Internet of Things in Regard to Industry 4.0

Tushar B. Kute,
http://tusharkute.com


IOT
Internet of things
TV

What is IoT ?

- The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.
- IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

What is IoT ?

- "Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist fire-fighters in search and rescue operations.
- These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices.

History of IoT

- 1999: The Term "Internet of Things"
  - Kevin Ashton: The term "Internet of Things" was coined by Kevin Ashton, a British technologist, while working at Procter & Gamble. He used it to describe a system where the internet is connected to the physical world via ubiquitous sensors.
- Early 2000s: Initial Developments
  - MIT Auto-ID Center: Researchers at the MIT Auto-ID Center developed standards for RFID and other sensors, which were critical for the development of IoT.

Examples of IoT Devices

- Smart homes: Thermostats, lights, security systems, and appliances.
- Wearables: Fitness trackers, smartwatches, and health monitors.
- Automotive: Connected cars with features like remote diagnostics and autonomous driving.
- Industrial: Sensors for monitoring equipment, supply chain management, and predictive maintenance.

How IoT Works ?

- Devices: Everyday objects are equipped with sensors and software.
- Connectivity: These devices connect to the internet, forming a vast network.
- Data Collection: Sensors gather data about their surroundings or their own state.
- Data Transmission: Collected data is sent to a central system or cloud.
- Analysis: Data is processed and analyzed to extract valuable insights.
- Action: Based on the analysis, devices or systems can be controlled or adjusted automatically.

How IoT Works ?

Sensors

Collecting data

Connectivity

Sending data to cloud

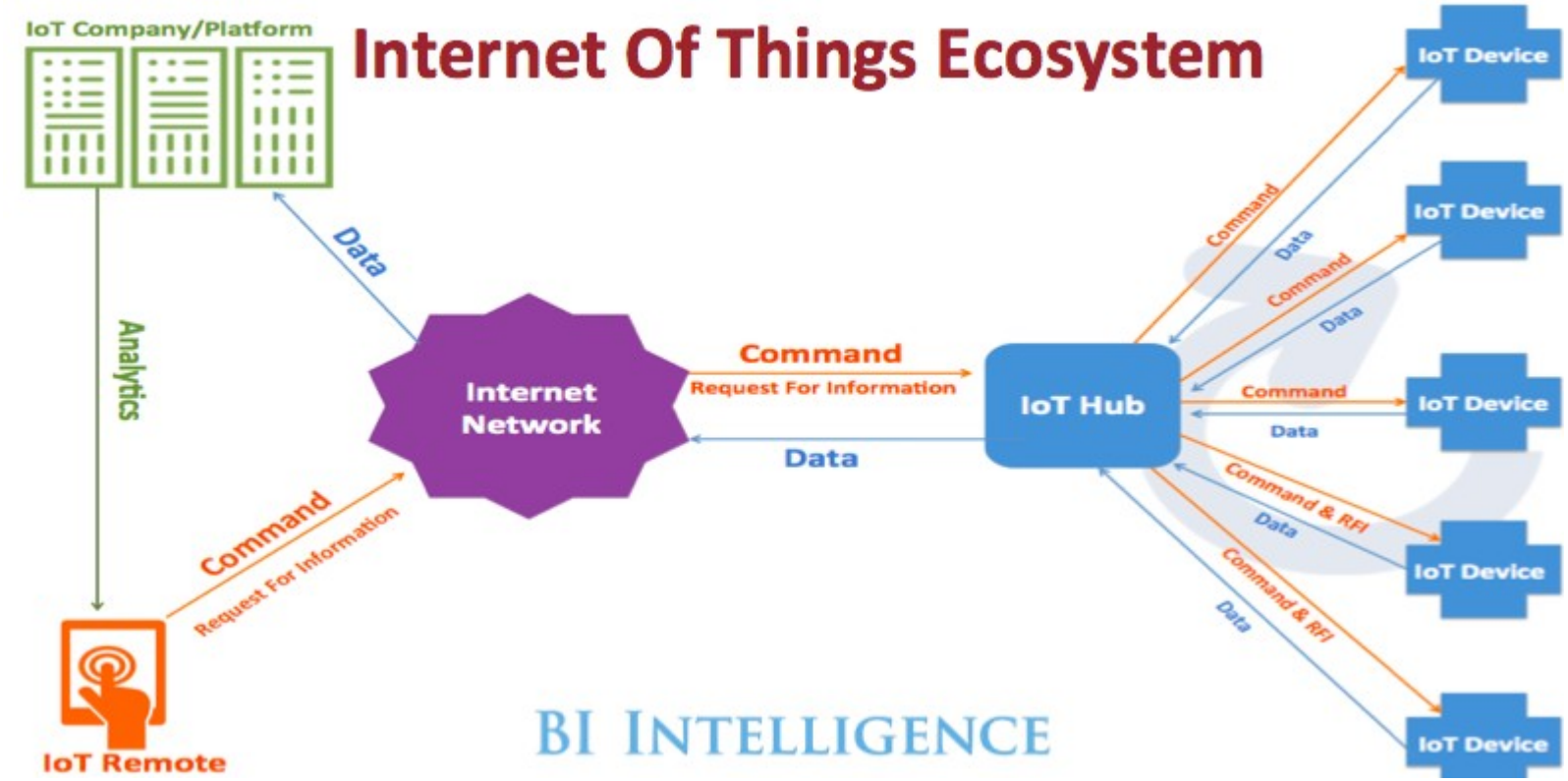
Data Processing

Making data useful

User Interface

Delivering information to user

IoT Eosystem



Structure of IoT

- The IoT can be viewed as a gigantic network consisting of networks of devices and computers connected through a series of intermediate technologies where numerous technologies like RFIDs, wireless connections may act as enablers of this connectivity.
  - Tagging Things : Real-time item traceability and addressability by RFIDs.
  - Feeling Things : Sensors act as primary devices to collect data from the environment.
  - Shrinking Things : Miniaturization and Nanotechnology has provoked the ability of smaller things to interact and connect within the “things” or “smart devices.”
  - Thinking Things : Embedded intelligence in devices through sensors has formed the network connection to the Internet. It can make the “things” realizing the intelligent control.

Key features

- **AI** – IoT essentially makes virtually anything “smart”, meaning it enhances every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can mean something as simple as enhancing your refrigerator and cabinets to detect when milk and your favorite cereal run low, and to then place an order with your preferred grocer.
- **Connectivity** – New enabling technologies for networking, and specifically IoT networking, mean networks are no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its system devices.

Key features

- Connectivity
  - Internet Access: Devices are connected to the internet, enabling them to communicate with each other and with centralized systems.
  - Networking Protocols: Utilizes standard networking protocols such as Wi-Fi, Bluetooth, Zigbee, and cellular networks to ensure reliable communication.

Key features

- Sensors
  - Data Collection: Embedded sensors in IoT devices collect real-time data from their environment.
  - Types of Sensors: Includes temperature sensors, motion detectors, GPS, accelerometers, and more, depending on the application.

Key features

- Automation and Control
  - Remote Control: Users can control devices remotely via smartphones, tablets, or computers.
  - Automation: Devices can perform tasks automatically based on predefined rules, schedules, or triggers (e.g., turning on lights when motion is detected).

Key features

- Data Processing and Analysis
  - Edge Computing: Data is processed closer to the source (on the device or local server) to reduce latency and bandwidth use.
  - Cloud Computing: Centralized data processing and storage in the cloud for more complex analysis and scalability.
  - Machine Learning and AI: Utilizes advanced algorithms to analyze data, detect patterns, and make intelligent decisions.

Key features

- Scalability
  - Large-Scale Deployment: IoT systems can scale from a few devices to millions, supporting extensive networks.
  - Interoperability: Ability to integrate with other systems and devices, often using open standards and APIs.

Key features

- Real-Time Operations
  - Instant Feedback: Provides real-time data and alerts, enabling immediate responses to changes or anomalies.
  - Continuous Monitoring: Constant monitoring of systems and environments for ongoing insights and improvements.

Key features

- Energy Efficiency
  - Low Power Consumption: Many IoT devices are designed to consume minimal power, often using energy-efficient protocols and hardware.
  - Battery Management: Optimized for long battery life, crucial for remote or hard-to-reach devices.

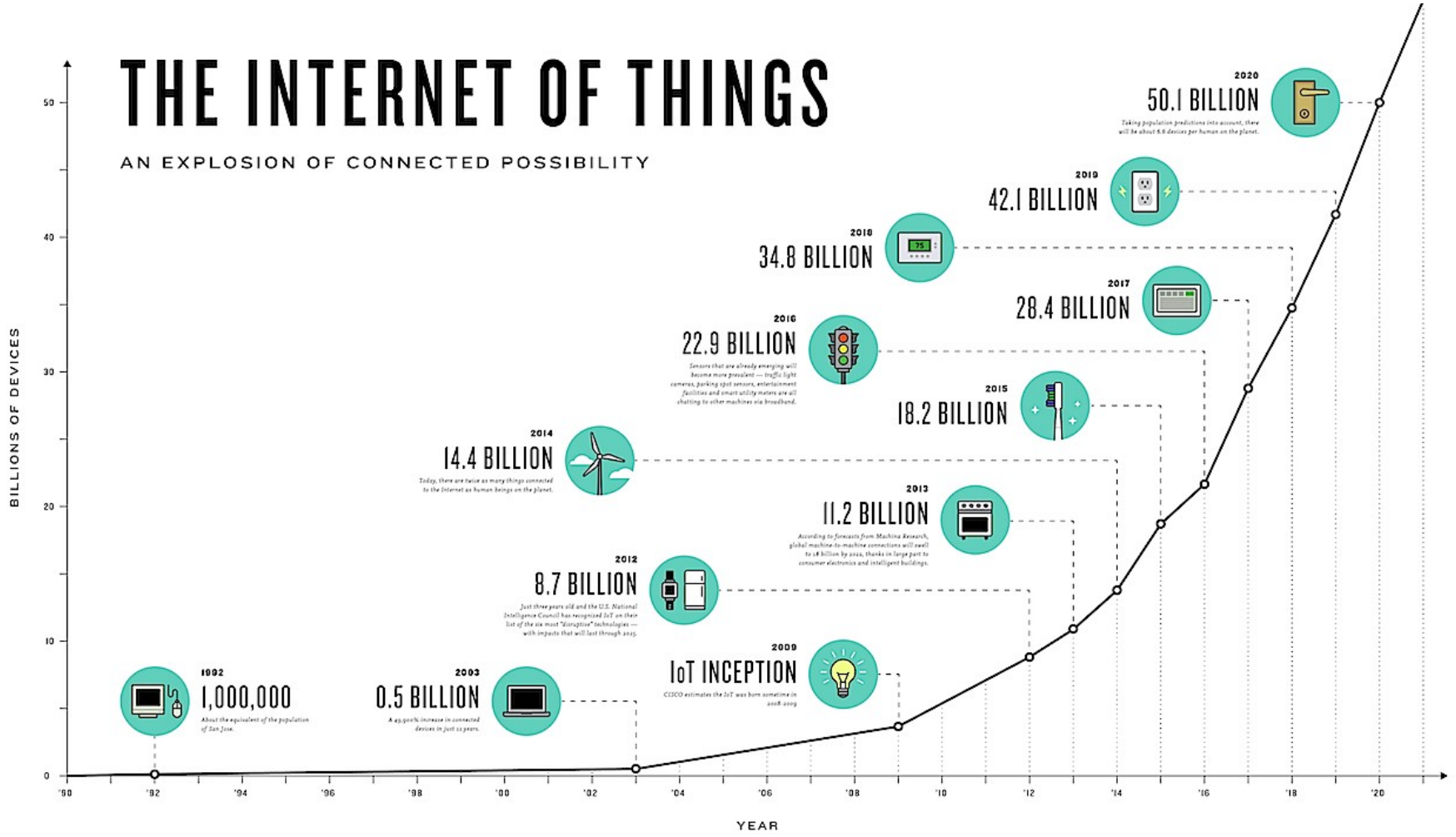
Key features

- Security and Privacy
  - Data Encryption: Ensures that data transmitted between devices and systems is encrypted and secure.
  - Access Control: Implements authentication and authorization measures to prevent unauthorized access.
  - Privacy Policies: Adheres to privacy regulations and standards to protect user data.

