# Unit-1 : Internet of Things Lecture-1

## Contents

**1.1 What is the Internet of Things(IoT)?**

**1.1.a Definition of Internet of things**

**1.1.b History of IoT**

**1.1.c Why we need IoT?**

**1.1.d Application of IoT**

**1.1.e Benefits of IoT**

**1.1.f How IoT works?**

**1.1.g IoT Features**

**1.1.h IoT Advantages**

**1.1.i IoT Disadvantages**

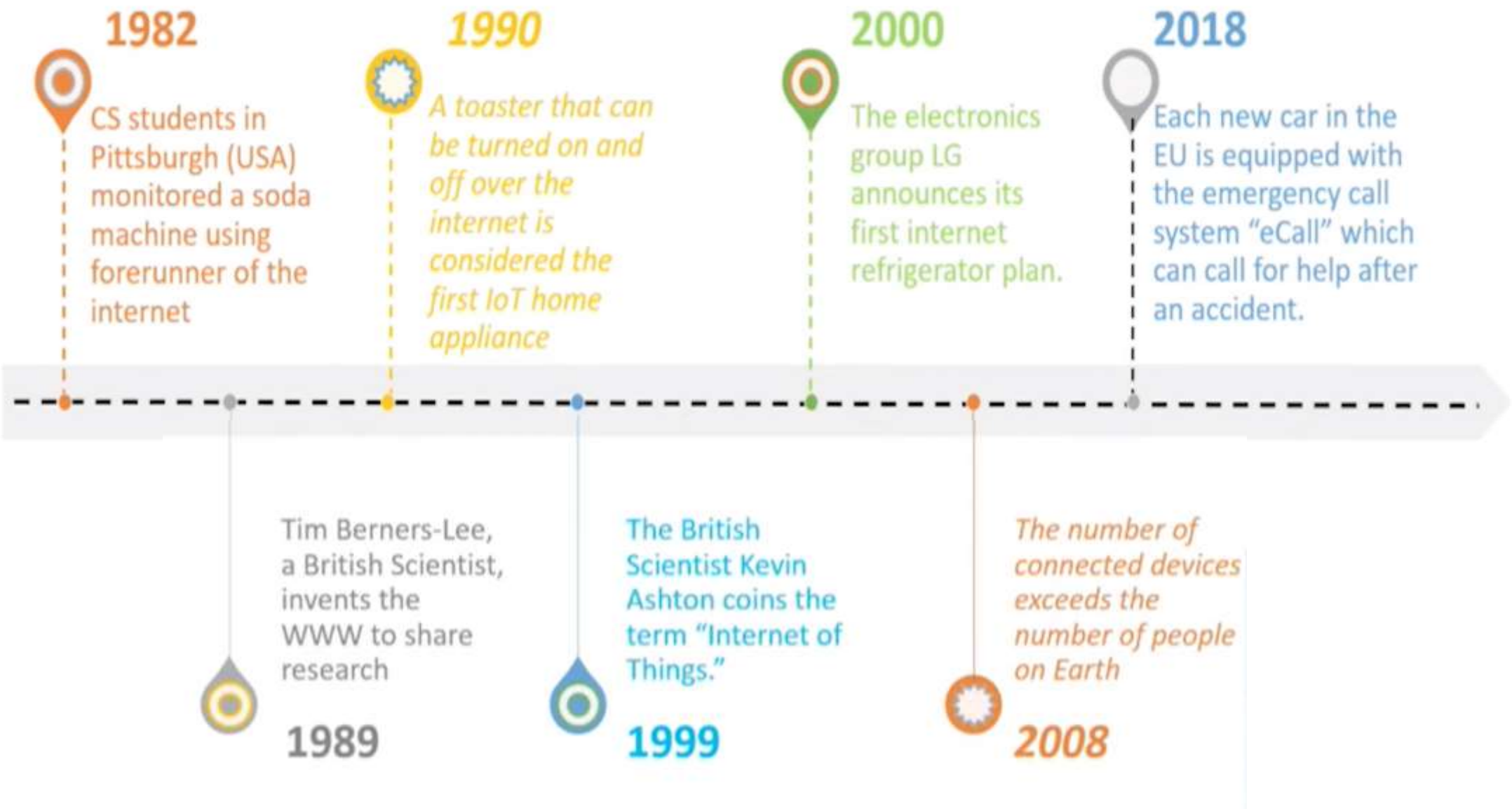
# 1.1.a- What is the Internet of Things?

INTERNET OF THINGS

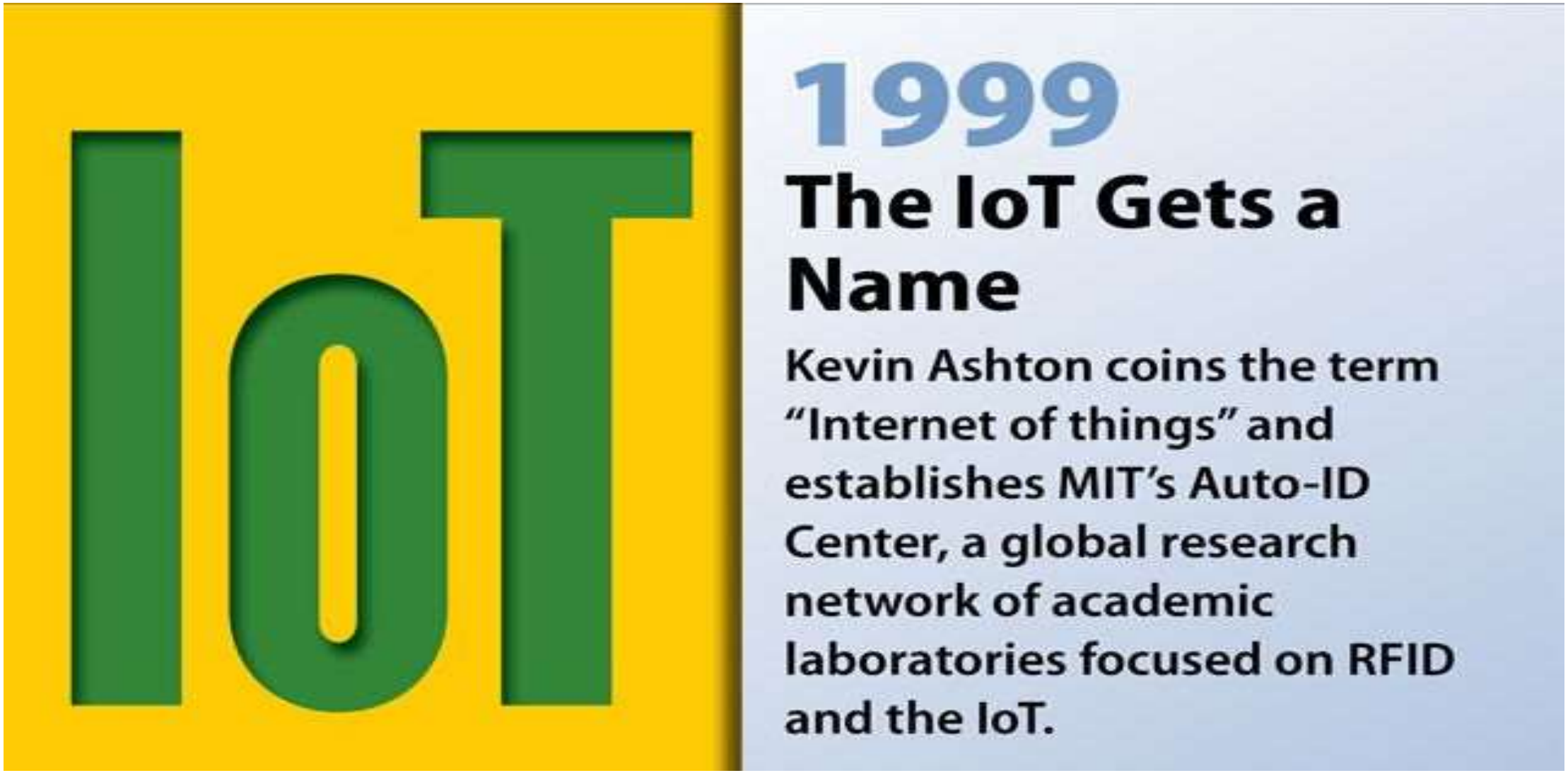
*World* where all the *devices* and *appliances* are *connected* to a *network* & are *used collaboratively* to achieve *complex tasks* that require a high degree of intelligence

Internet of Things is an *interaction between* the *physical* and *digital worlds using sensors* and actuators

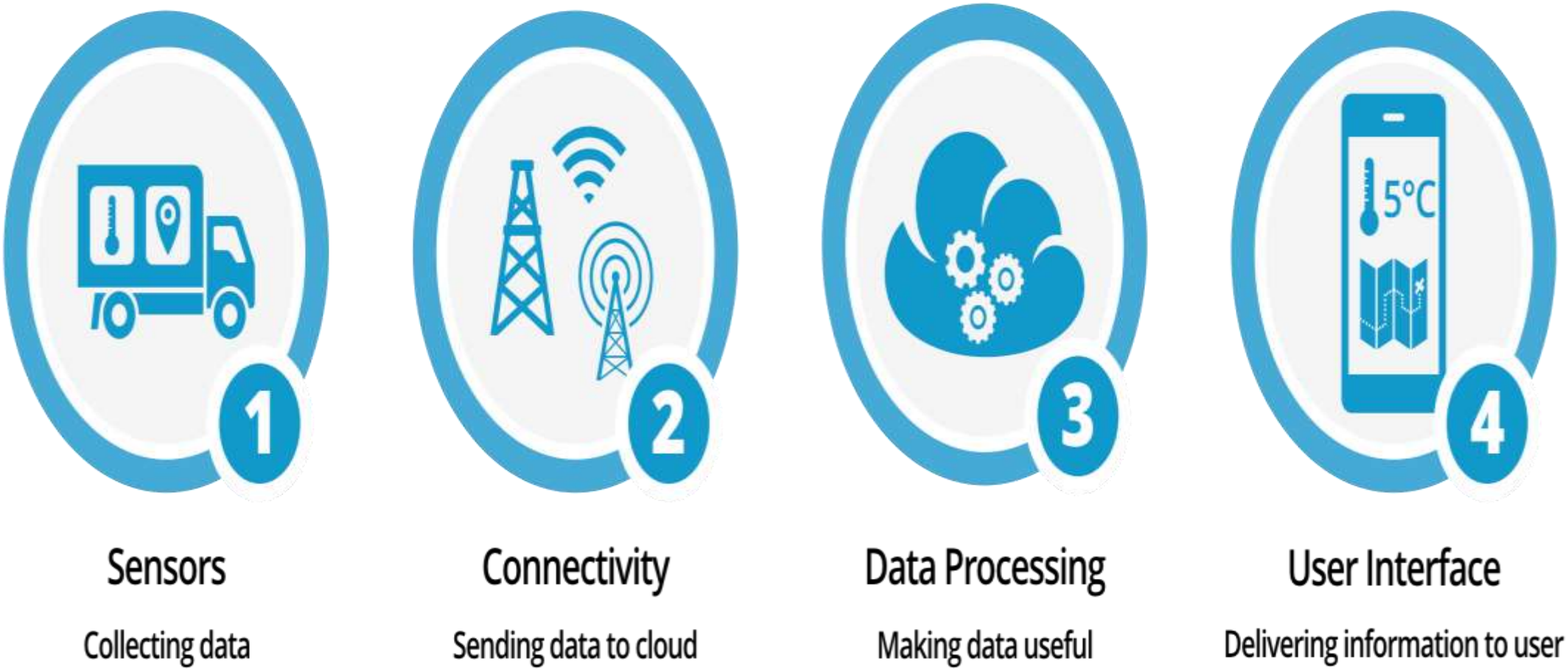
# Evolution of IoT



# 1.1.b- History of IoT



# 1.1.f- How IoT works?



IOT
FEATURES
01
AI
02
CONNECTIVITY
03
SENSORS
04
ACTIVE
ENGAGEMENT
05
DEVICES

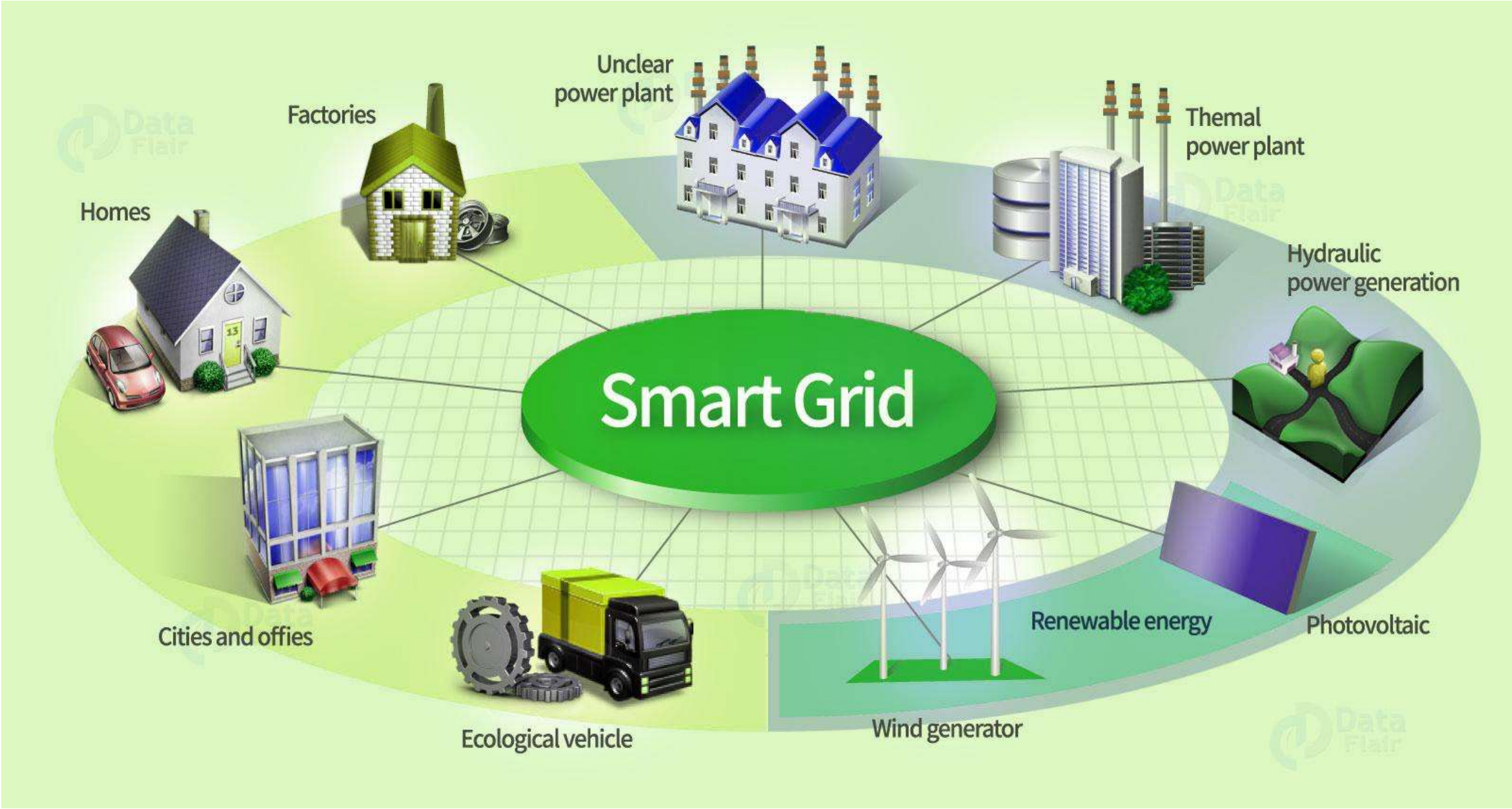
# IOT Applications and Usecases

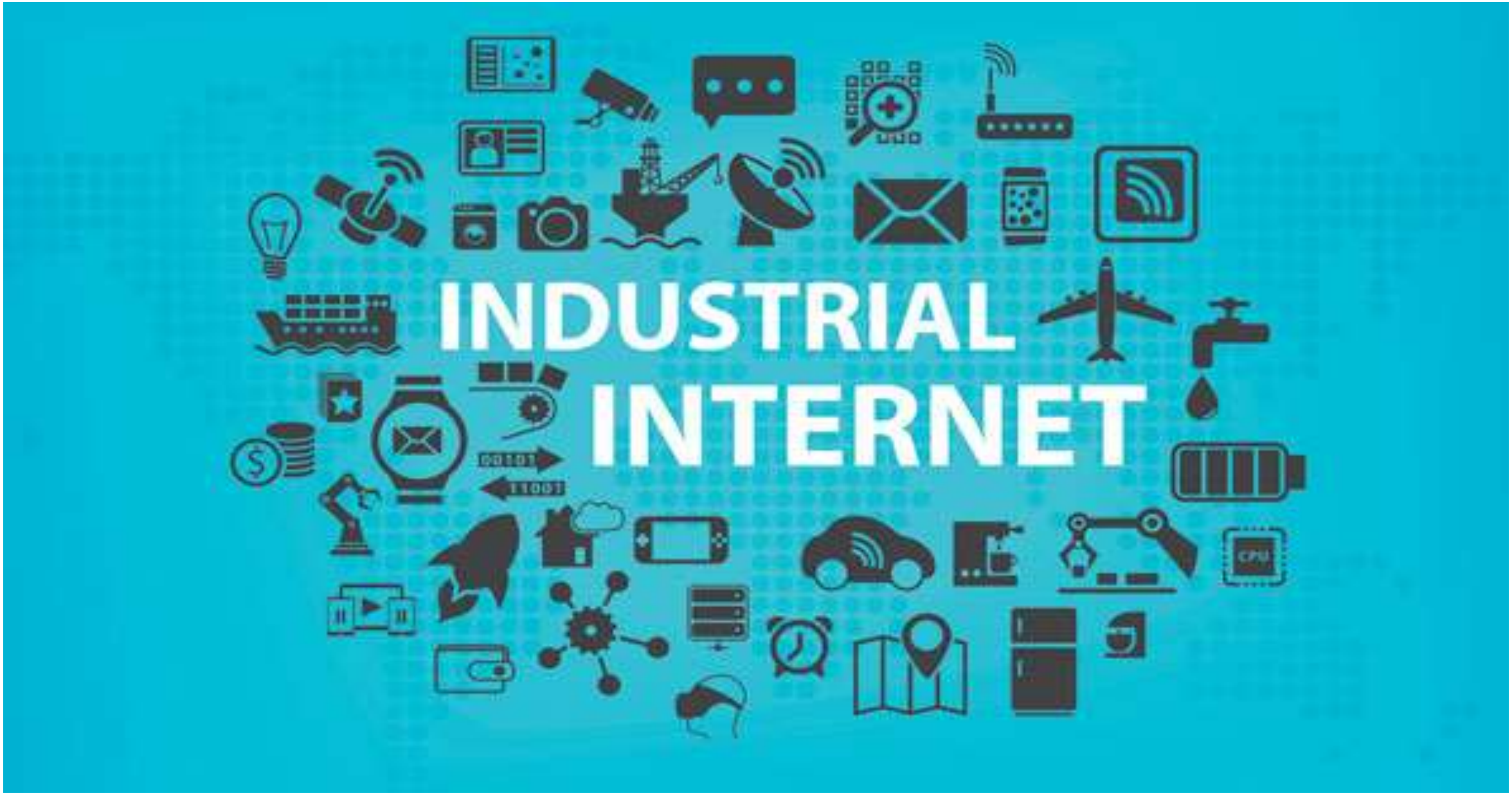
1. Smart home
2. Wearables
3. Smart City
4. Smart grids
5. Industrial internet
6. Connected car
7. Connected Health
8. Smart Retail
9. Smart Supply Chain
10. Smart Farming

# 1. Smart Home

# 2. Wearables

# 3. Smart City


Smart Grid
Unclear power plant
Factories
Themal power plant
Homes
Hydraulic power generation
Cities and offies
Ecological vehicle
Wind generator
Renewable energy
Photovoltaic


