
UPT UNIVERSIDADE PORTUCALENSE

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# Key issues

**How much data will be captured, sent and transmitted to the cloud?**

- Difficulties start to appear when the project escalates
    - Streaming and storing data from a small number of devices is easy
    - It becomes more difficult with the increase in that number

**What will you do with the data?**

- The data must
    - Help identify patterns, trends and possibilities for improvement
    - Serving a specific purpose
    - Solve a problem (eg: Improve operational efficiency, Help with equipment maintenance, Reduce waste)

**How long should the data be kept for?**

- It is not feasible to keep all the data generated by the devices forever
    - Storage costs

**Should data be archived when it is no longer needed?**

- It doesn't make sense to save data just to have it.
    - It is necessary that they serve a purpose

# Example

**We want to understand how much energy a building's lighting system consumes**

1. Install sensors
2. Sensors collect various data (atmospheric pressure, altitude, temperature,…)

- What data is useful?
  - Are there lights on in empty rooms?
  - Is it possible to dim the lights under certain circumstances? (ex: lighter days)

- **Data management :** process that, taking into account all available data, refines them to extract some specific metrics

# What data to keep and for how long?

**We want to understand how much energy a building's lighting system consumes**

- Real-time data:
  - Lights on or off?
  - Empty or occupied room?
  - Is natural light enough?

Memory
(short term)

- Historical data
  - We tried automatic sensors 6 months ago.
    - What was the impact in terms of energy costs?
  - When is the building most (and least) busy?
  - There are seasonal patterns present in the data?

Analytics Warehouse
(long term)

# Business Intelligence and Big Data

- Many devices
- Each transmits a lot of data

- Leveraging big data
  - Efficient analytical systems (Business Intelligence, BI)

- BI systems try (unsuccessfully) to respond to:
  - **Volume**: more and more applications, more data, from more sources. Storage and processing issues
  - **Velocity**: Need to process data in real time and respond in a timely manner
  - **Variety**: Increasingly diverse data formats

- Big Data
  - Adapts to the needs of IoT analytical data processing
  - It also responds to **veracity**: guarantee of veracity of data
  - Allows you use data
    - Structured, eg databases, files with predefined format
    - Unstructured, eg emails, word documents, pdf, videos, photos, sound, social media posts, …

# Common Uses of Big Data

**Industry**:

- Prediction of maintenance failures
- Customer Management (CRM, Customer Relationship Management)
- Control of manufacturing processes

**Telecommunications**

- Fraud detection and prevention
- Churn prevention (customer departures or service shutdowns)
- Quality control of the network

**Healthcare**

- Drug development and side effects
- Analysis of clinical trials
- Quality control of the provision of health services

**Energy and Utilities**

- Smart meter management
- Fault management in the distribution network

**Banking**

- Fraud detection
- Compliance and regulation
- Client management
- Capital markets surveillance

**Government**

- Crime prevention
- Combating terrorismo
- Fraud detection (tax, social security)

