

Internet of Things: Technologies

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Session Outline

- 1 Technology and Market Trends Today
- 2 IoT Statistics
- 3 Internet of Things(IoT) Concepts
- 4 IoT Definition & Services
- 5 Characteristics of IoT



Trends & Technologies



Applications Drive the Technology

5G

Edge Computing

Cybersecurity and AI.

Big-Data

Data science

Assisted Transportation.

Applications Drive the Technology

INDUSTRIAL Internet of things

Industrial IoT.

ARTIFICIAL INTELLIGENCE Deep learning, Reinforcement learning, Transfer learning, Generative models

MACHINE LEARNING

DEEP LEARNING

Cloud

BLOCK CHAIN TECHNOLOGY

Blockchain

Applications Drive the Technology

Smart cities

Robotics/ Intelligent Things



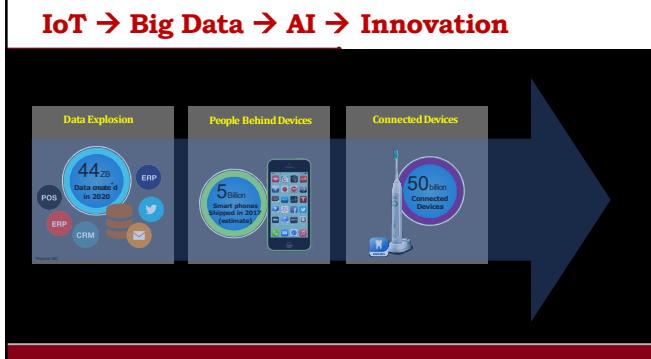




Industry 4.0

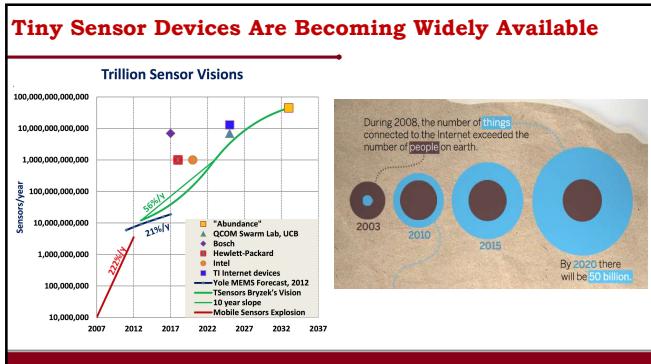
1 st Industrial Revolution	2 nd Industrial Revolution	3 rd Industrial Revolution	4 th Industrial Revolution
18 th Century	19 th - early 20 th Century	Late 20 th Century	2015-
 Steam engine	 Electricity, Conveyor belt	 Computers, Internet	 IoT, Big Data, AI, etc.
Mechanization	Mass production	Informization & automation	Intelligibility