INDUSTRIAL
INTERNET

# 6. Connected Car

# 7. Connected Health

Telemedicine

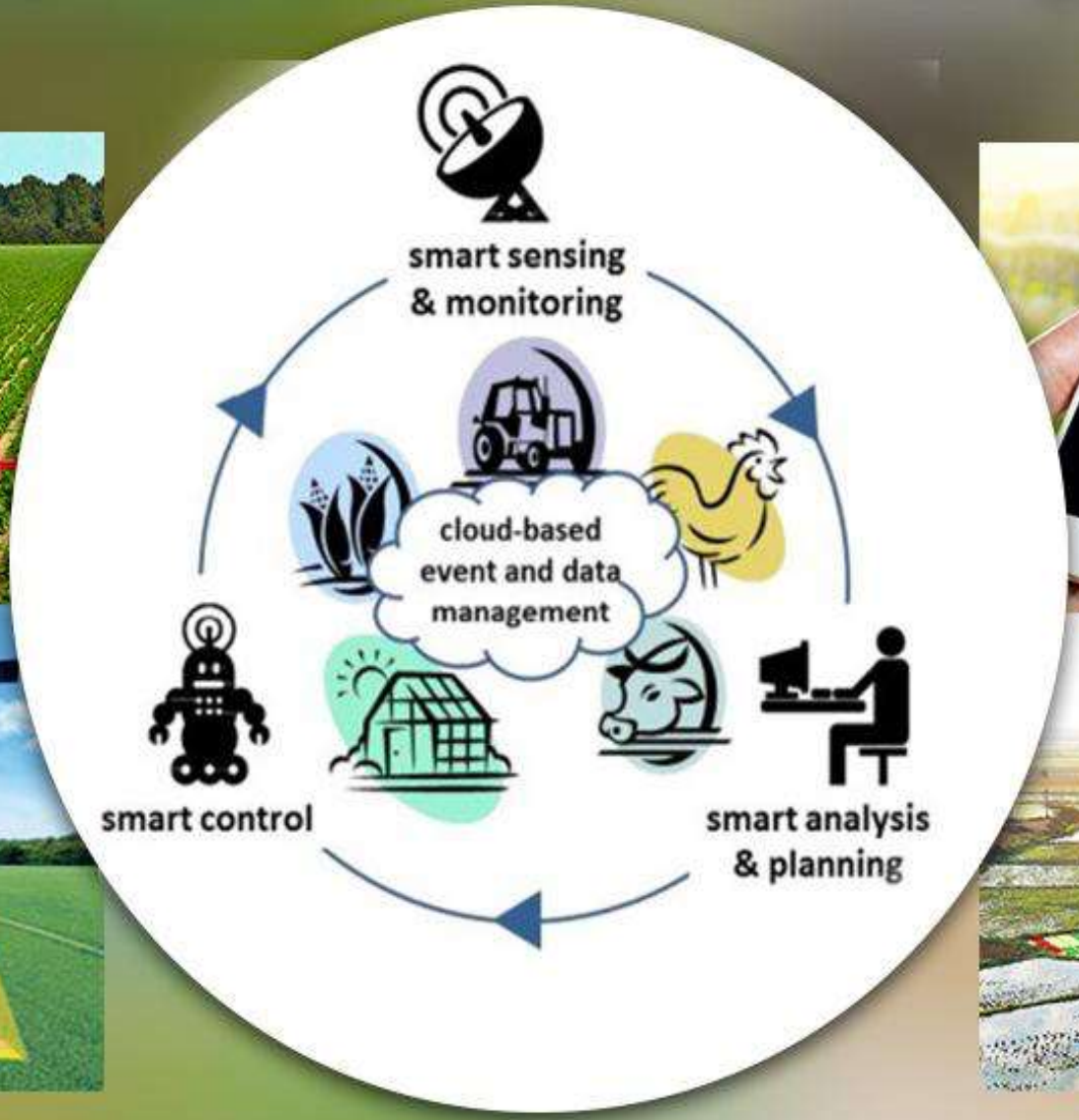
Digital health

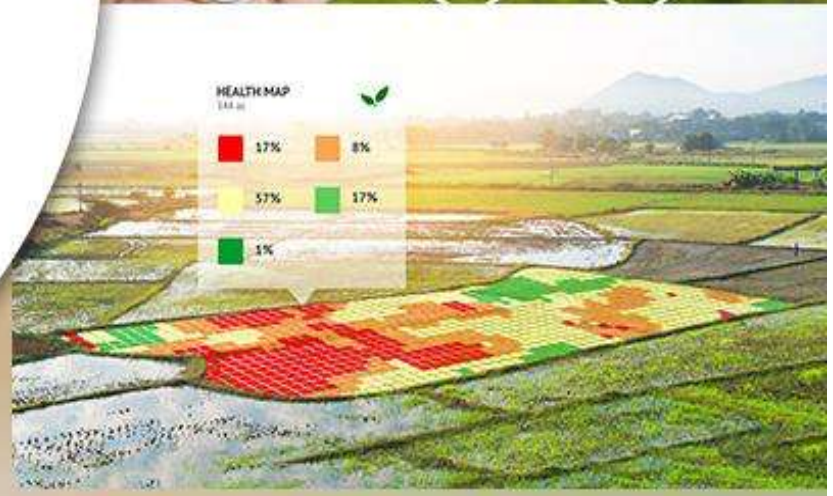
Telehealth

# 8. Smart Retail

# 9. Smart Supply Chain

# IoT in Smart Farming





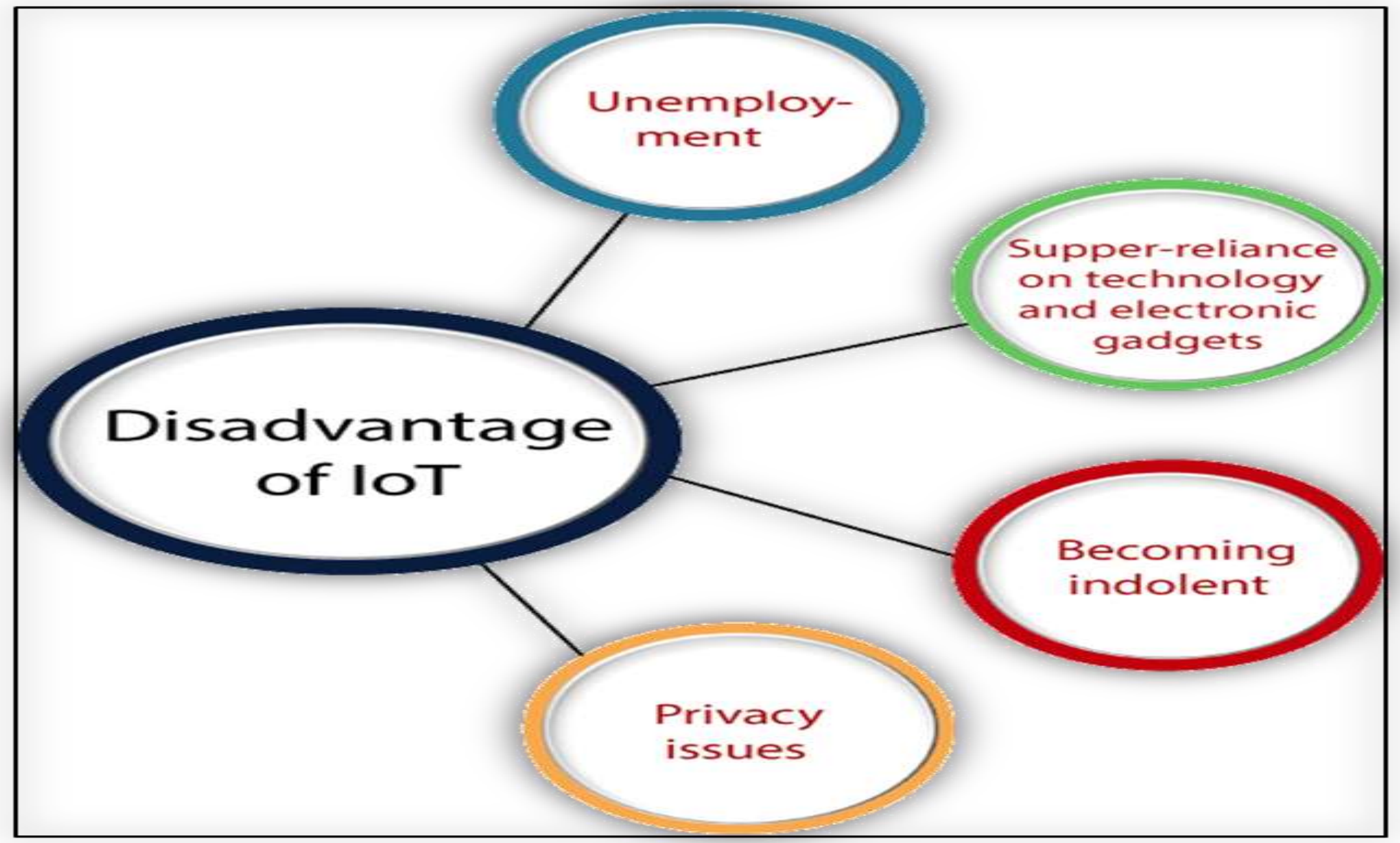
# Benefits of IoT

IoT

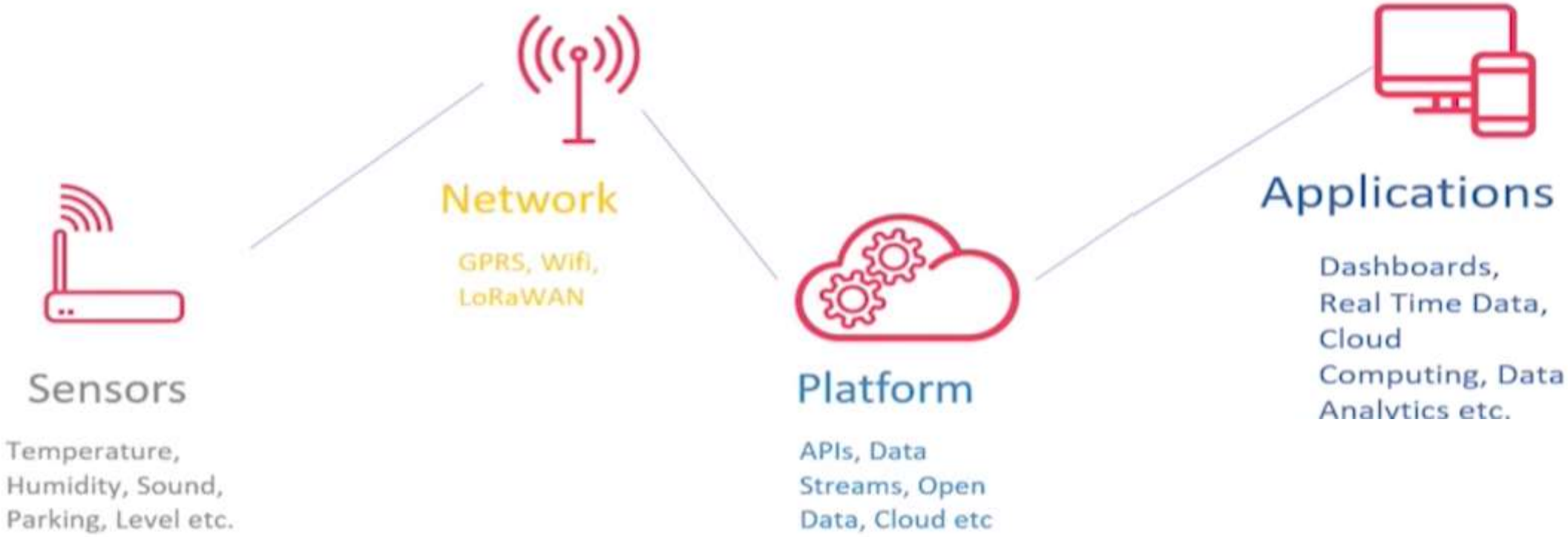
- Use of Smart Devices
- Achieve Customer-Centricity
- Reduction in Operational Cost
- Gathering Rich Data
- Enhanced Security Measures

# Why IoT?

Security
Efficient use of Energy
Advantages
Stay Connected
Improve Services
Reduce Wastage


Disadvantage of IoT
Unemploy-ment
Supper-reliance on technology and electronic gadgets
Becoming indolent
Privacy issues

# Major components of IoT



# Video links for IoT

- https://www.youtube.com/watch?v=LlhmzVL5bm8&list=PLv47xUrVi9DwEmrODg2S1e2VHQQYifFi0&index=29
- https://www.youtube.com/watch?v=6mBO2vqLv38

# Unit-1 : Internet of Things
# Lecture-2

**Contents:**

- What are sensors?
- Role of sensors in Automation and its importance.
- Applications of sensors in daily life.
- Various sensing technology and family.
- Sensors for Industry4.0 !!!!

# What are Sensors?

- Sensors are devices that convert a physical parameter or conditions into a signal that can be measured electrically.

- Once converted to an electrical signal it can be easily analyzed, multiplied and used for control.

- Thus Sensors form a inseparable part of measuring and providing effective measurement and control for automation

# What is transducer?

A device which converts one form of energy to another

When input is a physical quantity and output electrical ⟶ Sensor

When input is electrical and output a physical quantity ⟶ Actuator

Sensors

Physical parameter
↓
Electrical Output

Actuators

Electrical Input
↓
Physical Output

e.g. Piezoelectric:

Force -> voltage

Voltage-> Force

=> Ultrasound!

Microphone, Loud Speaker

Sensor & actuator are the type of transducers. Sensor is an input transducer and actuator is output transducer.

# Difference between Sensors & Actuators

| SENSORS | ACTUATORS |
|---|---|
| A sensor is a device that changes a physical parameter to an electrical output | An actuator is a device that converts an electrical signal to a physical output. |
| A sensor is an input transducer | An actuator is an output transducer |
| Sensor generates electrical signals | an actuator results in the production of energy in the form of heat or motion |
| Sensors are used in Magnetometer, cameras, microphones etc | Actuators are used in the LED, loudspeaker, motor controllers, laser, etc. |

# Role of Sensors in Industrial Automation

- First element in any control and measurement system.
- Sensors play an important role in the control system.
- Productivity, Quality, Reliability, and Safety heavily depend on the performance of the sensors.
- Sensors can be found in an extremely wide range of applications in industrial systems.

# Daily Life Applications

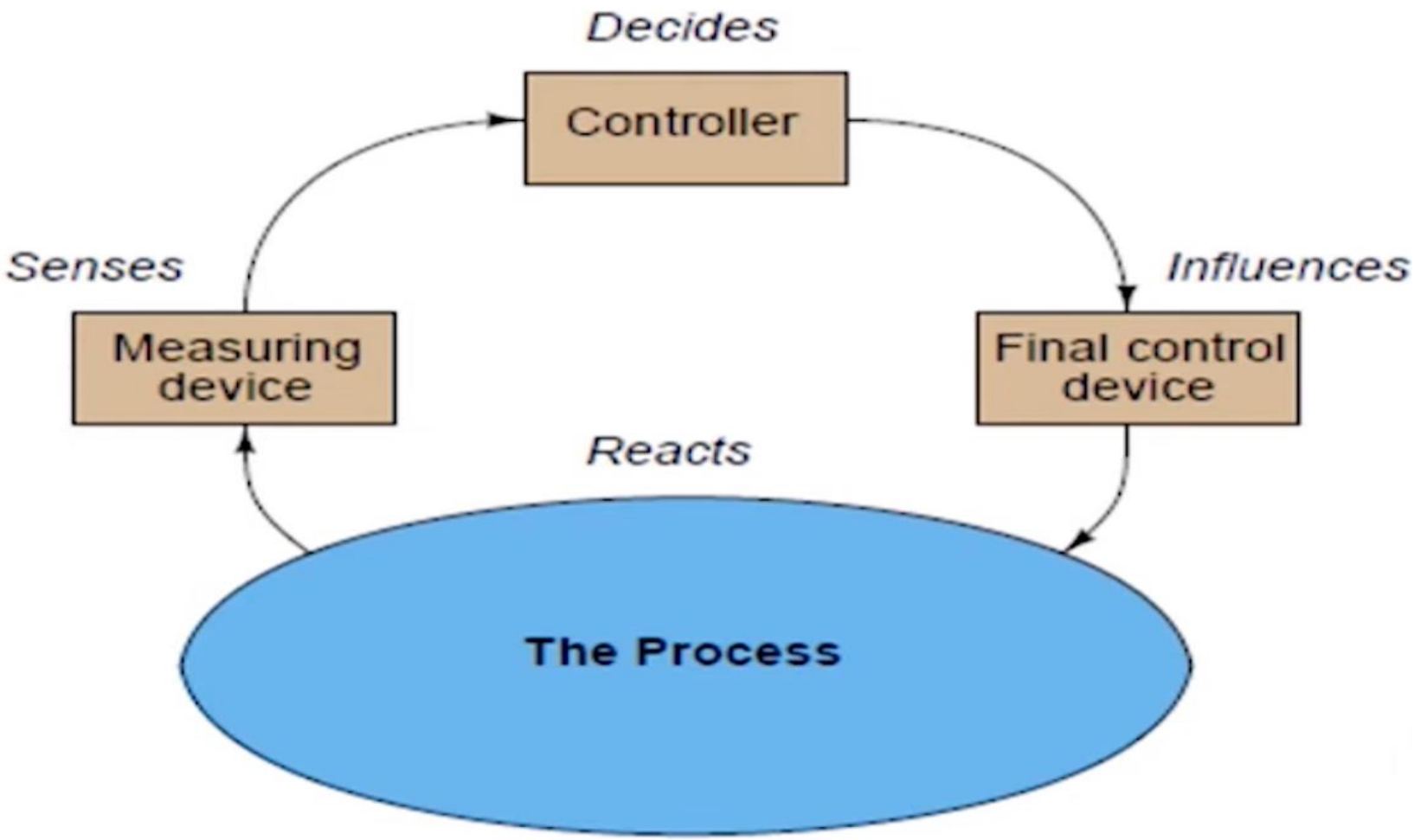
- A mercury-in-glass thermometer

- Temperature sensor in an microwave

- Temperature and humidity sensors in an AC

# Introduction

- Both Measurement and the final control device connect to Physical System is called "Process"



# Various Types of Sensors

- Hand Switch - Pressing the switch.
- Limit switch - Target contacting the switch
- Proximity Switch - Target no contacting
- Pressure Switch - Pressure
- Level Switch - Low Level
- Temperature Switch - Low Temperature
- Flow Switch -Low Flow rate

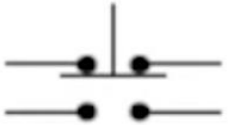
# Hand Switch

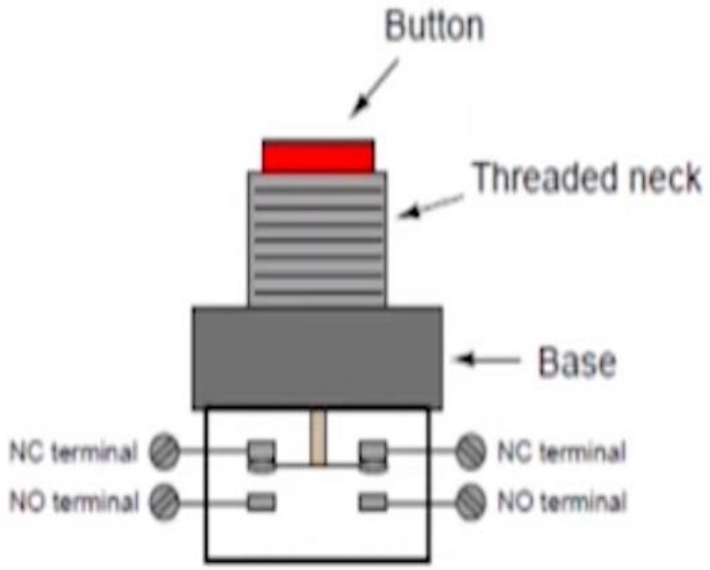
An electrical Switch actuated by a person's hand motion.

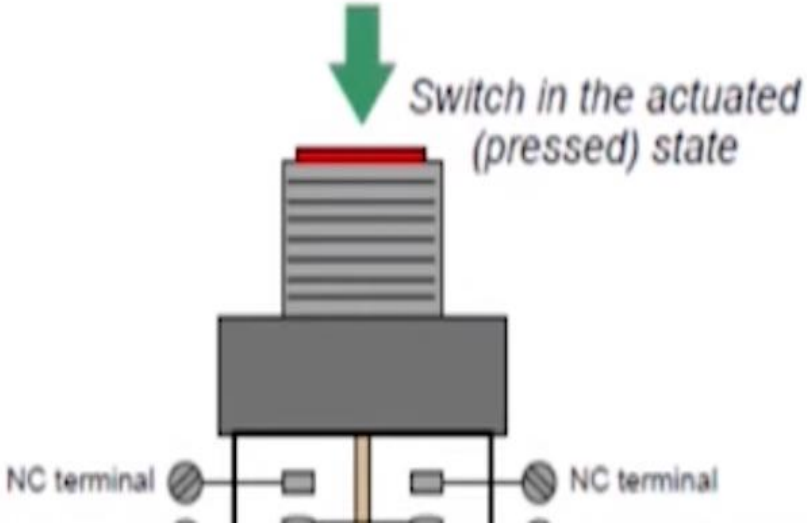
When pressed, the downward motion of the actuator breaks the electrical bridge between the two NC contacts, forming a new bridge between the NO contacts.

For Eg. Toggle switch, Pushbutton, Rotary Switch, etc.

Schematic Diagram Symbol





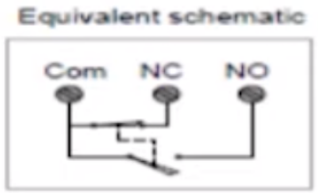
# Limit Switch

Detects the physical motion of an object by direct contact with that object.

A typical Limit switch design uses a roller-tipped lever to make contact with moving part.

Screw terminals on the switch body provide connection points with the NC & NO contacts.

Schematic Diagram Symbol



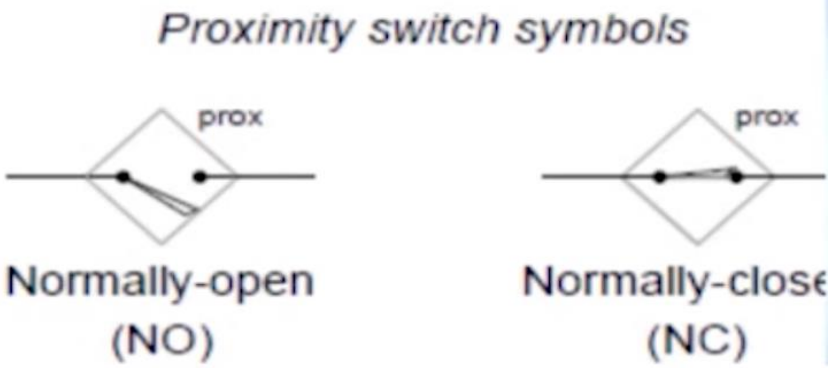
# Proximity Sensor/Switch

One Detecting the object from Proximity (Closeness).

These Switches are non-contact sensors, using Capacitive, Magnetic, Ultrasonic, Optical means to sense the proximity of objects.

Most of the Proximity sensors are active in design.

Schematic Diagram Symbol

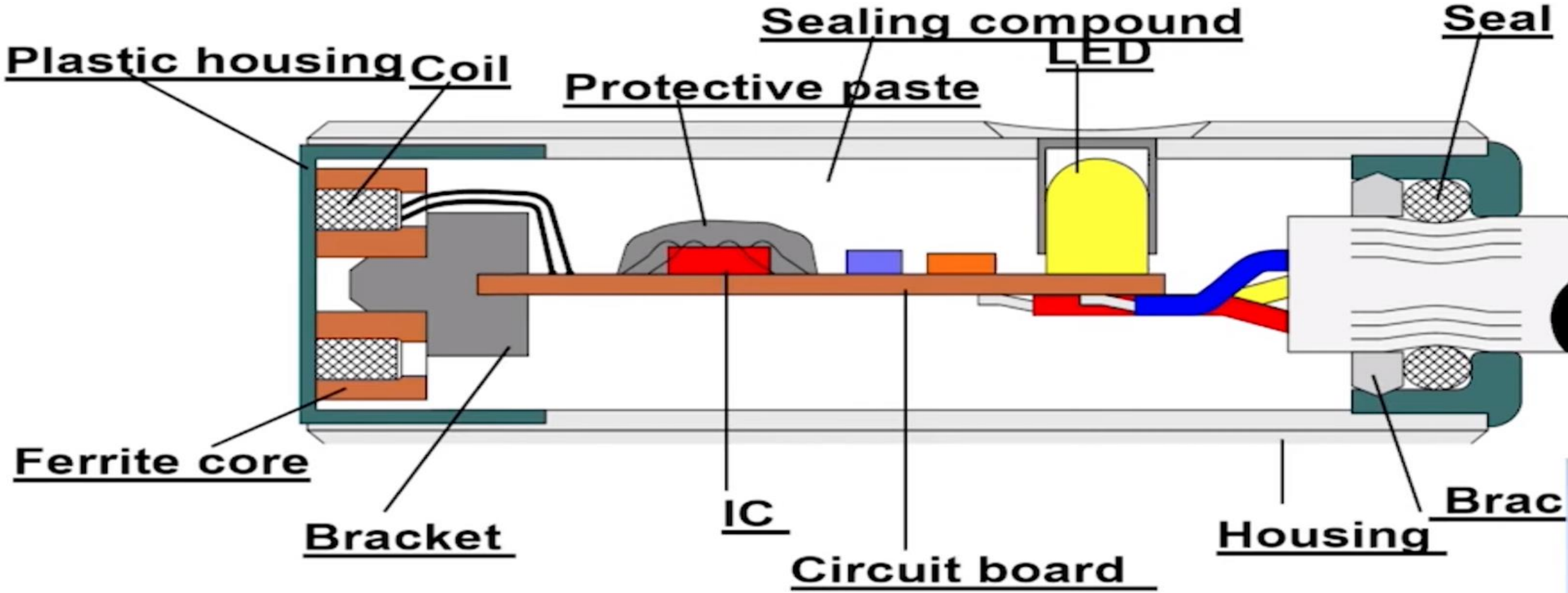


# Inductive Sensors

Inductive sensors are used to detect metal objects. Works on the law of electromagnetic induction.

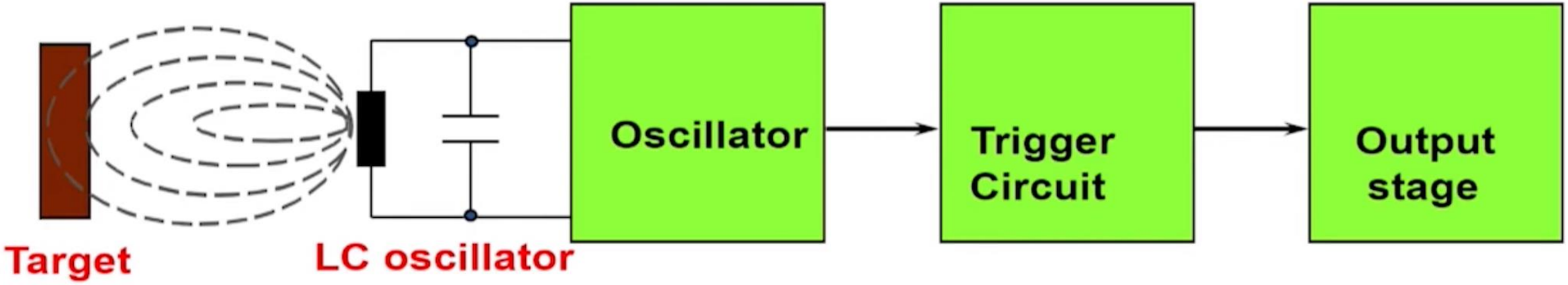
Can be used to detect material through non-conductive container walls like presence of glass tube , plastic pipe or rubber hose,

# Inductive Sensors - Basic construction




The heart is a coil with a ferrite core.
Enabling a magnetic field in only the target direction

# Inductive Sensors – Working Principle




The Oscillator creates a radio frequency that is emitted from the coil.
If a metal plate enters the radiated field, eddy current circulate with in the plate.

