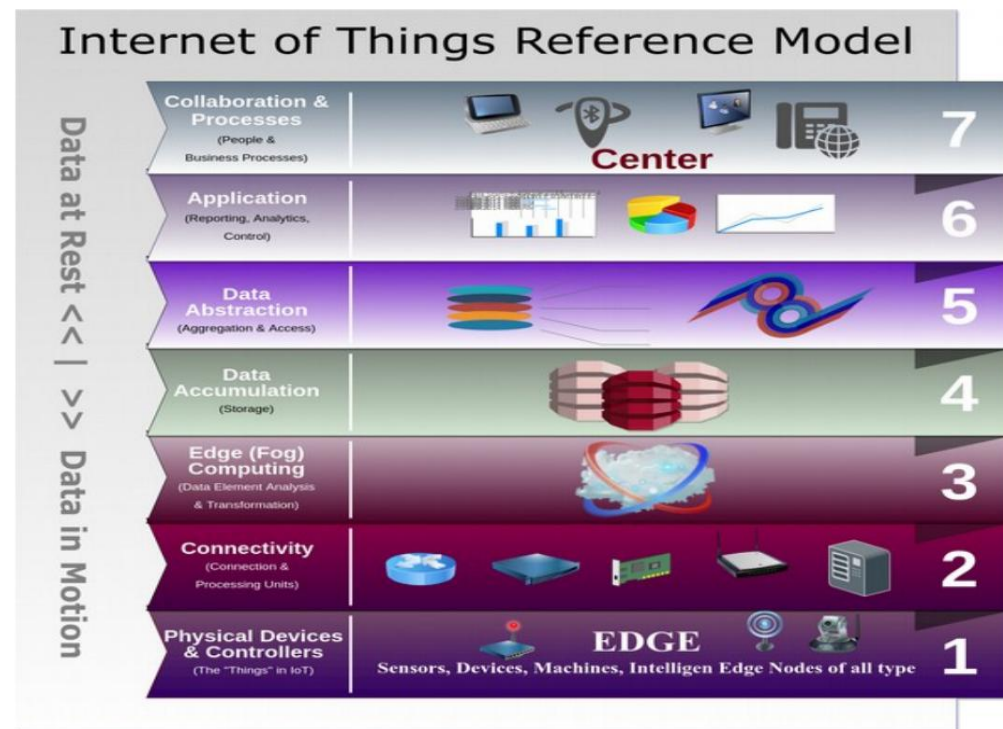Figura 11: Architettura a 4 livelli e relativi meccanismi di sicurezza utili



Figura 12: The Internet of Things Reference Model

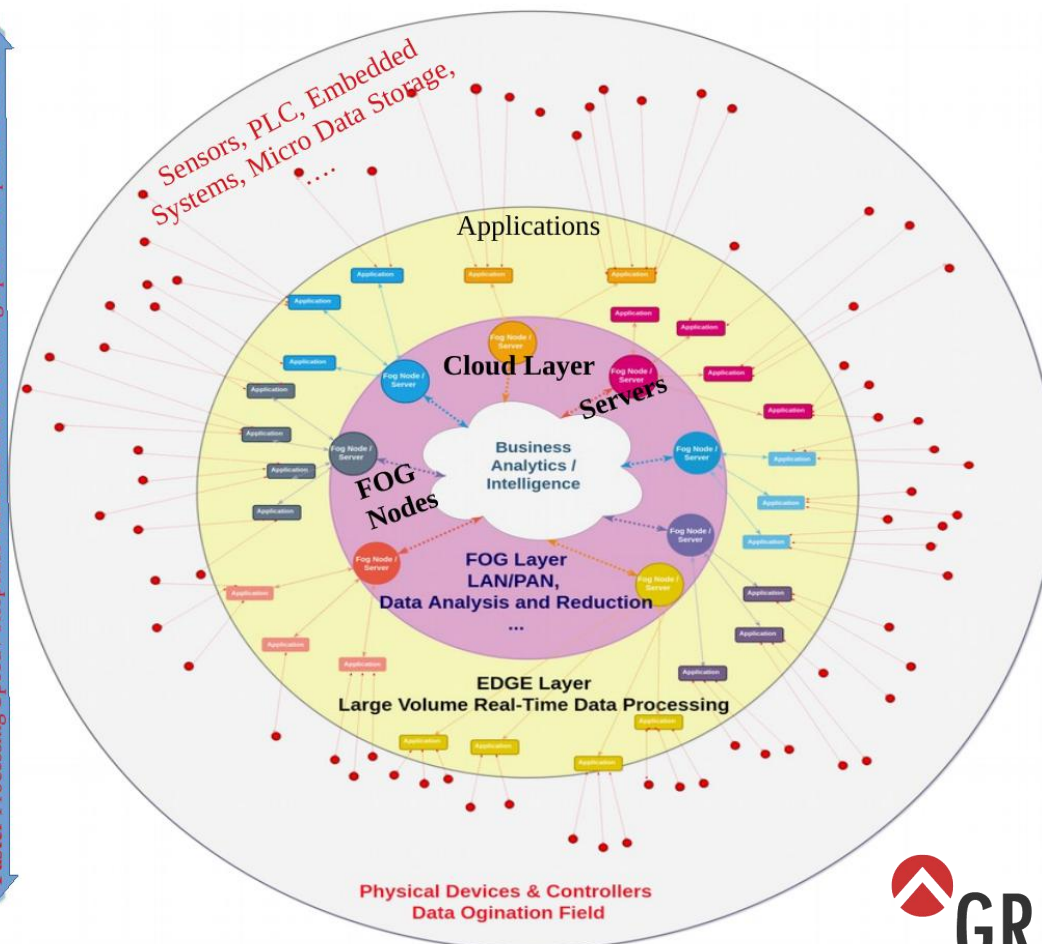GRUPPO FOS
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# IoTArchitecture, FOG and EDGE internet



*Figura 13: IoT Data Processing Layer Stack*