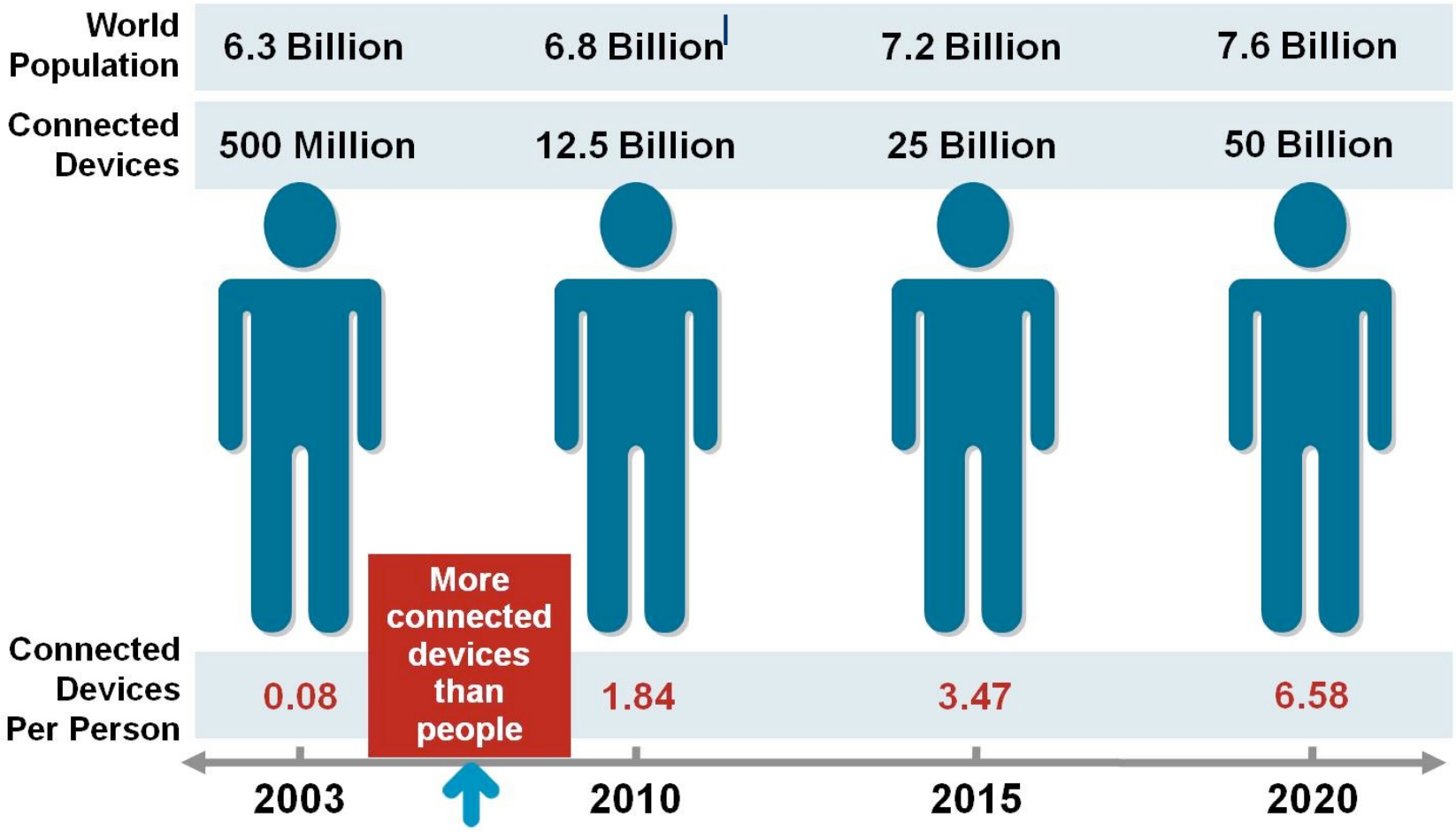
Key features

- User Interface
  - Mobile Apps: Provides user-friendly interfaces through mobile applications for easy control and monitoring.
  - Dashboards: Centralized dashboards offer comprehensive views of all connected devices and their statuses.