The oscillator stops when the load becomes too great. The trigger circuit senses the oscillators stops, then changes the state of the output switching device.

# Inductive Sensors - Sensing Range

The sensing range of a proximity switch is determined by the size of the coil. A large coil is available to give a longer sensing range however a larger sensor is needed.

- The sensing range is affected by the
- a) target size
- b) target composition
- c) switch mounting

# Inductive Sensor

Cylindrical
(M3, M4, M4.5..M8..M12..M18..M30)

Surface mounted / Rectangular
(Rhino, Varikont, Flat Pack)

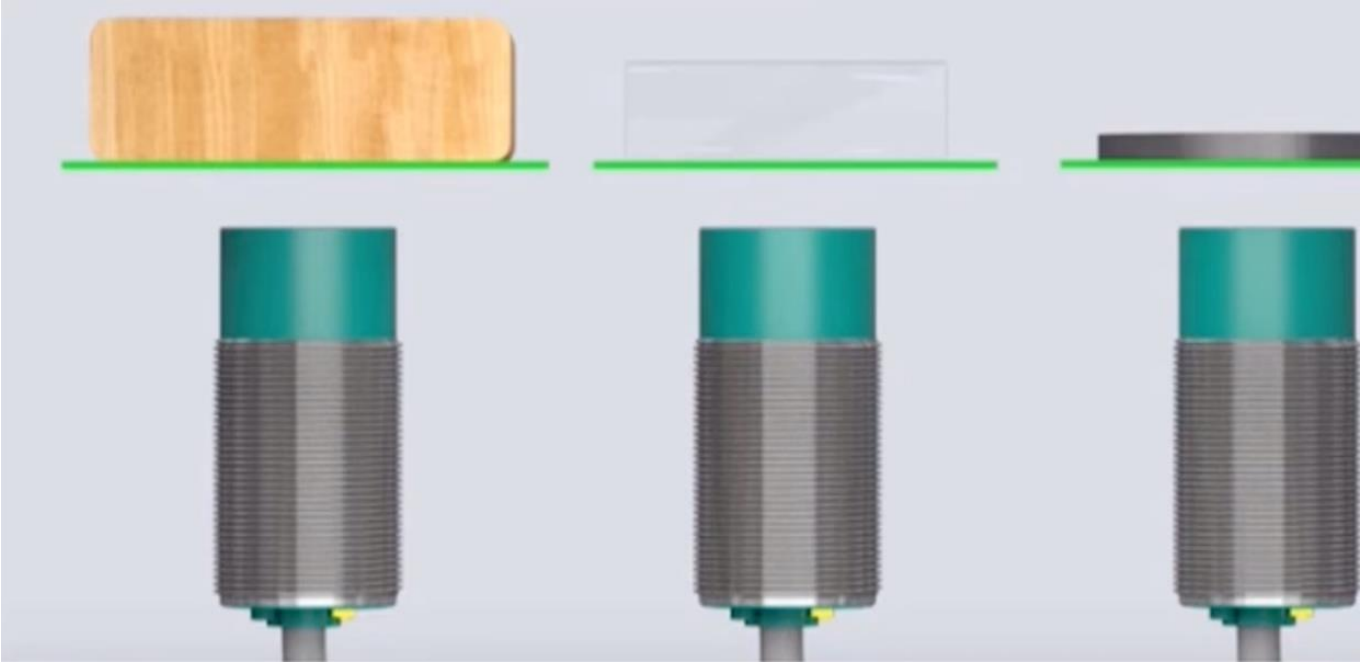
Slot
(2-30mm Slot Width)

Ring
(10-100mm Ring Diameter)

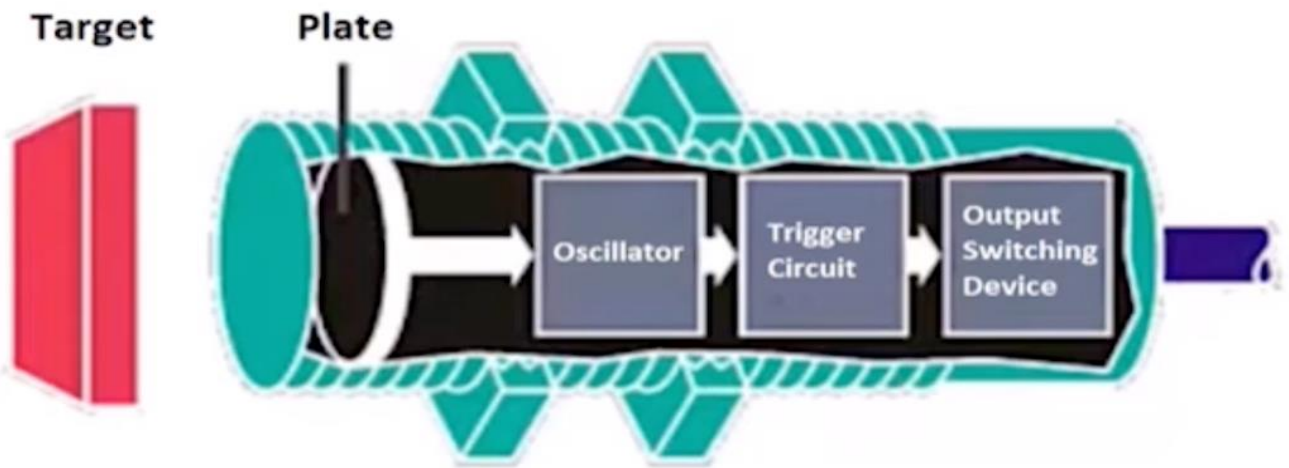
# Capacitive Sensors

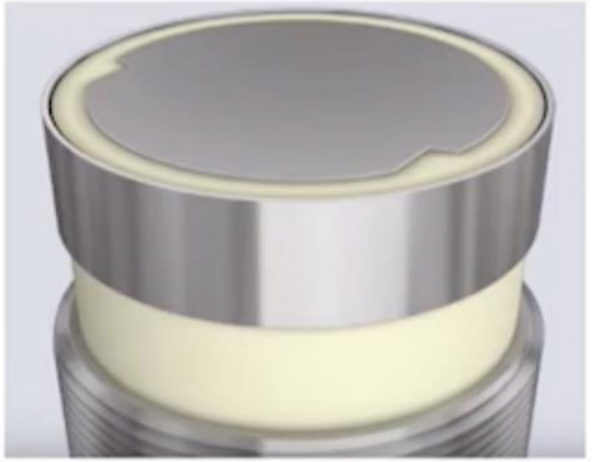
Capacitive sensors are used to detect liquids ,paper ,plastics, powders , granular material and also metal objects.

Can be used to detect material through non-conductive container walls like presence of liquid in glass tube , plastic pipe or rubber hose,



# Capacitive Sensors - Working Principle



A metal Plate at the end of the sensor, is electrically connected to the oscillator.
The target to be sensed act as a second plate.
The oscillator senses the external capacitance between the target and the plate.
As the target approaches the oscillation reaches the threshold level and activate the switching device.

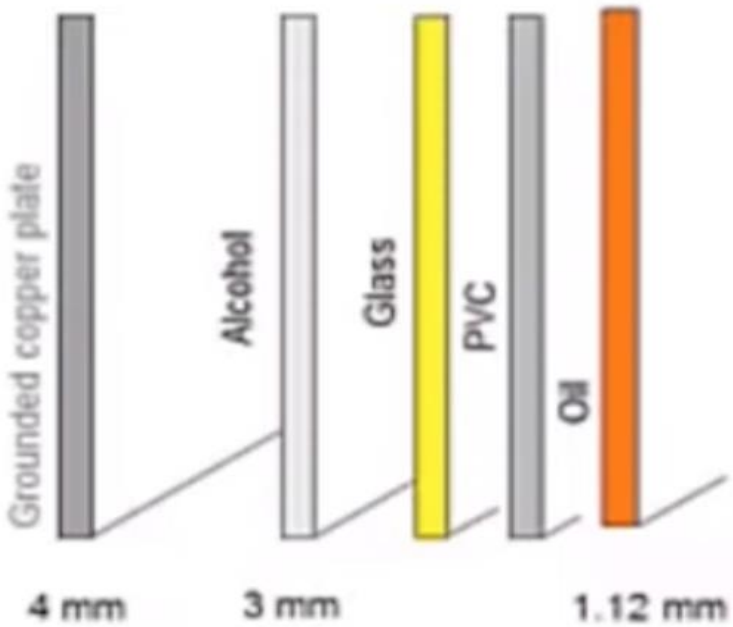
# Capacitive Sensors - Sensing Range

The sensing range from the sensor to the material is determined by

- Size of target
- Sensitivity of sensor
- Dielectric Strength (permittivity)

$$C = \frac{\text{Area} \times \text{Dielectric}}{\text{Gap}}$$

| Material | Dielectric | Reduction factor |
|---|---|---|
| Grounded copper plate | >100 to 10,000 | 1 |
| Water | 80 | 1 |
| Alcohol | 22 | 0.75 |
| Glass | 5 to 16 | 0.6 |
| Ceramic | 4 to 7 | 0.5 |
| PVC | 2.3 to 3.4 | 0.45 |
| Wood (dry) | 3 to 7 | 0.3 |
| Oil | 2.6 to 2.9 | 0.28 |
| Paper (dry) | 1.6 to 2.6 | 0.25 |
| Air | 1 | 0 |

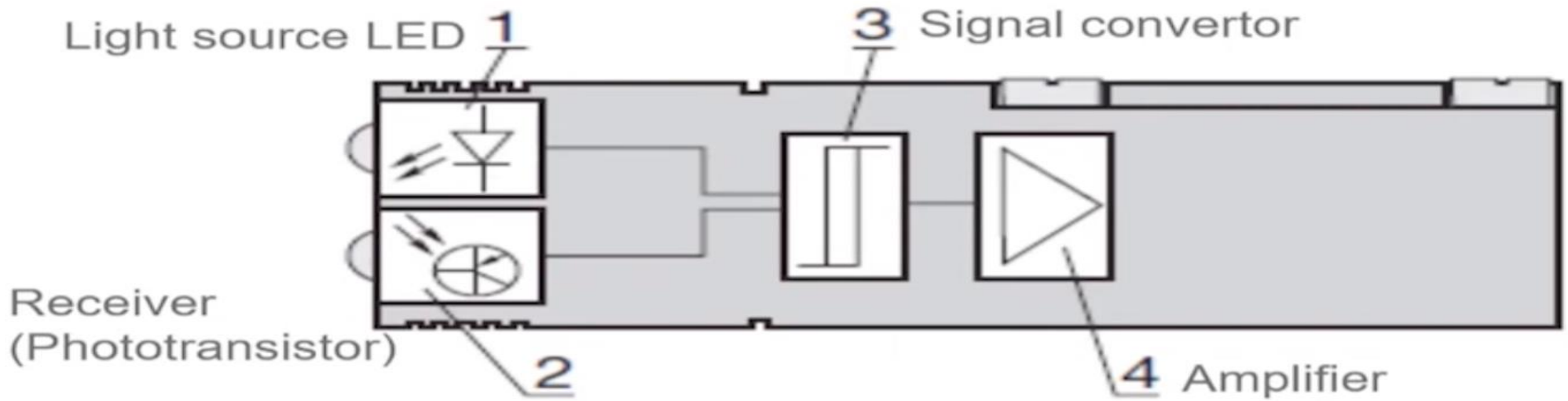


# Photoelectric Sensors

Devices that trigger output stage when the presence and absence of the light is detected.

Consists of an Emitter (light source LED), a Receiver to detect the emitted light and associated electronics that evaluate and amplify the detected signal causing the sensors output switch to change state.

# Photoelectric Sensors – Working Principle




- Light pulses are generated by switching LED off and on a predetermined frequency which increases the light intensity and lifetime of the LED.
- Light pulses are received by phototransistor are converted to electrical signal.
- Upon verification, the output of the sensor is switched accordingly.

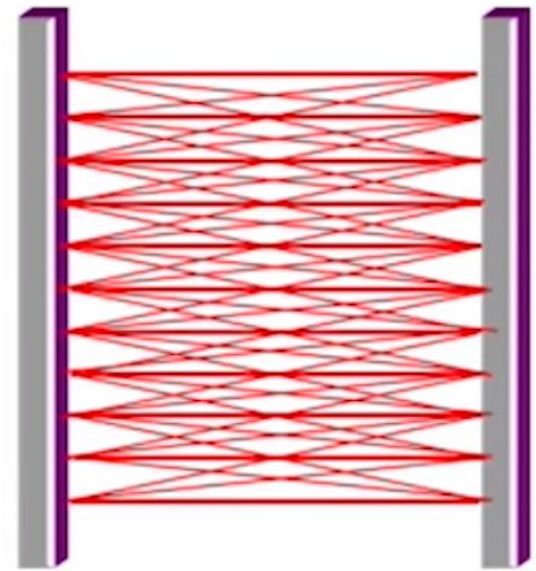
# Photoelectric Sensors – Types

Thru-Beam

Slot

Direct Detection – Diffuse beam

Light Grid



Retro-Reflective

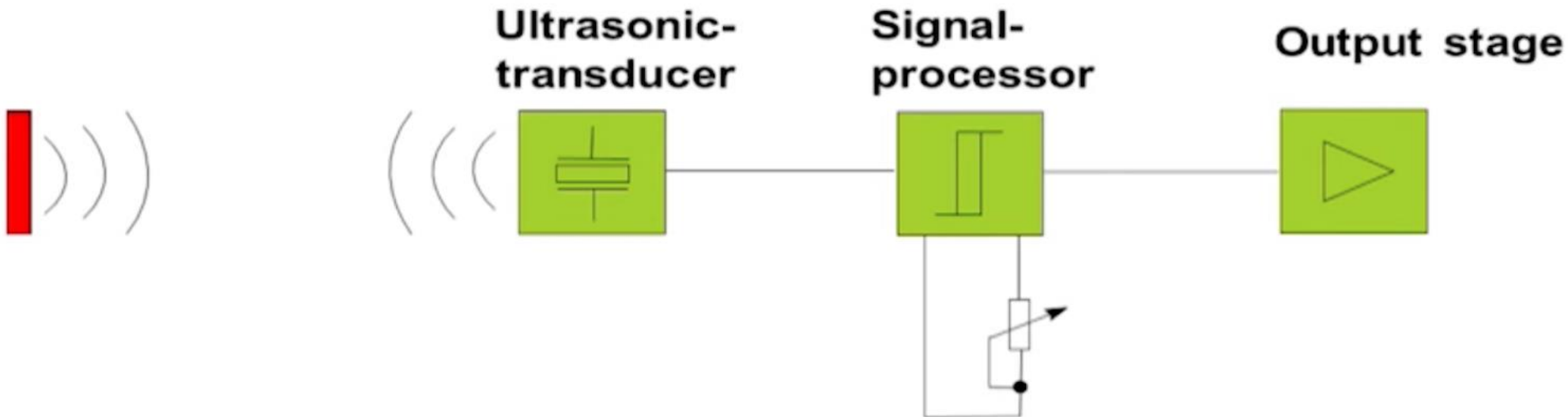
# Ultrasonic Sensors

Ultrasonic sensors is a device that uses high-frequency sound waves to detect objects, 20,000 Hz above

Ultrasonic bridge the gap between inductive & Photoelectric sensing.

They are unaffected by the target Color, ambient noise or dusty atmospheric.

# Ultrasonic Sensors – Working Principle




The oscillator circuit inside the sensor housing produces a frequency that causes the crystal disc to vibrate and emit sound pulses.

If an target is within sensing range, a sound wave will be reflected back to a receiver in the sensor to indicate its presence.

The frequency of the ultrasonic is above the range that can be heard by humans

# Ultrasonic Sensors – Features

**Benefits**

- Large operation range
- Detects liquids and solid/bulk materials
- Soiling proof
- Colour neutral
- Switching distance is material independent.

**Drawbacks and problems**

- Sensitive to environment conditions (temperature, air-pressure, air-humidity...)
- Blind zone

# Applications

# Video link

https://www.youtube.com/watch?v=a_rhr4jtZtY&feature=emb_logo

# Unit-1 : Internet of Things
# Lecture-3

## Contents

**1.3** IoT components: layers

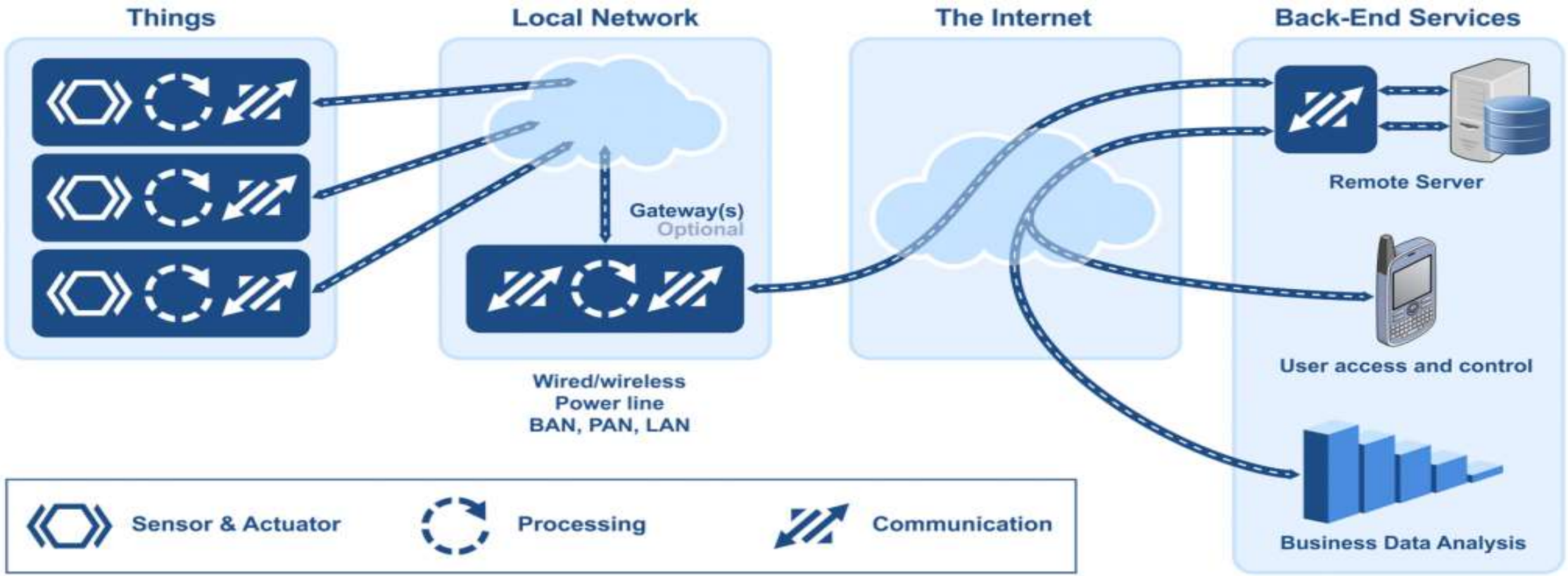
1.3.a IoT architecture

1.3.b IoT taxonomy of key components

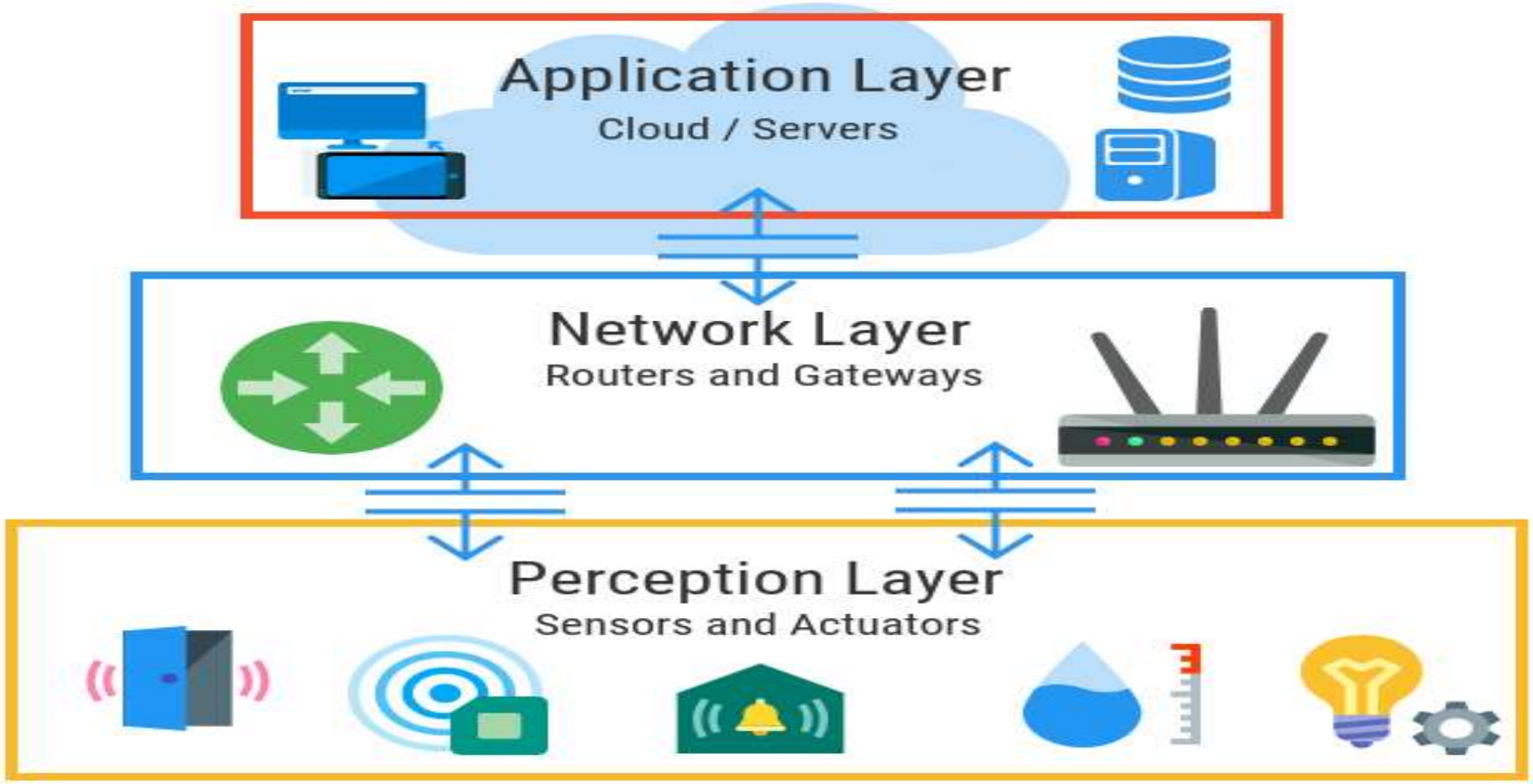
# 1.3 IoT components: layers

There are four main components of an IoT system:

- The Thing itself (that is, the device)
- The local network (this can include a gateway, which translates proprietary communication protocols to Internet Protocol)
- The Internet
- Back-end services (enterprise data systems, or PCs and mobile devices)



