• Temperature, Humidity, CO2, TVOC, PM1.0 / 2.5 / 4 / 10, Formaldehyde, Ozone, Barometric Pressure, Water Leak, Ambient Light, Noise/Sound Level • Motion and Presence • Flow and Pressure of gases and liquids • Shock and Vibration • Occupancy and Presence detection (Offices, Cars in parking lots, Hospitals, Restaurants, etc.) • GDPR compliant People Counting (Doorways and Corridors of Offices, Airports, Hotels, Commercial centers, Congress centers, Retail spaces, Schools, Universities, etc.) • Doors Windows Opening State Distances detection • Ultrasonic Monitoring or Float arm level gauges of fill levels and status of remote containers assets • Soil Moisture, Soil Temperature, Soil Electrical Conductivity • Tilt Orientation (G-force and accelerometer sensors) • Push/Touch buttons • GPS TDOA geolocation • Energy usage and health condition of the power line (Switch, Voltage, Current, Power Factor, Power Consumption) • Weather Stations (Solar radiation, Precipitation, Lightning strike detector, Wind speed, Wind direction, Humidity, Temperature, Vapor Pressure, Barometric Pressure)

IoT

• Industrial Automation, Security, Assets Management • Buildings Automation • Energy - Smart Power • Utilities • Transportation • Logistics • Environmental Intelligence • Healthcare • Agriculture - Smart Farming • Fire Alarm Systems • Smart Metering • Smart City • Smart Village • Home Automation and Security • Tracking • Wearables • Digital Signage • Infotainment • Hotspots • Automotive* • Video Surveillance* *(Hiperlan or Mobile LTE Cat-1 / Cat-4)

LPWAN

LoRa

sigfox

MQTT HTTP

4G LTE

LTE-M

NB-IoT

5G

IoT Gateway

Ethernet
4G LTE

Network / Application Server
PaaS SaaS Cloud (Public, Private, Hybrid)
Device Management
Connectivity Management
Data Sinks Output Connectors
(ERP, Azure IoT Hub, Google Cloud,
AWS Kinesis, Kafka, etc.)
Storage
Rule Engine

API REST
HTTP

ERP / CRM
Grafana
Analytics
Applications

- EU 868 MHz
- Battery Life up to 5 / 10 / 20 years*
- Open space examples: 10 Km LoRa - 30 Km NB-IoT LTE Cat NB1 - 50 Km Sigfox*
  *Depending on the operating conditions
- Connectivity/Protocols multistd sensors
- Edge AI sensors
- TinyML
- SenseCAP Gateways

Synonyms	LTE-M: LTE Cat-M1	NB-IoT: LTE Cat-NB1
Bandwidth	●●○	●○○
Building penetration	●●○	●●●
Mobility	●●●	●○○
SMS support	●○○	○○○
Low latency	●●○	●○○
Module cost savings	●●○	●●●
Battery life	●●○	●●●

Triple Cut SIM / eSIM

IoT Example of General Scenarios

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Scenario

- **First the needs**, then the choice of technology
- **Connectivity** is one of the major issue (availability, energy efficiency, cost, quality of service, security)
- Completeness of the total offering reducing TTM (Sensors/IoT Modules, Connectivity, Platform)
- Most suitable Platform (Connectivity Management, SIMs/Devices Management, Data Management & Analytics, Cloud Services, Application Enablement, Security, Interoperability, Data Sinks Output Connectors).
- Translating data into business value
- Ability to scale

Connectivity

Main aspects to be considered

- Battery-powered, long range, high penetration
- IoT Modules costs, Data Loss, Duty Cycle restrictions
- Sufficient domestic and international coverage to scale up implementation when needed
- Network operation for the lifecycle deployment without modification or replacement of devices and considering eventual regulatory changes
- Bandwidth available for potential developments and evolutions requiring more data between devices and applications

LPWAN → LoRaWAN vs Cellular

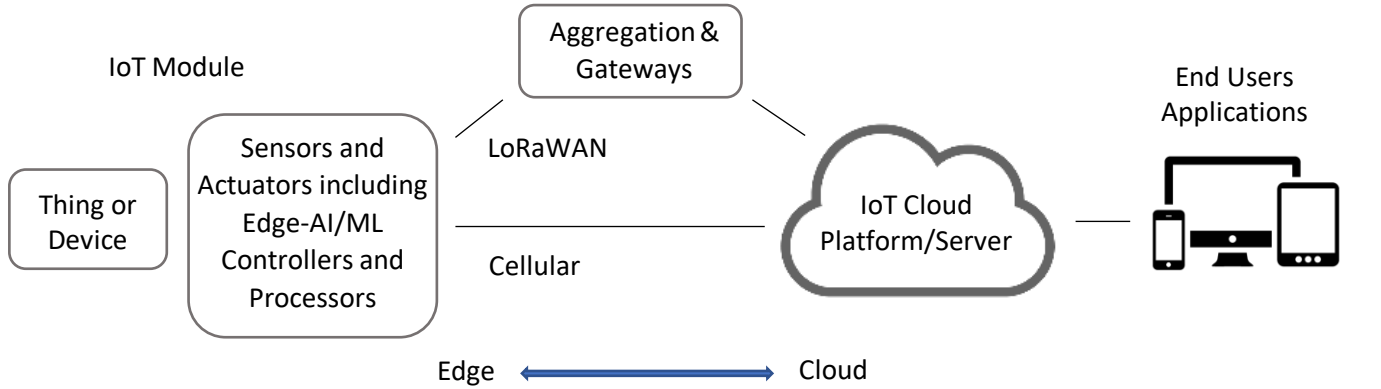
- LoRaWAN (LPWAN protocol)
  - ISM unlicensed bands and LoRa® modulation
  - Suitable **for local areas without a (stable) cellular network** and use with small amounts of data bursts at infrequent intervals
  - Of the three forms of public, private and community networks, the currently viable option is to use a private network which involves infrastructure investments
- 2G/3G/4G/5G Cellular Networks with additional LTE standards NB-IoT and **LTE-M** specifically designed for LPWAN
  - High quality services as higher bandwidths, lower latency, higher reliability, well-proven security features, and better coverage compared to LoRaWAN®
  - SIM cards are highly secure, devices with SIM, eUICC and eSIM are tamper-proof