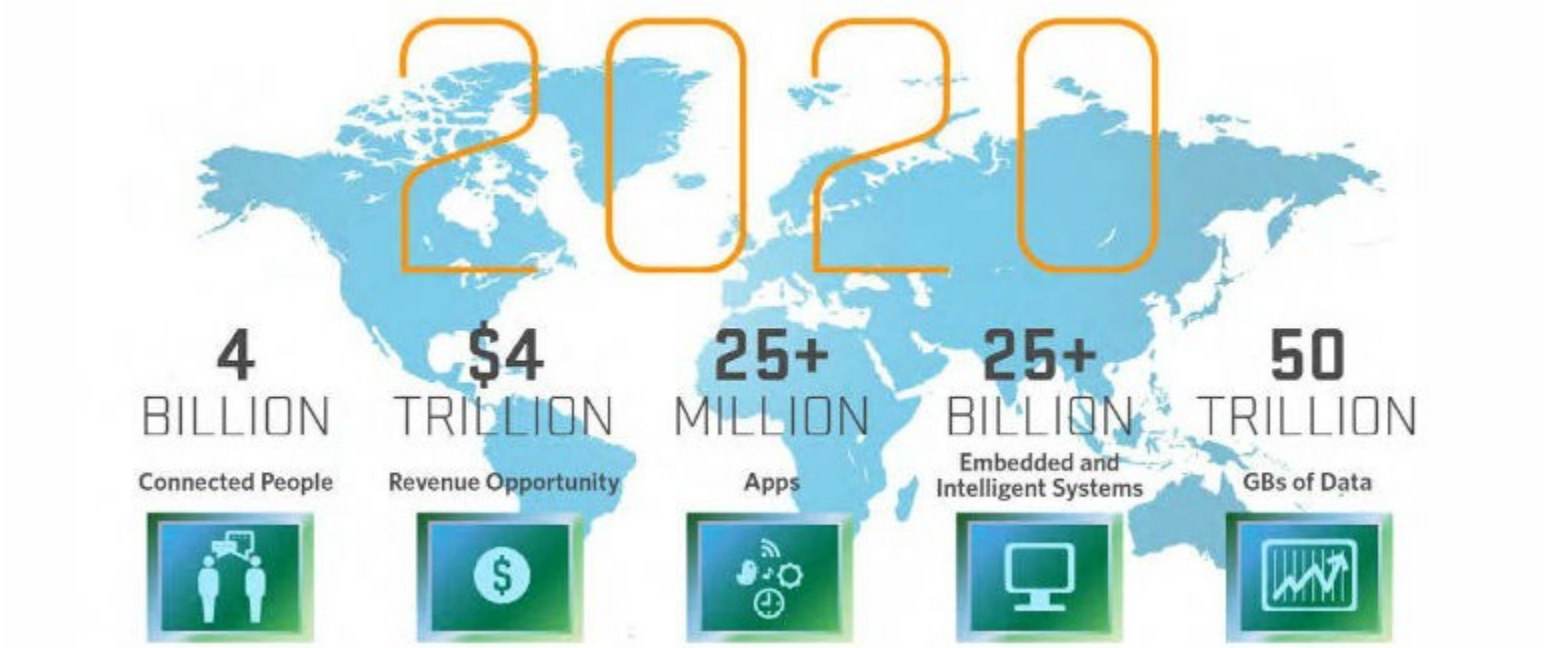
Growth of IoT



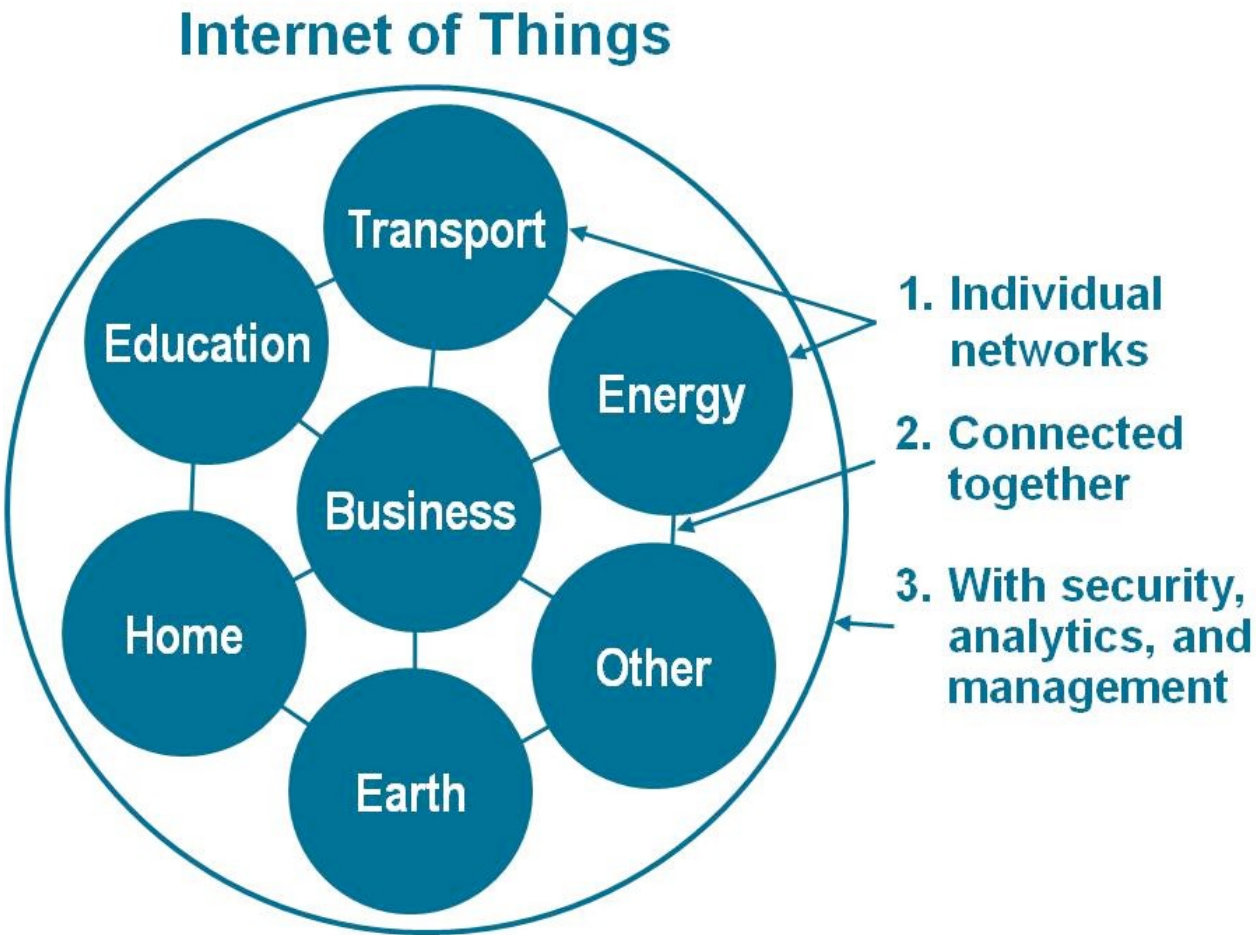
Current and Future Prospect



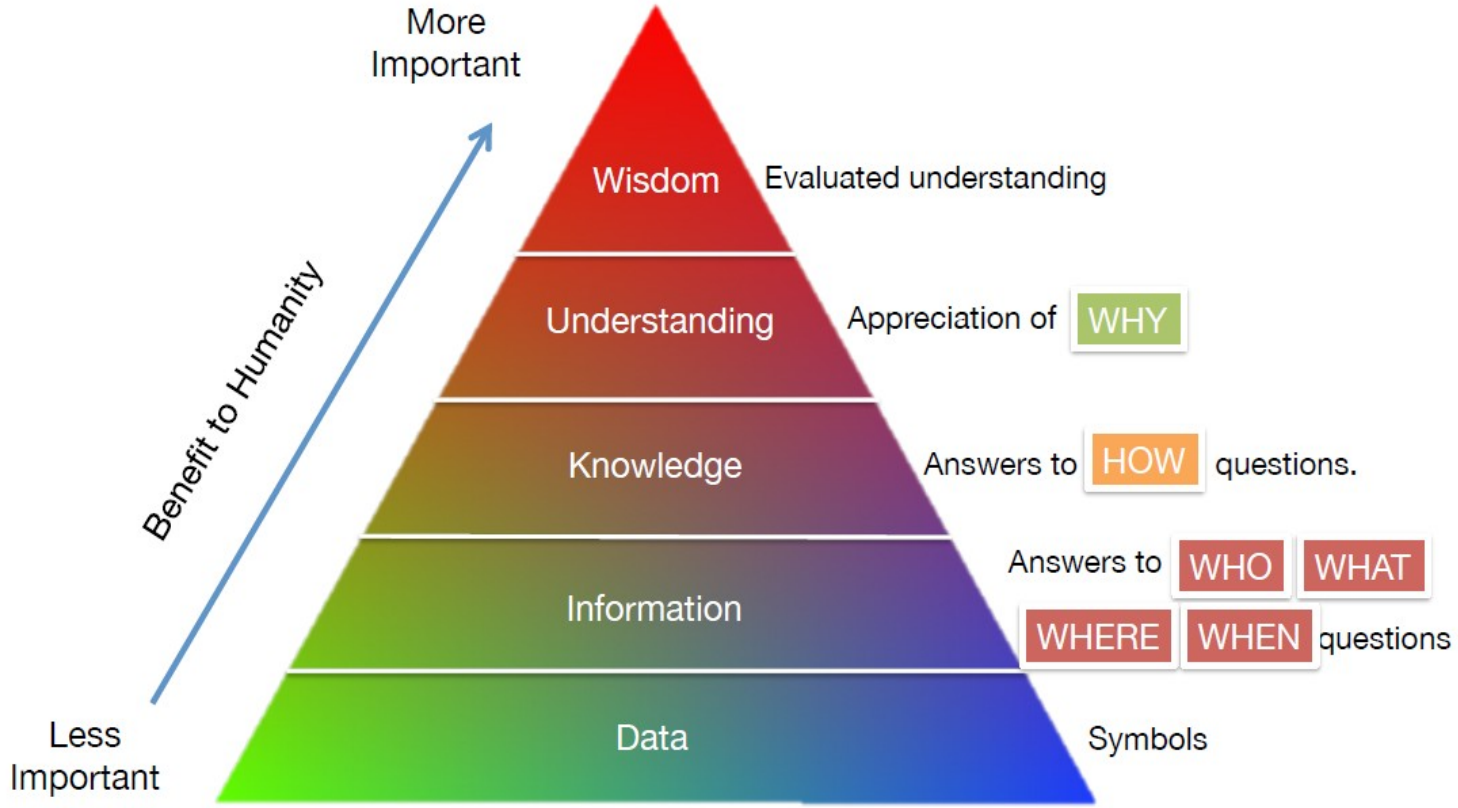
IoT in 2020


2020
4
BILLION
Connected People
$4
TRILLION
Revenue Opportunity
25+
MILLION
Apps
25+
BILLION
Embedded and Intelligent Systems
50
TRILLION
GBs of Data

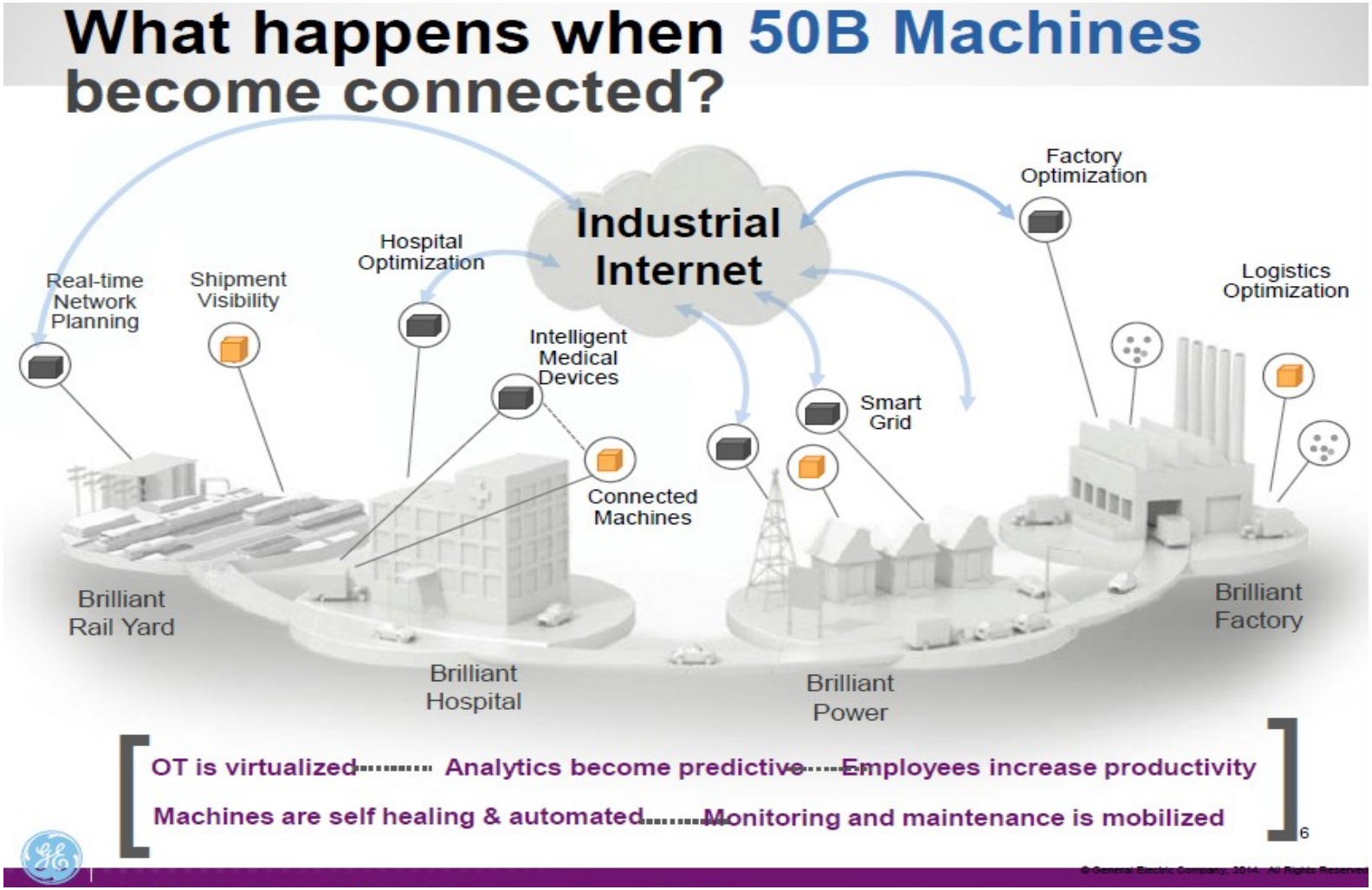
Network of Network



Turning data into wisdom



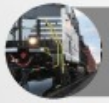
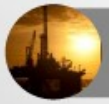
Future of IoT



Potential of IoT

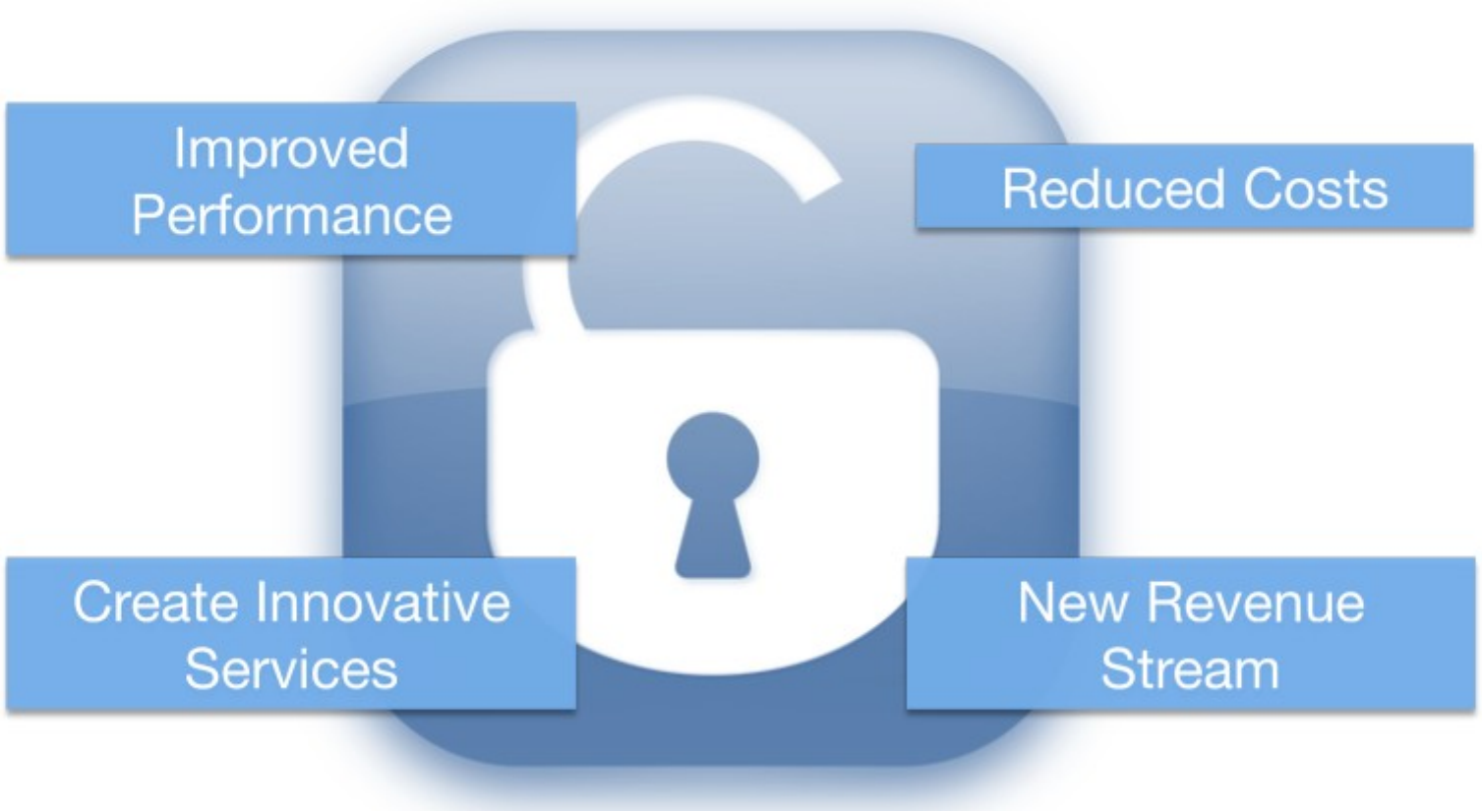
Value of Industrial Internet is huge

Connected machines and data could eliminate up to $150 billion in waste across industries