# 1.3.a Three Layer (Tier) IoT Architecture



# 1.3.b IoT taxonomy of key components

There is no single consensus on architecture for IoT, which is agreed universally

**Basic Architecture**

**Application Layer**

*Responsible for delivering application specific services to the user. Defines applications in which the Internet of Things can be deployed.*

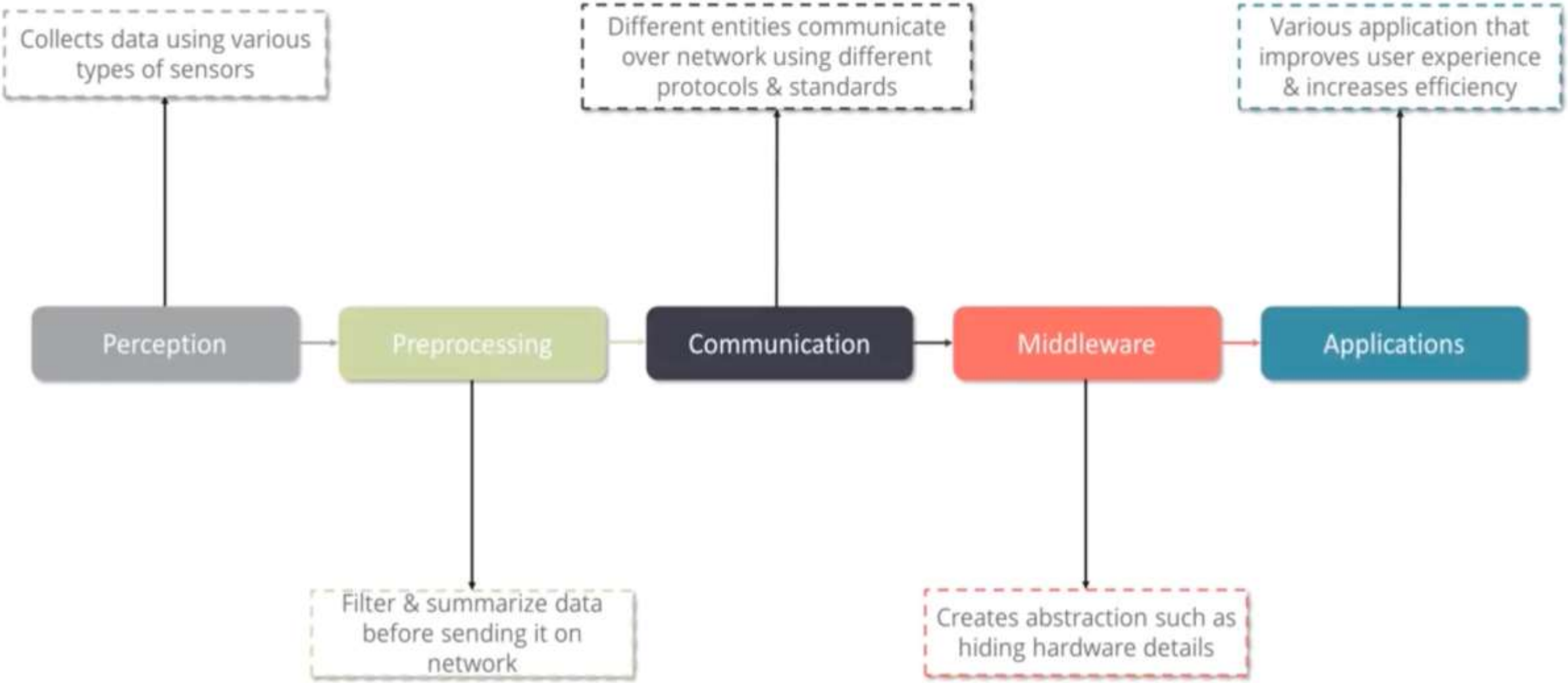
**Network Layer**

*Responsible for connecting smart things, network devices, and servers. Also used for transmitting and processing sensor data.*

**Perception Layer**

*Sensors sense and gather information about the environment. Senses physical parameters or identifies other objects in the environment.*

# IoT Taxonomy



# Five Layer Architecture

- Business Layer
- Application Layer
- Processing Layer
- Transport Layer
- Perception Layer

# Seven Layer Architecture

| | |
|---|---|
| People & Process | Layer 7 – Transformational decision making based on "Thing" Apps & Data |
| Applications | Layer 6 – Custom Apps built using "Thing" data |
| Data Analysis | Layer 5 – Reporting, Mining, Machine Learning |
| Data Ingestion | Layer 4 – Big Data, Harvest & storage of "Thing" data |
| Global Infrastructure | Layer 3 – Cloud infrastructure (public, private, hybrid, managed) |
| Connectivity/Edge Computing | Layer 2 – Communications, Protocols, Networks, M2M, Wifi, Telecom, HW Kits |
| Things | Layer 1 - Devices, sensors, controllers, etc. |

# Video link

https://www.youtube.com/watch?v=pS_w1KG2cPw&list=PLv47xUrVi9DwEmrODg2S1e2VHQQYifFi0&index=25

# Unit-1
# Lecture-4
# Smart City

# Smart City

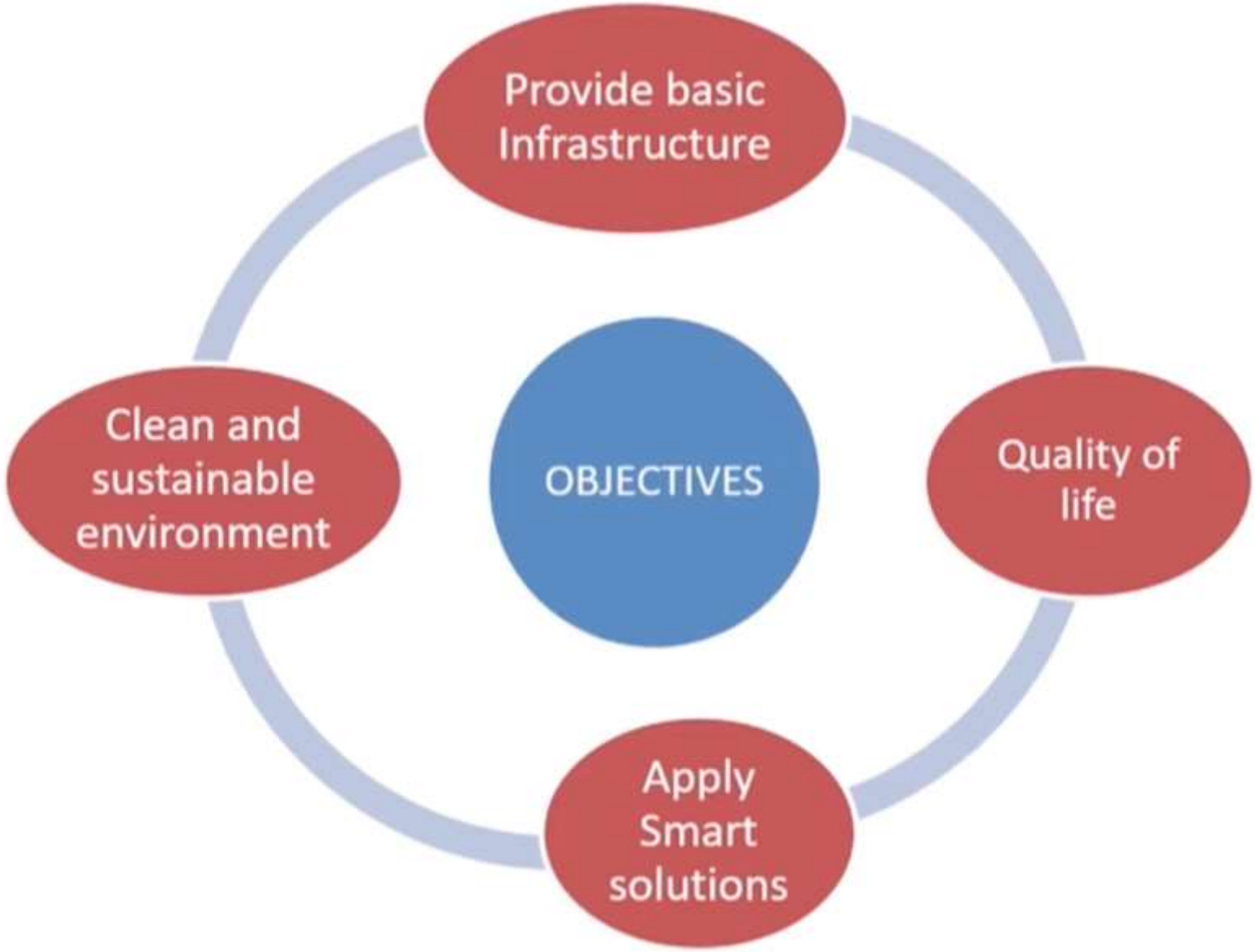
***WHAT?***

- A smart city is a framework, predominantly composed of Information and Communication Technologies (ICT), to develop, deploy, and promote sustainable development practices to address growing urbanization challenges.

***HOW?***

- Cloud-based IoT applications receive, analyze, and manage data in real-time to help municipalities, enterprises, and citizens make better decisions that improve quality of life

# Objectives


Provide basic Infrastructure
Clean and sustainable environment
OBJECTIVES
Quality of life
Apply Smart solutions

# Why do we need smart cities?

Urbanization is a non-ending phenomenon.

Today, 54% of people worldwide live in cities, a proportion that's expected to reach 66% by 2050.

One hundred ninety-three countries have agreed upon the agenda of the Sustainable Development Goals (SDGs), in September 2015 at the United Nations

# How is IoT technology making cities smarter and better?

- Cloud-based central control system
- Integrating solar power
- Secure wireless connectivity
- Free parking spaces and EV charging docks
- High-power embedded LEDs

# What makes smart cities successful

- In addition to people, dwellings, commerce, and traditional urban infrastructure, there are four essential elements necessary for thriving smart cities:

  1. ***Pervasive wireless connectivity***
  2. ***Open data***
  3. ***Security you can trust in***
  4. ***Flexible monetization schemes***

# What makes smart cities successful!

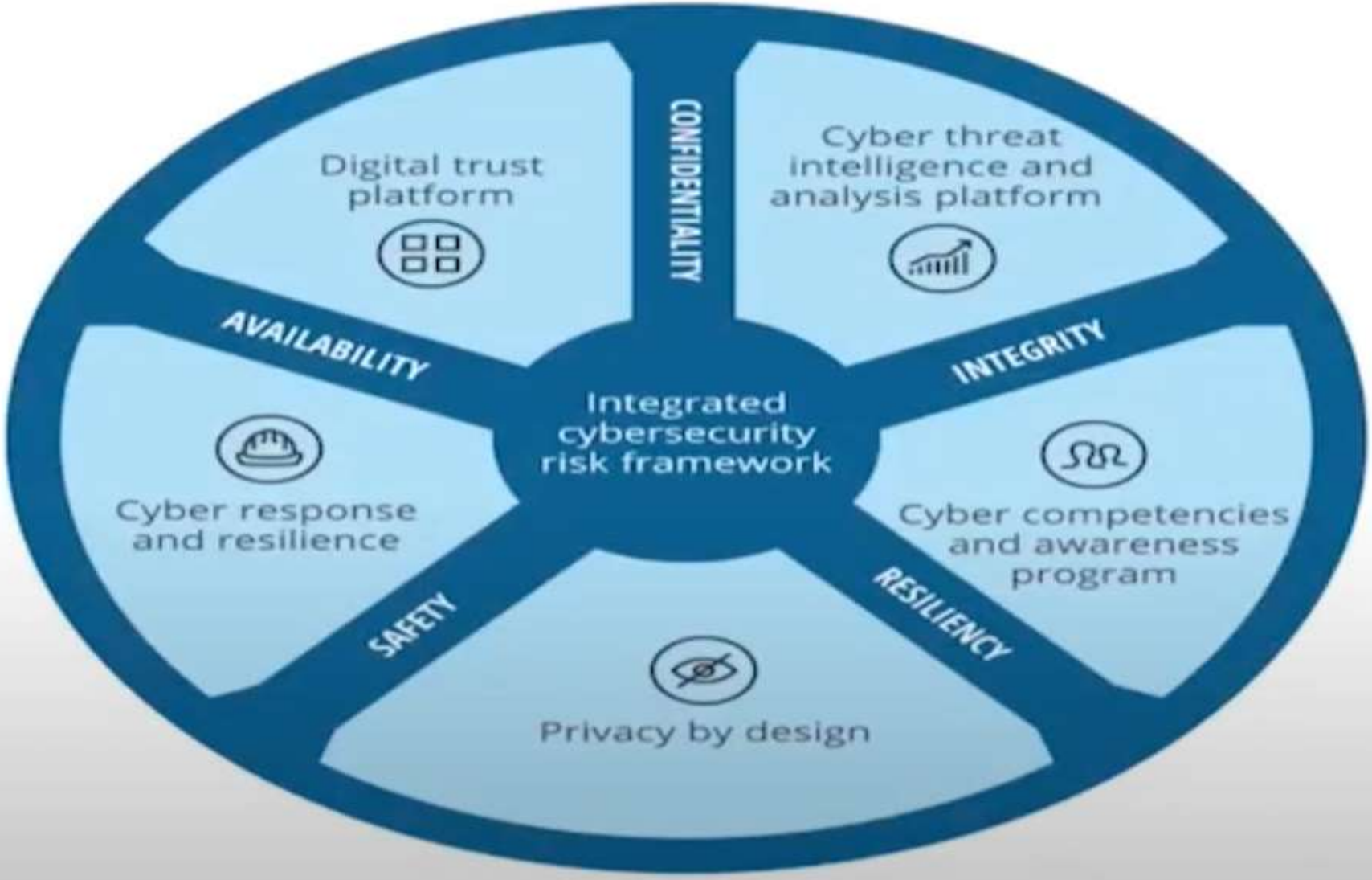
- Citizens engage with smart city ecosystems in various ways using smartphones and mobile devices and connected cars and homes.

- Pairing devices and data with a city's physical infrastructure and services can cut costs and improve sustainability.

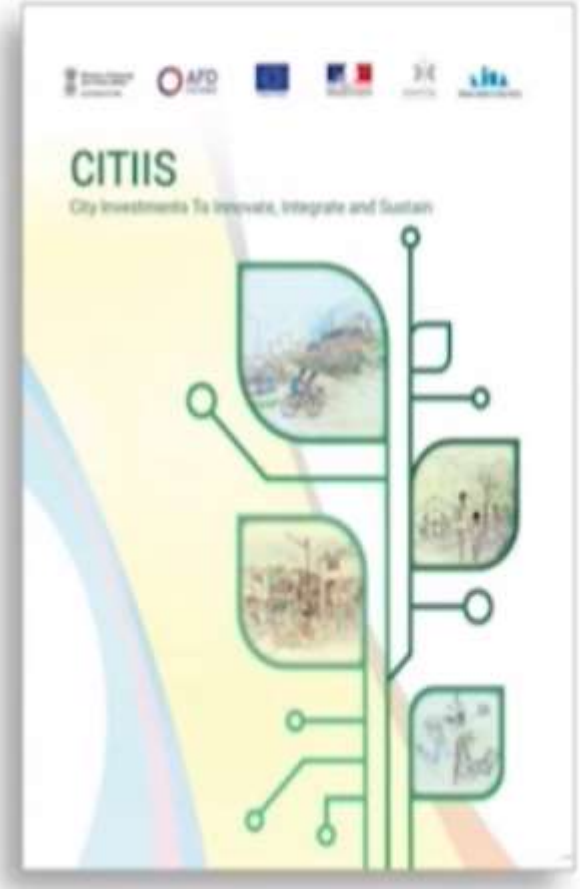
- Communities can improve energy distribution, streamline trash collection, decrease traffic congestion, and improve air quality with help from the IoT.

# Can smart cities be secured and trusted?

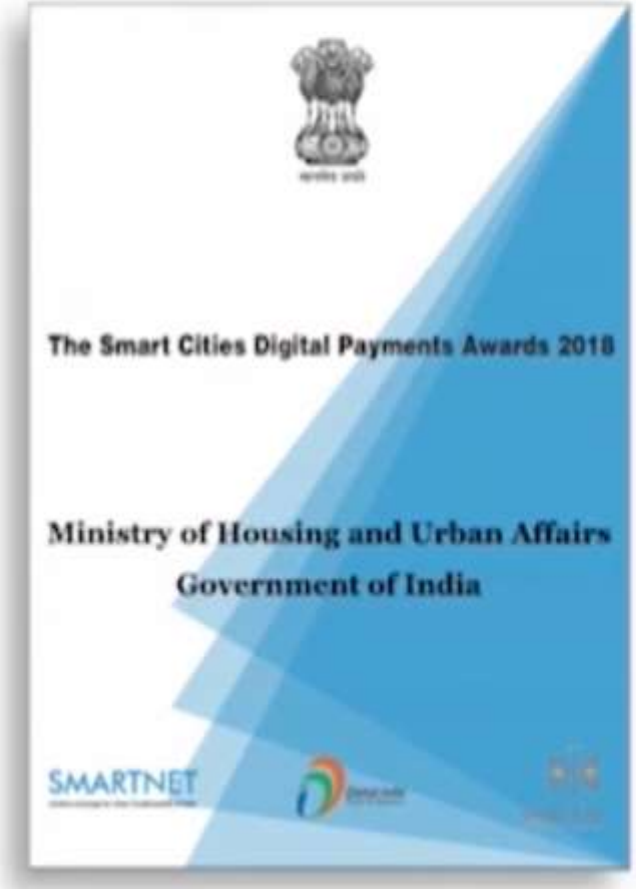
# Core security objectives for smart city solutions



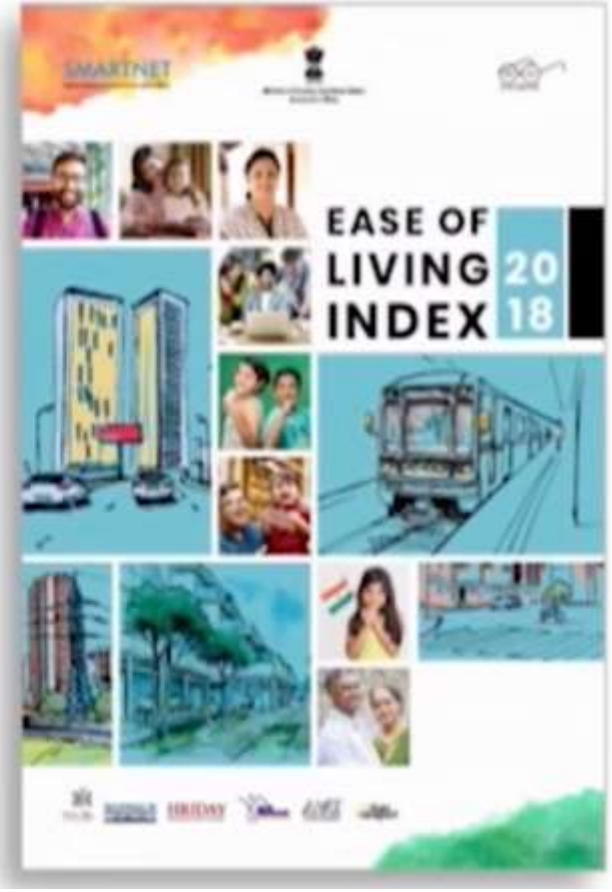
# Initiatives by Indian Government




CITIIS Challenge




Smart Cities Digital Payment Awards, 2018




Ease of Living Index

India smart city fellowship and internship program

# India Smart Cities Fellowship (ISCF) and Internship (ISCI) Program

- India Smart Cities Fellowship (ISCF) and Internship (ISCI) Program Launched To Provide Opportunity to Youth to Work In the Domain of Urban Planning and Governance

- Smart Cities Digital Payments Awards 2018 Launched to Reward Cities at the Forefront of Digital Payments

- 'Citiis' Challenge Announced to Select Innovative Smart City Projects for Financial Support and Foreign Technical Assistance

- Local Area Plan (Lap) & Town Planning Scheme (Tps) To Be Implemente In 25 Cities on Pilot Basis for Fast Resolution of Area Based Infrastructu Issues

# Implementation Status

Ease of Living

Walkable Streets, Parks, Waterfronts

Smart Governance

Command & Control Centers, Mobile Applications

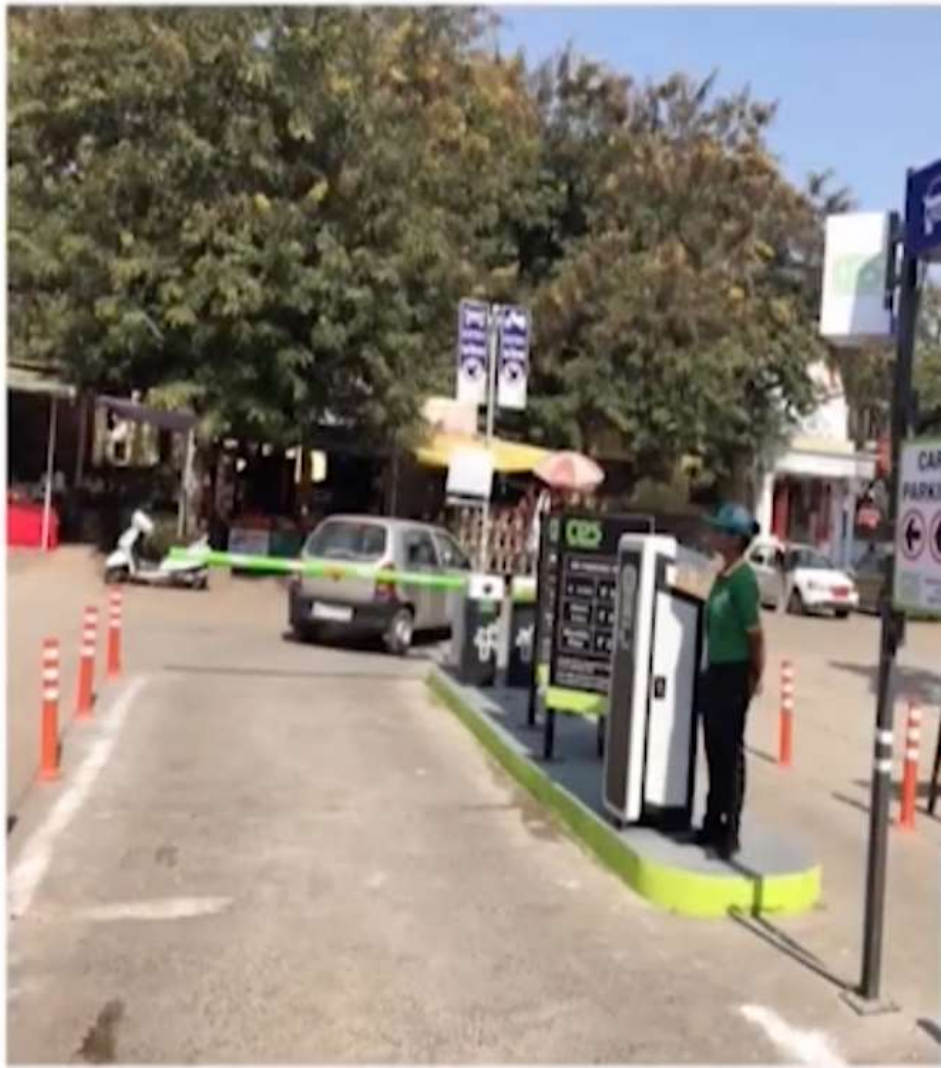
Connected Communities

Smart Schools, Heritage, Arts & Culture

Urban Resilience

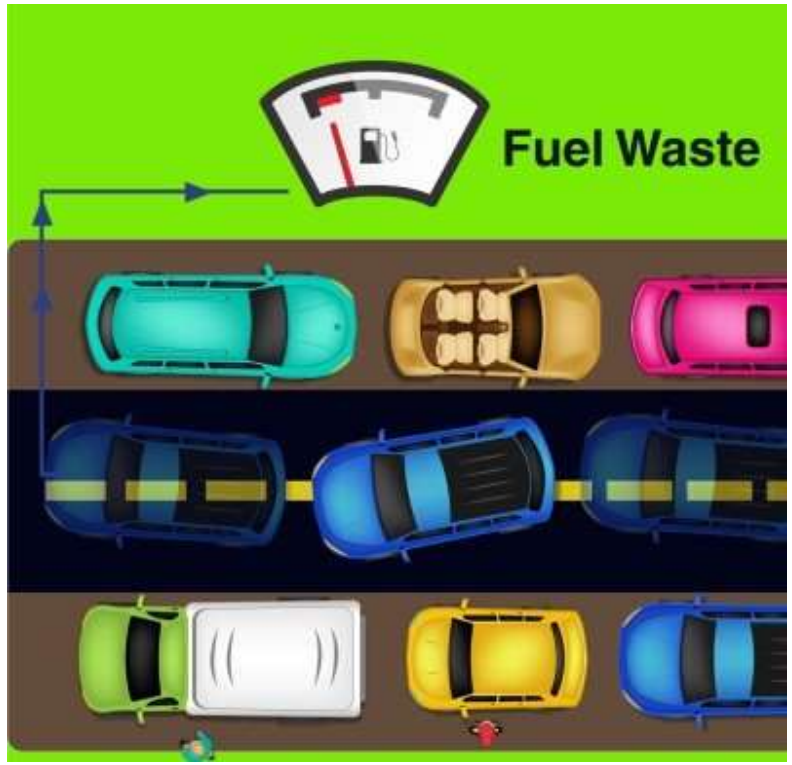
Solar and Wind Energy, Water & Waste Water, Waste to Energy