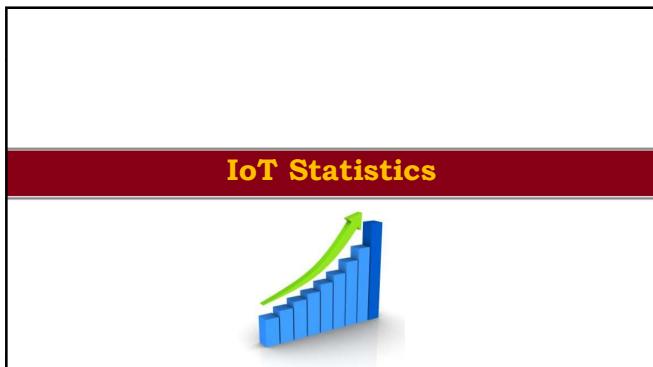
IoT → Big Data → AI → Innovation

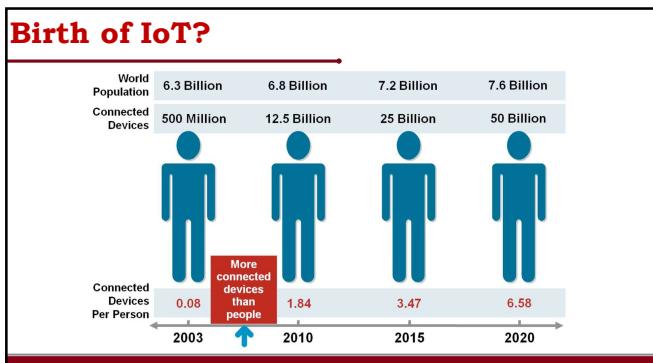


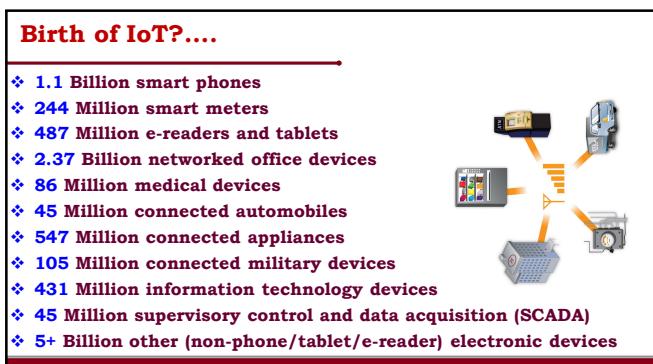
Market Trends Today



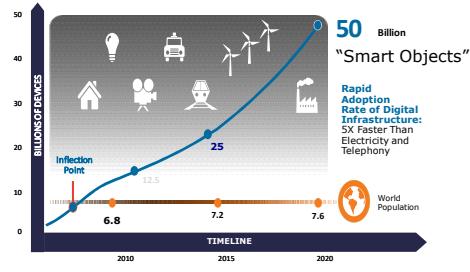








IoT Is Here Now – and Growing!



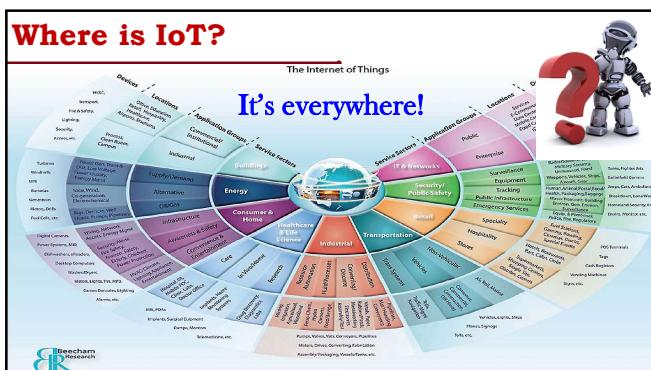
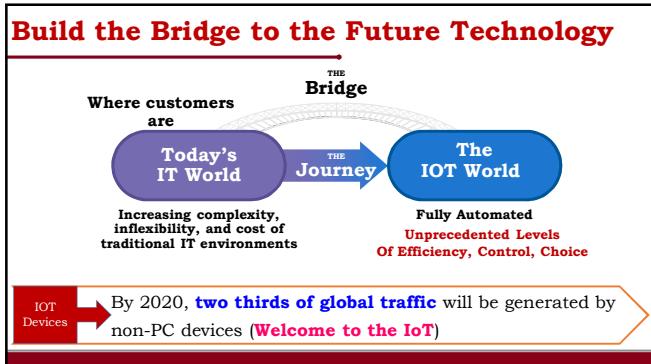
The IoT Market

- ❖ **8.4 Billion Devices** connected to the **Internet in 2017**
- ❖ As of 2018, **10.1 billion IoT units**
- ❖ Expected to grow to **28.1 billion IoT devices** by **2019**
- ❖ Revenue growth from **\$1.9 trillion in 2018 to \$7.1 trillion in 2020**

Rough Market Size

- ❖ Current Internet
- ✓ **700 Million hosts**
- ✓ **1.4 Billion users**
- ✓ **100+ Billion microcontrollers worldwide**
- ✓ **10 Billion shipments a year**
- ❖ The Internet of Things has the potential for a **size in Trillions**
- ❖ By 2020 **50B connected devices(Cisco), 40ZB of data (IDC)**





Why be concerned about IoT?

- ❖ It's just **another computer**, right?
 - ✓ Imagine your **network with 1,000,000 more devices**

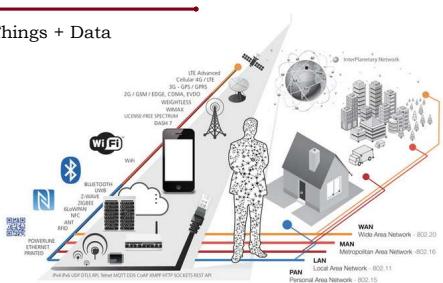


Why Internet of Things

- Dynamic control of industry and daily life
 - Improve the resource utilization ratio
 - Better relationship between human and machine
 - Flexible configuration
 - Universal transport & internetworking
 - Accessibility & Usability?
 - Acts as **technologies integrator**

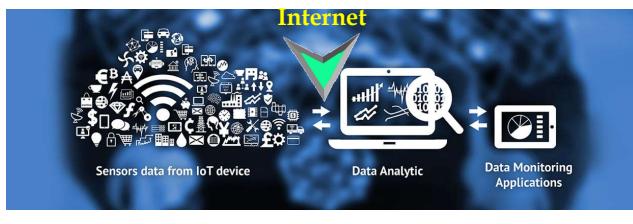
What is IoT ?

