



Προηγμένες Μεθόδους Κατασκευής  
MSc  
Προϊόντων από Ξύλο

# Internet of Everything and applications (Διαδίκτυο των Πάντων και εφαρμογές)

ΛΑΛΛΑΣ ΕΥΘΥΜΙΟΣ

ΕΠΙΚΟΥΡΟΣ ΚΑΘΗΓΗΤΗΣ

ΠΑΝ/ΜΙΟ ΘΕΣΣΑΛΙΑΣ

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Προηγμένες Μεθόδους Κατασκευής  
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- IoE definition
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- IoE prospects
- IoE applications and digital transformation



*“the Internet of Everything (IoE) is bringing together **people, process, data,** and **things** to make **networked connections more relevant and valuable** than ever before, turning information into **actions** that create new capabilities, richer experiences, and unprecedented **economic opportunity** for businesses, individuals, and countries.”, (Cisco, 2013) .*



# IoE Definition

IoE is the intelligent connection of people, process, data and things.

*The Internet of Everything (IoE)* describes a world where billions of objects have sensors to detect measure and assess their status; all connected over public or private networks using standard and proprietary protocols.



# IoE Definition (II)

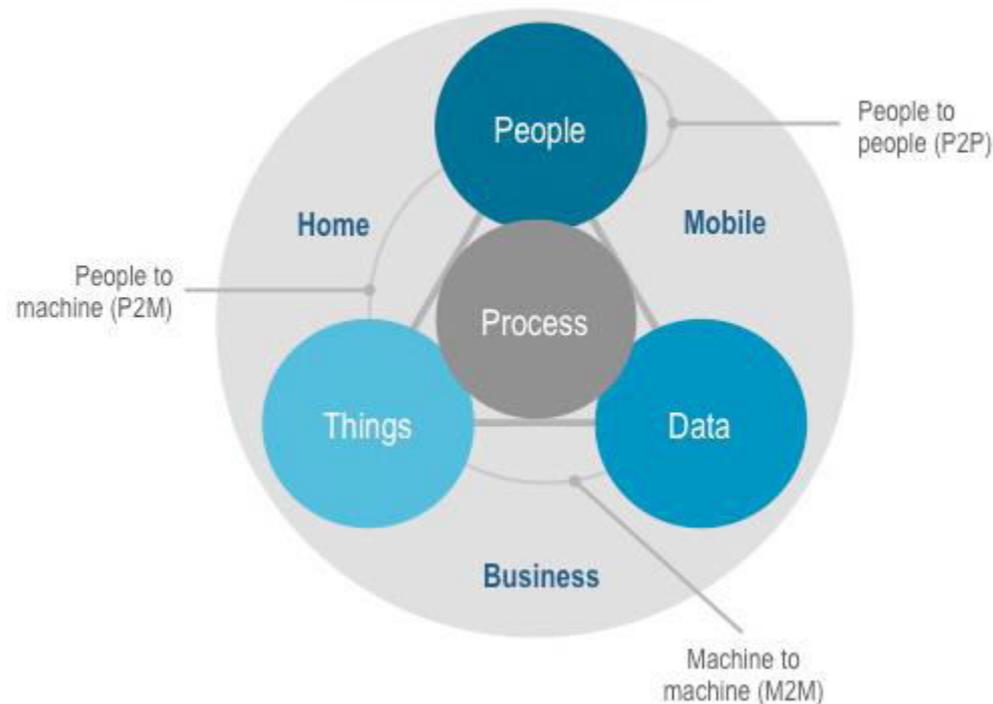
Major applications range from digital sensors and interfaces used for remote appliances to industrial ML systems and other distributed intelligent and automated machinery types

A concept that extends the IoT on M2M communications and to more complex systems that also encompasses people and processes

# IoE : Connected the unconnected

IoE brings together **people, process, data, and things** to make networked connections more relevant and valuable than ever before – turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries.

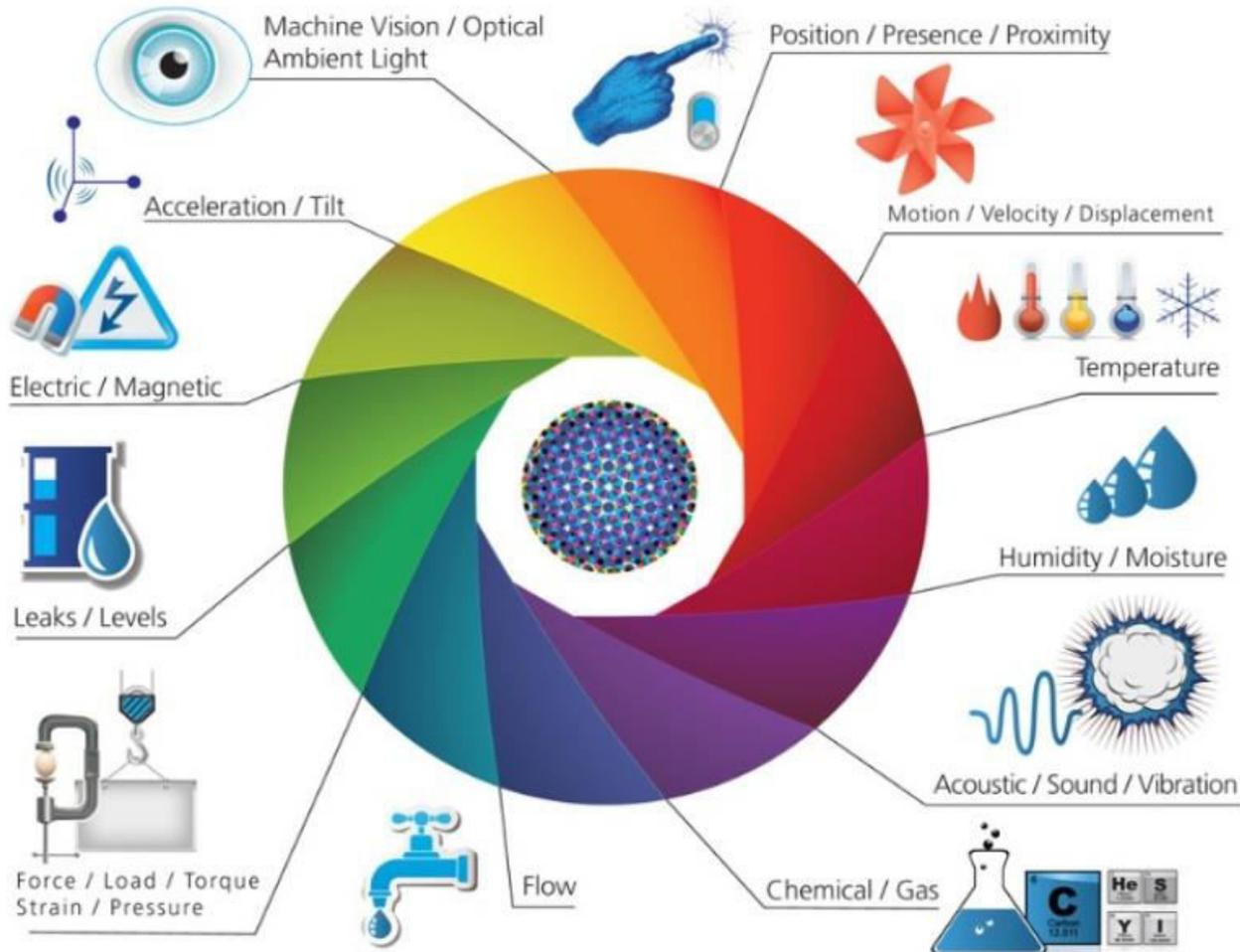
## Internet of Everything





# 1 SENSORS & ACTUATORS

We are giving our world a digital nervous system. Location data using GPS sensors. Eyes and ears using cameras and microphones, along with sensory organs that can measure everything from temperature to pressure changes.