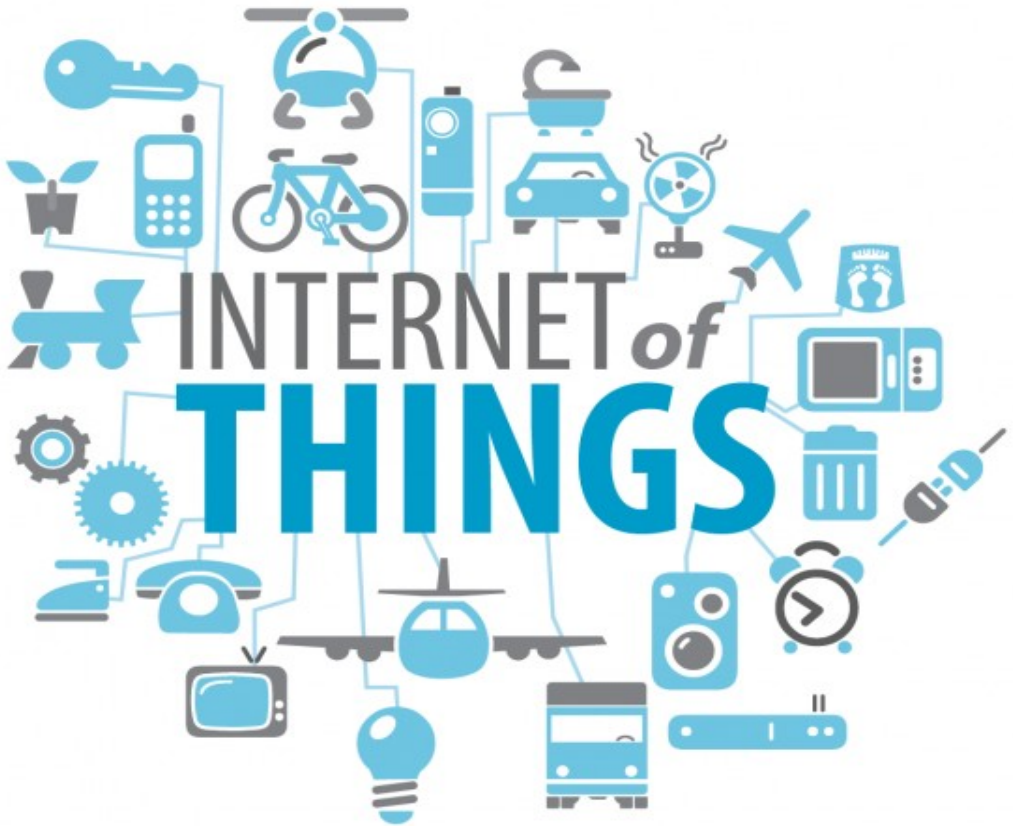
Industry	Segment	Type of savings	Estimated value over 15 years (Billion nominal US dollars)
 Aviation	Commercial	1% fuel savings	$30B
 Power	Gas-fired generation	1% fuel savings	$66B
 Healthcare	System-wide	1% reduction in system inefficiency	$63B
 Rail	Freight	1% reduction in system inefficiency	$27B
 Oil and Gas	Exploration and development	1% reduction in capital expenditures	$90B

Note: Illustrative examples based on potential one percent savings applied across specific global industry sectors. Source: GE estimates

Unlock massive potential

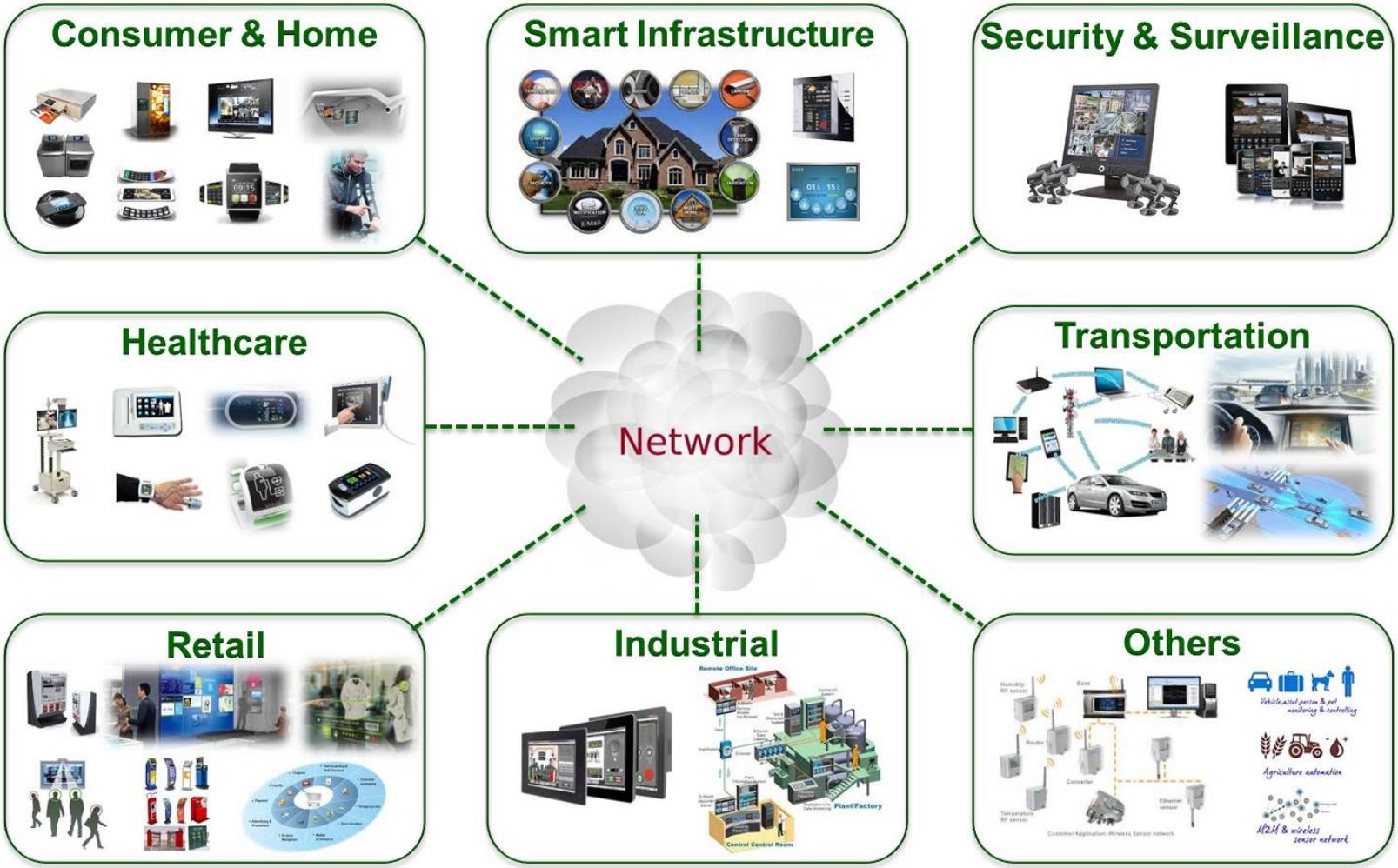


Applications of IoT

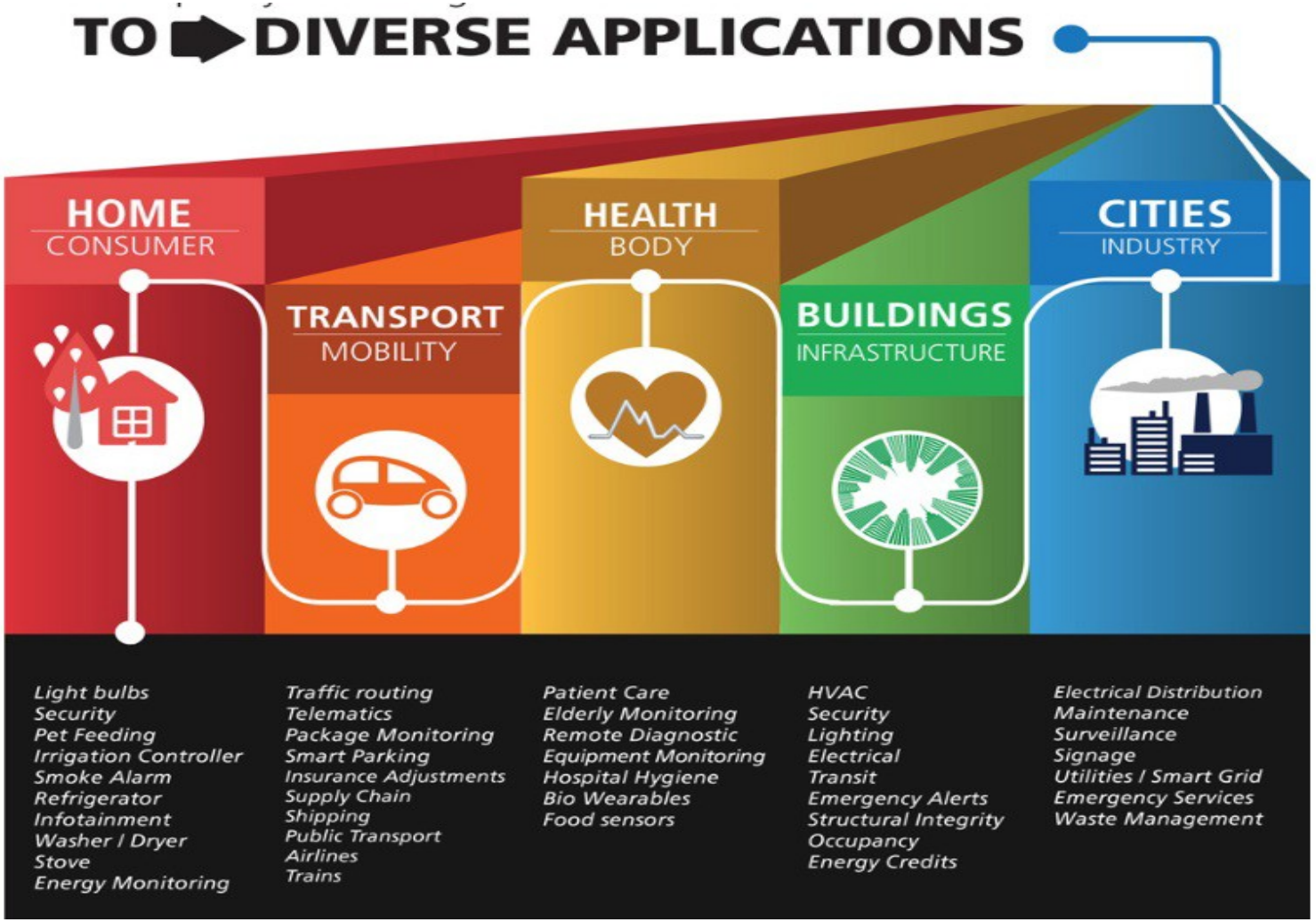


The ultimate goal of IoT is to automate human life.