# Smart Parking



# *Benefits analysis of Smart Parking Technology*

- Optimized parking
- Reduced traffic
- Reduced pollution
- Enhanced User Experience
- Integrated Payments
- Increased Safety
- Decreased Management Costs
- Increased Service and Brand Image



# Smart Toilets

Bio Toilets near Guwahati Municipal Office

Faridabad Smart Toilet at Sector 19 Market

Solapur E-Toilets

# Video analysis by police

# Integrated Command & Control Centers(Smart Governance)

Visakhapatnam ICCC - Smart Poles & Environmental Sensors at 50 locations monitor real-time pollution

Bhopal ICCC - Online City bus transport operations City Center) monitor various outputs

# Solar Rooftop(Urban Resilience)

Diu is the first district in India to run on 100 % renewable energy in daytime

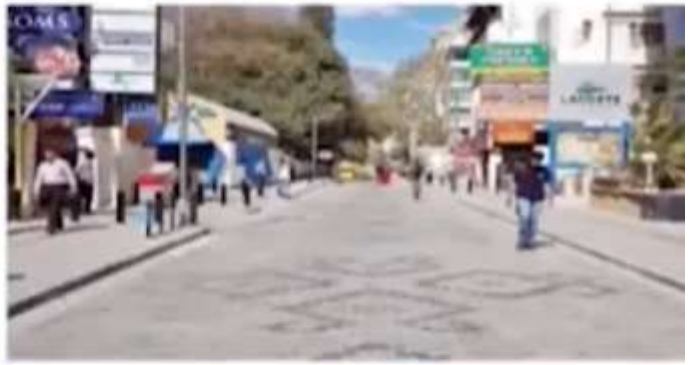
Jaipur Solar rooftop -1.1 MW energy produced fron public buildings brought down their electricity bills

# Pedestrian and Cycle friendly Streets(Ease of Living)

Pune - Universal accessibility for elderly/physically challenged by providing tactile track

Visually Improved, congestion free & Safer Roads; Improved road junctions

# Upgradation of Church Street, Bengaluru



# Smart City

Smart city includes

- Traffic management
- Water distribution
- Waste management
- Urban security
- Environmental monitoring
- Reduce noise and pollution
- Structural Health of Buildings
- City Energy Consumption
- Smart Parking
- Smart Lighting
- Automation of public Buildings
- Make cities safer.
- Better use of the public resources

# Smart City Challenges

- **Privacy and Security:** Compromised IoT data can be used for financial gain, or to create civil distress and advance political or hacktivist goals.
- **Data Issues:** Another smart city challenge stems from the massive amounts of data that must be constantly collected, analyzed and shared.
- **Governance and Funding:** Political cycles and their dynamics have an effect on the development and management of smart cities.
- **The human angle:** Determined leadership, effective policy decisions, and meaningful collaboration between all stakehol to drive a city to success.

# Unit-1
# Lecture-5
# Industry 4.0

**Contents:**

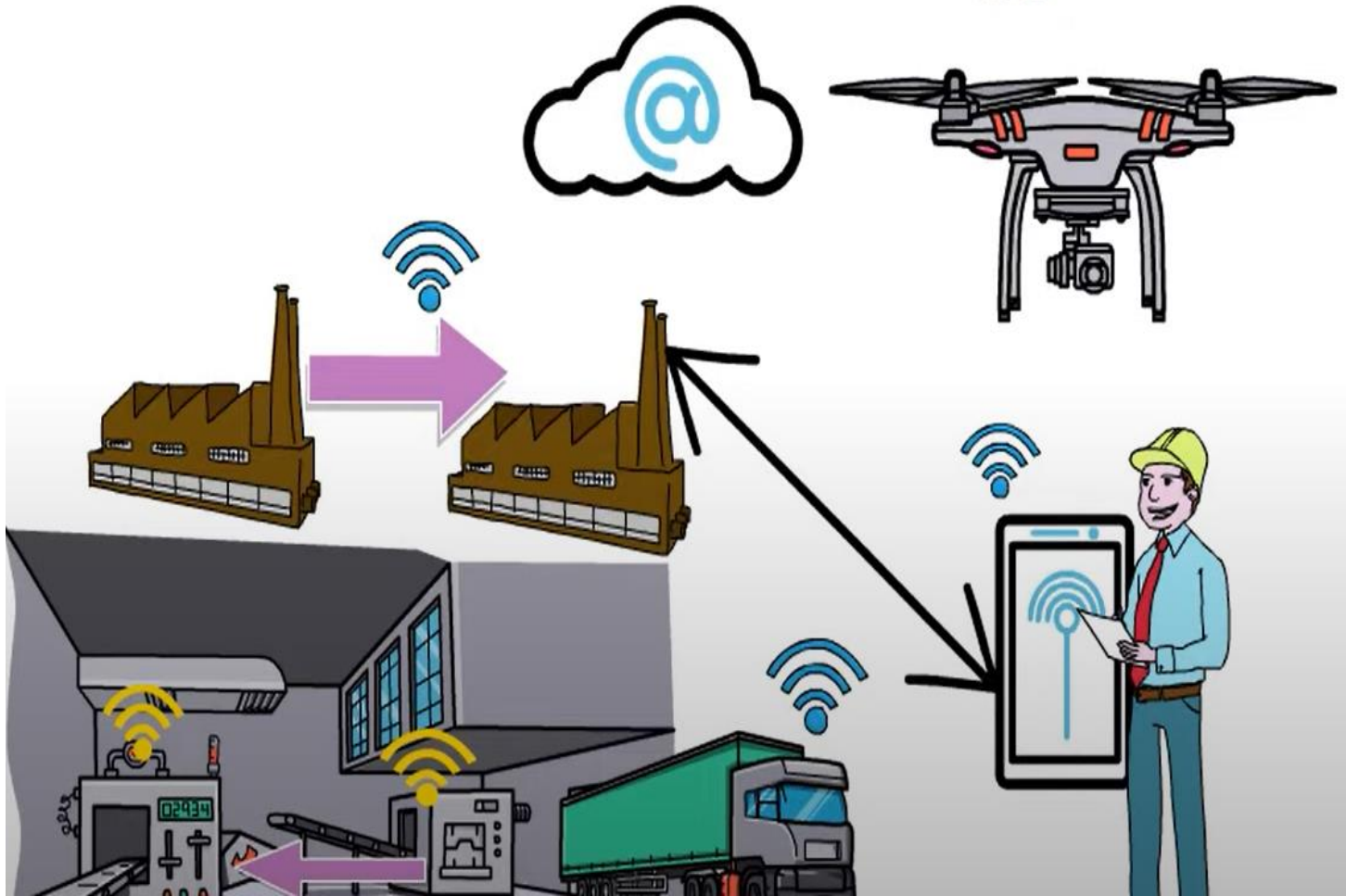
- Introduction to IIOT: The Concept
- Industrial Automation and Its Elements
- Industrial Control Architecture
- How to implement IoT in Industrial Domain
- Benefits and Future Scope

# Industrial Internet of Things: The Concept

**IoT:** The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

**IIoT:** The Industrial IoT connects critical machines and sensors in high-stakes industries such as aerospace and defense, healthcare and energy. These are systems in which failure often results in life-threatening or other emergency situations.

**"Industry 4.0 is a new phase in the Industrial Revolution that introduce intelligent networking of machines and processes for industry with the help of information and communication technology"**

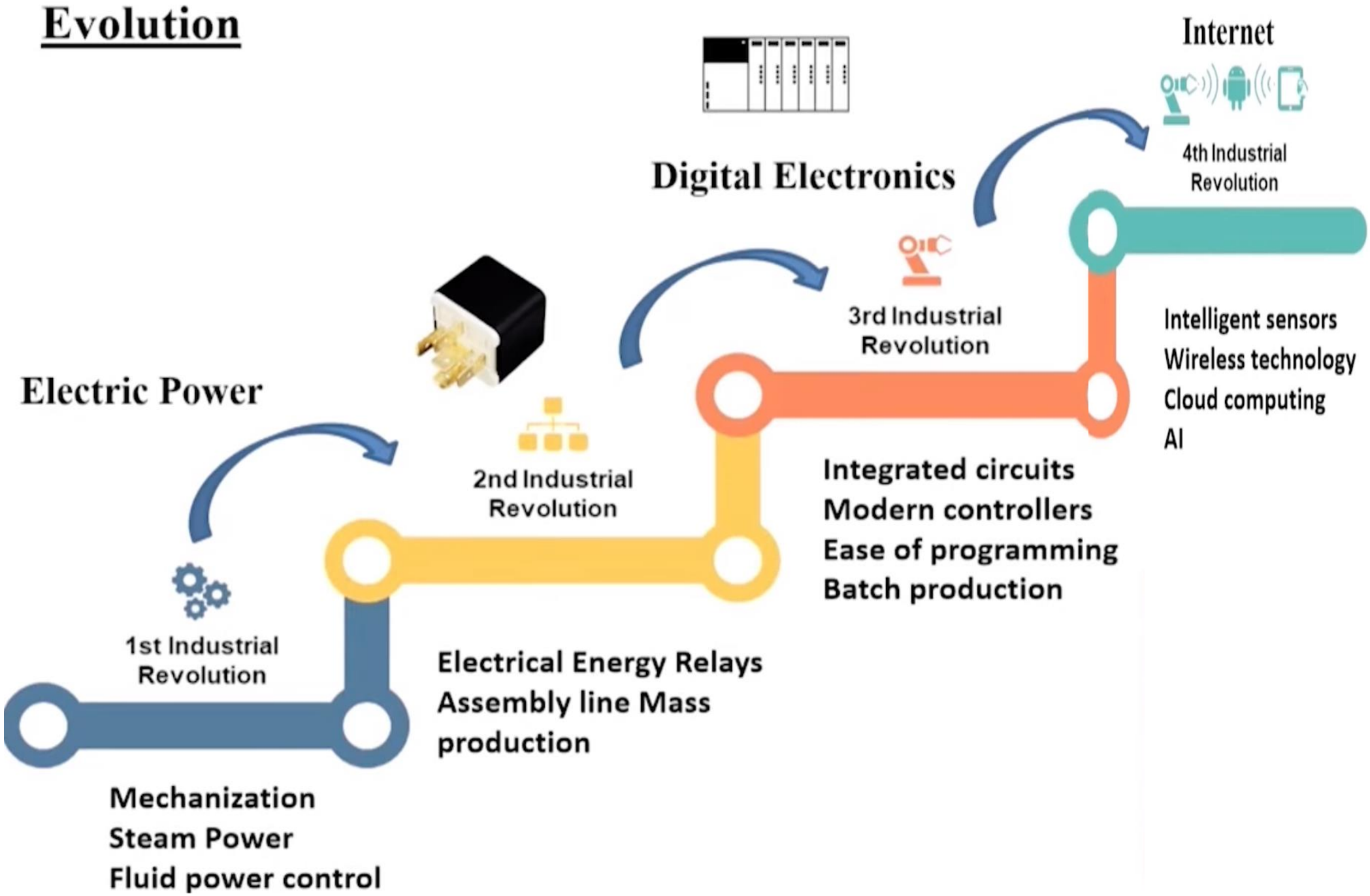


# Industrial Automation & Its Elements

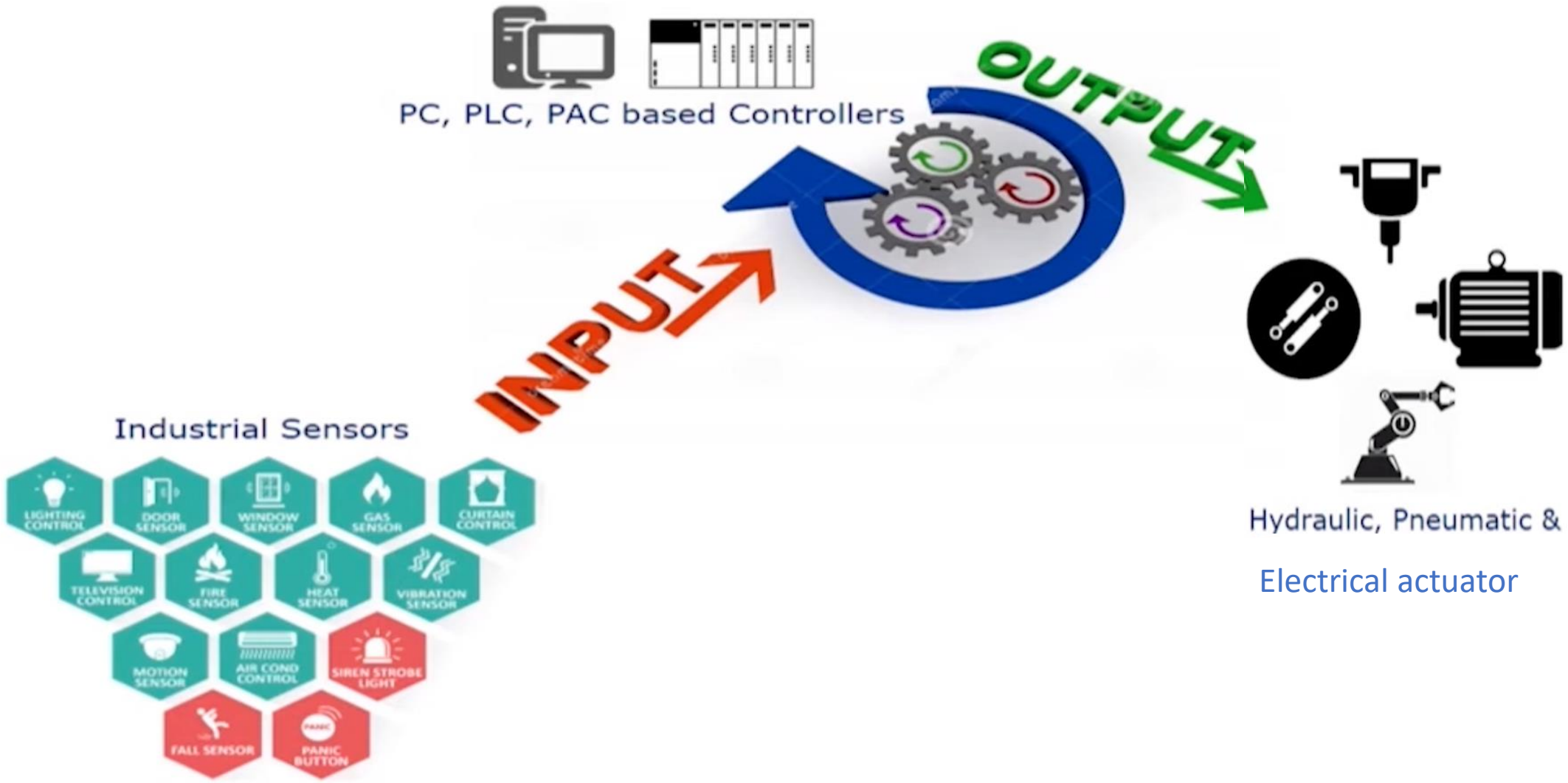
## Automation

Automation is the integration of machines into a self-governing system by replacement of human labor with machines power of some form.

# Evolution

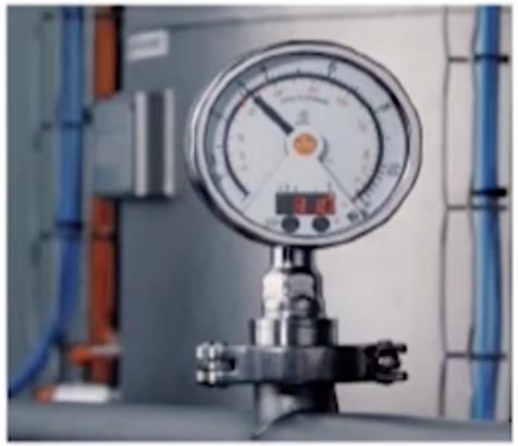

Internet
Digital Electronics
4th Industrial Revolution
3rd Industrial Revolution
Intelligent sensors
Wireless technology
Cloud computing
AI
Electric Power
2nd Industrial Revolution
Integrated circuits
Modern controllers
Ease of programming
Batch production
1st Industrial Revolution
Electrical Energy Relays
Assembly line Mass production
Mechanization
Steam Power
Fluid power control

# Elements of Automation System:



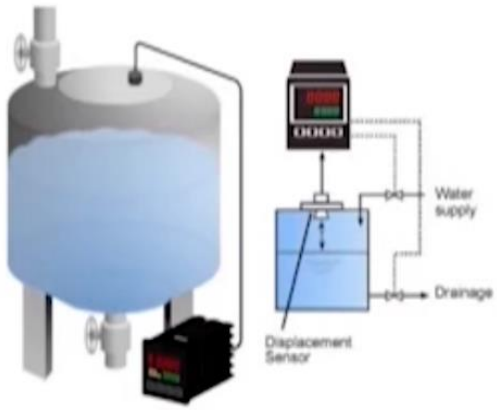
# Industrial Sensors:

Optical sensors



Pressure sensors

Flow sensors




Level sensors

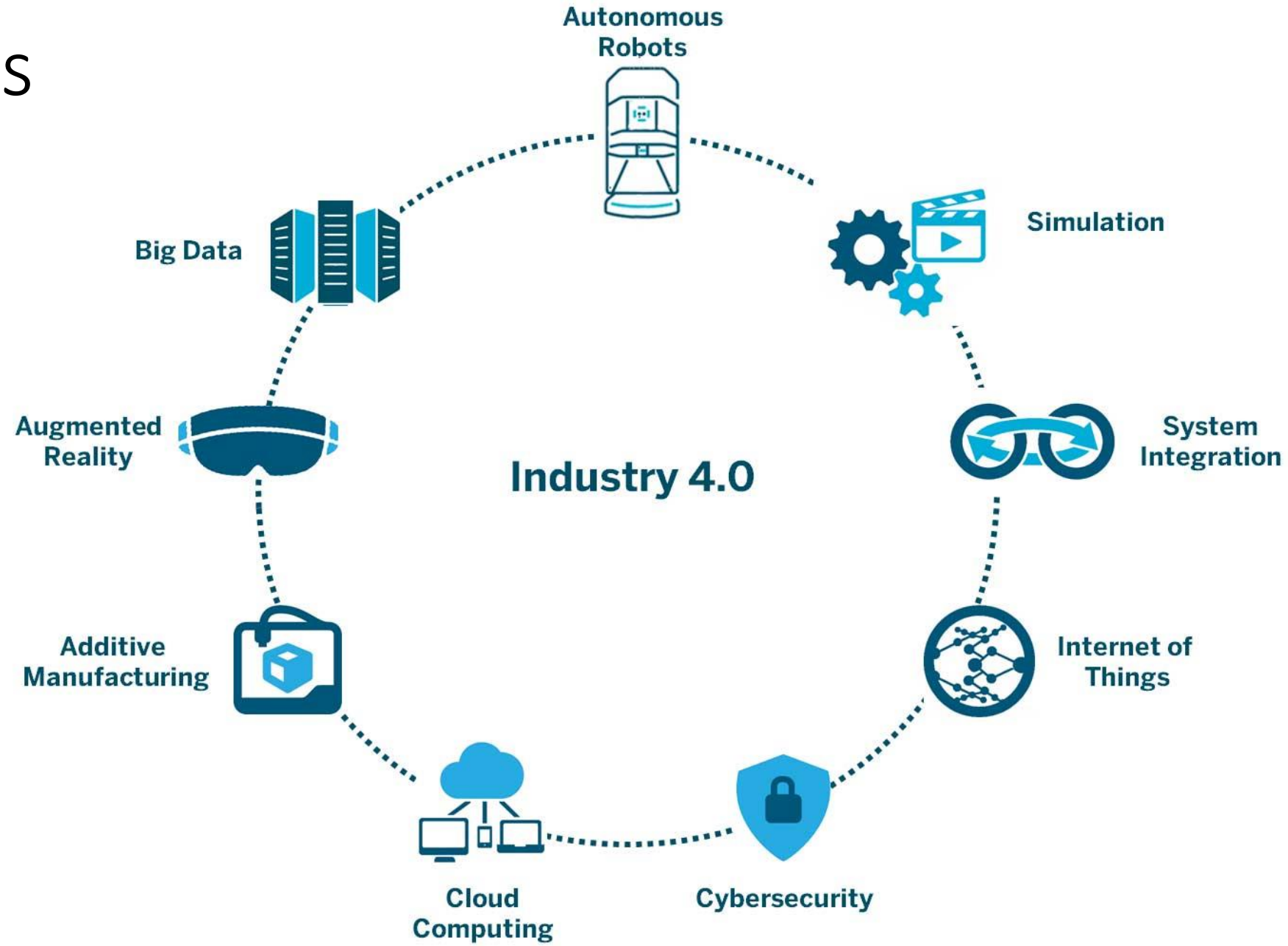
Temperature sensors

# Industrial Controllers:

**Controller**

- Embedded Controller
- Industrial Controller
  - **Single Loop Controllers**
    - Discrete / On – Off Controller
    - P , PI, PID Controller
  - **Multi Loop Controllers**
    - PLC
    - DCS
    - Industrial PC

# Features

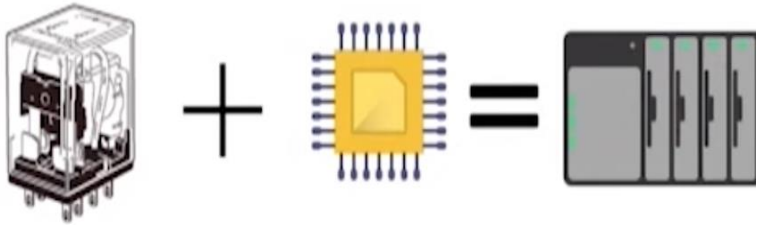

Autonomous Robots
Simulation
System Integration
Internet of Things
Cybersecurity
Cloud Computing
Additive Manufacturing
Augmented Reality
Big Data
Industry 4.0