- ## ❖ Internet + Things + Data



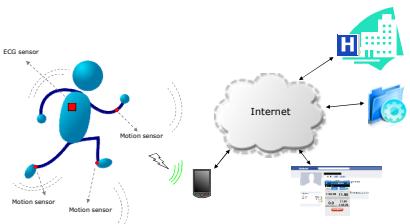
What is IoT ?

- ❖ Internet + Things + Data



People Connecting to Things

- ❖ Internet connects all **people**, so it is called "the **Internet of People**"



What is Internet?

- ❖ Internet + Things + Data

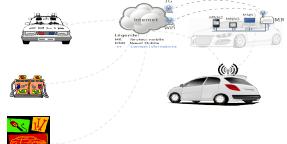
- ✓ Providing **Internet connection** to potentially **ANYTHING**
- ✓ **Internet connects all People**, so it is called "**the Internet of People**"
- **Network of Machines** (PCs, switches, routers, servers, etc.)
- **Content (mostly) generated by people** - web pages, e-mails, pictures, videos, etc.



What is IoT ?

❖ Internet + Things + Data

- ✓ IoT connects all things, so it is called “**the Internet of Things**”
- ✓ Network of “Smart Things”, capable of sensing the physical world, and communicating, **without human intervention**



What is IoT ?

❖ Internet + **Things** + Data

❖ **Things** are highly constrained nodes in terms of

- Physical size,
- CPU power,
- Memory (few tens of kilobytes)
- Bandwidth (Maximum of 250 KB/s, lower rates the norm)
- Power Consumption is critical, if battery powered then energy efficiency is paramount



Smart (Things) Devices

❖ “A **smart device** is an **electronic device**, that can operate to some extent **interactively and autonomously**.”



Smart Things

What's Smart?

- ❖ IoT = **Instrument, Interconnect, Intelligently process (3 I's)**
- ✓ Old Smart = **Can think and Can compute** 
- ✓ Now Smart = **Can find quickly, Can Delegate** 
- ❖ Smart Grid, Smart Meters, Smart Cars, Smart homes, Smart Cities, Smart Factories, Smart Smoke Detectors, ...

Smart IoT



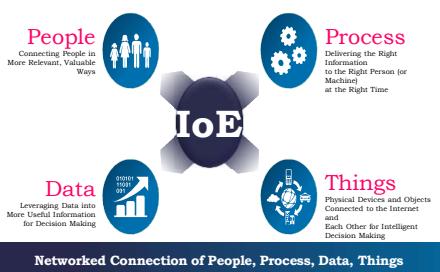
What is IoT ?

- ❖ Internet + Things + Data
- ELECTRICITY: \$319**
- | Appliance | Usage (kWh) | Cost (\$) |
|-----------|-------------|-----------|
| Poll Lamp | 100 | 10 |
| Lights | 150 | 15 |
| Fridge | 50 | 5 |
| DVds | 10 | 1 |
| Computer | 10 | 1 |
| Tv | 10 | 1 |
| Kitchen | 10 | 1 |
| hWAC | 10 | 1 |
| Mic | 10 | 1 |
- Usage (kWh) 0 50 100 150 200 250 300
- LIGHTS: \$48**
- | Appliance | Usage (kWh) | Cost (\$) |
|----------------|-------------|-----------|
| Master Bedroom | 100 | 10 |
| Master Closet | 24 | 2.4 |
| Main Living | 12 | 1.2 |
| Master Bedrm | 12 | 1.2 |
| Living Room | 12 | 1.2 |
| Lower Hlfyng | 12 | 1.2 |
- FRIDGES: \$39**
- | Appliance | Usage (kWh) | Cost (\$) |
|----------------|-------------|-----------|
| Kitchen Garage | 100 | 10 |
- COMPUTER: \$33**
- | Appliance | Usage (kWh) | Cost (\$) |
|------------|-------------|-----------|
| Virtual PC | 10 | 1 |
| Sys Lnter | 10 | 1 |
| Brn's Lamp | 10 | 1 |
- TVS: \$28**
- | Appliance | Usage (kWh) | Cost (\$) |
|--------------|-------------|-----------|
| Master Bedrm | 100 | 10 |
| Living Room | 100 | 10 |
| Kids | 10 | 1 |
- KITCHEN: \$19**
- | Appliance | Usage (kWh) | Cost (\$) |
|---------------|-------------|-----------|
| Dishwsh | 100 | 10 |
| Microwave | 10 | 1 |
| Oven | 10 | 1 |
| Stove/Cooktop | 10 | 1 |
- Usage (kWh) 0 20 40 60 80
- ❖ **Internet of Things** is heading toward a **fully connected world**

What is IoT ?