Applications of IoT



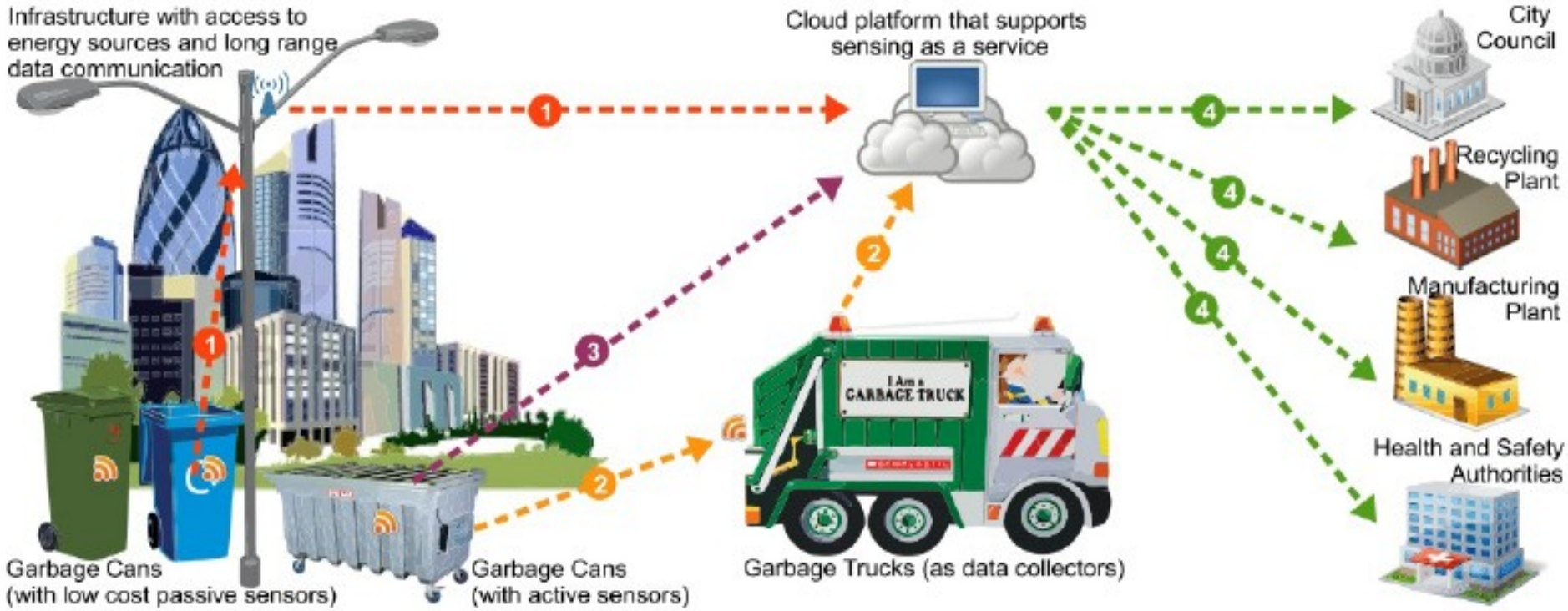
Many more…


TO DIVERSE APPLICATIONS
HOME
CONSUMER
TRANSPORT
MOBILITY
HEALTH
BODY
BUILDINGS
INFRASTRUCTURE
CITIES
INDUSTRY
Light bulbs
Security
Pet Feeding
Irrigation Controller
Smoke Alarm
Refrigerator
Infotainment
Washer / Dryer
Stove
Energy Monitoring
Traffic routing
Telematics
Package Monitoring
Smart Parking
Insurance Adjustments
Supply Chain
Shipping
Public Transport
Airlines
Trains
Patient Care
Elderly Monitoring
Remote Diagnostic
Equipment Monitoring
Hospital Hygiene
Bio Wearables
Food sensors
HVAC
Security
Lighting
Electrical
Transit
Emergency Alerts
Structural Integrity
Occupancy
Energy Credits
Electrical Distribution
Maintenance
Surveillance
Signage
Utilities / Smart Grid
Emergency Services
Waste Management

Application

Smart Parking

Efficient Waste Management in Smart Cities Supported by the Sensing-as-a-Service



[Source: "Sensing as a Service Model for Smart Cities Supported by Internet of Things", Charith Perera et. al., Transactions on Emerging Telecommunications Technology, 2014]

Sensors even in holy cow

- In the world of IoT, even the cows will be connected and monitored. Sensors are implanted in the ears of cattle. This allows farmers to monitor cows' health and track their movements, ensuring a healthier, more plentiful supply of milk and meat for people to consume. On average, each cow generates about 200 MB of information per year.

IOT Application Scenario - Shopping

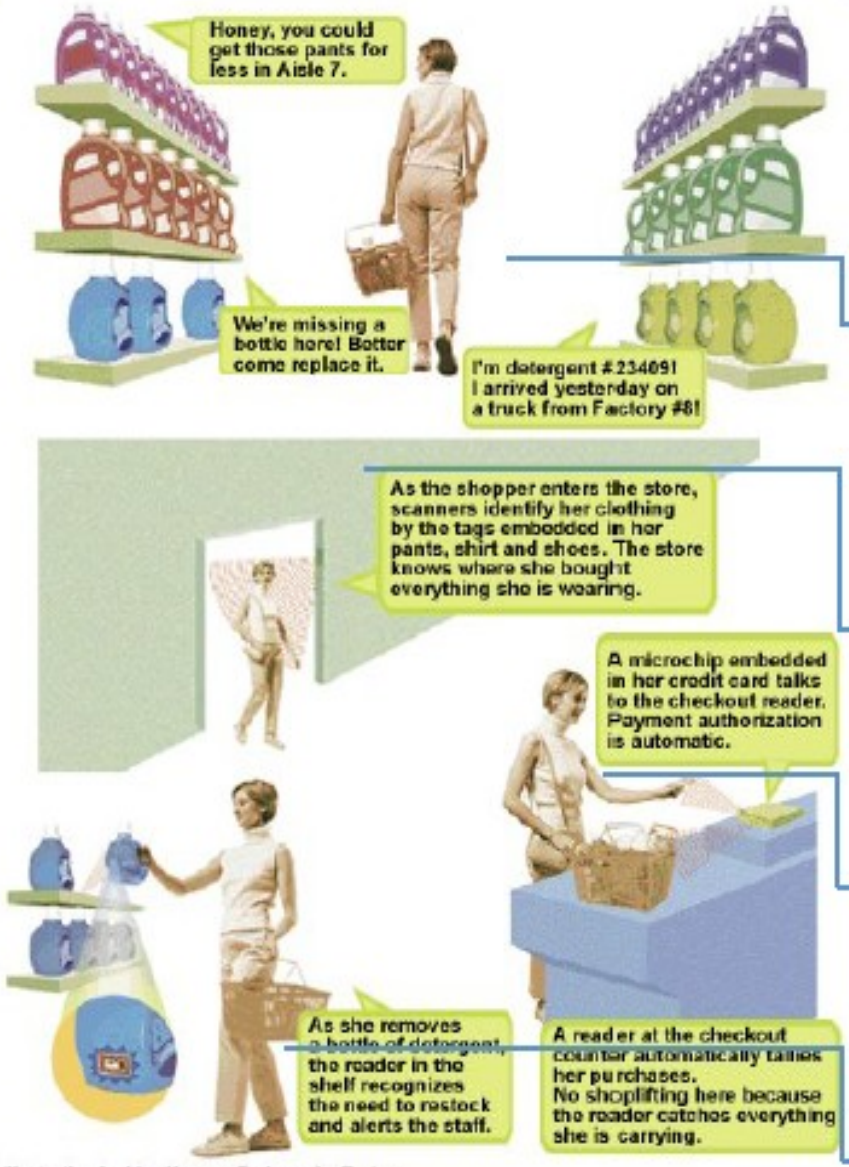


Illustration by Lisa Kneuse Brahman for Forbes

(2) When shopping in the market, the goods will introduce themselves.

(1) When entering the doors, scanners will identify the tags on her clothing.

(4) When paying for the goods, the microchip of the credit card will communicate with checkout reader.

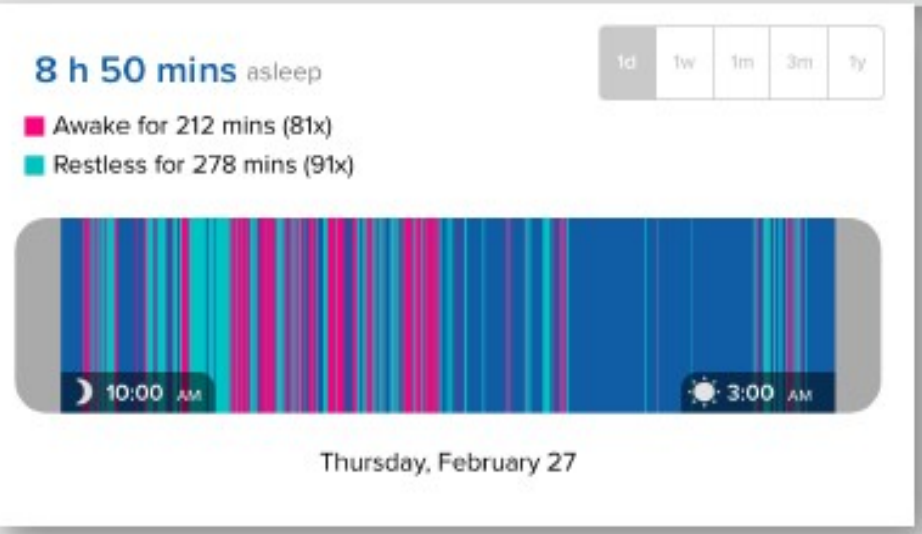
(3) When moving the goods, the reader will tell the staff to put a new one.


HOW MANY STEPS
HAVE YOU
WALKED TODAY?

How Well Do I Sleep?

Sleep

You went to bed at	Time to fall asleep	Times awakened	You were in bed for	Actual sleep time
11:00PM	0min	20	6hrs 40min	6hrs 6min

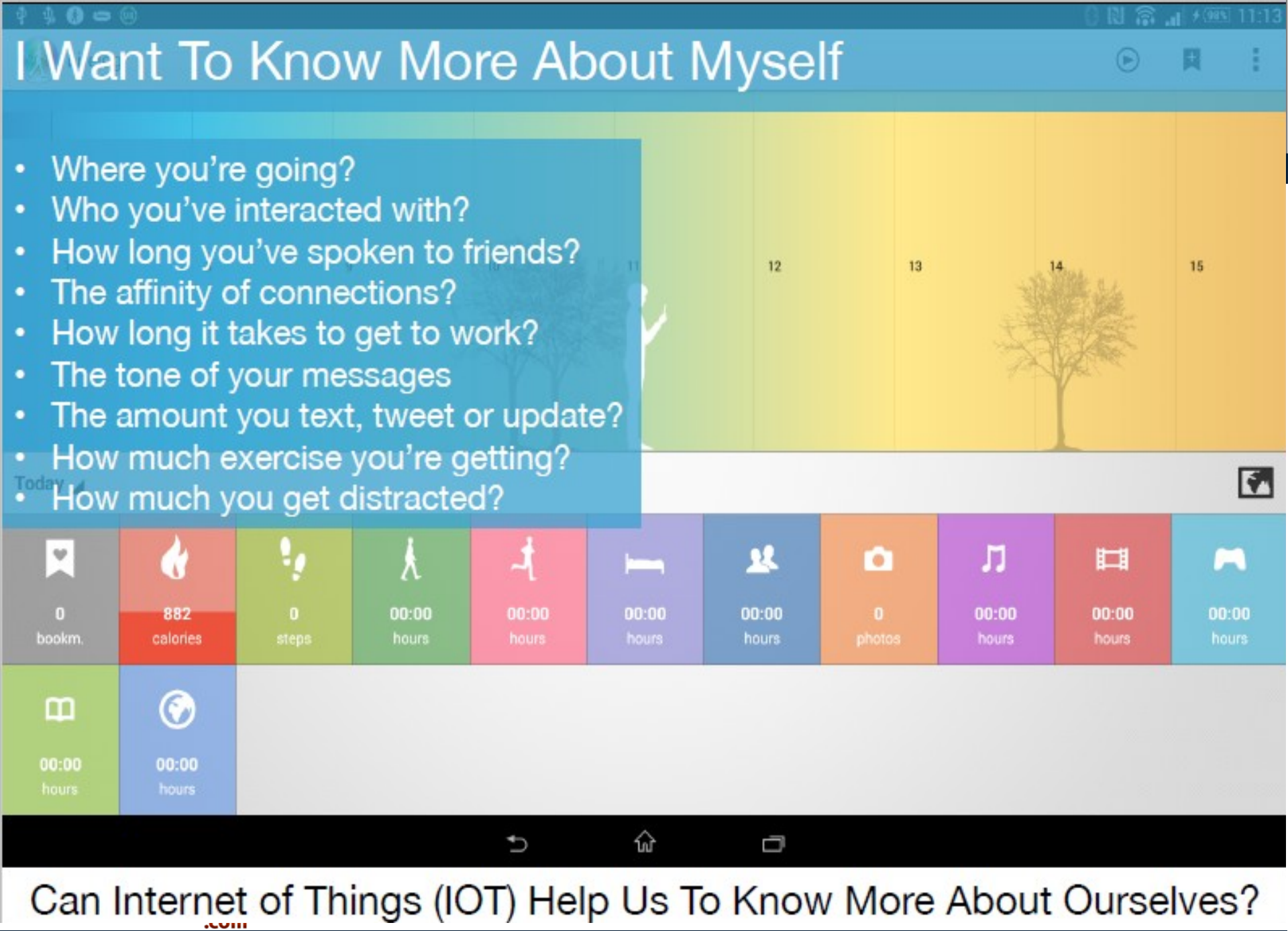


Sleep Stats

fitbit flex
Wireless Activity + Sleep Wristband

I Want To Know More About Myself

- Where you're going?
- Who you've interacted with?
- How long you've spoken to friends?
- The affinity of connections?
- How long it takes to get to work?
- The tone of your messages
- The amount you text, tweet or update?
- How much exercise you're getting?
- How much you get distracted?