# What is Augumented Reality (AR)?

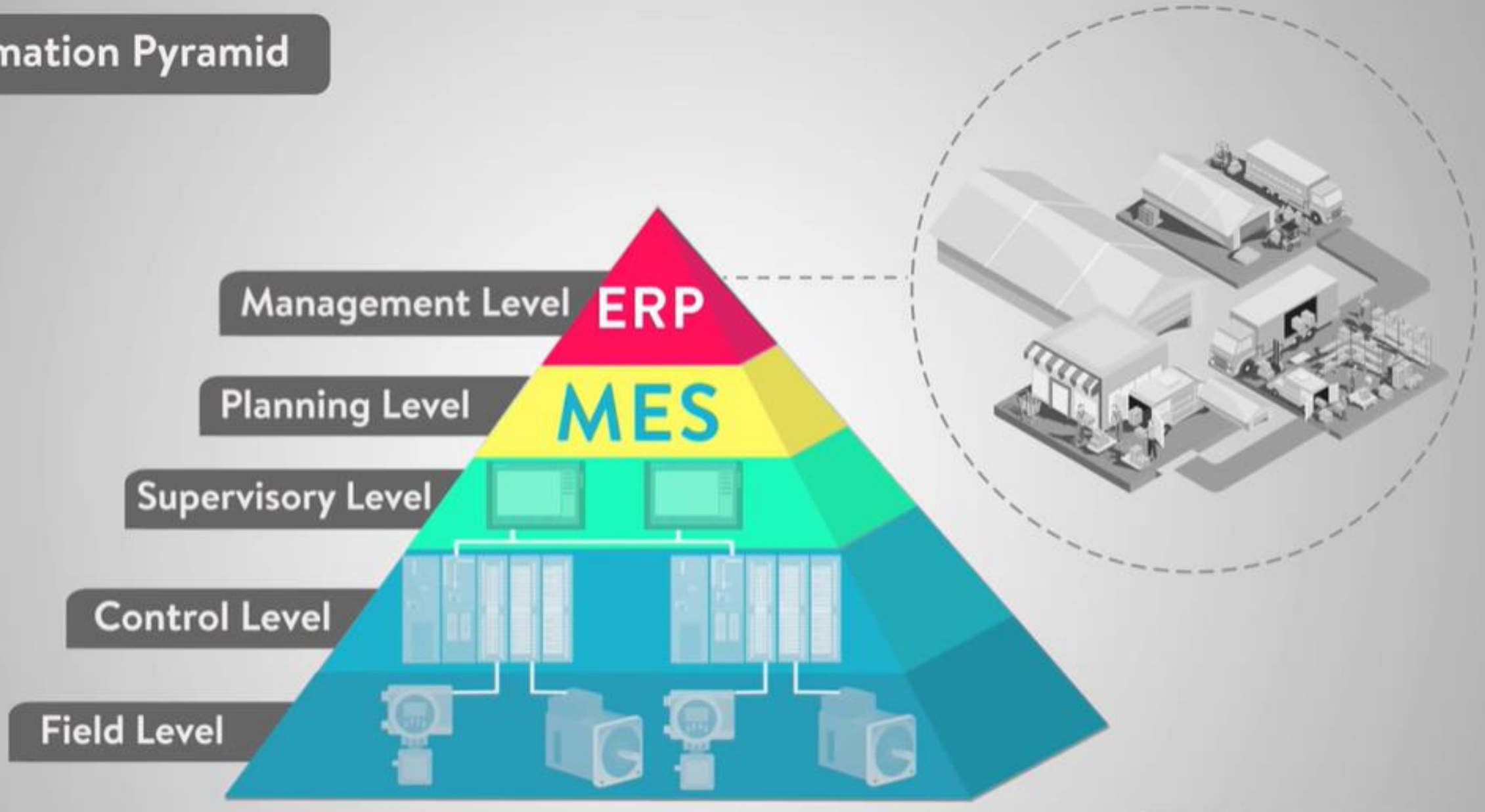
**It is a technology that create enhanced version of real world infront of you by adding a layer of digital information on that**

# Industrial Logic Controllers:

- Originated in late 1960s.
- A PLC is a ruggedized digital industrial computer control system that can be reprogrammed to carryout operations in industrial automation.
- PLC continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices.

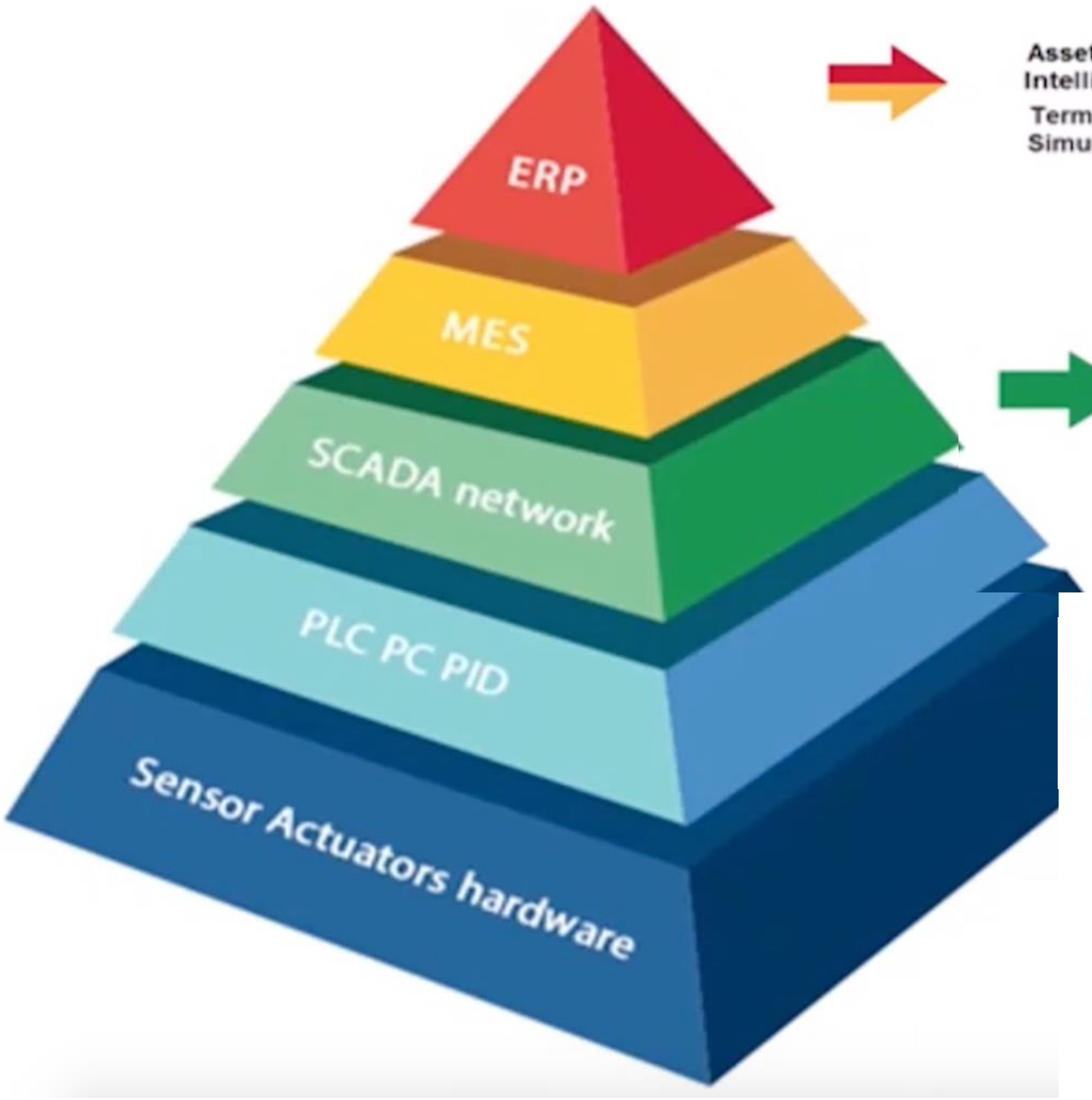


# Automation Pyramid




REALPARS

# Automation Pyramid:



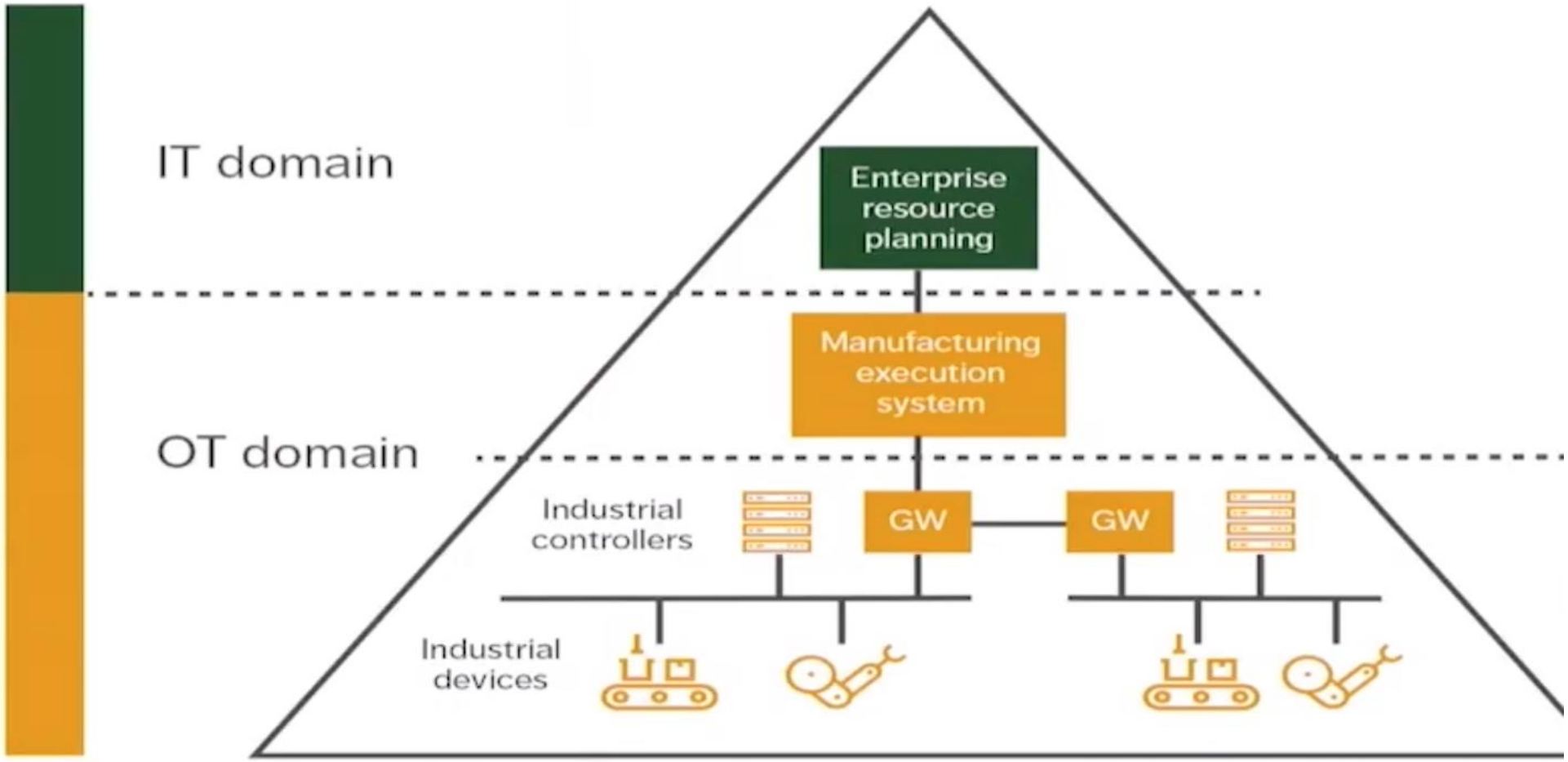

Asset Management solutions
Intelligent Alarm Handling
Terminal Automation Solutions
Simulation and Modeling

HMI based software Solutions
Trend / Display builder
OPC server & Clients
FDT • DTM Fieldbus
Alarm Management

Soft Controllers
Embedded Solutions
Device Drivers/ Protocols
Field Controllers

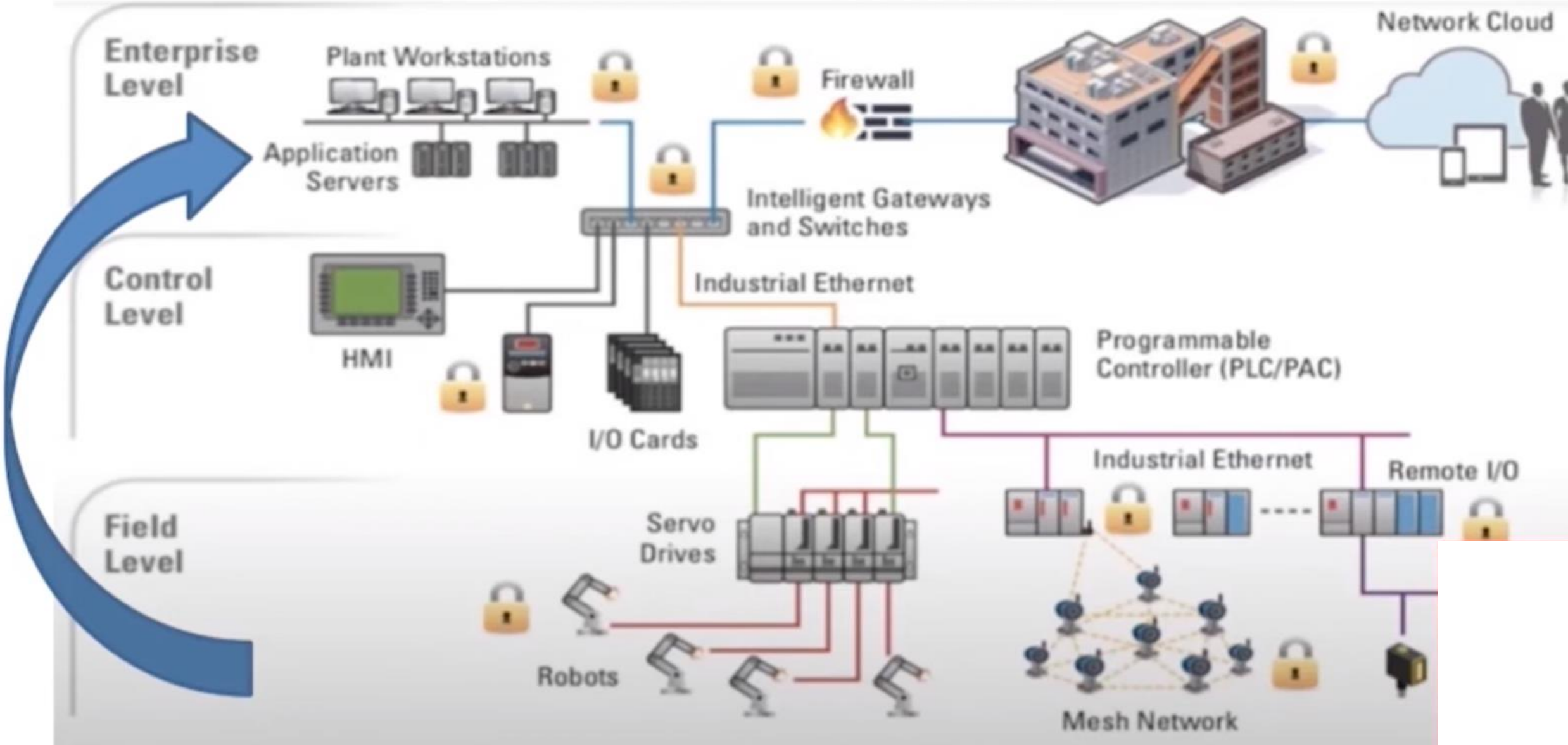
Transmitters
Sensors
Actuators
Valves, pumps, motors

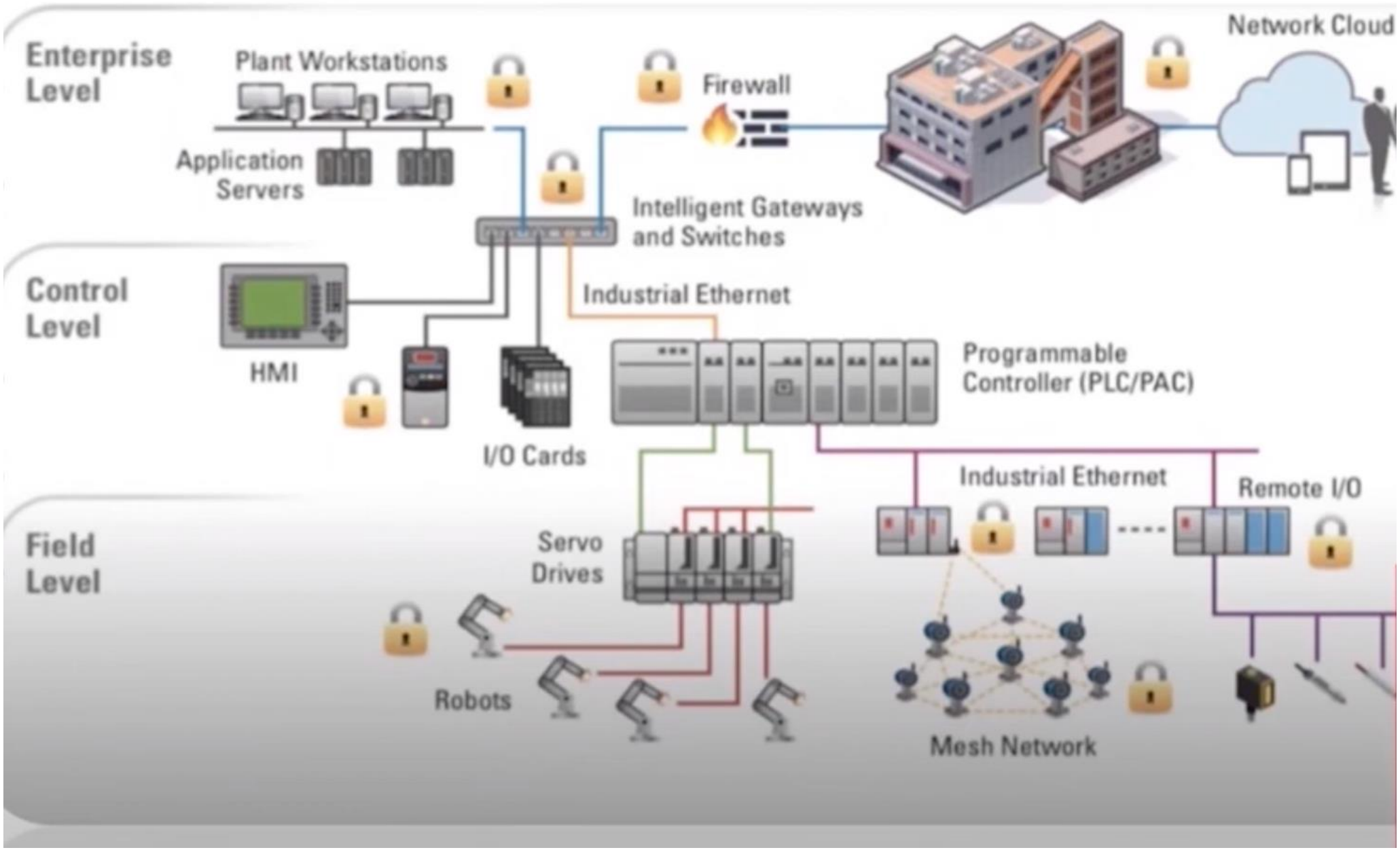
# Automation Pyramid with IoT:




Field Level

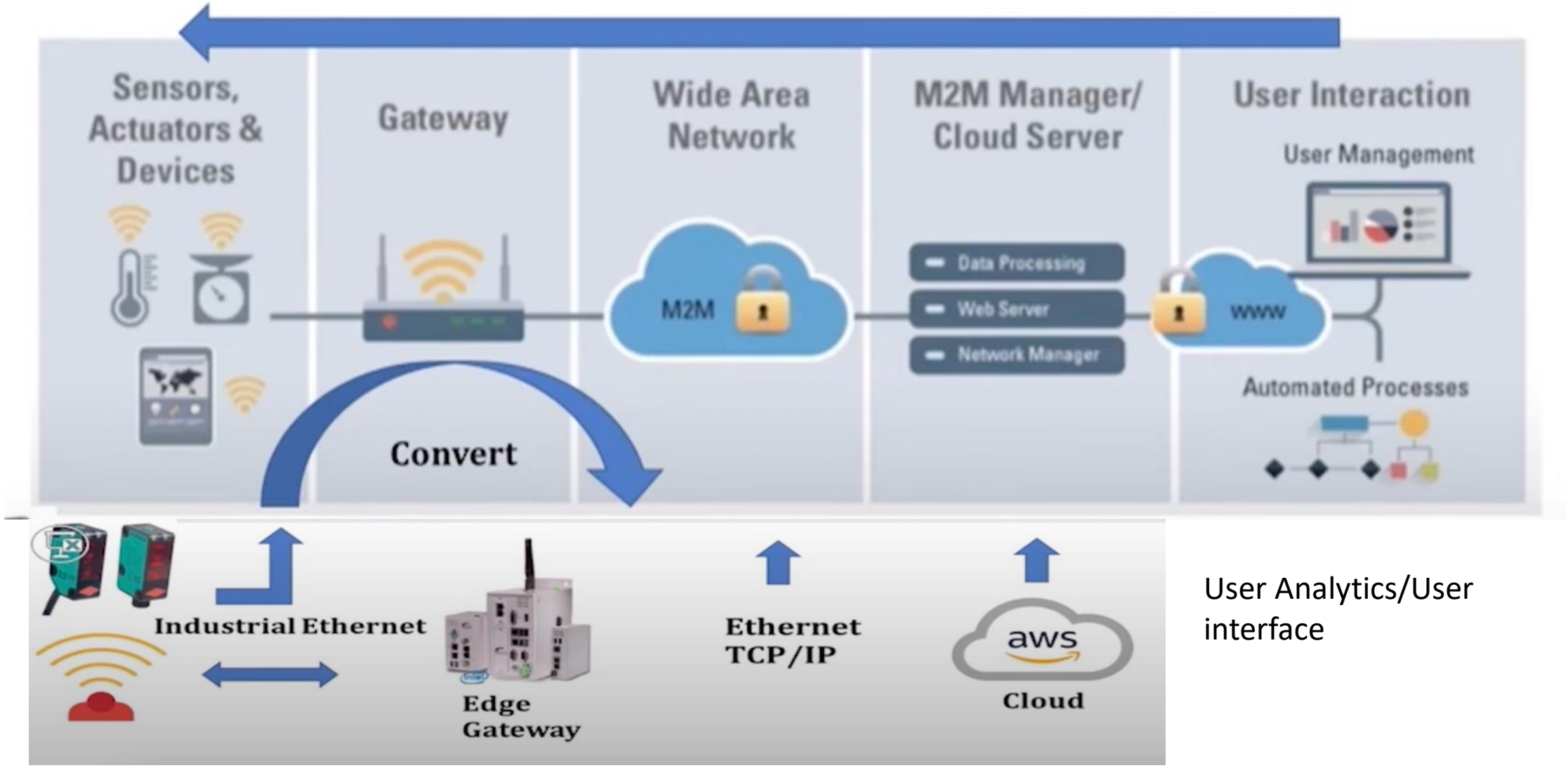
# Implementation Strategies:




Enterprise Level
Plant Workstations
Application Servers
Firewall
Network Cloud
Intelligent Gateways and Switches
Control Level
HMI
Industrial Ethernet
Programmable Controller (PLC/PAC)
I/O Cards
Industrial Ethernet
Remote I/O
Field Level
Servo Drives
Robots
Mesh Network