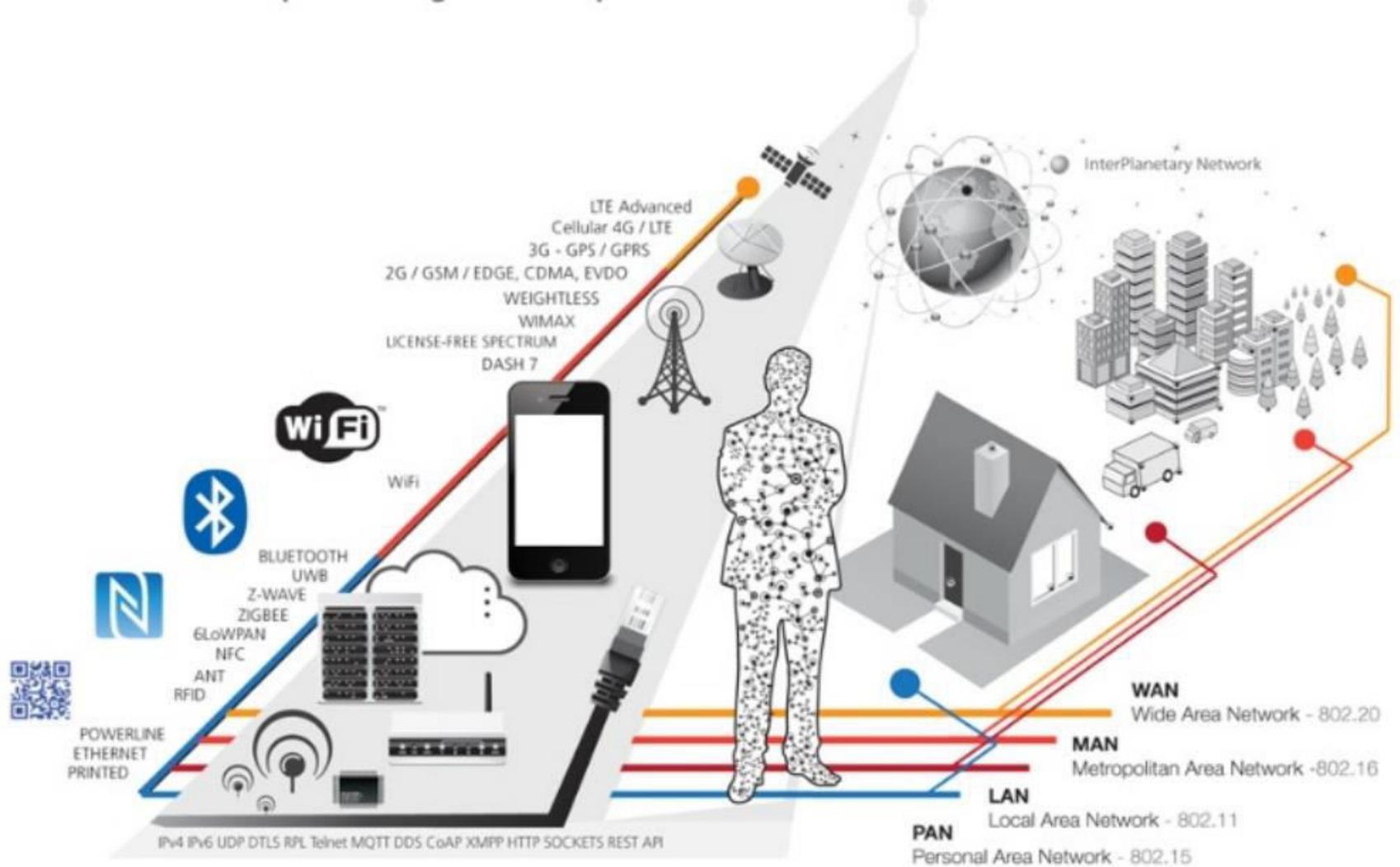




# 2 CONNECTIVITY

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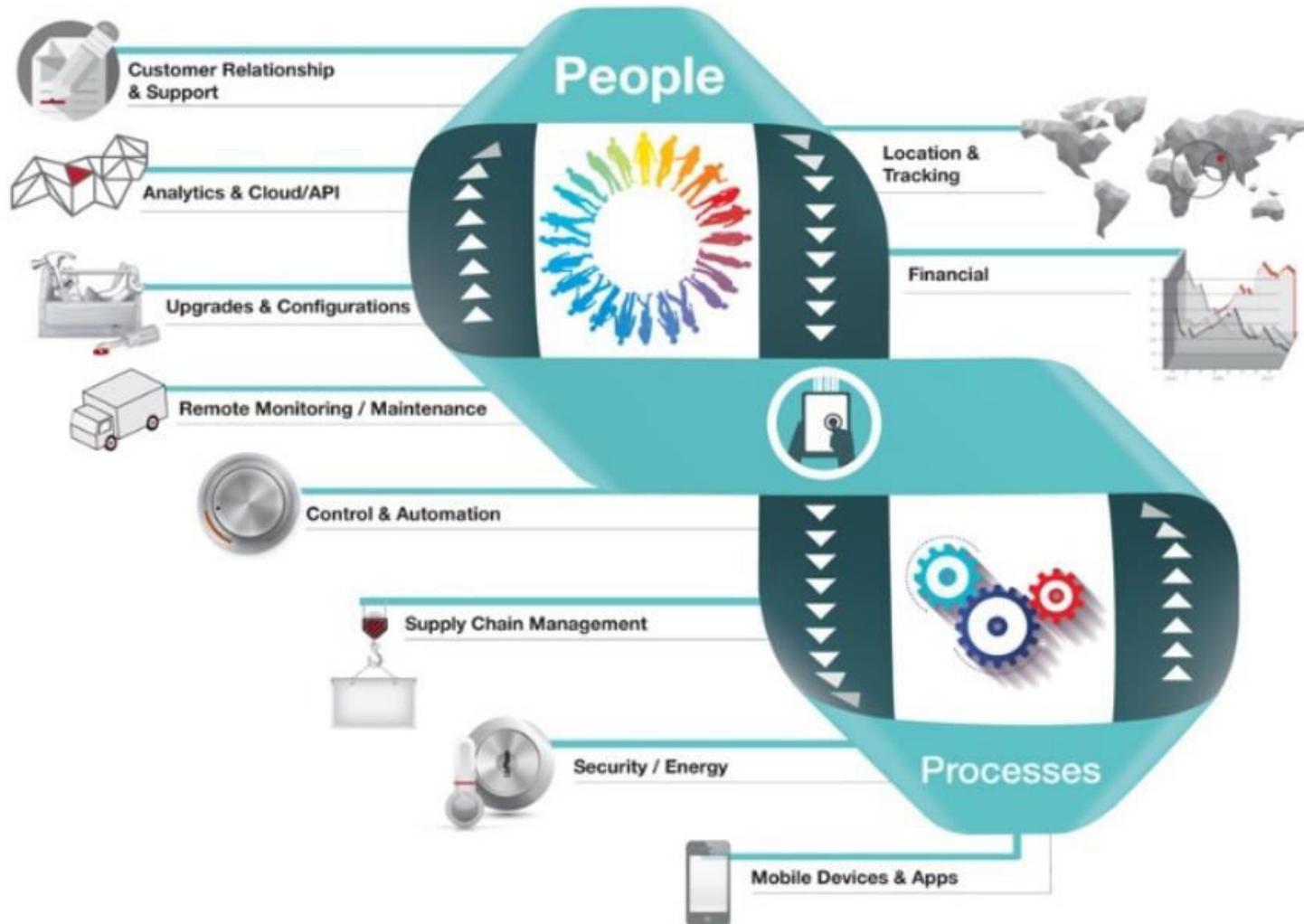
These inputs are digitized and placed onto networks.





# 3 PEOPLE & PROCESSES

These networked inputs can then be combined into bi-directional systems that integrate data, people, processes and systems for better decision making.



# The interactions between these entities are creating new types of smart applications and services.

SENSORS + CONNECTIVITY + PEOPLE + PROCESSES

Starting with popular connected devices already on the market



## SMART THERMOSTATS

nest



Save resources and money on your heating bills by adapting to your usage patterns and turning the temperature down when you're away from home.

## CONNECTED CARS

CAR  
2GO



Tracked and rented using a smartphone. Car2Go also handles billing, parking and insurance automatically.

## ACTIVITY TRACKERS

BASIS



Continuously capture heart rate patterns, activity levels, calorie expenditure and skin temperature on your wrist 24/7.

## SMART OUTLETS

belkin



Remotely turn any device or appliance on or off. Track a device's energy usage and receive personalized notifications from your smartphone.

## PARKING SENSORS

STREETLINE  
CONNECTING THE REAL WORLD



Using embedded street sensors, users can identify real-time availability of parking spaces on their phone. City officials can manage and price their resources based on actual use.



# Features of IoE

- **Input:** Allows analog or external data to be put into a piece of hardware
- **Output:** Allows a piece of hardware to be put back into the internet
- **Decentralization and moving to the edge** — data is processed not in a single center, but in numerous distributed nodes
- **Relation to every technology in the process of digital transformation** — cloud computing, fog computing, AI, ML, IoT, Big Data, etc. Actually, a rise in Big Data and the IoE technology development are interconnected



## 4 Pillars of IoE

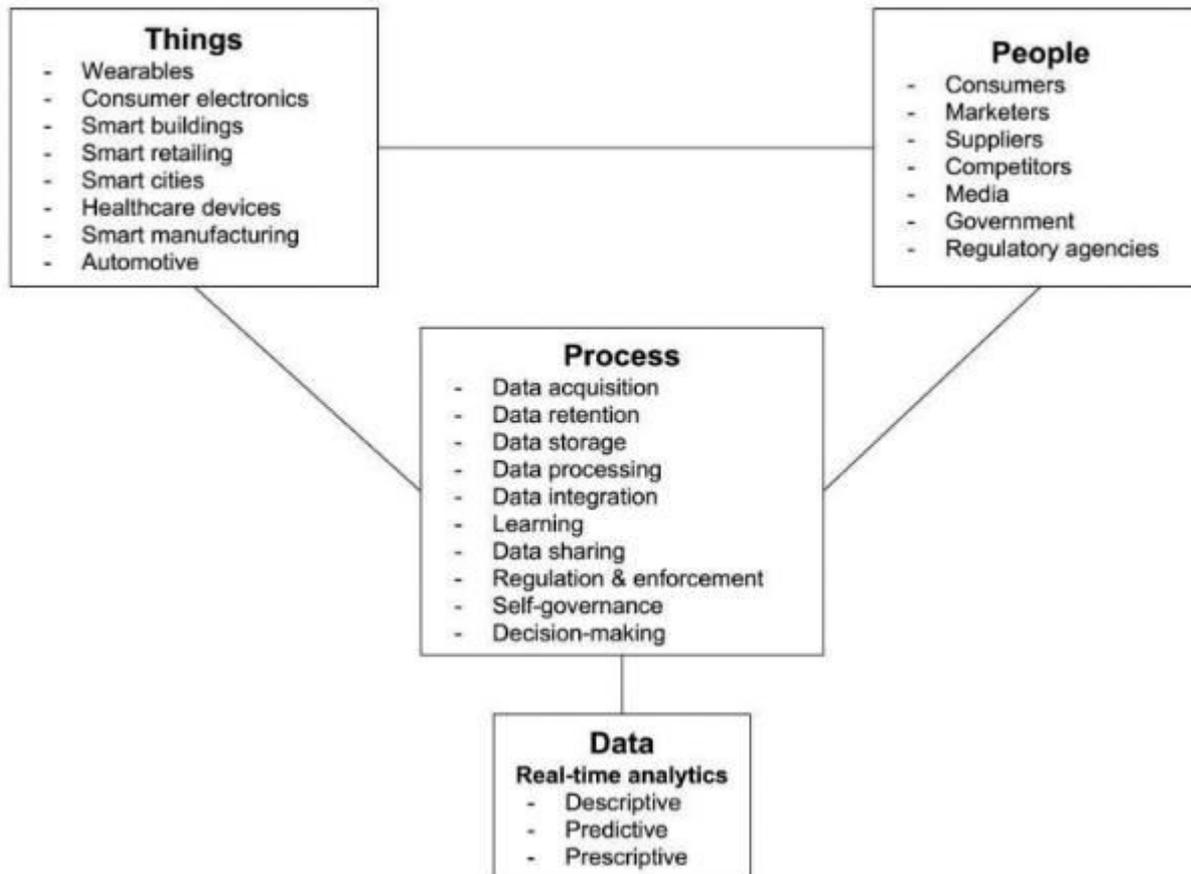
**People:** Connecting people in more relevant, valuable ways

**Data:** Converting data into intelligence to make better decisions

**Process:** Delivering the right information to the right person (or machine) at the right time

**Things:** Physical devices and objects connected to the Internet and each other for intelligent decision making.

# 4 Pillars of IoE (II)





# Pillars of IoE : 1. People, 2. Data

- **People:** Connecting people in more relevant, valuable ways.
  - People provide their personal insights via websites, applications or connected devices they use (such as social networks, healthcare sensors and fitness trackers);
  - AI algorithms and other smart technologies analyze this data to “understand” human issues and deliver relevant content according to their personal or business needs that helps them quickly solve issues or make decisions.
- **Data:** Converting data into intelligence to make better decisions.
  - The raw data generated by devices has no value. But once it is summarized, classified and analyzed, it turns into priceless information that can control various systems and empower intelligent solutions.



# Pillars of IoE : 3. Process, 4. Things

- **Process:** Delivering the right information to the right person (or machine) at the right time.
  - Different processes based on artificial intelligence, machine learning, social networks or other technologies ensure that the right information is sent to the right person at the right time.
  - The goal of processes is to guarantee the best possible usage of Big Data.
- **Things:** Physical devices and objects connected to the Internet and each other for intelligent decision making; often called *Internet of Things (IoT)*.
  - Various physical items embedded with sensors and actuators generate data on their status and send it to the needed destination across the network.



# IoE vs IoT: The differences

- IoT focuses on physical objects only.
- IoE encompasses four components (things, processes, data and people)
- The IoT, in essence, is the interconnectivity of physical objects that send and receive data,
- IoE is a wider term that includes, apart from IoT, numerous technologies and people as the end-nodes.