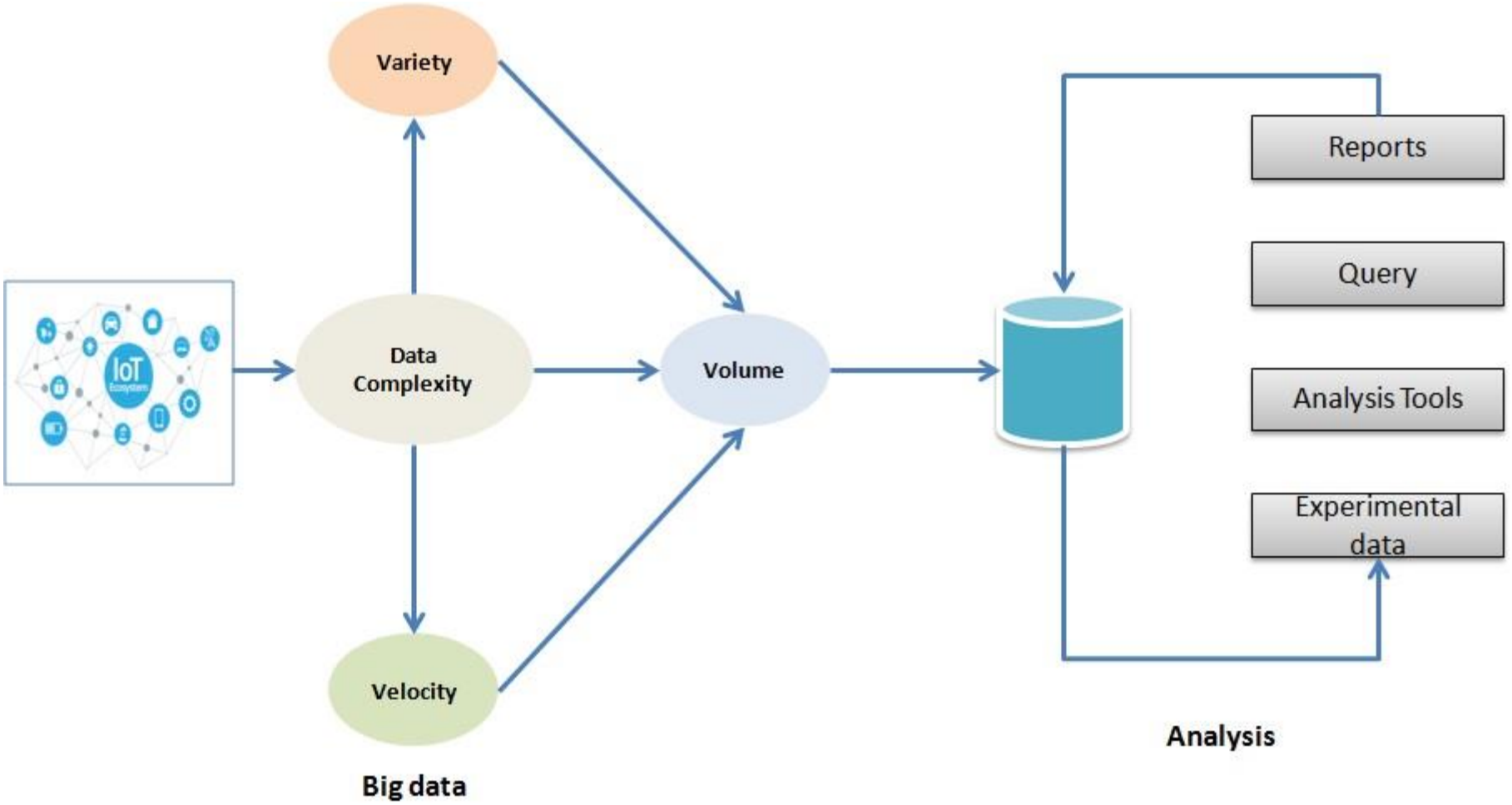
**Media**

- Targeting ad campaigns
- Audience analysis

**Retail**

- Price adjustment in the face of competition
- New store opening location management
- Client management