Can Internet of Things (IOT) Help Us To Know More About Ourselves?

Thought Controlled Computing

The flagship product, MindWave, is a headset that can log into your computer using just your thoughts. Researchers recently used the EEG headset to develop a toy car that can be driven forward with thought.

NeuroSky's smart sensors can also track your heart rate and other bodily metrics and can be embedded in the next generation of wearable devices.

"We make it possible for millions of consumers to capture and quantify critical health and wellness data," Yang (CEO of Softbank) said. Softbank is the funder.

[Source: http://venturebeat.com/2013/11/04/next-step-for-wearables-neurosky-brings-its-smart-sensors-to-health-fitness/]

The Smart *Internet of Things* School

Personalized learning with adaptive eTextbooks

Digital classroom white boards and display

iBeacons

Complete coverage with high performance Wi-Fi

Video recorders for lecture capture

Wearables for athletics and attendance tracking

International Collaboration and social exchange

Online testing

Sensors on trash receptacles

Supplies and inventory tracking by sensor with auto-reorder

Student devices & eTextbooks
- Notebooks
- Tablets
- Smartphones

Robot cleaning

Augmented and virtual reality

Makerspaces with 3D printers and laser trimmers

Robotics for STEM and remote presence

Internet of Things-based HVAC

Monitor and display of air quality throughout school

File and program storage, local or cloud-based
- Demographics, academics, behavior, interests
- LMS, CMS, SIS
- Educational programs and applications
- Video files: lectures and recorded lab experiments

Surveillance security cameras

Wi-Fi sensors and locks
- Entrances and exits
- Classroom doors

Sensors track buses and verify student passengers

Network application analytics to monitor devices and network behavior

Sensors in parking lot and driveways

Technology Challenges

- At present IoT is faced with many challenges, such as:
  - Scalability
  - Technological Standardization
  - Inter operability
  - Discovery
  - Software complexity
  - Data volumes and interpretation
  - Power Supply
  - Interaction and short range communication
  - Wireless communication
  - Fault tolerance

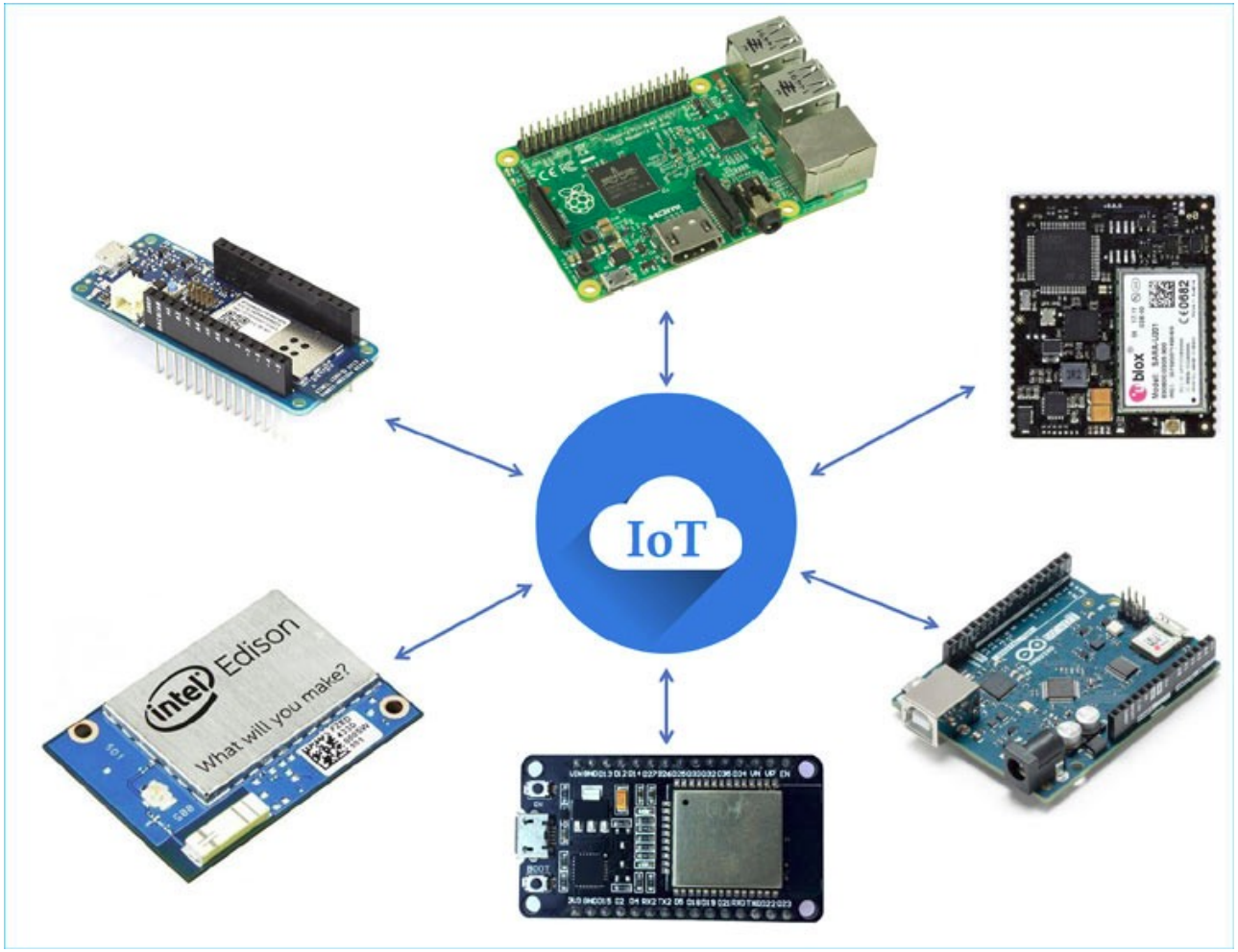
Big Data

"Big Data is not magic. It doesn't matter how much data you have if you can't make sense of it."

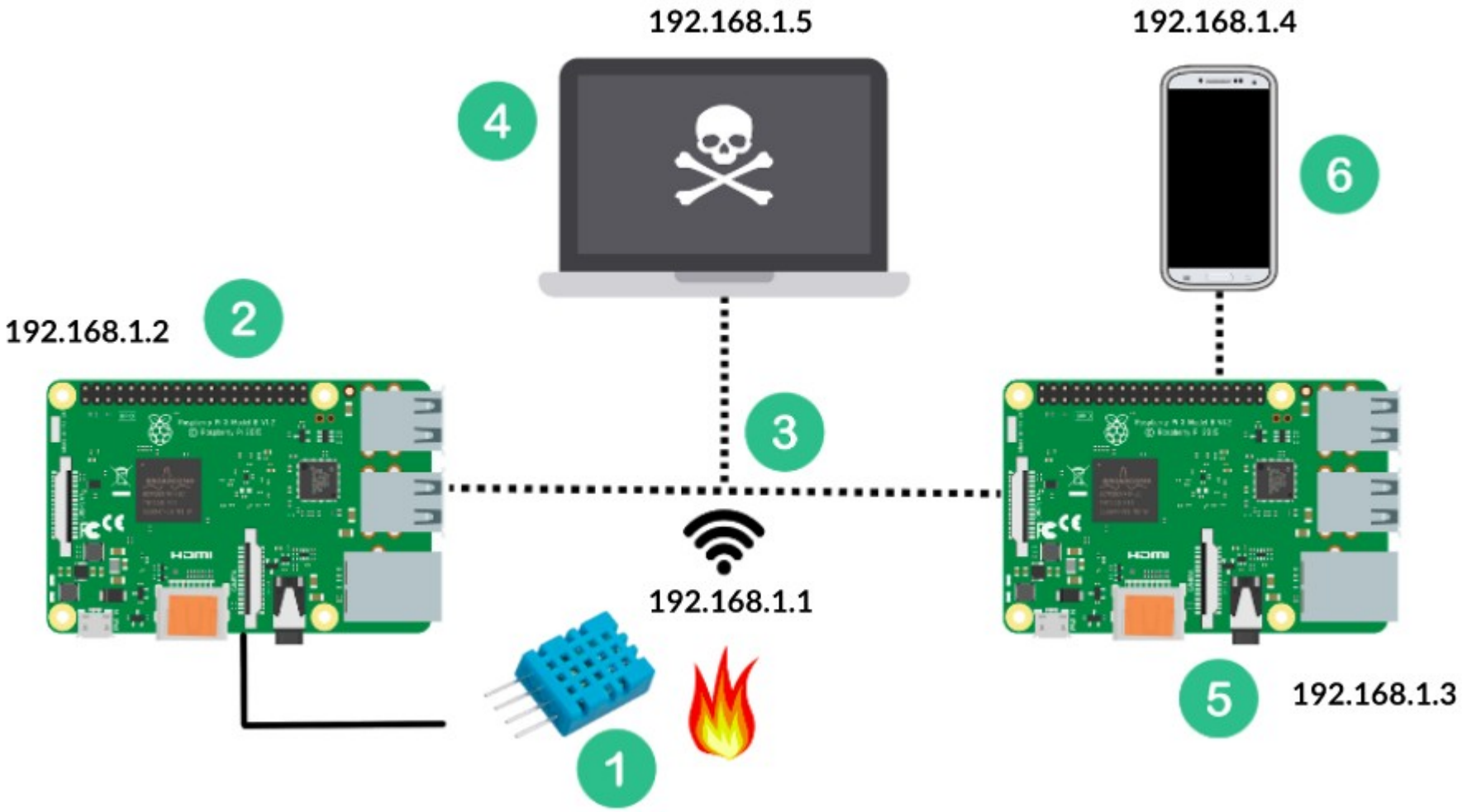
Criticism and Controversies

- Scholars and social observers and pessimists have doubts about the promises of the ubiquitous computing revolution, in the areas as:
  - Privacy
  - Security
  - Autonomy and Control
  - Social control
  - Political manipulation
  - Design
  - Environmental impact
  - Influences human moral decision making