This way

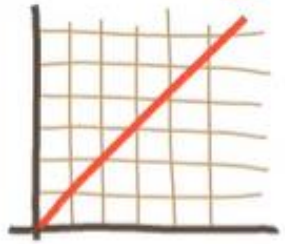
# Process Flow:




User Analytics/User interface

# What are the Benefits of Industry 4.0?

1) Productivity and Efficiency



2) Cost Optimisation

3) New opportunities

4) Customer Satisfaction

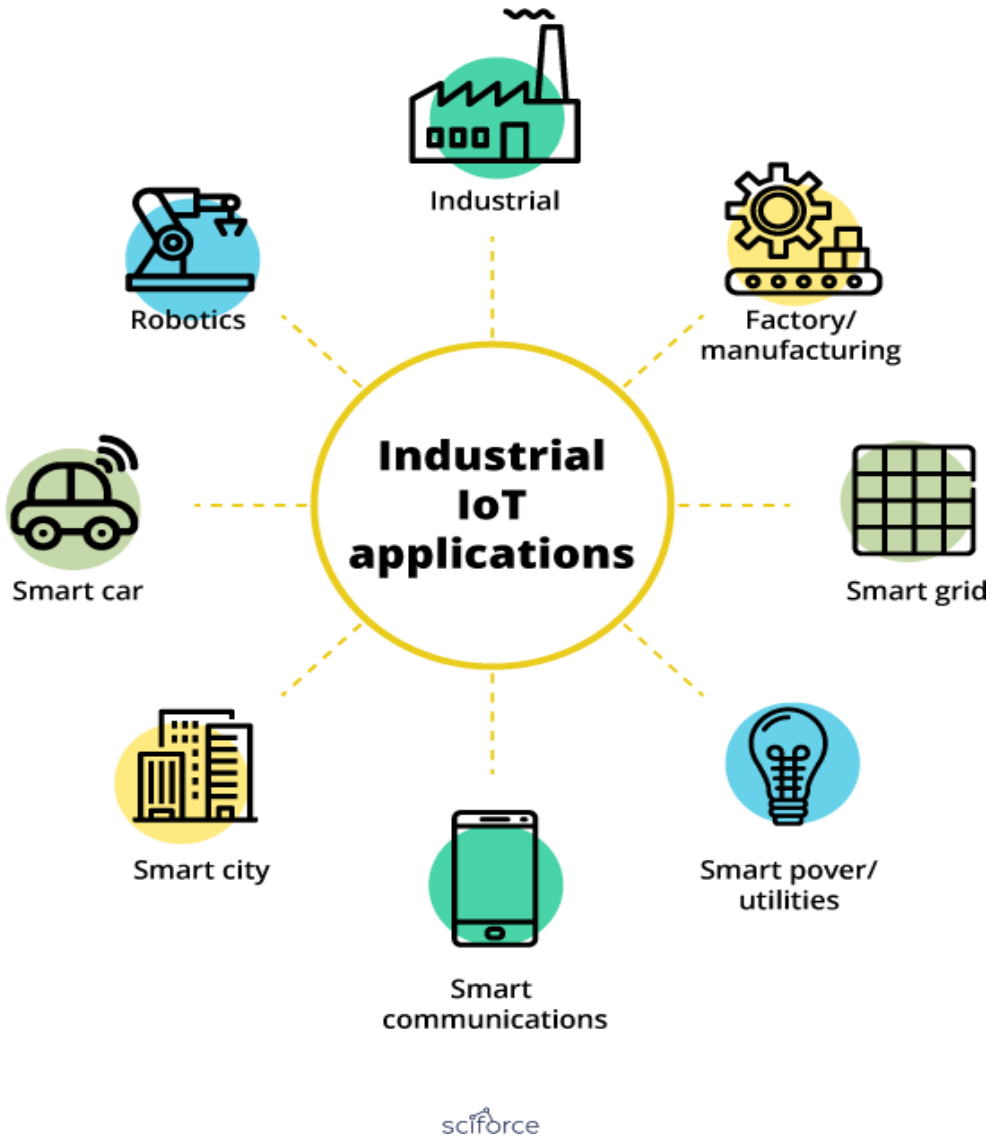
5) Safety

## Benefits & Future Scope:

- IoT enables the enterprises to have more and better access to the data related to th services, and internal systems.
- We can apply Data Science to analyze this large amount of data to draw insights about the products, services and associated systems.
- Data from the components and machinery tell us about its present condition and predicts its future outcome.
- The future of IoT is virtually unlimited due to advances in technology and consumers desire.
- A Networking and connectivity protocol has made it possible to connect people and machines on all platforms.
- From an individual's perspective IoT offers excellent career opportunities which need to be harnessed.

# Applications of Industrial IOT

- Smart Factory
- Smart Asset Monitoring
- Smart Connected Worker
- Facility management
- Inventory management
- Plant Safety and Security
- Quality control
- Packaging Optimization
- Logistics and Supply Chain Optimization
- Production flow monitoring



# Unit-2 : Cloud Computing
# Lecture-6

# What is cloud in cloud computing?

# What is cloud computing?

cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet (“the cloud”) to offer faster innovation, flexible resources, and economies of scale. You typically pay only for cloud services you use, helping lower your operating costs, run your infrastructure more efficiently and scale as your business needs change.

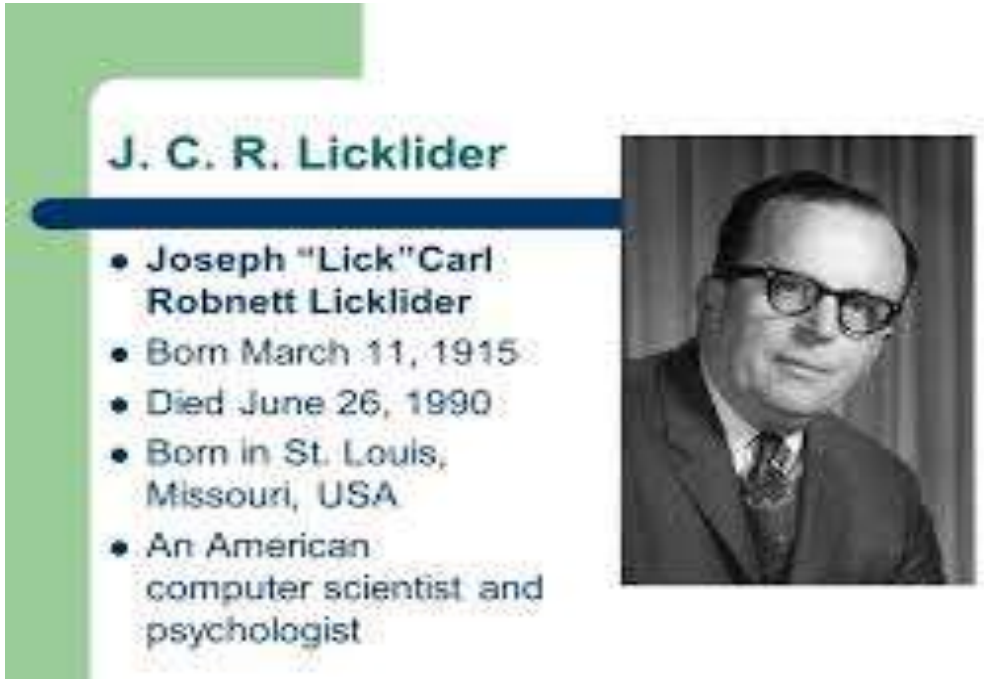
**OR**

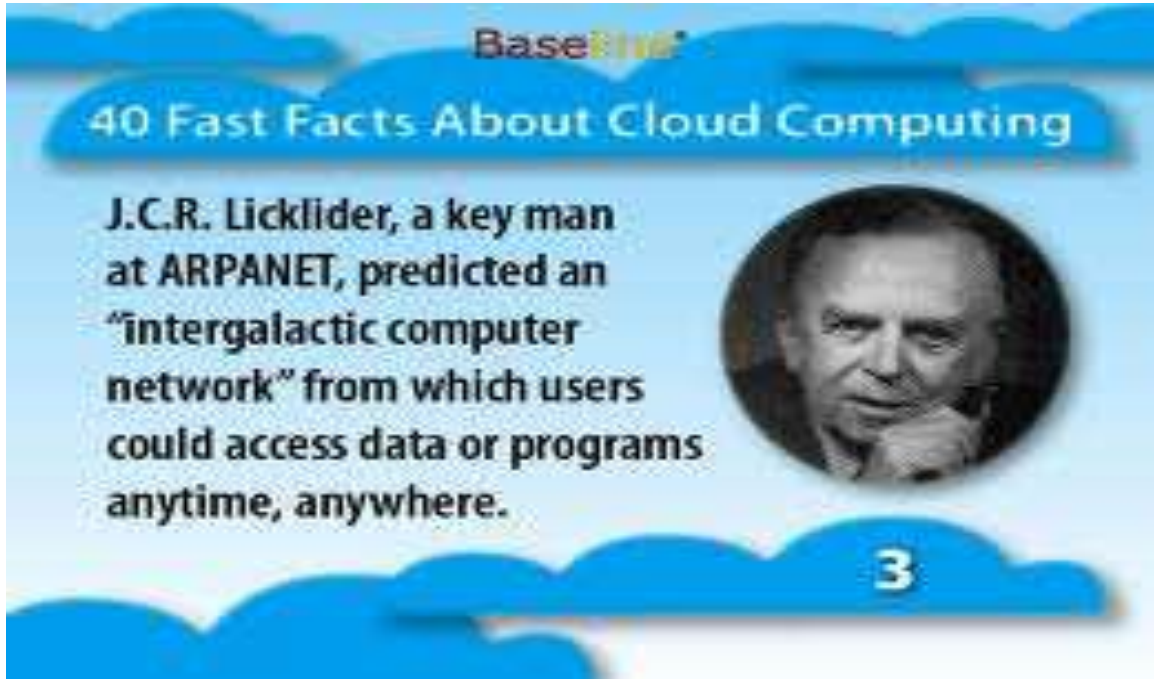
Cloud Computing refers to manipulating, configuring, and accessing the hardware and software resources remotely. It offers online data storage, infrastructure, and application.

Cloud Computing, also known as on-demand computing services is a term that has gained widespread use in the last fifteen years. With the exponential increase in data being captured and its uses those have accompanied society's transition into the digital-native 21st century, it is becoming more and more difficult for individuals, organizations and Governments to keep all of their vital information, programs, and systems up and running on on-premises computing facilities. The solution to this problem is one that has been around for nearly as long as the internet, but that has only recently gained widespread application for businesses.

# Who invented cloud?

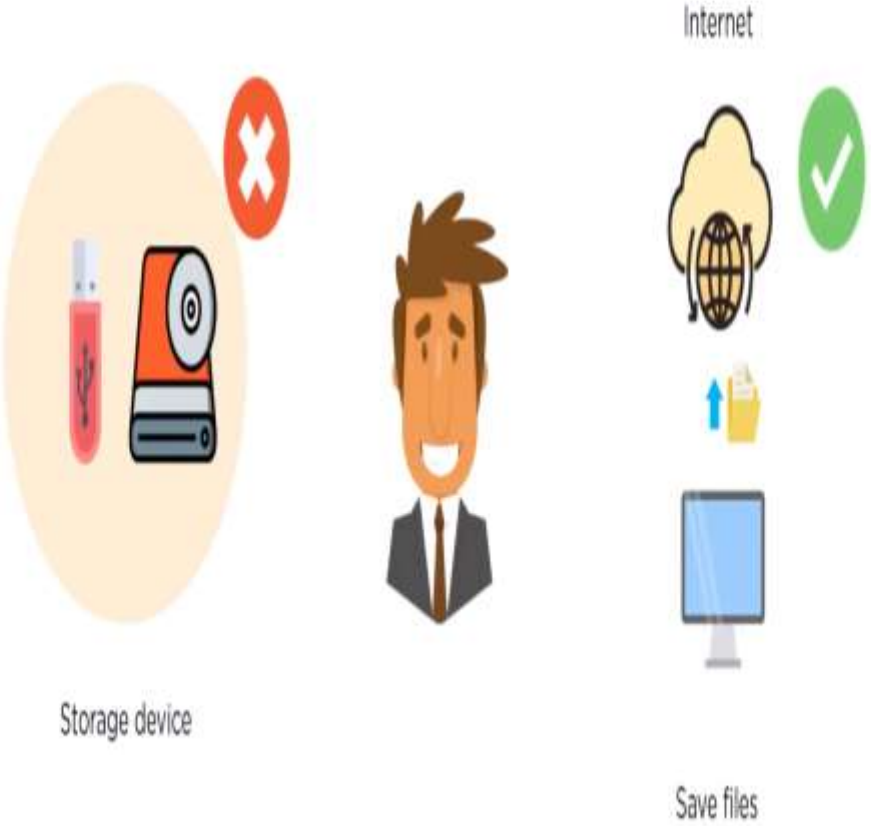
## Joseph Carl Robnett Licklider

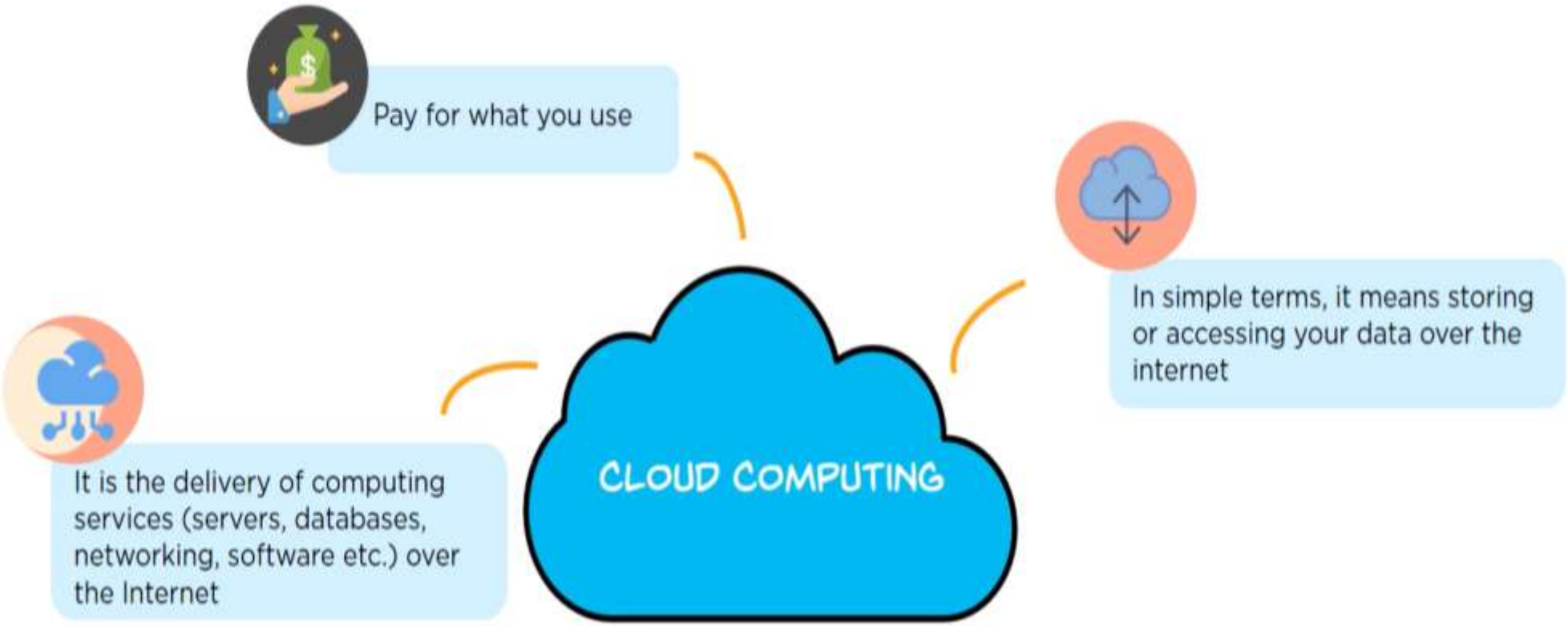


Cloud computing is the delivery of on-demand computing services over the internet on a pay-as-you-go basis

Rather than managing files on a local storage device, cloud computing makes it possible to save them over internet



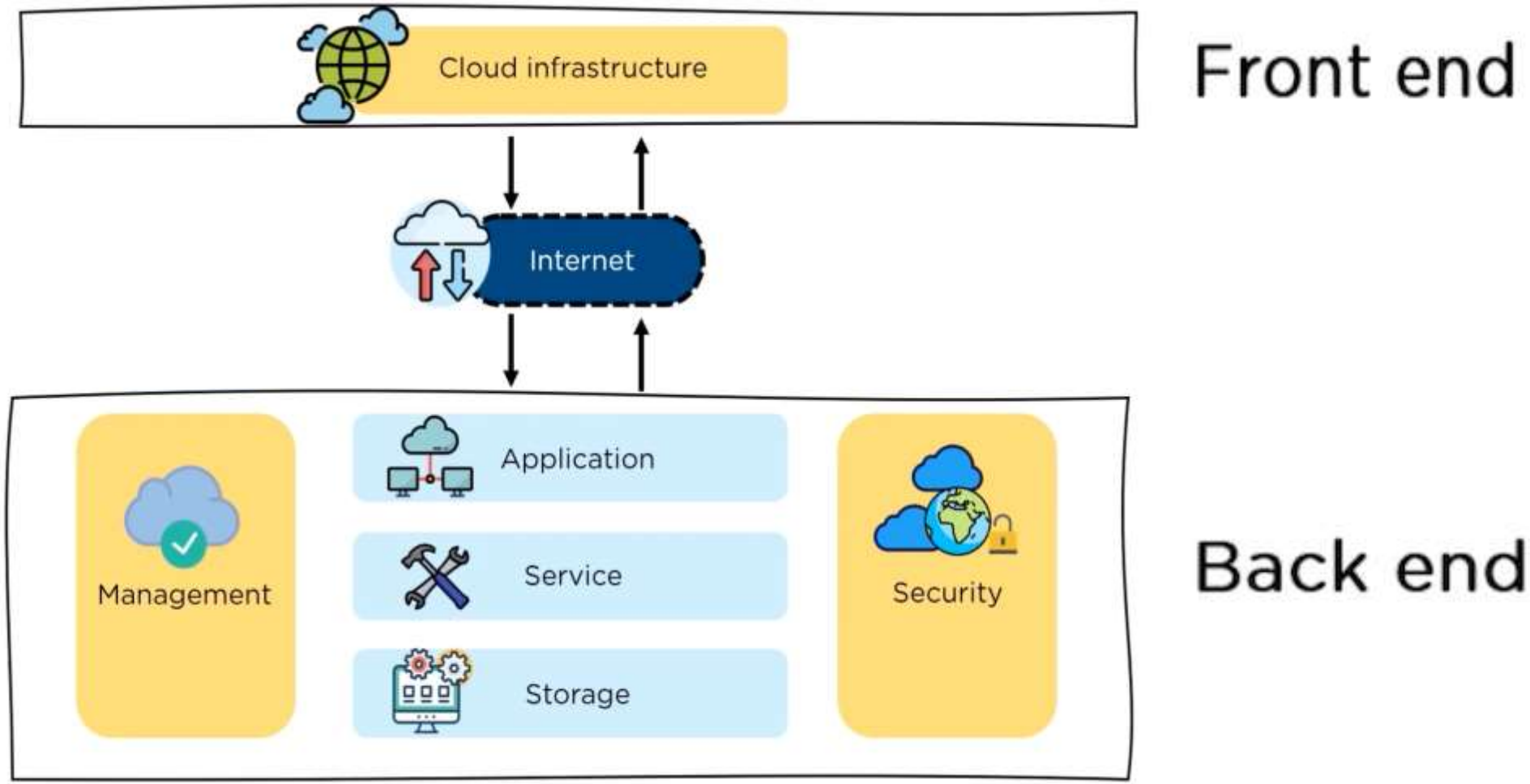



Note: Companies offering these computing services are called cloud providers

# Features of Cloud Computing

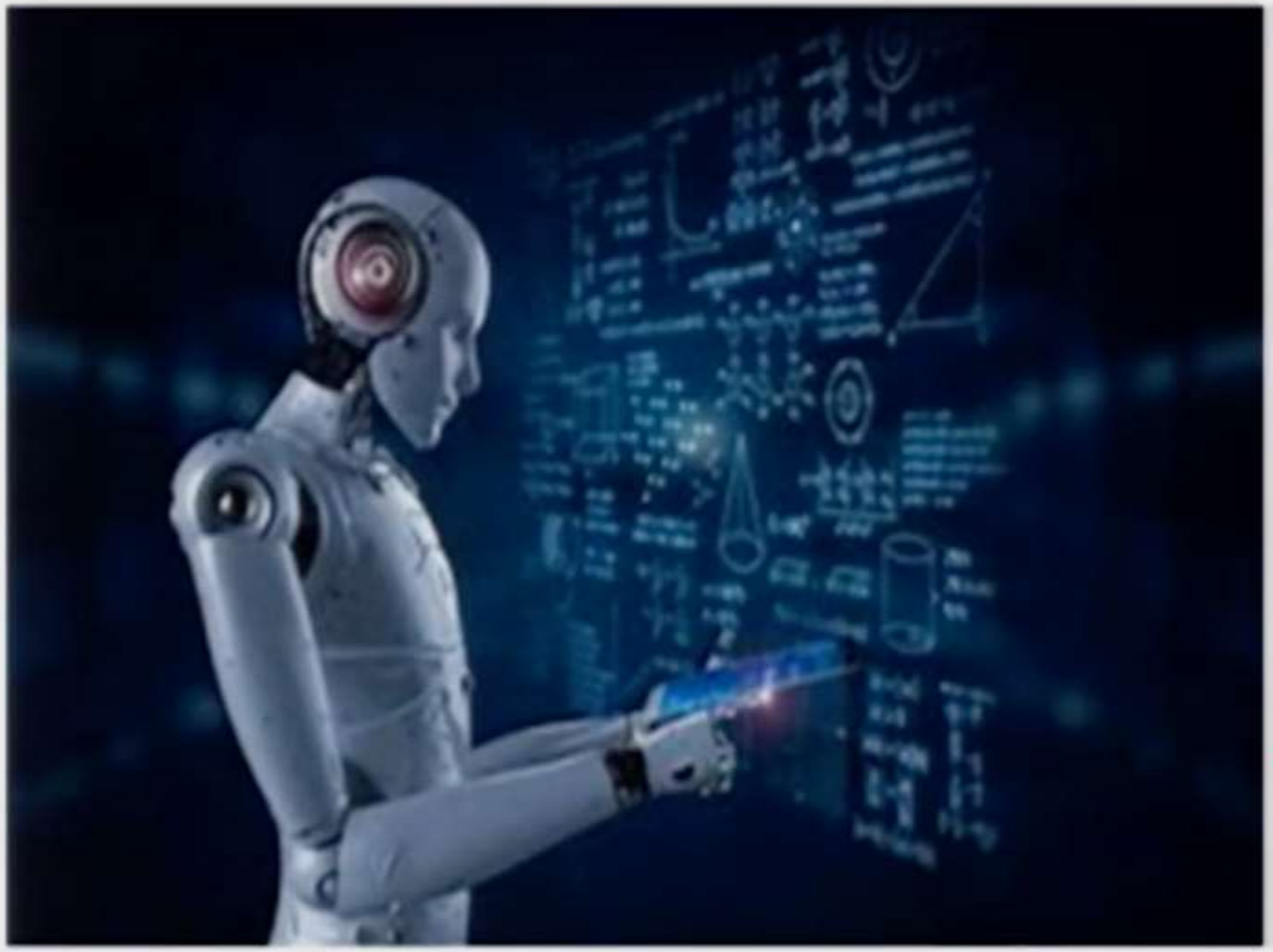
Cloud Computing AWESOME Features

# Cloud Computing Architecture

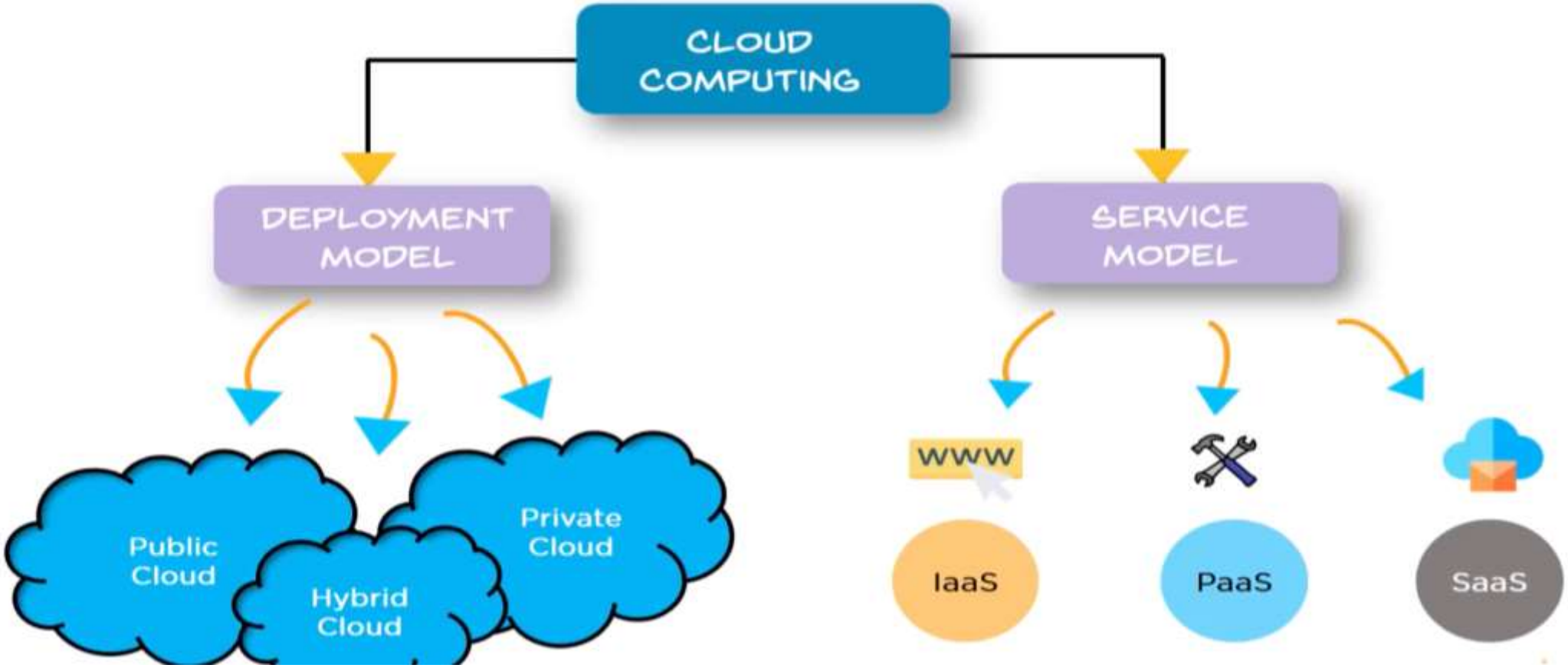


# Emerging Technologies in Cloud Computing

- Containers
- Serverless
- Microservices
- DevOps
- Internet of Things
- Artificial Intelligence
- ...Quantum Computing