# IoE vs IoT: The similarities

- **Decentralization** — both systems are distributed and don't have a single center; each node works as a small management center and is able to perform certain tasks independently
- **Security issues** — distributed systems are still highly vulnerable to penetration and cyber attacks; the more devices are connected to the network, the higher the susceptibility to breaches

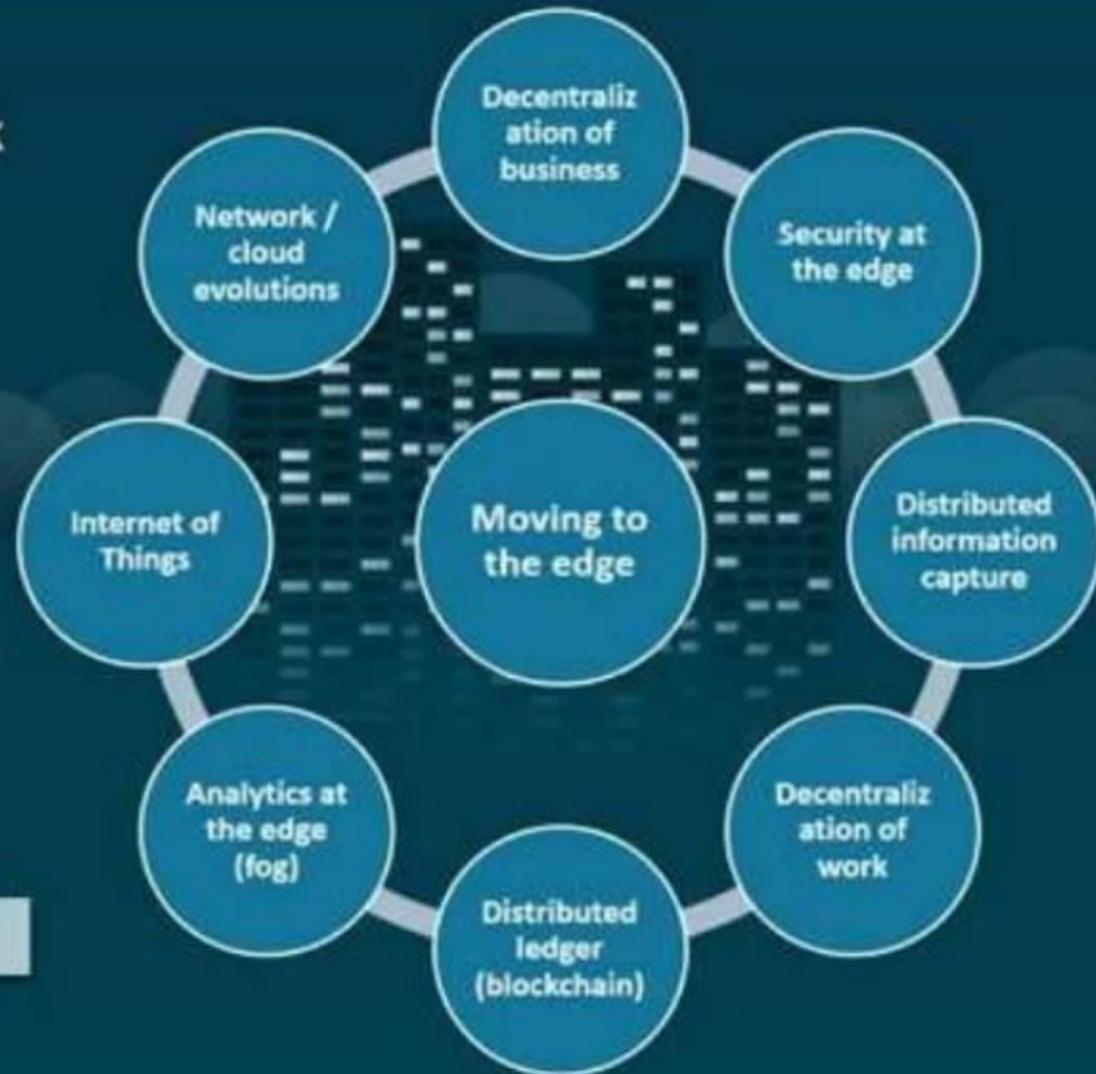


# IoE : Connecting..everything!

IoE: Everything connected  