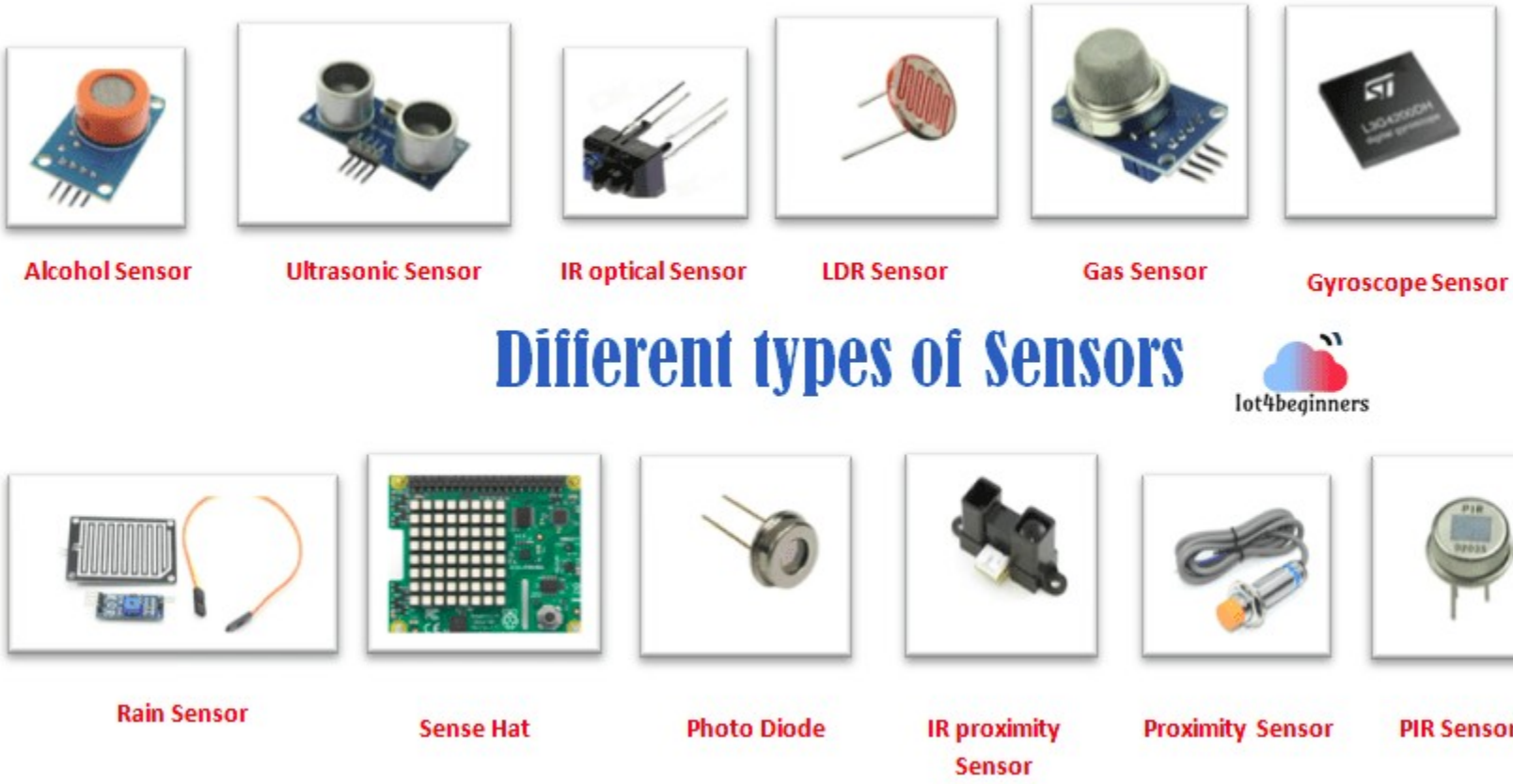
IoT Hardware



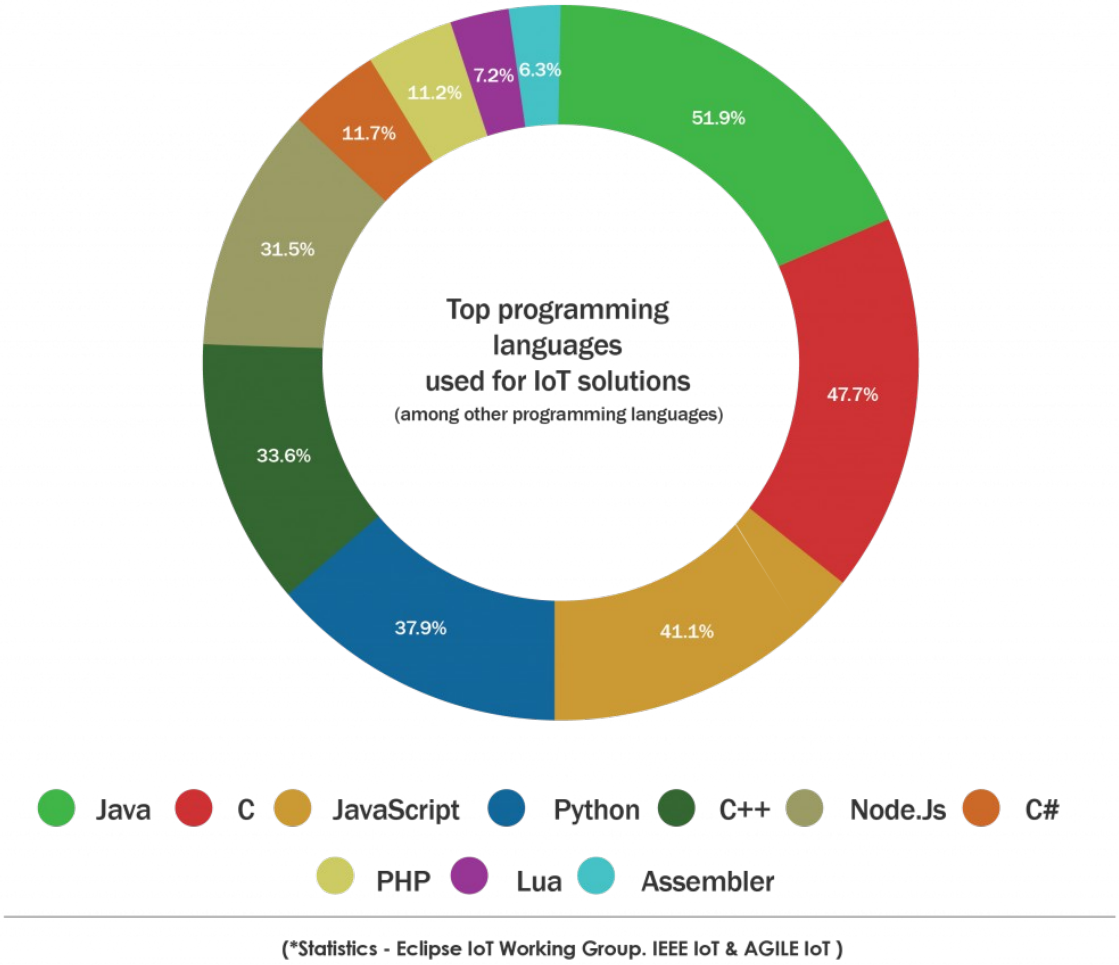
Sample IoT Design



Sensors in IoT



Programming Languages in IoT



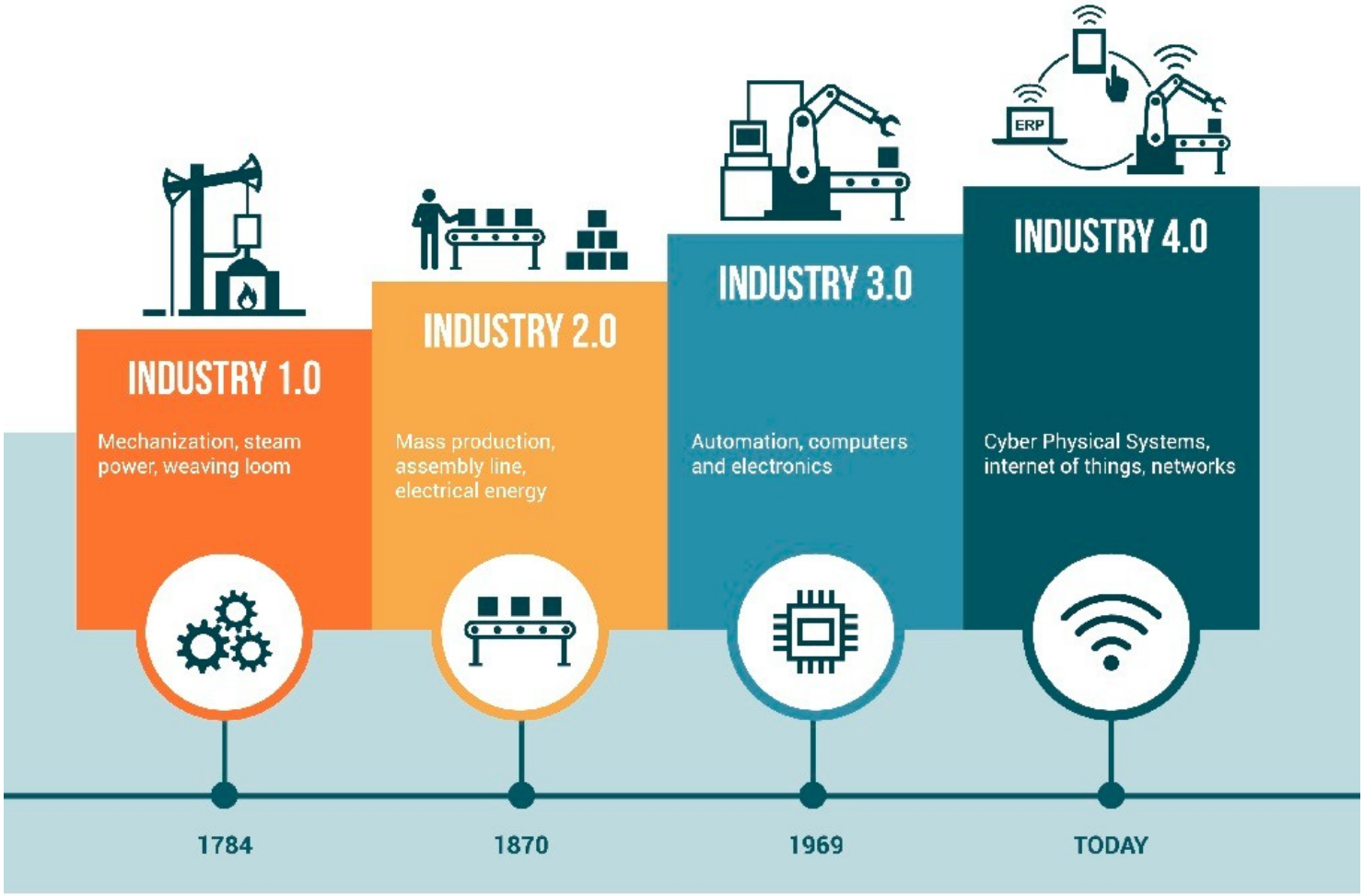
(*Statistics - Eclipse IoT Working Group. IEEE IoT & AGILE IoT)