# Big Data and IoT

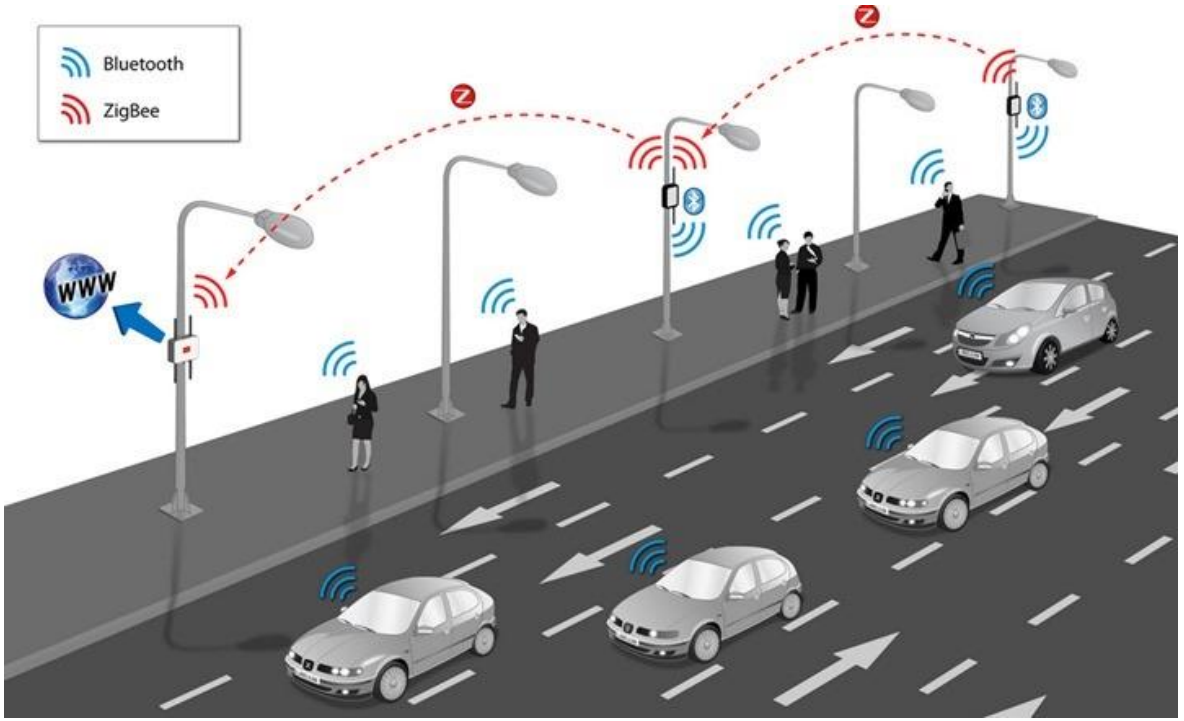



https://www.whizlabs.com/blog/iot-and-big-data/

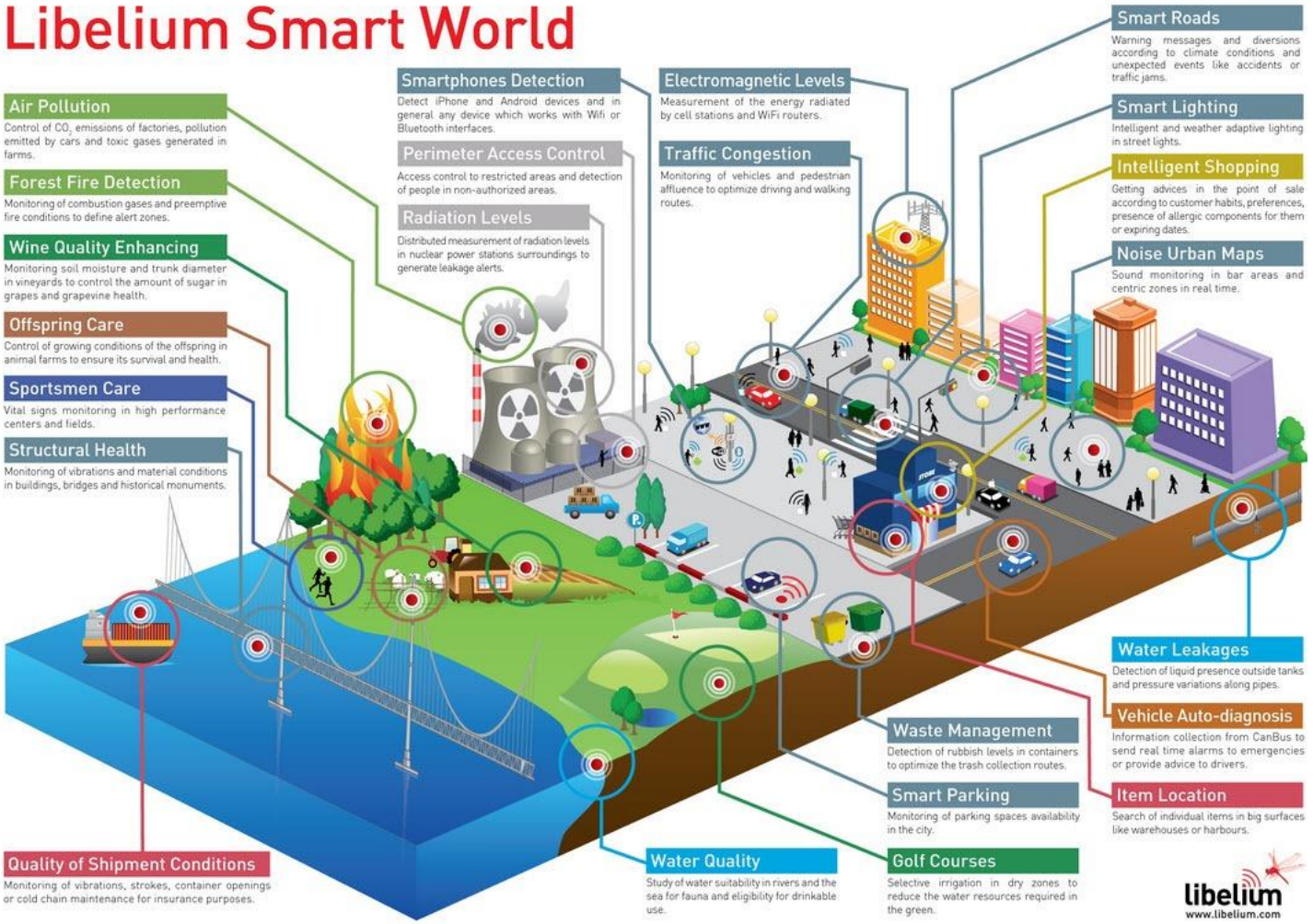
# Wireless Sensor Network (WSN)

Interconnection of a certain number of equipment equipped with sensors capable of observing the physical environment, which may or may not contain certain mechanisms (known as actuators) with the ability to interact with the environment such as the water taps of some fire alarms.

*Pplware, 2015*



# WSN Libelium



# Virtual Sensors

- **Soft sensors** are inferential models that use easily measured variables to estimate process variables that are hard to measure due to technological limitations, large measurement delays, or high investment costs *(Kadlec et al., 2009).*

- Examples:
  - Measure biomass concentration, based on CO2 and O2 concentrations
  - Kalman filters to estimate location
  - Estimate speed in electric motors
  - Fuzzy computing in process control
  - Estimate food quality