- in a large distributed network

IoE fits in a context  
of  
ubiquitous  
decentralization

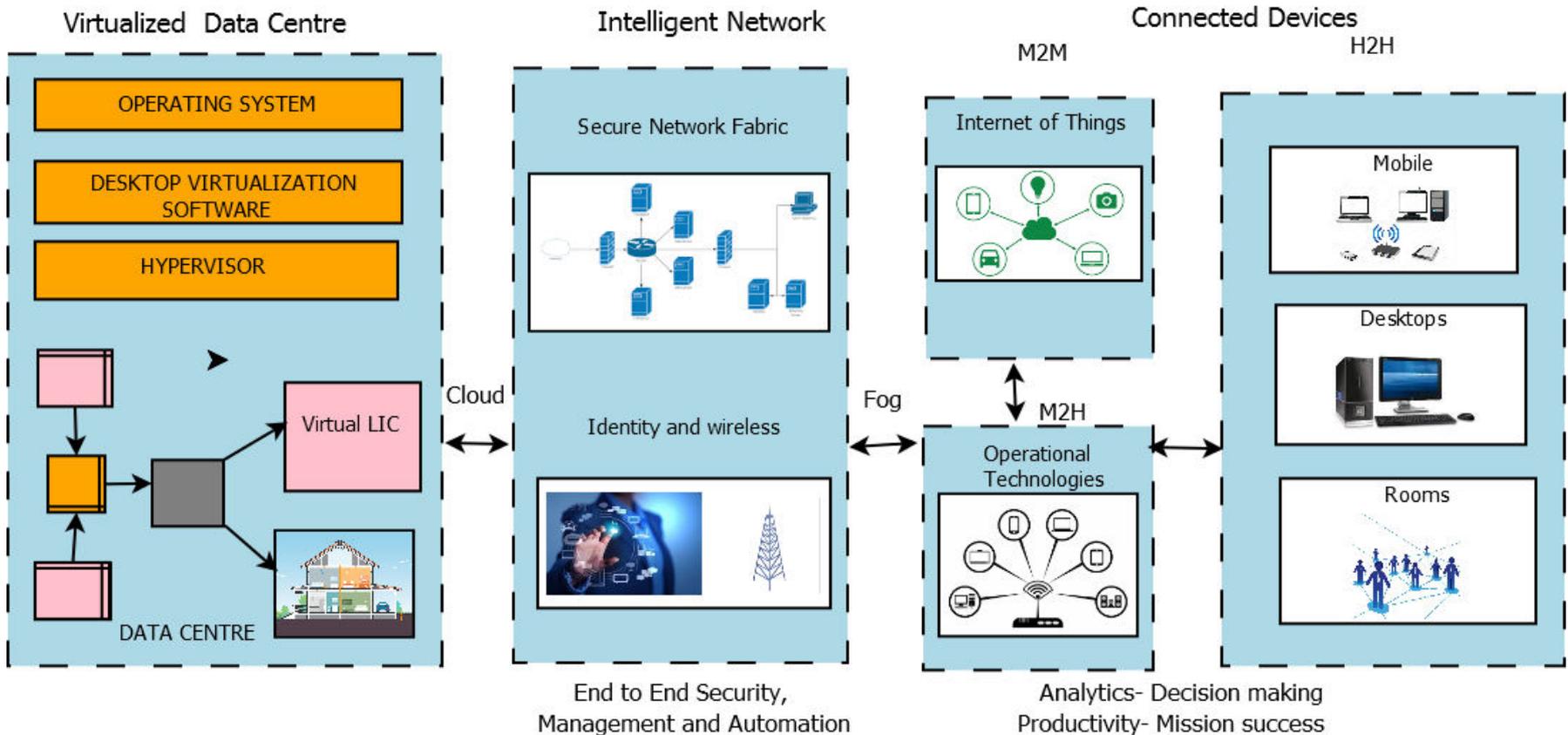
Internet of Everything



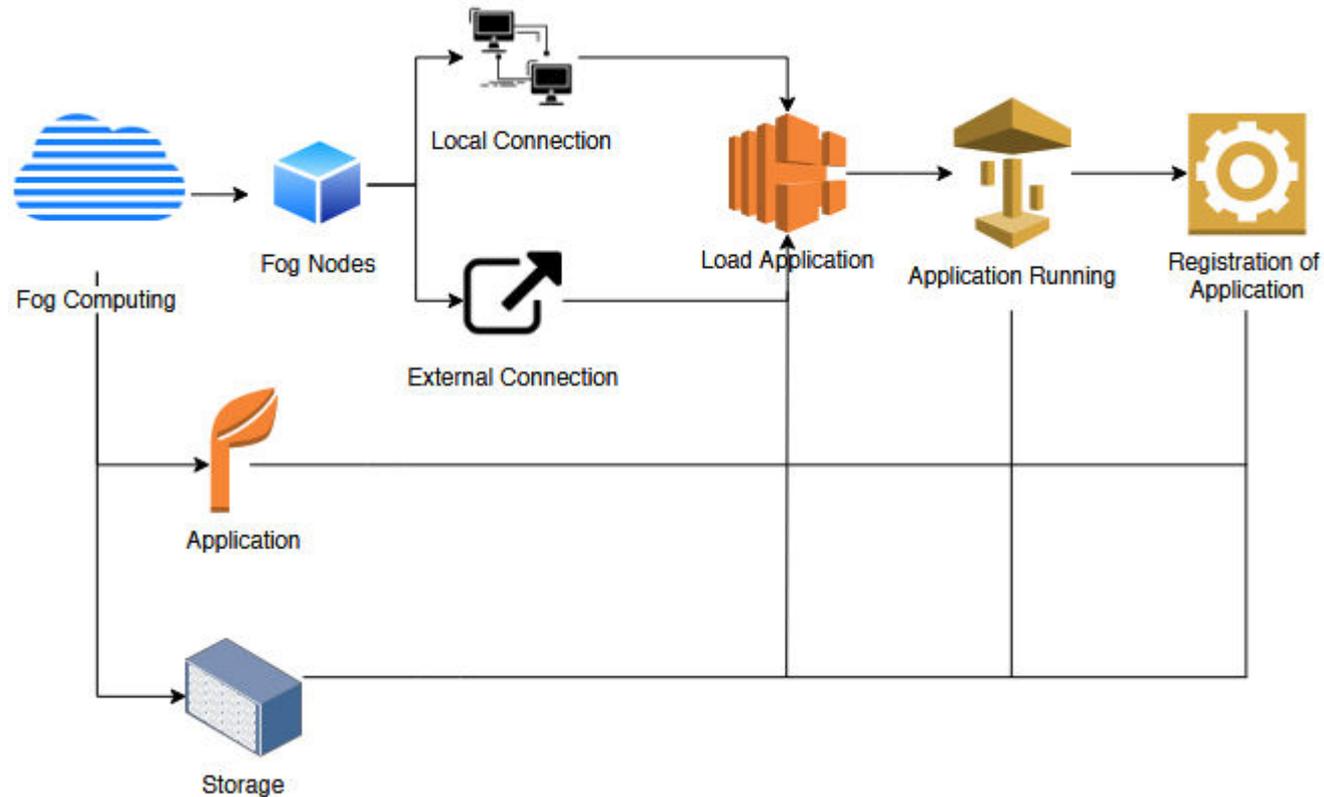


# IoE Generic Architecture

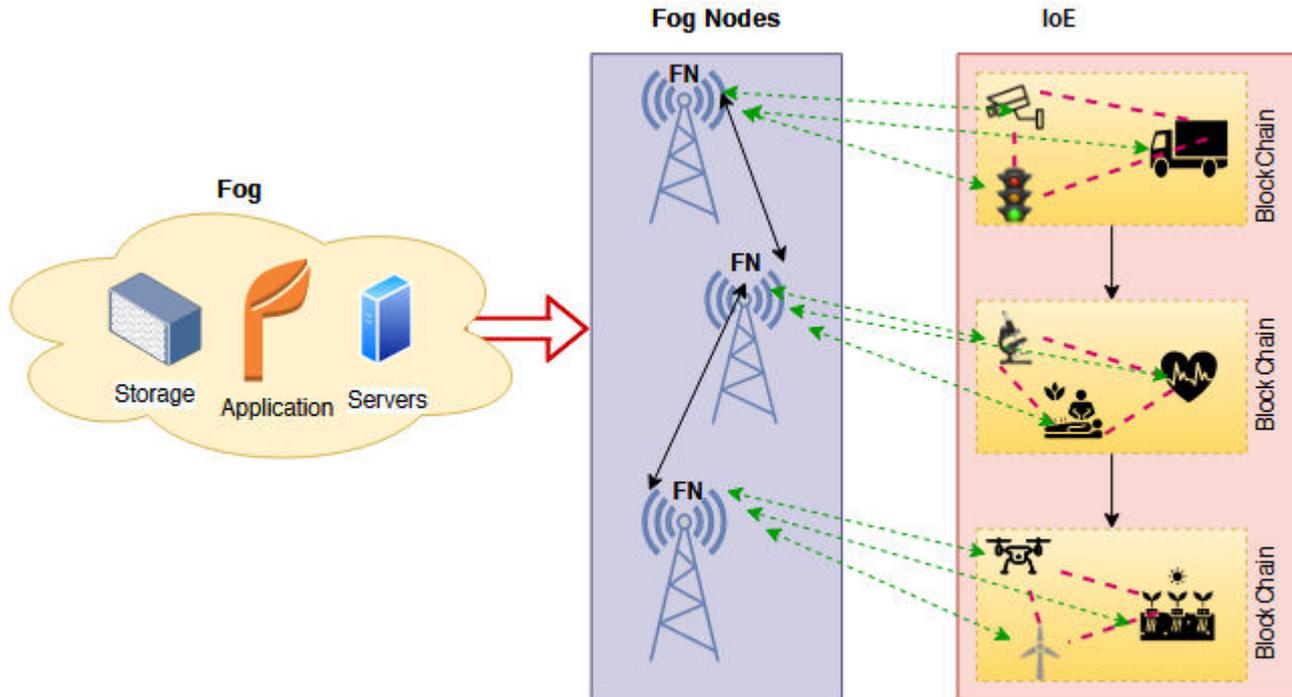
INTERNET OF EVERYTHING: GENERAL SOLUTION ARCHITECTURE



# IoE Generic Architecture (II)



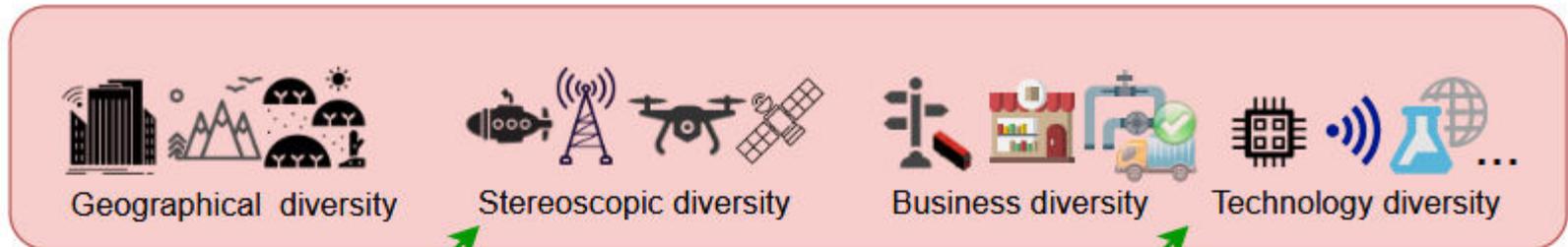
# A Blockchain based IoE Architecture



Blockchain based fog supported architecture for smart cities.