SUMMARY
Internet of Things
Only Tip of an Iceberg

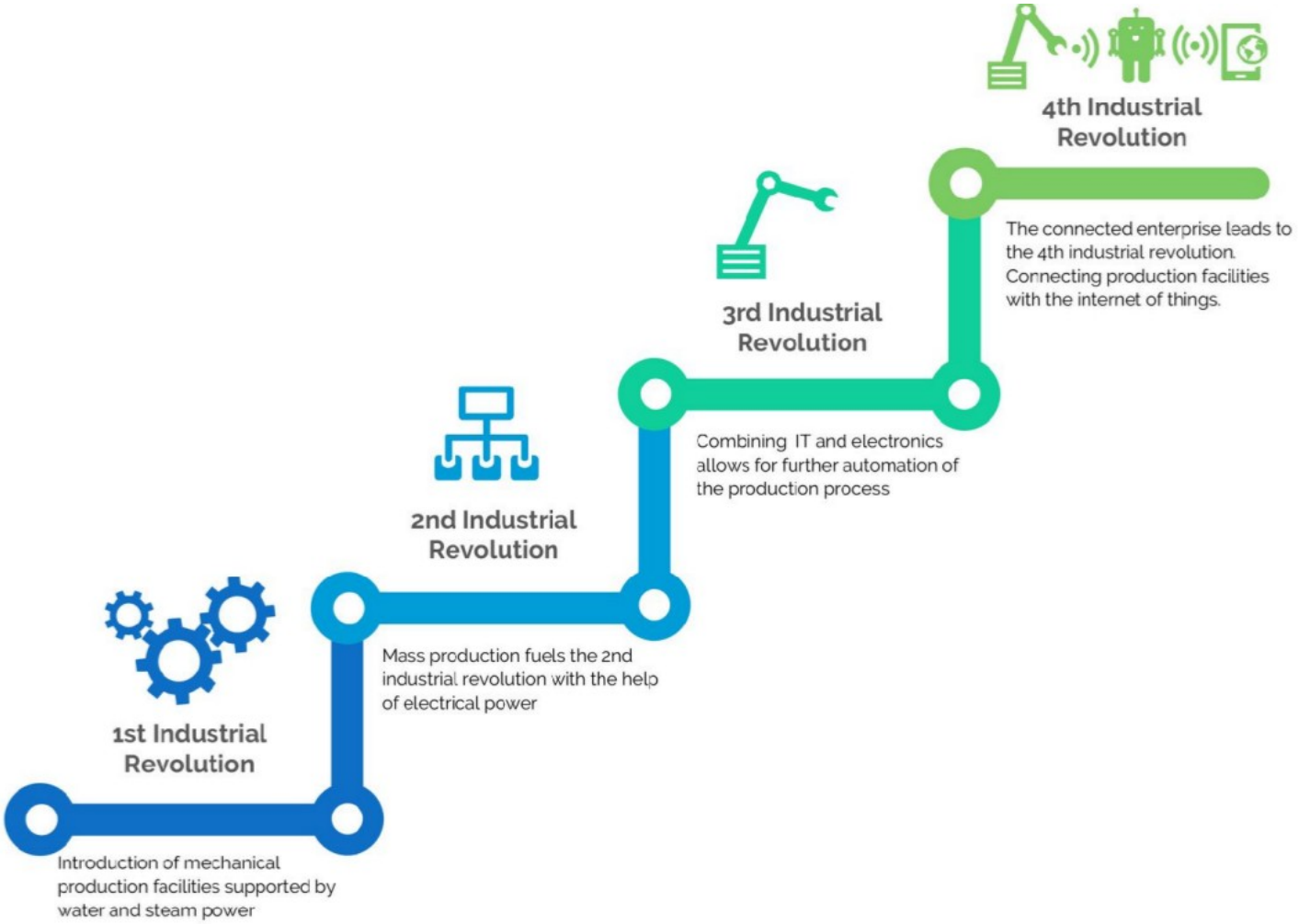

WHAT IS
A.I.?

Industry 4.0?

Industry 4.0


ERP
INDUSTRY 1.0
Mechanization, steam power, weaving loom
INDUSTRY 2.0
Mass production, assembly line, electrical energy
INDUSTRY 3.0
Automation, computers and electronics
INDUSTRY 4.0
Cyber Physical Systems, internet of things, networks
1784
1870
1969
TODAY

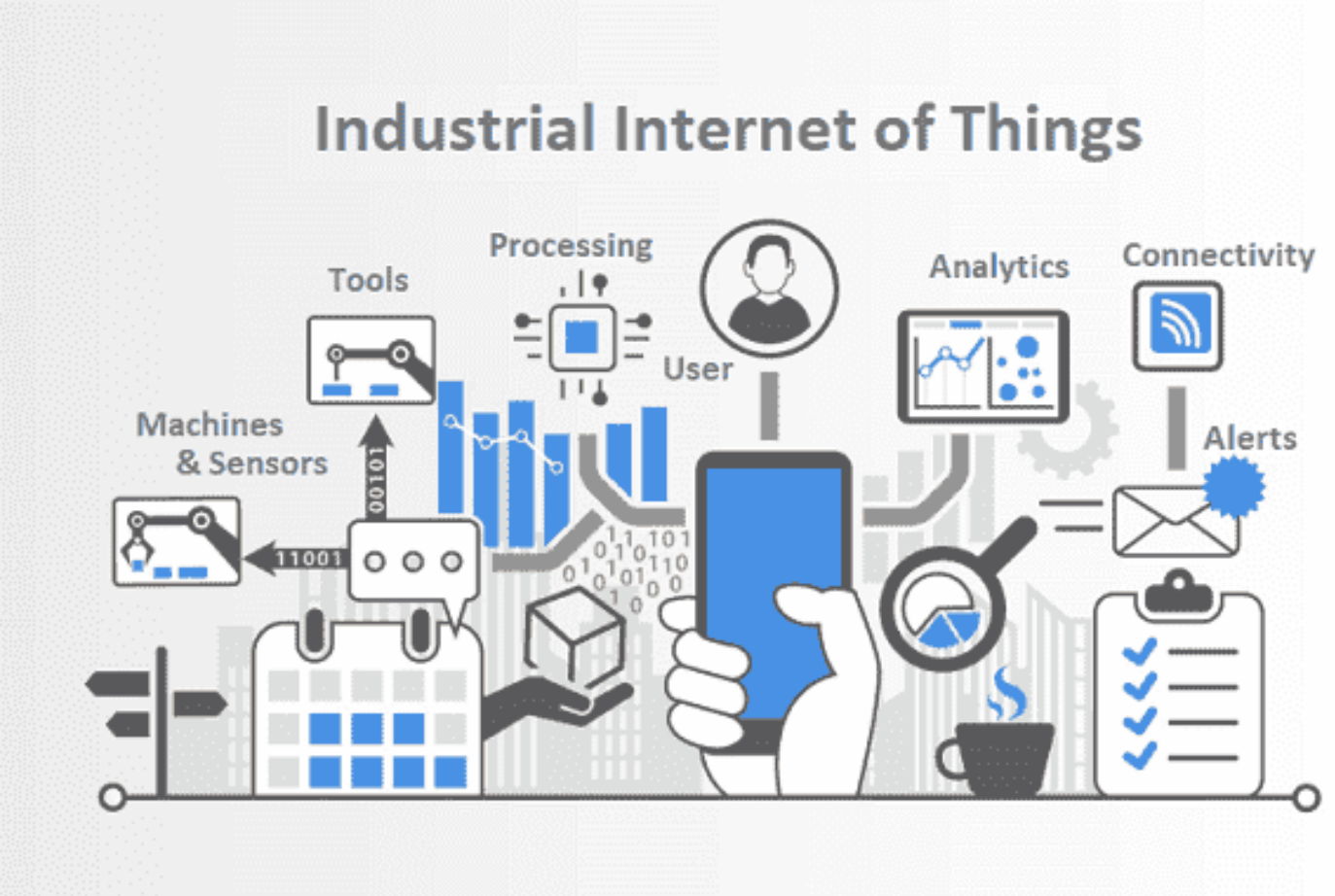
Industry 4.0


4th Industrial Revolution
The connected enterprise leads to the 4th industrial revolution. Connecting production facilities with the internet of things.
3rd Industrial Revolution
Combining IT and electronics allows for further automation of the production process
2nd Industrial Revolution
Mass production fuels the 2nd industrial revolution with the help of electrical power
1st Industrial Revolution
Introduction of mechanical production facilities supported by water and steam power

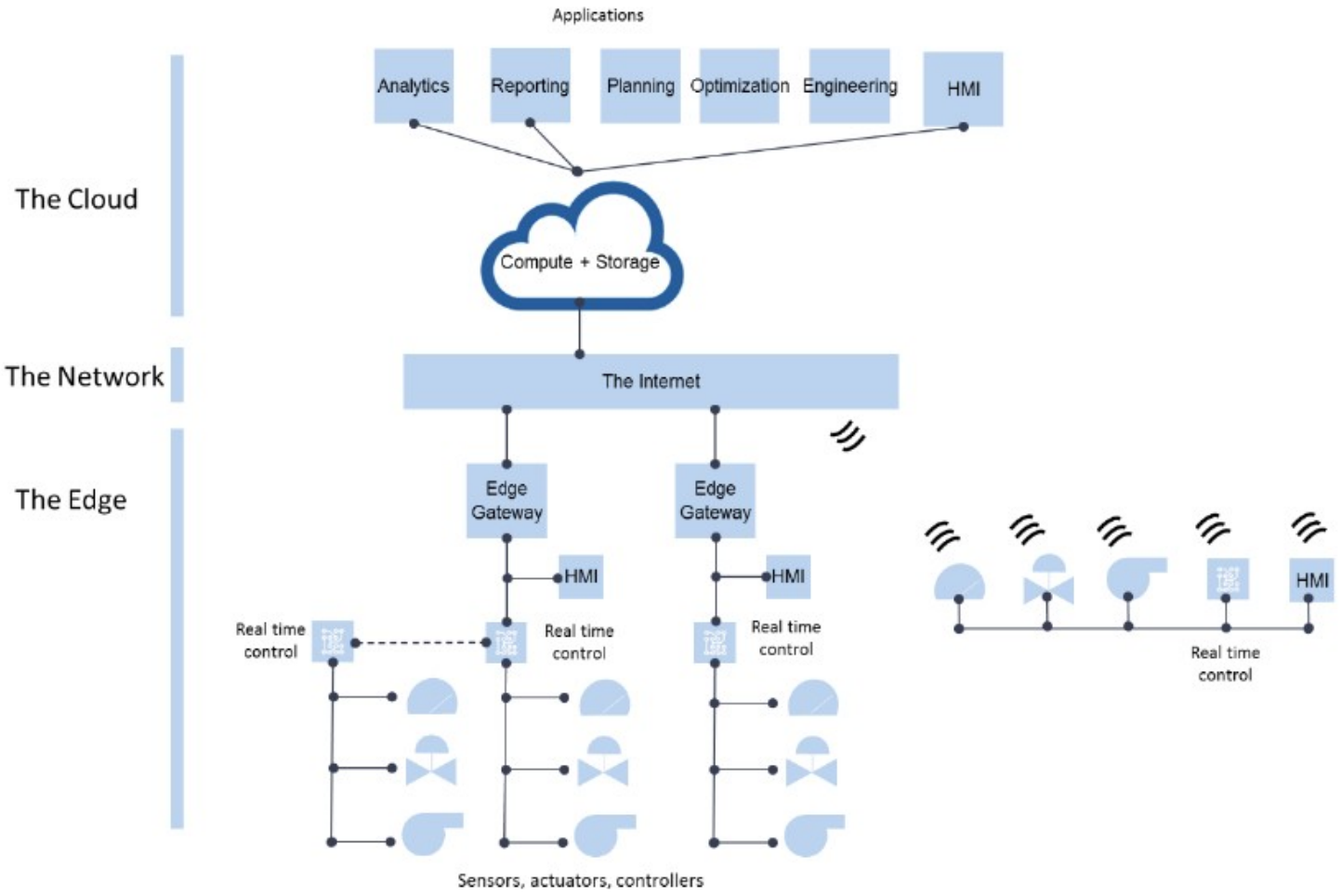
What is industrial IOT ?

- The industrial internet of things (IIoT) is the use of smart sensors and actuators to enhance manufacturing and industrial processes.
- Also known as the industrial internet or Industry 4.0, IIoT leverages the power of smart machines and real-time analytics to take advantage of the data that dumb machines have produced in industrial settings for years.
- The driving philosophy behind IIoT is that smart machines are not only better than humans at capturing and analyzing data in real time, they are better at communicating important information that can be used to drive business decisions faster and more accurately.

What is industrial IOT ?



Industrial IOT Architecture



Applications

- Digital twins
- Product development
- Design customization
- Shop floor performance improvement
- Logistics optimization
- Predictive maintenance
- Generative design
- Price forecasting of raw material
- Robotics
- Quality assurance

Reference: AI Multiple

Thank you

@mitu_skillologies

@mITuSkillologies

@mitu_group

@mitu-skillologies

@MITUSkillologies

kaggle

@mituskillologies

Web Resources
https://mitu.co.in
http://tusharkute.com

@mituskillologies

contact@mitu.co.in

tushar@tusharkute.com