Sensor biocompatível
https://mc.ai/a-safe-wearable-soft-sensor/

# Complex Event Processing

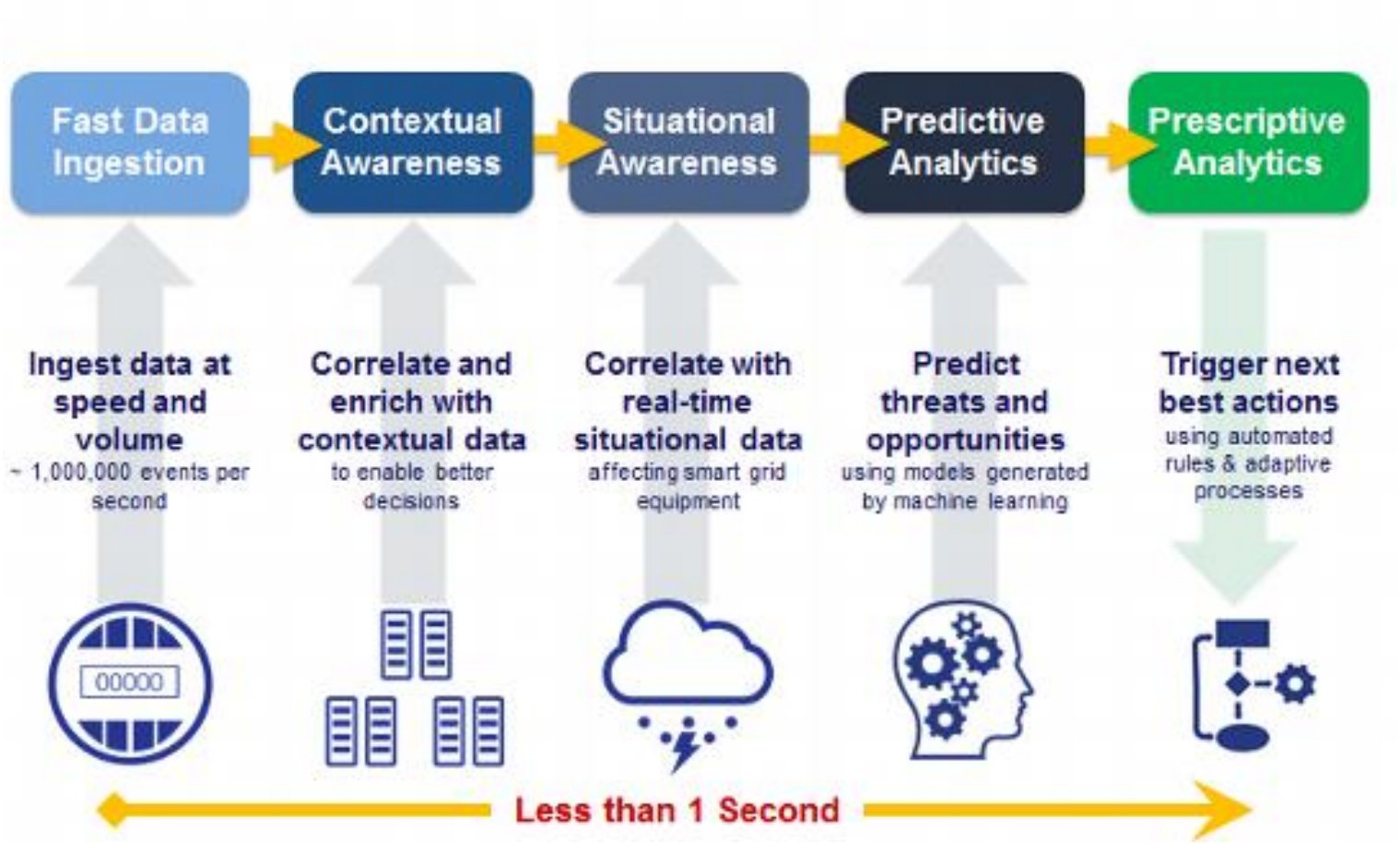
CEP, Complex Event Processing

- Objective: to draw conclusions from the data in real or near real time.
- Emerging network technology that uses distributed message-based systems, databases and applications
- Used for demanding applications that improve situation awareness and support real-time decisions
- Combines data from various sources to infer events or patterns that suggest more complicated circumstances
- It can provide the ability to define, manage and predict events, situations, conditions, opportunities and threats.

- **Data** received about events are transformed into more useful, higher-level "complex" event data designed to provide information about what's happening.
  - Data: news, text messages, social media posts, stock market feeds, traffic reports, weather reports, …

- **Event**: "change of state", when a measurement exceeds a predefined limit
  - Event-oriented: the calculation is triggered by receiving event data
  - The events being analyzed may be happening in different parts of an organization

# Complex Event Processing



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Do conhecimento à prática.