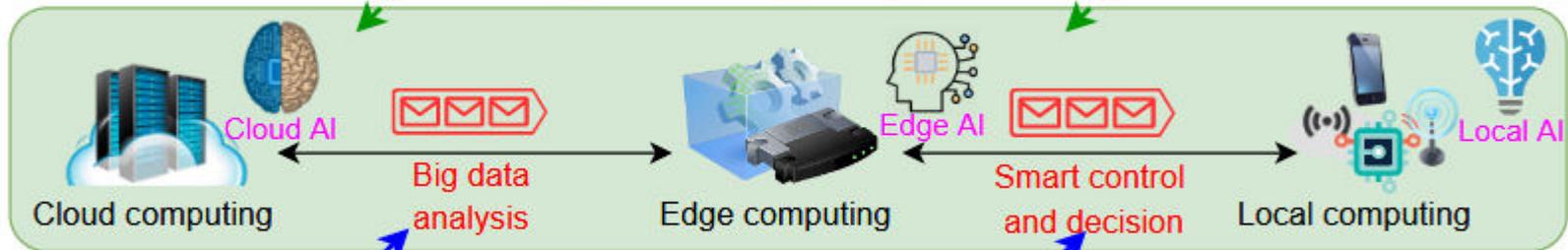
# The 3 Expectations of IoE

**3**  
**Diversity**



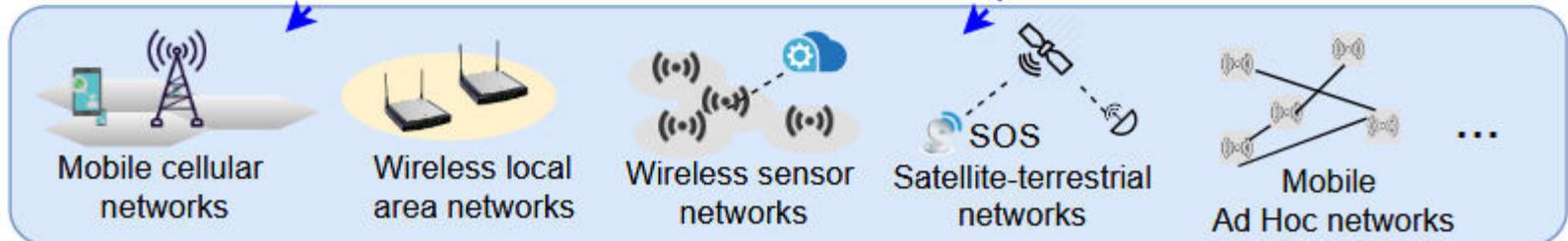
Applications/Supporting Services

**2**  
**Intelligence**

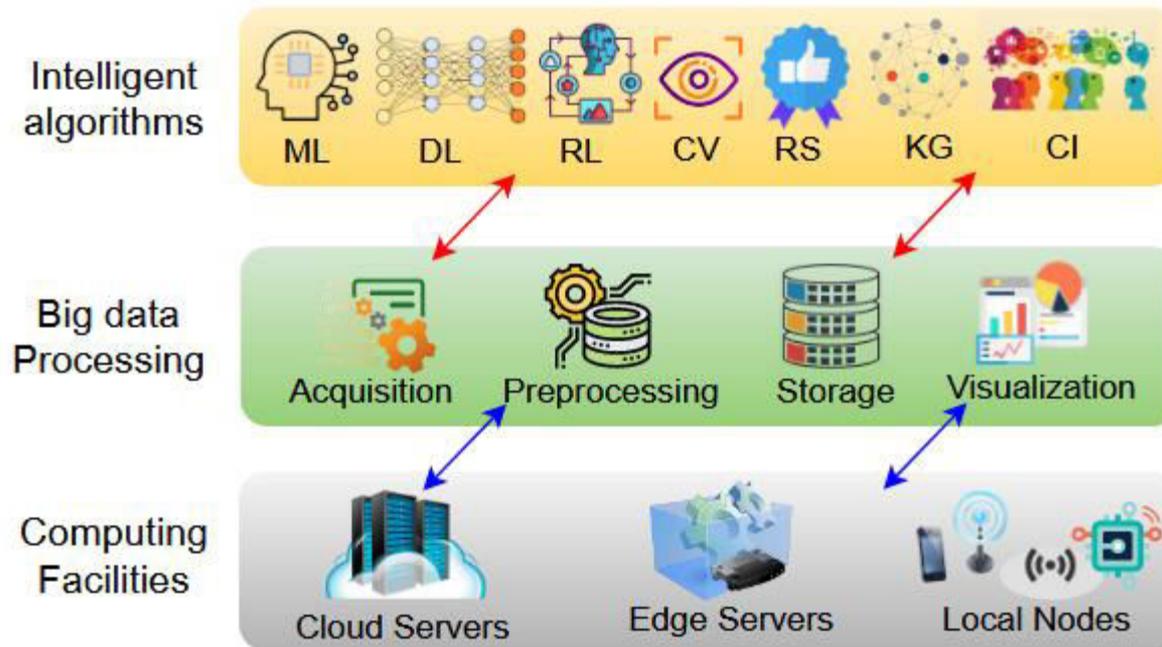


Data collection/uploading

**1**  
**Scalability**

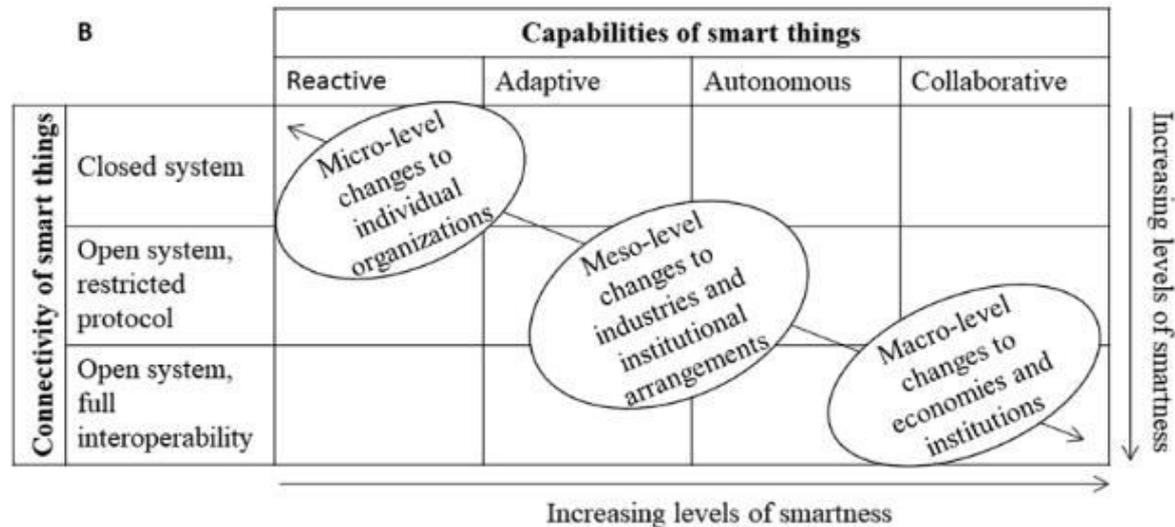
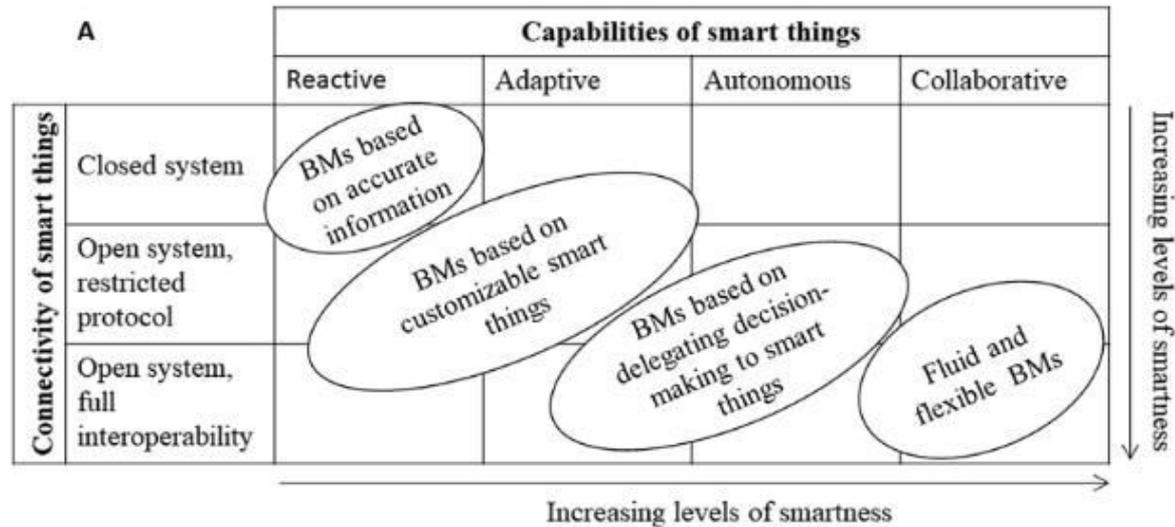


# Enabling Intelligent technologies of IoE



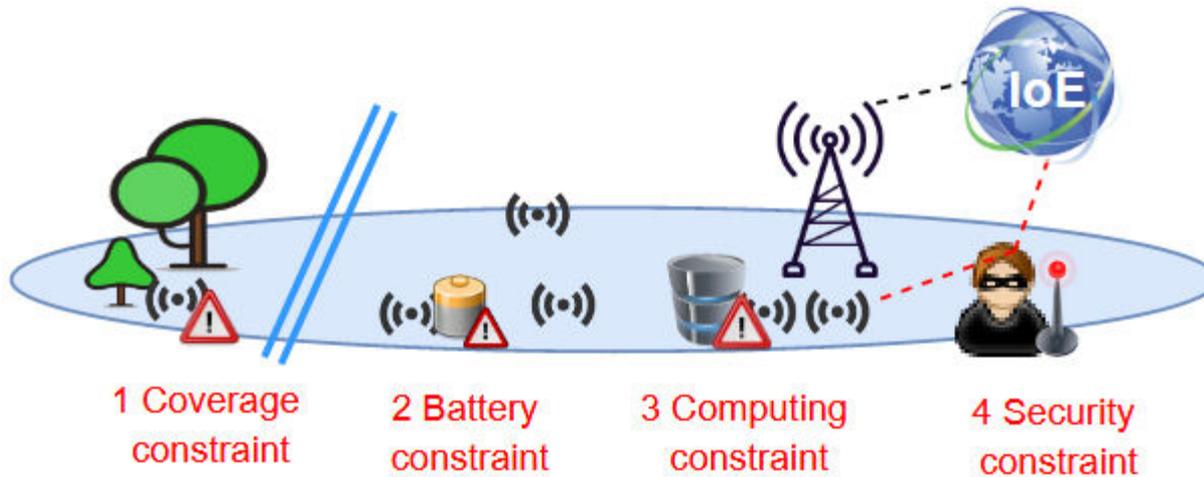
Intelligent algorithms including machine learning (ML), deep learning (DL), reinforcement learning (RL), computer vision (CV), recommendation system (RS), knowledge graph (KG) and collective intelligence (CI) outperform statistical methods in diverse tasks like regression, classification, clustering and decision-making

# IoE Intelligent Levels

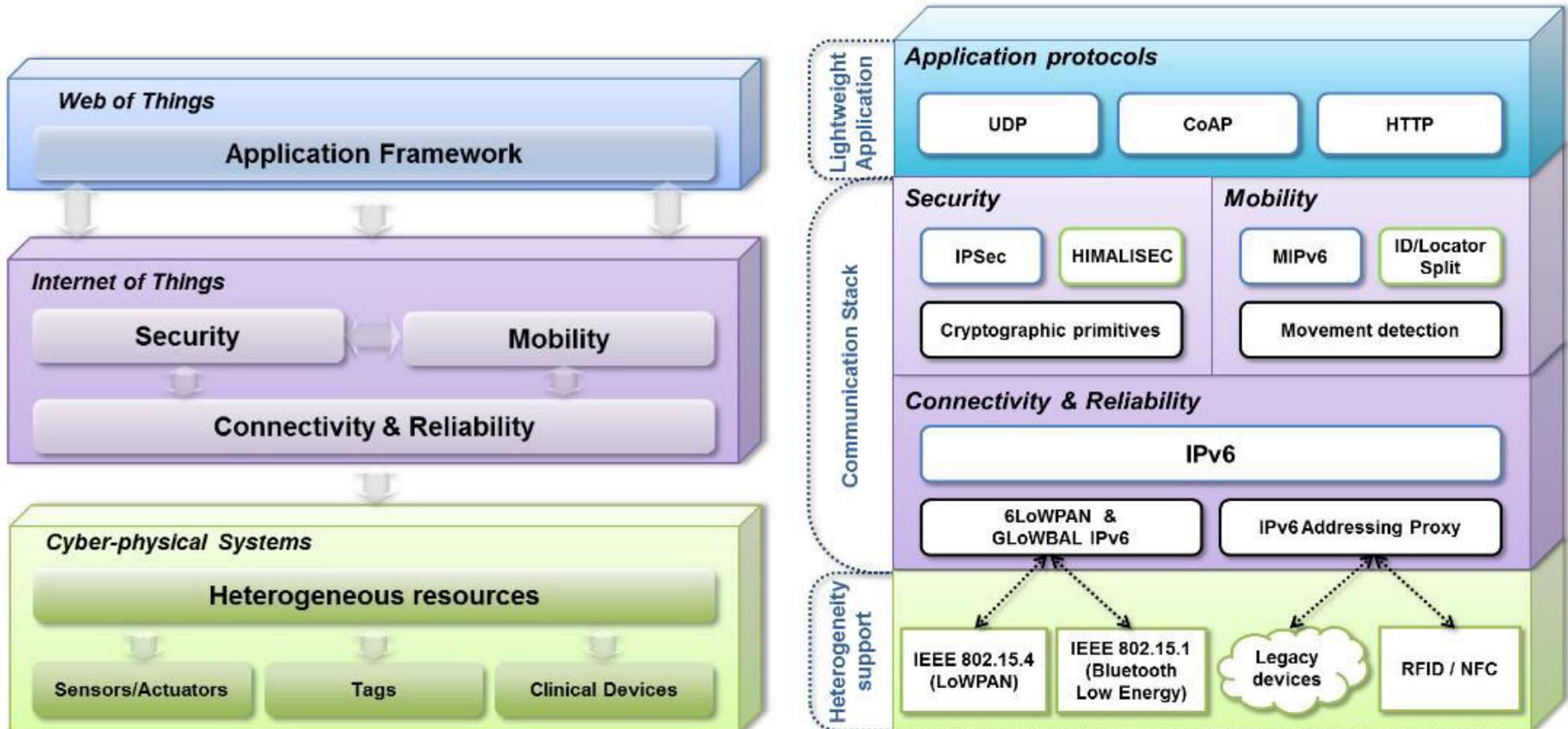


Taxonomy of the increasing levels of smartness for things in the Internet of Everything, (A) their implications for business models (BMs), and (B) the abstraction level of their effects in the economy.