Main Markets

- Smart Car - Automotive
- Smart Utility:

- Smart Metering
- Smart Asset Management

- Industry 4.0
- Oil & Gas
- Smart Building
- Smart City
- Smart Factory
- Smart Healthcare
- Smart Home
- Smart Logistics/Tracking
- Smart Agriculture
- Example of European country market volume: Italy 8.3 Billion euro



IoT LPWAN LoRaWAN vs Cellular

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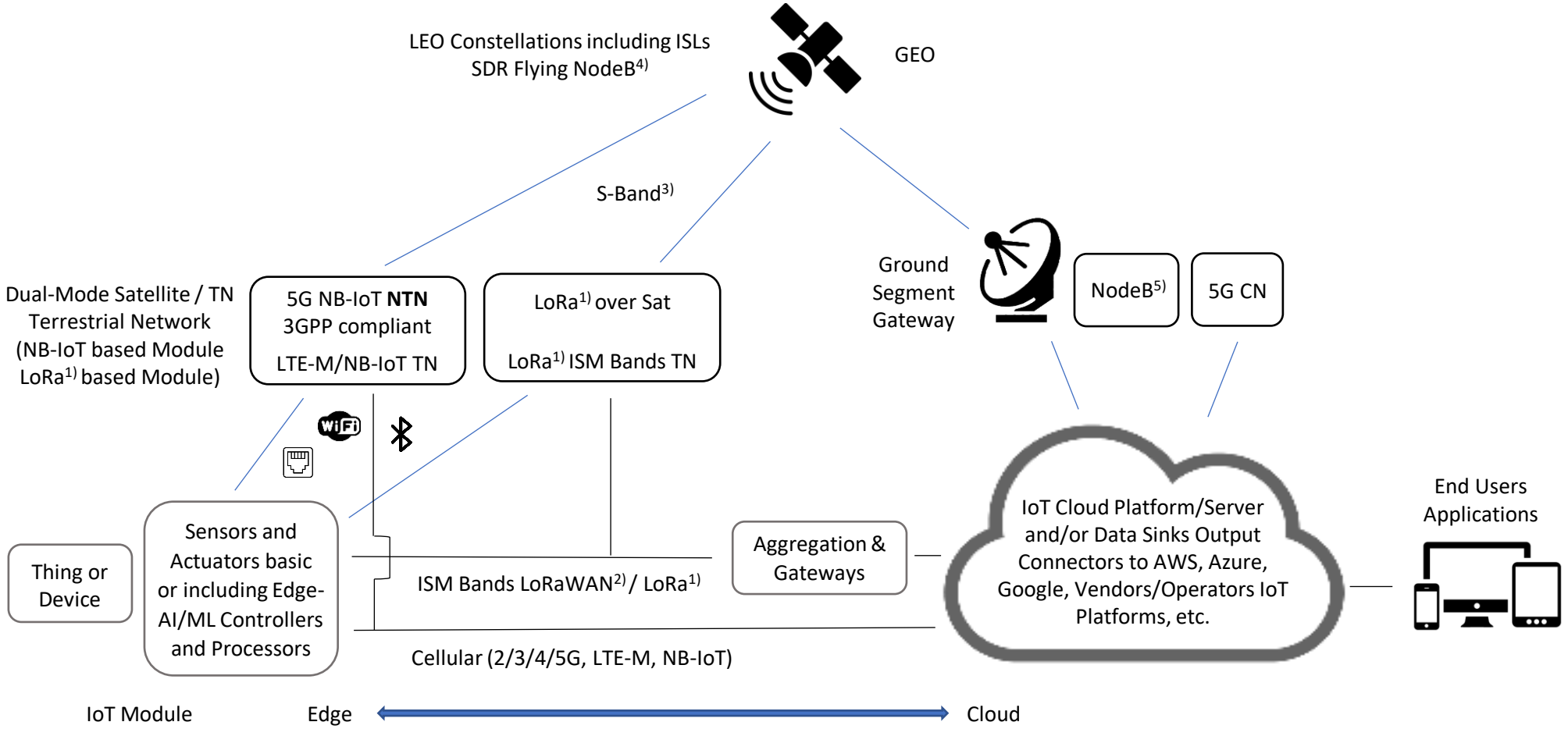

1) LoRa® is a proprietary wireless **modulation** derived from Chirp Spread Spectrum (CSS) technology
2) LoRaWAN® is a Media Access Control (MAC) layer **protocol** built on top of LoRa modulation
3) S-Band traditionally used for TT&C, is highly resilient in all environmental conditions.
Market includes also Dual-Mode TN/Sat IoT Terminals for GEO in Ku/Ka-Band for Fixed and Dynamic i.e. Comms-on-the-Pause (COTP) or Comms-on-the-Move (COTM) applications
4) Regenerative mode
5) Transparent mode
6) The most suitable connectivity depends on local/international coverage, amounts of data bursts at infrequent/frequent intervals, bandwidth, latency, mobility, battery life, modules costs