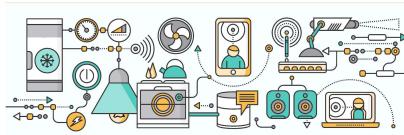
- ❖ The Internet of Things is the **intelligent connectivity of physical devices** driving massive gains in
 - ✓ **Efficiency**
 - ✓ **Business Growth**
 - ✓ **Quality of Life**

Finally Internet of Everything (IoE)



Various Names, One Concept

- ❖ **M2M (Machine to Machine)**
- ❖ **"Internet of Everything" (Cisco Systems)**
- ❖ **"World Size Web" (Bruce Schneier)**
- ❖ **"Skynet" (Terminator movie)**



IoT Definition

DEFINITION

Internet of Things : Definition

Wikipedia →

- The **Internet of Things**, also called The **Internet of Objects**, refers to a **wireless network between objects**, usually the **network will be wireless and self-configuring**, such as household appliances.

Internet of Things : Definition

WSIS 2005 →

- By embedding **short-range mobile transceivers** into a **wide array of additional gadgets and everyday items**, enabling new forms of communication between people and things, and between things themselves.

Internet of Things : Definition

IoT 2008

The term "Internet of Things" has come to describe a **number of technologies** and **research disciplines** that enable the **Internet to reach out into the real world of physical objects**.

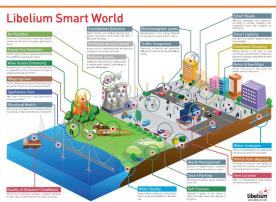


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Internet of Things : Definition

IoT 2020

"Things having **identities** and **virtual personalities** operating in **smart spaces** using **intelligent interfaces** to **connect and communicate** within social, environmental, and user contexts".



Internet of Things : Definition

ITU

A device is a **piece of equipment** with the **mandatory capabilities of communication** and **optional capabilities of sensing, actuation, data capture, data storage and data processing**.



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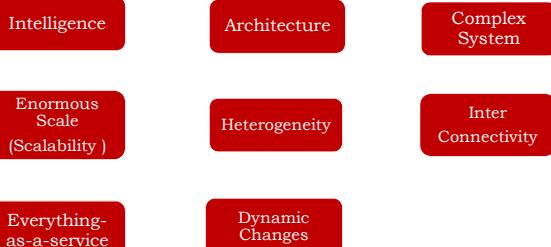
IoT Services

- ❖ Enabled by wide **scale data gathering**
 - ❖ **Monitoring** of massive systems
 - ❖ **Real-time insight** to processes
 - ❖ **Observation** of systems
 - ❖ **Performance** measurement and Optimization
 - ❖ **Proactive and predictive** methods
 - ❖ **Anything, Anywhere, Anytime, Anyway, Anyhow (5 A's)**

Characteristics of IoT

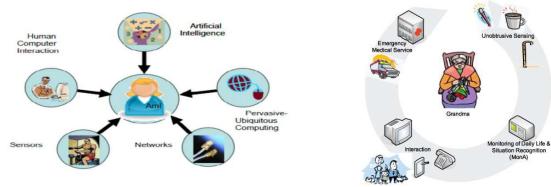


Characteristics of IoT



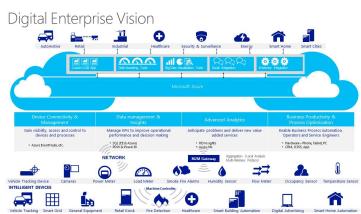
Intelligence

- Intelligence • Knowledge extraction from the generated data



Architecture

- Architecture • A Hybrid Architecture supporting many others



Characteristics of IoT

Complex System

- A diverse set of dynamically changing objects



Scalability

Enormous Scale (Scalability)

- The number of devices that need to be managed and communicate with each other will be at least an order of magnitude larger than the devices connected to the current Internet.



Characteristics of IoT

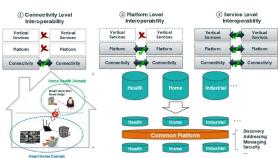
Heterogeneity

- The devices in the IoT are heterogeneous as based on different hardware platforms and networks.

Heterogeneity

Heterogeneity

- The devices in the IoT are **heterogeneous** as based on **different hardware platforms and networks**.
- Devices can interact with other devices or service platforms through **different networks**.



Inter Connectivity

Inter connectivity

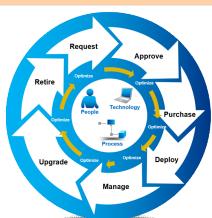
- Anything** can be **interconnected** with the global information and communication infrastructure



Everything-as-a-Service

Everything-as-a-service

- Consuming **resources as a service**



Dynamic Changes

Dynamic
Changes

- The **state of devices change** dynamically
- Eg., sleeping and waking up, connected and/or disconnected, context of devices- location and speed.



All **power** is within you;

You can do **anything** and **everything**.

Thank U