# Facing Challenges of IoE



# State of the art protocols for IoE

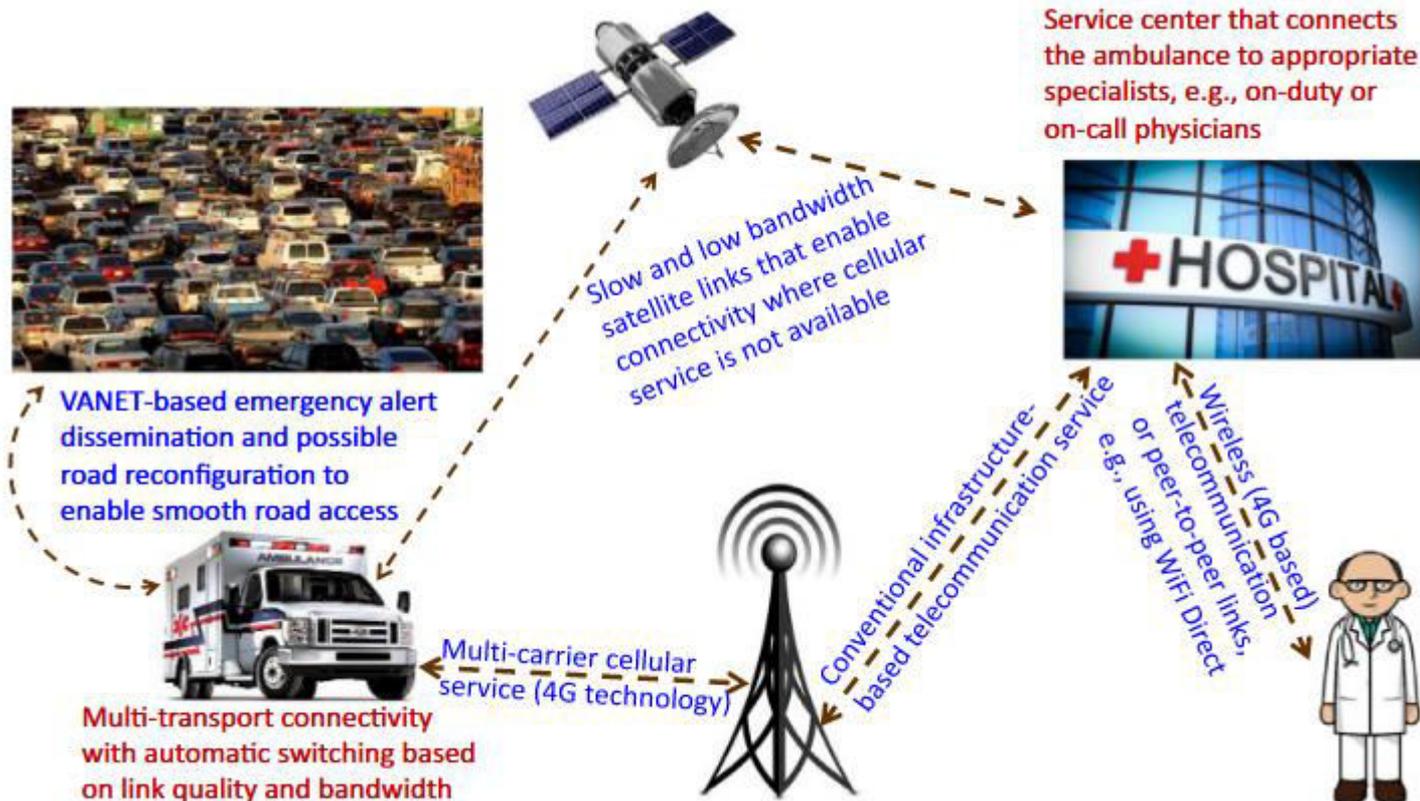




# IoT applications: Healthcare

- *Simultaneous reporting and monitoring*: Real-time monitoring via connected devices can save lives in event of a medical emergency like heart failure, diabetes, asthma attacks, etc.
- *End-to-end connectivity and affordability*: It enables interoperability, machine-to-machine communication, information exchange, and data movement that makes healthcare service delivery effective.
- *Data assortment and analysis*: Vast amount of data that a healthcare device sends in a very short time owing to their real-time application is hard to store and manage if the access to cloud is unavailable. IoT devices can collect, report and analyses the data in real-time and cut the need to store the raw data.
- *Tracking and alerts*: On-time alert is critical in event of life-threatening circumstances. Medical IoT devices gather vital data and transfer that data to [doctors for real-time tracking](#), while dropping notifications to people about critical parts via mobile apps

# An IoE virtualized Healthcare case study





# IoE applications: Education

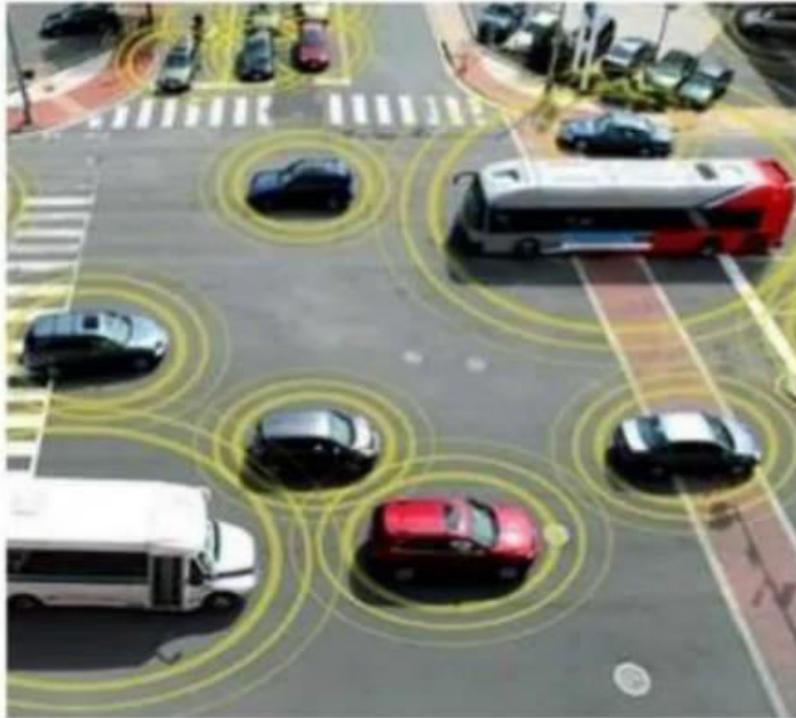
- **Global networking among students and educators:** Students can now interact with peers, mentors and educators worldwide using connected devices such as digital highlighters and interactive boards, while sitting in the comfort of their home or classroom.
- **Enhancement of textbooks:** Quick Response (QR) codes have made their way into the school textbooks. Feedback, assignments and additional knowledge resources become easily available to students when they scan the QR codes with their smartphones.
- **Easier data collection and analysis:** Students now use Radio-frequency identification (RFID) chips to tag and track physical objects or even birds and animals round the clock, irrespective of the weather or other conditions and schools have started to initiate automatic data analysis using applications based on the cloud.



# IoE applications: Education (II)

- **Greater safety in campuses:** Digitised identity cards and wristbands are used to track visitors, staff and students. Data on the last-known locations are stored on a server which ensures that every area on campus is accessed only by the right people.
- **The cards and wristbands** also act as digital wallets and enable cashless payments. School buses are also enabled with GPs tracking, which makes the journey to and from school safer and lets parents know their child's whereabouts.

# IoE applications: Efficient Transportation



- 1 billion cars on the road today
- 4 billion projected by mid-century
- China: 100 km traffic jam lasts nine days in August 2012
- Sao Paulo, Brazil: traffic jams typically exceed 100 miles; average commute 2–3 hours
- By 2040, 75% of cars will be autonomous

Connected, intelligent cars could boost highway capacity by 273%

Construction sites, poor rerouting, and a lack of information about traffic status are all issues that lead to incidents. IoE provides solutions in the form of better information sharing with the public, and between various parties directly affecting road traffic.



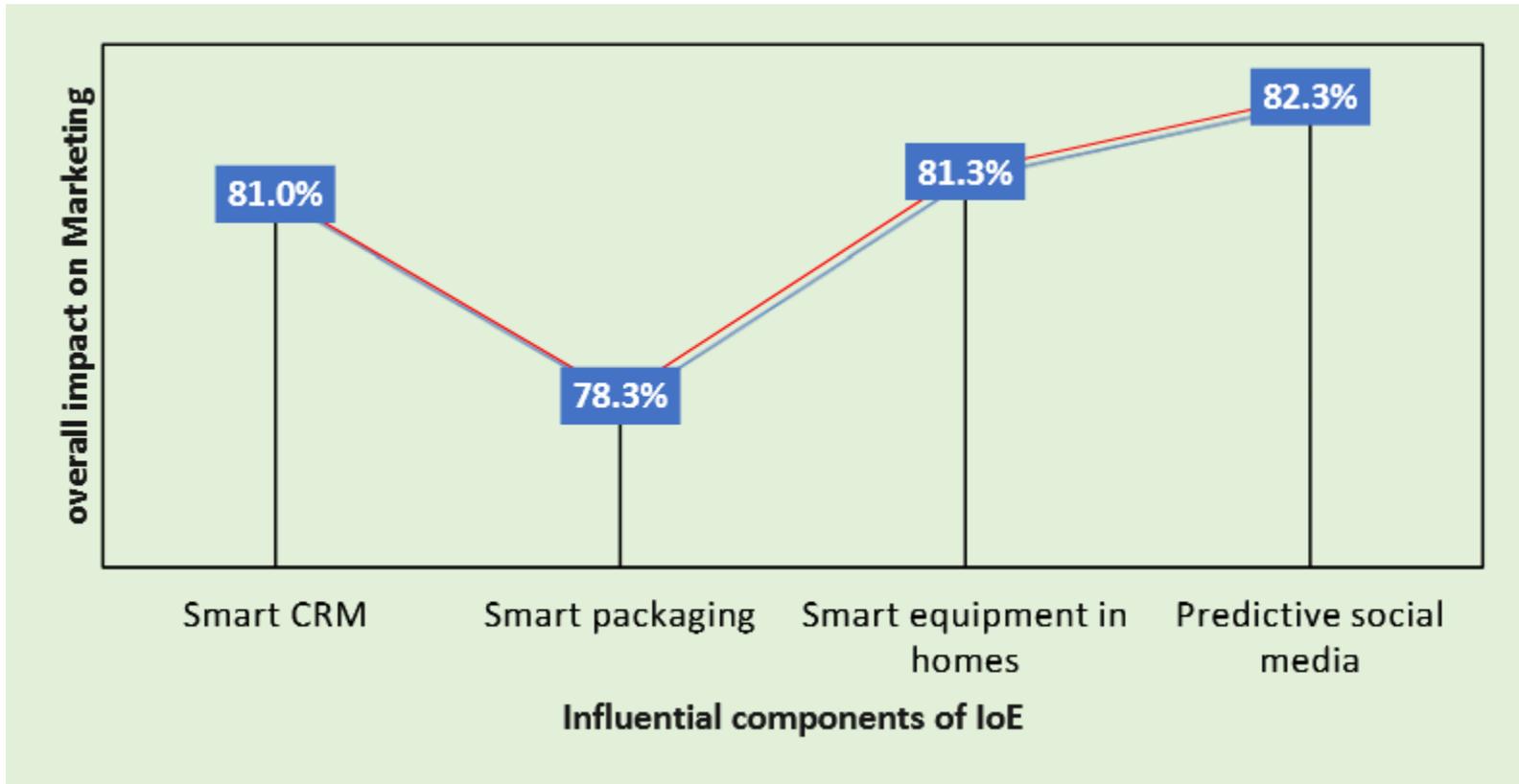
# Environmental IoE applications

**Conquering Climate Change.** IoE will eventually allow us to become better stewards of our finite resources by improving how we sense, understand, and even manage our environment.

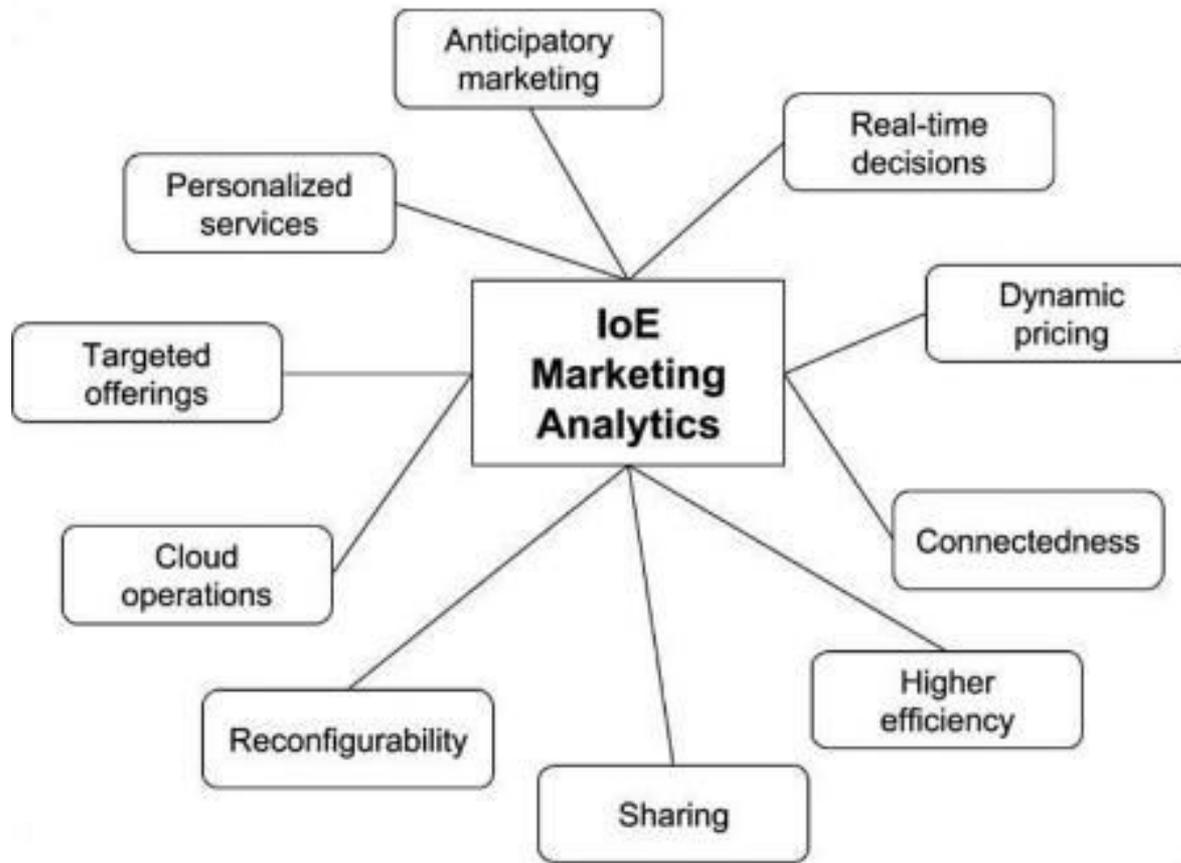
**Hunger:** By understanding and predicting long-term weather patterns, farmers will be able to plant crops that have the greatest chance for success.

**Drinkable Water:** IoE will have the ability to fix many of the problems that reduce our clean water supply, such as industrial waste, unsustainable agriculture, and poor urban planning.

# IoE impact in marketing applications



# IoE benefits in marketing applications





# IoE and AI for industry applications

**AI and IoT data analysis:** There are four types of Internet Data Analysis of Things that can be useful for AI:

- Streaming data visualization – Treat streaming data immediately by defining, discovering and displaying data in intelligent ways to facilitate the decision-making process to take place without delays.
- Accuracy of time series of data – Maintain a high level of confidence in the data collected with high accuracy and integrity of the data.
- Predictive and advanced analysis – Very important step in which decisions can be made based on the data collected, discovered and analysed.
- Geospatial and real-time location (logistic data): Maintain a calm and controlled flow of data.
- When the data collected from the Internet of Things is analysed using Artificial Intelligence, app developers and companies can make informed decisions by the identification and understanding of patterns in the analysed data.
- This entails various benefits, both for consumers and app developers. It allows app developers to find solutions to IoT products and innovations in the IT industry.



# IoE and customer experience

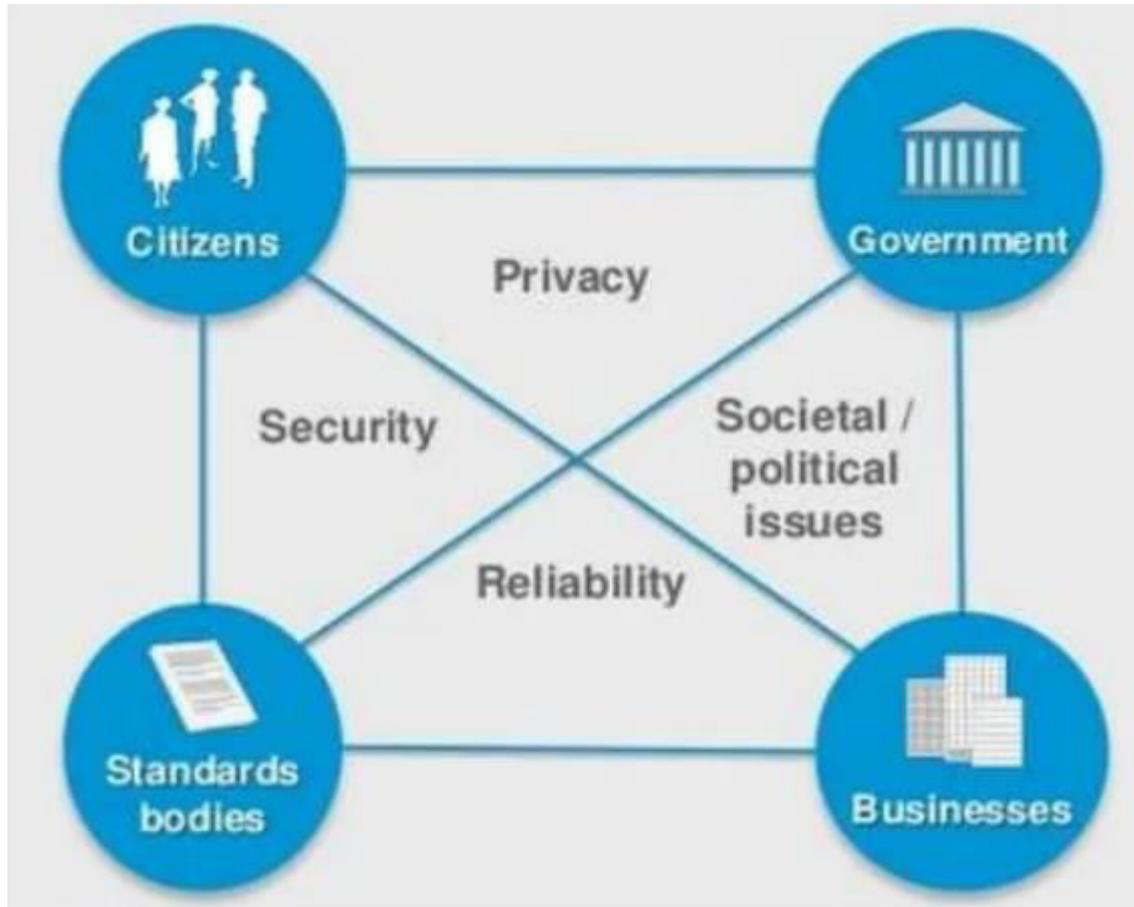
- **Monitor and improve experiences with company offerings** :Customers increasingly expect that their IoT devices will connect with pertinent locations and customer support, the report noted.
- **Personalize each situation for the customer**: Customers expect their IoT devices to adjust and refine services and capabilities based on real-world context, the report said. For example, "Schneider Electric's smart commercial electrical panels monitor energy use and problems and deliver custom notifications to customers and service techs based on their business' needs
- **Automatically improve and learn over time via updates to products and services**: Businesses are gathering IoT data from their products to analyze customer experiences and learn to improve, the report said. "Companies like Tesla are also delivering entirely new features, such as Tesla Autopilot, to existing products by adding software that uses IoT sensors and control in new ways," the report said.
- **Reinvent product access and purchase**: Firms are also using IoT to create new products and service offerings. For example, "Kaeser Kompressoren has added a compressed-air-as-a-service option to its industrial air compressor lineup for customers who would rather pay per use than own or lease," the report said. "Chinese startup Mobike offers dockless bike sharing for consumers to find and ride bikes within their service zone."

# IoE case study: Smart cities

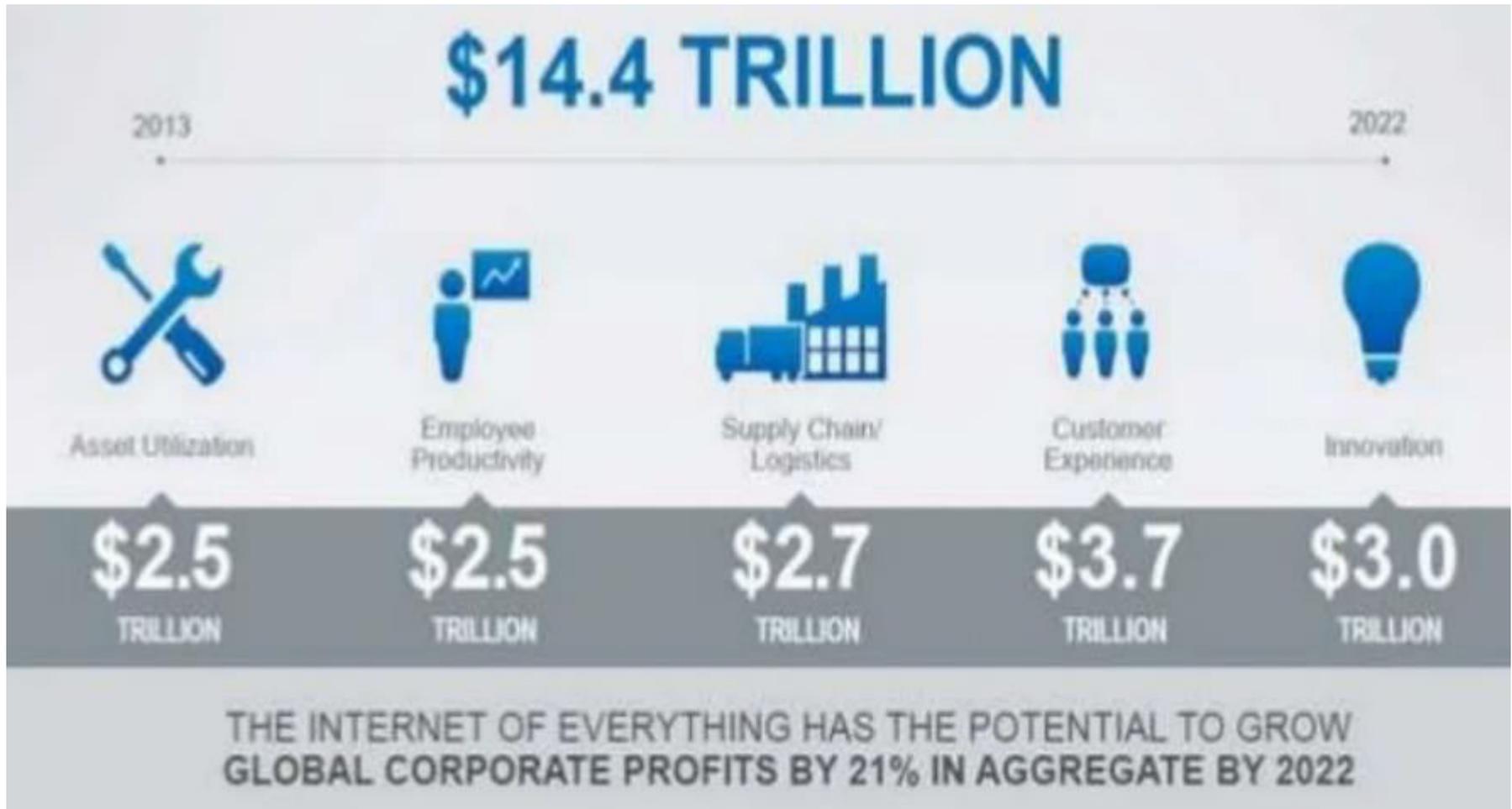
Interactive platform that integrates information from open government programs, local businesses, and citizens to provide meaningful and powerful knowledge anytime, anywhere, on any device.



# IoE Co-operation Requirements



# Market Investment Prospects of IoE





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# IoE and Digital Transformation commercial case studies

- Barilla
- Columbia Sportswear
- Del Papa Distributing
- intu
- Mayland Real Estate
- MGM Resorts
- International
- Stary Browar
- Tesco's F&F
- Trinity Leeds

# Barilla Gives Consumers Insight into the Journey of Their Food



Breaking down information silos across their supply chains

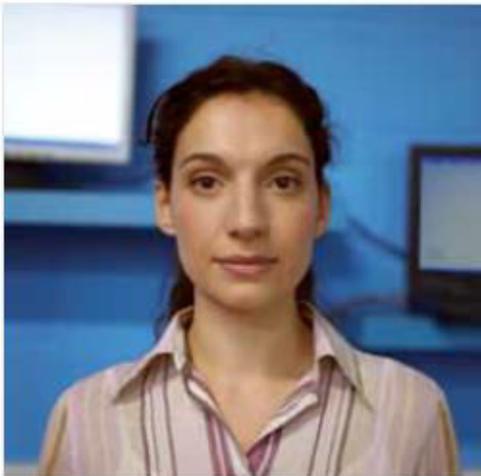


Providing consumers with greater transparency into the sources of their food

Barilla adopted a new technology platform called Safety for Food (S4F), which enables consumers to scan a QR code on the back of limited edition product packages to easily access a website that tells the story of the specific production batch, through a detailed analysis of all major phases of the supply chain.

# Columbia Sportswear Makes the Most of Space and Increases Resiliency

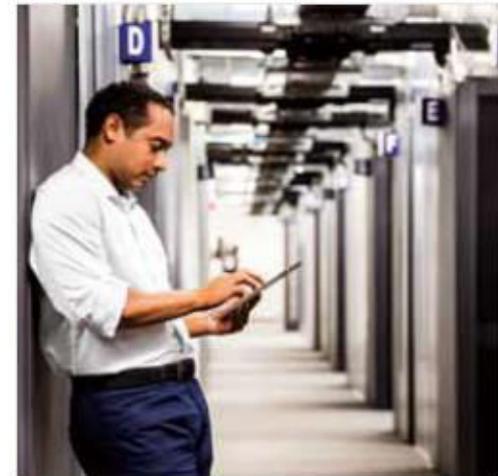
*Columbia Sportswear is improving store operations. They have:*



Reduced in-store IT infrastructure from eight to four rack units, saving US\$20,000 annually on power



Established a backup connection for point of sale applications and voice



Eliminated the cost of sending technicians to stores to install or update servers

Columbia Sportswear turned to a Store-in-a-Box solution, by adopting a platform running all critical store systems on a single server.

Columbia Sportswear's PoS applications are virtualized, allowing them to move their virtual machine to the public cloud so customers can continue to make purchases even if one power supply fails.

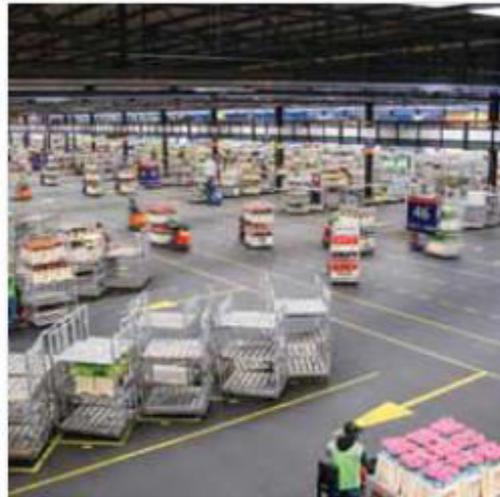
There is also the flexibility to quickly add new IT services such as sales analytics, digital signage, or customer behavior analysis without the time and costs of adding physical servers.

# Del Papa Distributing Boosts Security, Shipping Capacity, and Service

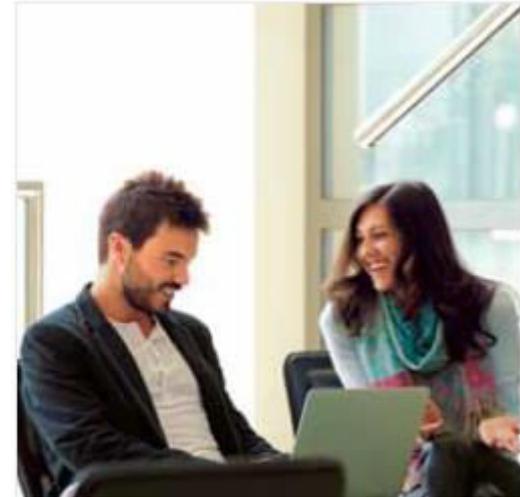
*Del Papa Distributing has captured value with the Internet of Everything. They have:*



Gained better control over all entrances and restricted areas



Increased daily shipping capacity by six percent



Freed up more time for sales representatives to interact with customers

Cisco designed a network for Del Papa that connects previously unconnected people and things. Employees who are not located at headquarters, teams can come together quickly with high-quality video and audio conferencing, top-level security, that would help them provide an excellent customer experience.

Now a last-minute order can reach staff instantly anywhere in the warehouse

# Shopping Center, intu, Transforms Shopper Experiences for the Digital Era

*intu is benefiting from the Internet of Everything. They:*



Grew their customer database to one million unique registrations and a 50 percent opt-in rate for promotions



Gained a view into footfall traffic to measure the popularity of events and locations



Used location-based technologies to improve the customer experience

Intu created a fully connected line of stores, providing better in-store experiences that shoppers are demanding in the digital era today.

A holistic view of all shopping centers building new virtual features that put customers at the heart of business.

With all this new data, intu is able to understand how people move around stores and what draws their interest providing location-based analytics.

# Mayland Real Estate Gains Insight into Shopper Behavior from Location Information

*With the Internet of Everything, Mayland Real Estate has:*



Enhanced shopper experiences through free Wi-Fi and personalized offers



Correlation of shopper behavior with advertising campaigns and mall events



The ability to see what types of tenants attract visitors

Online merchants can track the product viewing history of their customers, and then make personalized offers to them.

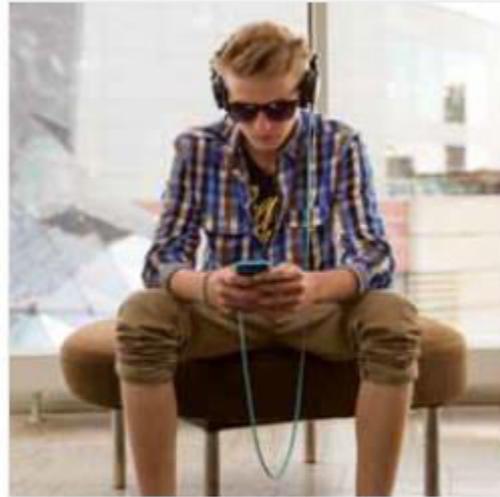
Information of whether the shopper has visited the mall before, the duration of a shopper's stay, shopper behavior patterns, and who comes to the mall for specific events based on the interconnected location services.

# MGM Resorts International Enriches Guest Experiences with Digital Transformation

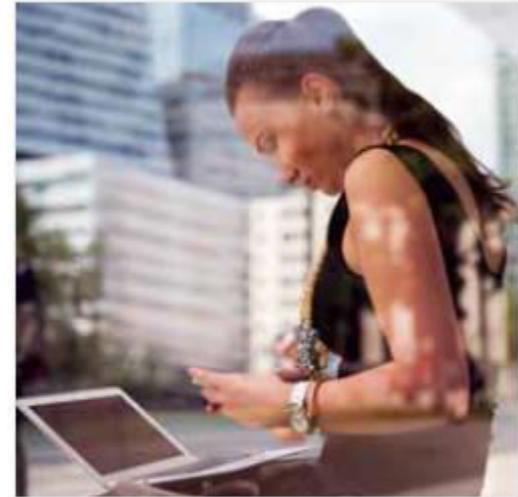
*MGM Resorts International gives guests the ultimate experience, including:*



Seamless Wi-Fi roaming and interconnection among MGM Resorts properties in Las Vegas



Power to the most demanding mobile applications to further engage, entertain, and enhance guest experiences



Up to 30 percent faster connectivity

MGM deployed the hospitality industry's largest next-generation Wi-Fi network, that can market to guests in real time, based on guest preferences.

# Stary Browar Becomes a Digital Business and Transforms Customer Experiences

*Stary Browar is becoming a digital business, gaining:*



Deeper engagement with customers



Extensive analytics obtained from Wi-Fi



Improved safety and security of guests

Stary Browar's (a shopping, arts, and business center located in Poland,) IoE network solution, any customer logged in to the organization's app to connect with friends over social media, use a virtual map to find what they're looking for, and receive personalized offers directly on their mobile devices.

# F&F Keeps Customers Connected providing Them with the Latest Styles and Trends

*F&F revolutionized their in-store shopping experience. They:*



Grew online sales by 50 percent during a key holiday period



Personalized advice and deals based on store location



Provided employees with new ways to help customers

Using the IoE, F&F now helps in-store customers connect for the personalized experience they get online.

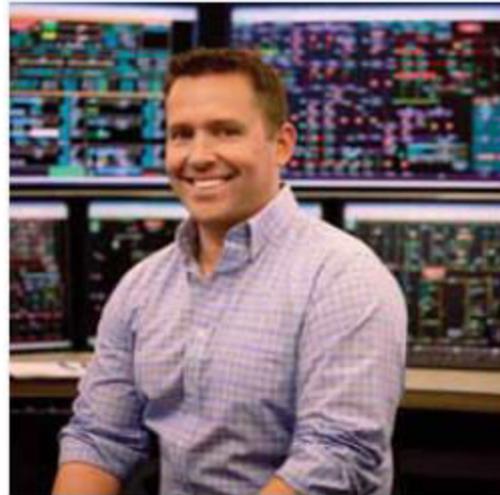
They can visit a specialized kiosk called an Online Order Point, ask an employee to look something up on their F&F tablet, or connect over Wi-Fi on their own personal device

# Trinity Leeds Ranks in the Top Five United Kingdom Retailers with Digital Transformation

*Trinity Leeds has transformed the customer experience. They:*



Attracted 22 million visitors  
in the first 12 months



Simplified facilities management  
by connecting all building systems  
to one network



Earned a spot in the top five best  
shopping places on the list of  
United Kingdom retail destinations

Trinity Leeds is taking advantage of the IoE to connect people, process, data, and things to create a powerful integration platform for retail innovation.

Shoppers can get connected and check their smartphone apps for personalized shopping offers. view social media streams on interactive touchscreens.

Retailers can also get connected with shoppers through the smartphone apps, as well as through in-store digital signage



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- Thank You!!!