# Types of Cloud Computing



# Characteristics of IaaS

- There are the following characteristics of IaaS -
- Resources are available as a service
- Services are highly scalable
- Dynamic and flexible
- GUI and API-based access
- Automated administrative tasks

# Characteristics of Platform as a Service (PaaS)

- There are the following characteristics of PaaS -
- Accessible to various users via the same development application.
- Integrates with web services and databases.
- Builds on virtualization technology, so resources can easily be scaled up or down as per the organization's need.
- Support multiple languages and frameworks.
- Provides an ability to "**Auto-scale**".

# Characteristics of Software as a Service

- Also called as "**on-demand software**"
- Managed from a central location
- Hosted on a remote server
- Accessible over the internet
- Users are not responsible for hardware and software updates. Updates are applied automatically.
- The services are purchased on the pay-as-per-use basis
- **Example:** BigCommerce, Google Apps, Salesforce, D

# Difference between IaaS, PaaS, and SaaS

The below table shows the difference between IaaS, PaaS, and SaaS -

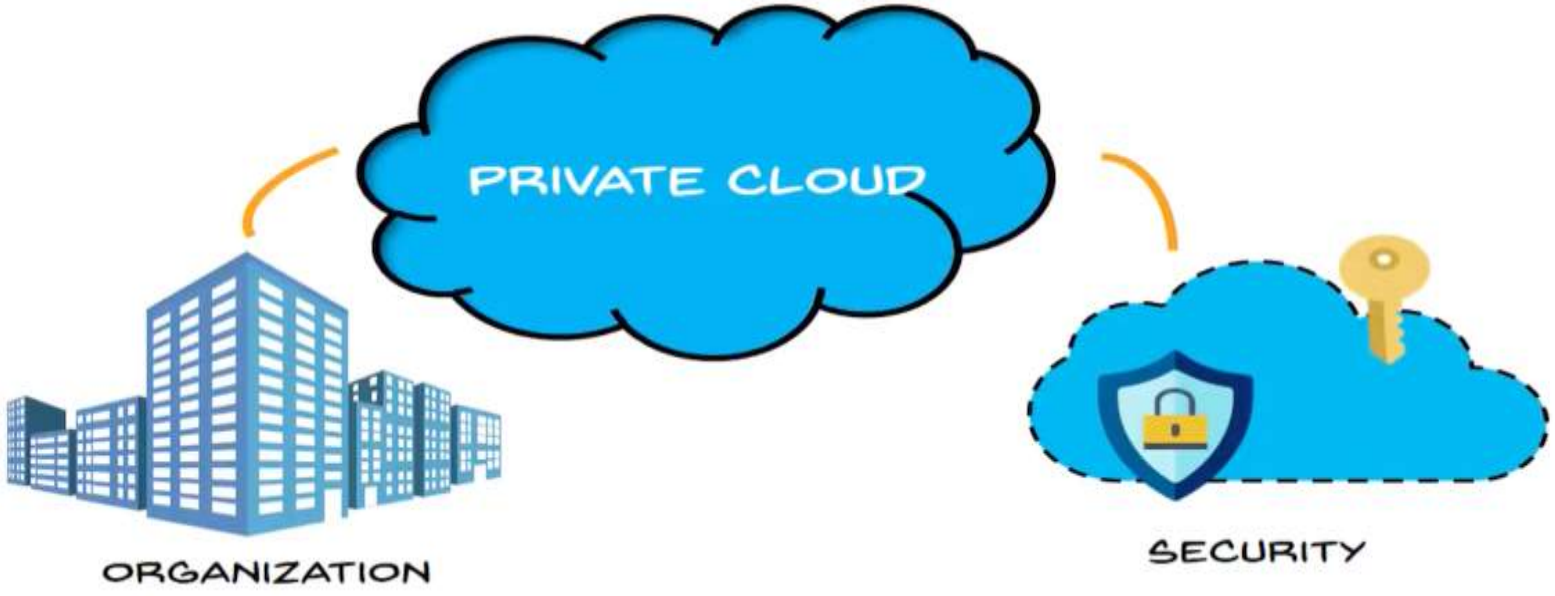
| IaaS | Paas | SaaS |
|---|---|---|
| It provides a virtual data center to store information and create platforms for app development, testing, and deployment. | It provides virtual platforms and tools to create, test, and deploy apps. | It provides web software and apps to complete business tasks. |
| It provides access to resources such as virtual machines, virtual storage, etc. | It provides runtime environments and deployment tools for applications. | It provides software as a service to the end-users. |
| It is used by network architects. | It is used by developers. | It is used by end users. |
| IaaS provides only Infrastructure. | PaaS provides Infrastructure+Platform. | SaaS provides Infrastructure+Platform +Software. |

# Public Cloud :-

The cloud infrastructure is made available to the general public over the internet and is owned by a cloud provider

Example: AWS, Microsoft Azure, IBM's Blue Cloud and Sun Cloud

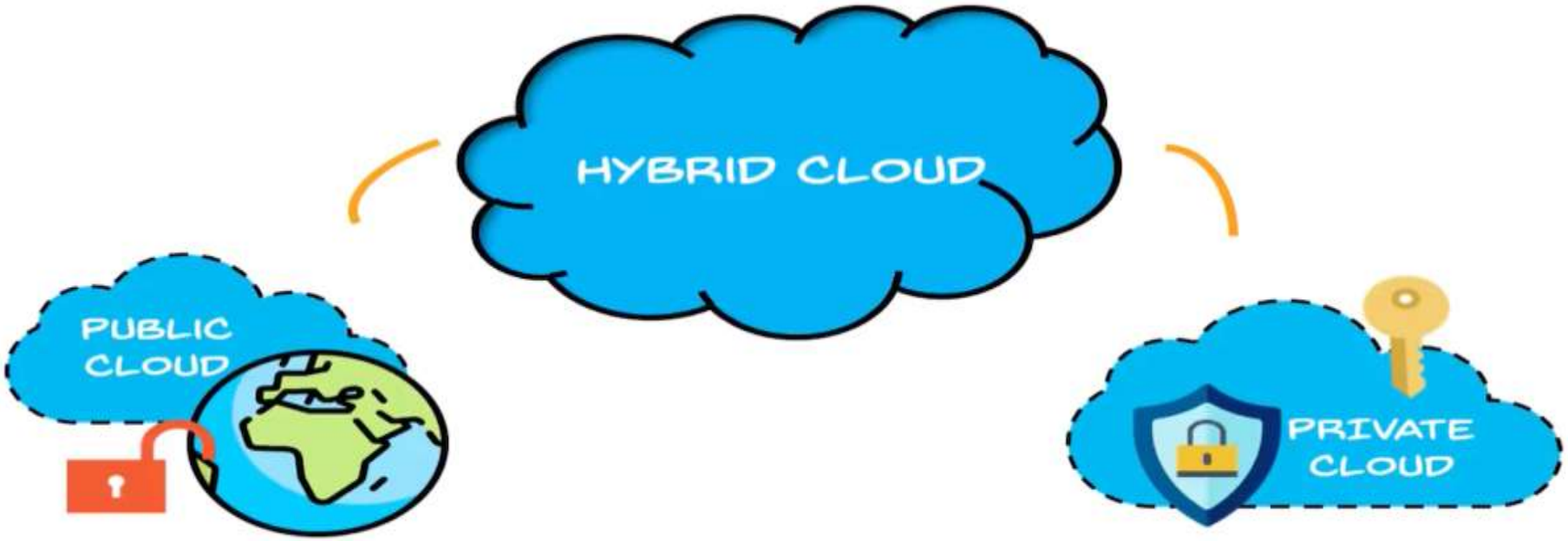
# Private Cloud :-




The cloud infrastructure is exclusively operated by a single organization. It can be managed by the organization or a third party and may exist on-premise or off-premise

Example: AWS, VMware

# Hybrid Cloud :-




It consists the functionalities of both public and private cloud

For example:
Federal agencies opt for private clouds when sensitive information is involved
Also, they use the public cloud to share datasets with general public or other government departments

# IaaS :-

IaaS
WWW
IaaS is a cloud service that provides basic computing infrastructure
Services are available on PAY-FOR-WHAT-YOU-USE model
IaaS providers include Amazon Web Services, Microsoft Azure and Google Compute Engine
Users: IT Administrators

IAAS PRODUCTS AND SERVICES
amazon web services
EC2
Microsoft Azure
GOGRID

# IaaS

- Infrastructure as a service offerings would include such items as virtual servers, virtual desktop, security, networking, storage.
- Makes it possible for smaller firms to have the same infrastructure as large firms.
- Involves services that require large investments to deploy, maintain, and upgrade.
- IaaS approaches virtualization in a way that we can maintain consistency. With virtualization it is possible to manage hardware desktops and hardware servers just like software is managed.
- DigitalOcean
- Linode
- Rackspace
- Amazon Web Services (AWS)
- Cisco Metacloud
- Microsoft Azure
- Google Compute Engine (GCE)

# PaaS :-

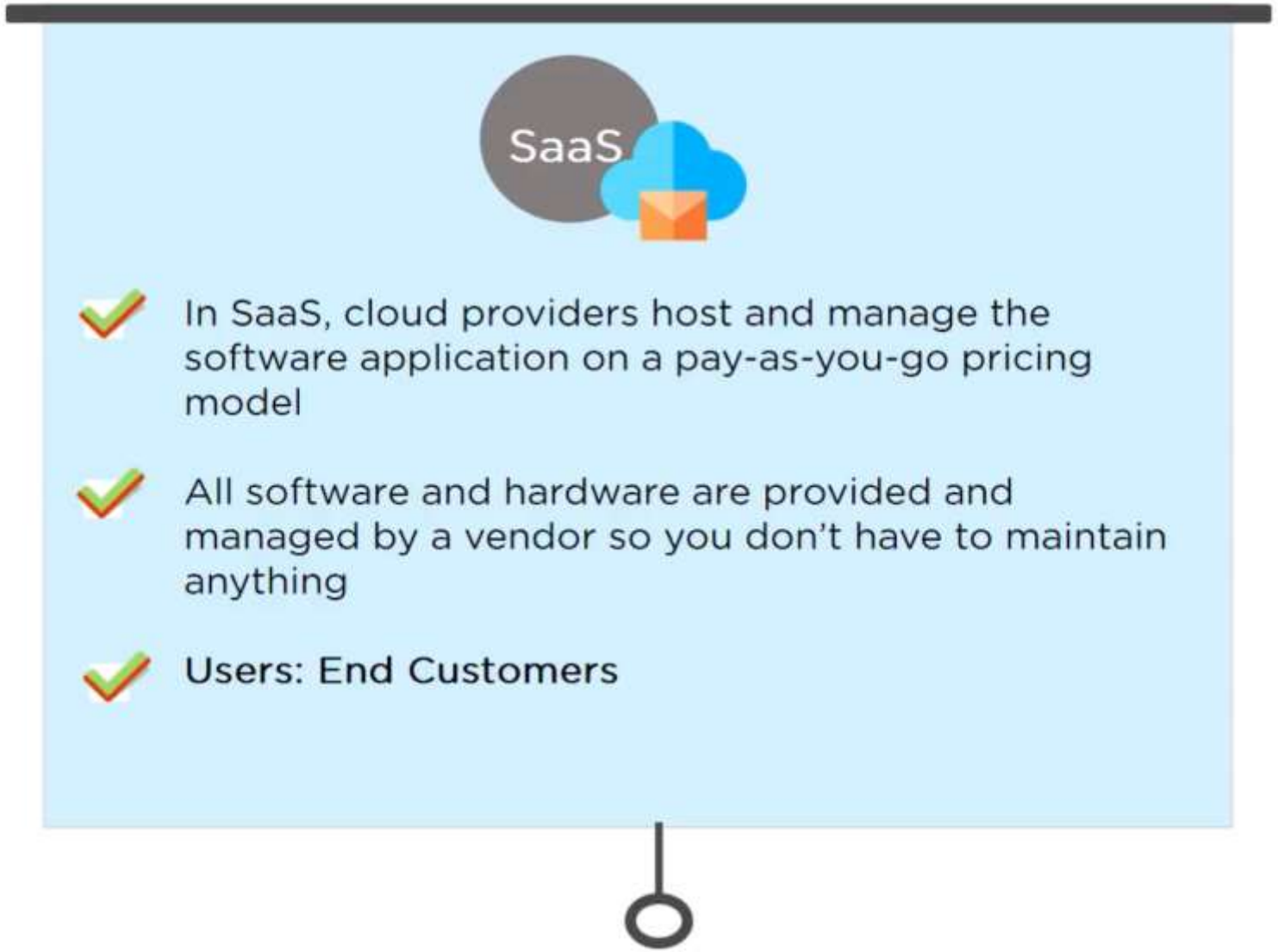
PaaS

- PaaS provides cloud platforms and runtime environments for developing, testing, and managing applications
- It allows software developers to deploy applications without requiring all the related infrastructure
- Users: Software Developers

# PaaS

- Platform as a Service delivers standard and top-of-the-line development frameworks and tools.
- Firms of any size can implement development environments that match their needs, and there is no need, again, for big investments in the IT infrastructure to support these development environments
- A big offering with Platform as a Service is a DevOps tool offering.
- AWS Elastic Beanstalk
- Windows Azure
- Heroku
- Force.com
- Google App Engine
- OpenShift

# SaaS :-


SaaS
In SaaS, cloud providers host and manage the software application on a pay-as-you-go pricing model
All software and hardware are provided and managed by a vendor so you don't have to maintain anything
Users: End Customers

SAAS PRODUCTS AND SERVICES
Office 365
Google Apps

# SaaS

- Software as a service is when software is provided by a third party. They host the application, and maintain the application, and then offer it to customers online, over the Internet.
- SaaS offerings are very common. We see accounting, conference meetings and tools, time tracking, payroll office products.
- Google Workspace (formerly GSuite)
- Dropbox
- Salesforce
- Cisco WebEx
- SAP Concur
- GoToMeeting

# Benefits of Cloud Computing

# UNIT-2
# Lecture-7

## AWS & Google

## Contents

2.2 What is AWS?

2.2.a History of AWS

2.2.b Features of AWS

2.2.c AWS Architecture Diagram

2.3 Google Cloud platform

2.3.a Features of AWS

2.3.b Google Cloud Platform Services

2.3.d GCP Architecture Diagram

# 2.2 What is AWS?

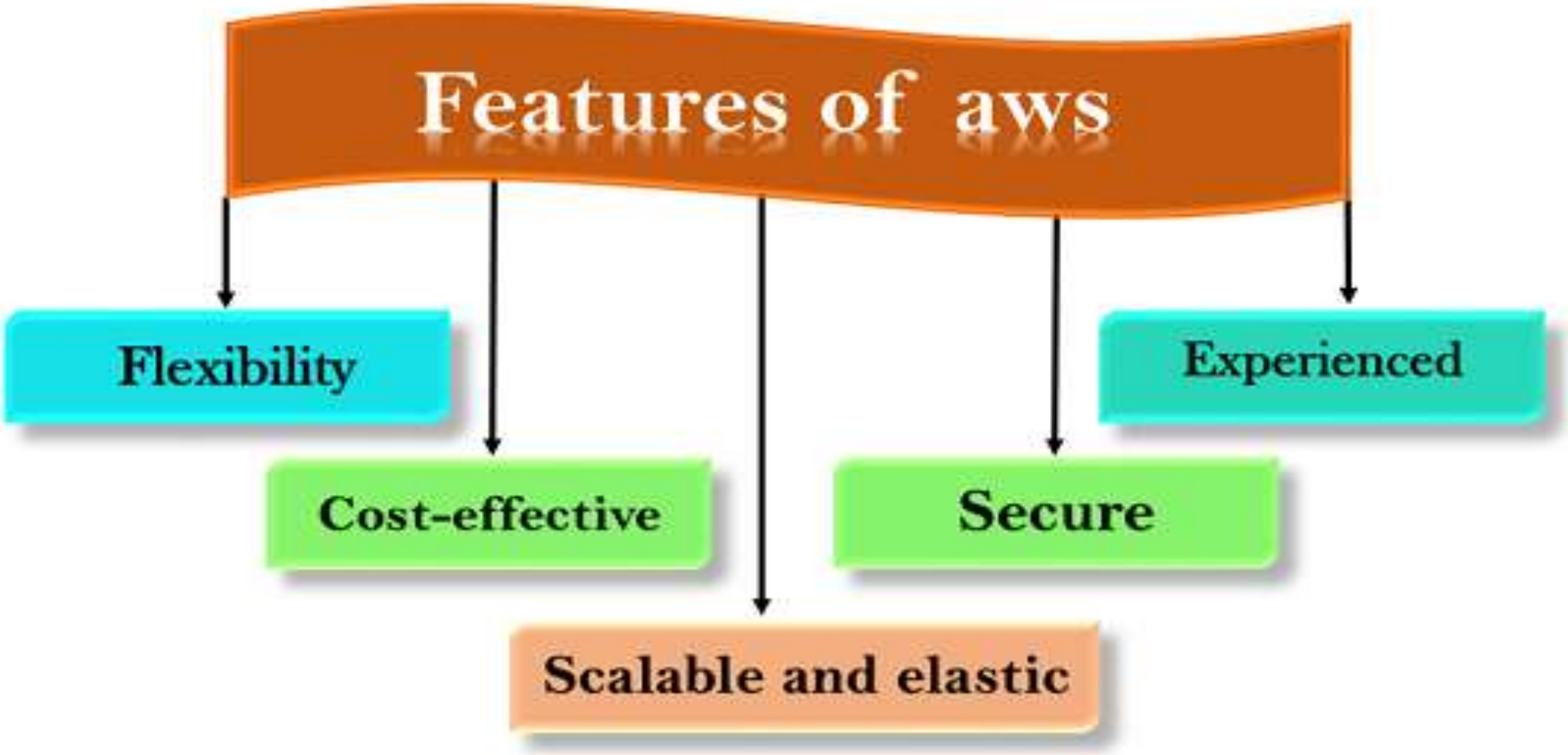
- AWS stands for Amazon Web Services.
- The AWS service is provided by the Amazon that uses distributed IT infrastructure to provide different IT resources available on demand. It provides different services such as infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS).
- Amazon launched AWS, a cloud computing platform to allow the different organizations to take advantage of reliable IT infrastructure.

amazon web services

**Combining the fraction of energy required with a less carbon-intense power mix, customers can end up with a reduction in carbon emissions of 88% by moving to the cloud and AWS.**

A large scale cloud provider achieves approximately 65% server utilization rates verses 15% on premises, which means when company moves to cloud they typically provision fewer than ¼ of the servers than they would on premises. In addition a typical on premises data center is 29% less efficient in their use of power compared to typical large scale cloud provider that uses world class facility designs, cooling system and work load optimize equivalent.

# 2.2.b Features of AWS



Referring to Magic Quadrant for Cloud Infrastructure as a Service, Worldwide (2019) AWS scored highest in both axes of measurement— Ability to Execute and Completeness of Vision. For the ninth year in a row, AWS is evaluated as a Leader

# AWS Global Infrastructure Map

AWS now spans 76 Availability Zones within 24 geographic regions around the world, and has announced plans for nine more Availability Zones and three more AWS Regions in Indonesia, Japan, and Spain.

# Why Cloud Infrastructure Matters

The AWS Global Cloud Infrastructure is the most secure, extensive, and reliable cloud platform, offering over 175 fully featured services from data centers globally

With millions of active customers and tens of thousands of partners globally, AWS has the largest and most dynamic ecosystem. Caters to customers across virtually every industry and of every size.

**24 Launched Regions**

Each with multiple Availability Zones (AZ's)

**3 Announced Regions**

**76 Availability Zones**

**1 Local Zone**

For ultralow latency applications

**2x More Regions**

With multiple AZ's than the next largest cloud provider

**245 Countries and Territories Served**

**97 Direct Connect Locations**

# Regions

AWS has the concept of a Region, which is a physical location around the world where we cluster data centers. We call each group of logical data centers an Availability Zone. Each AWS Region consists of multiple, isolated, and physically separate AZ's within a geographic area. Unlike other cloud providers, who often define a region as a single data center, the multiple AZ design of every AWS Region offers advantages for customers. Each AZ has independent power, cooling, and physical security and is connected via redundant, ultra-low-latency networks. AWS customers focused on high availability can design their applications to run in multiple AZ's to achieve even greater fault-tolerance. AWS infrastructure Regions meet the highest levels of security, compliance, and data protection.

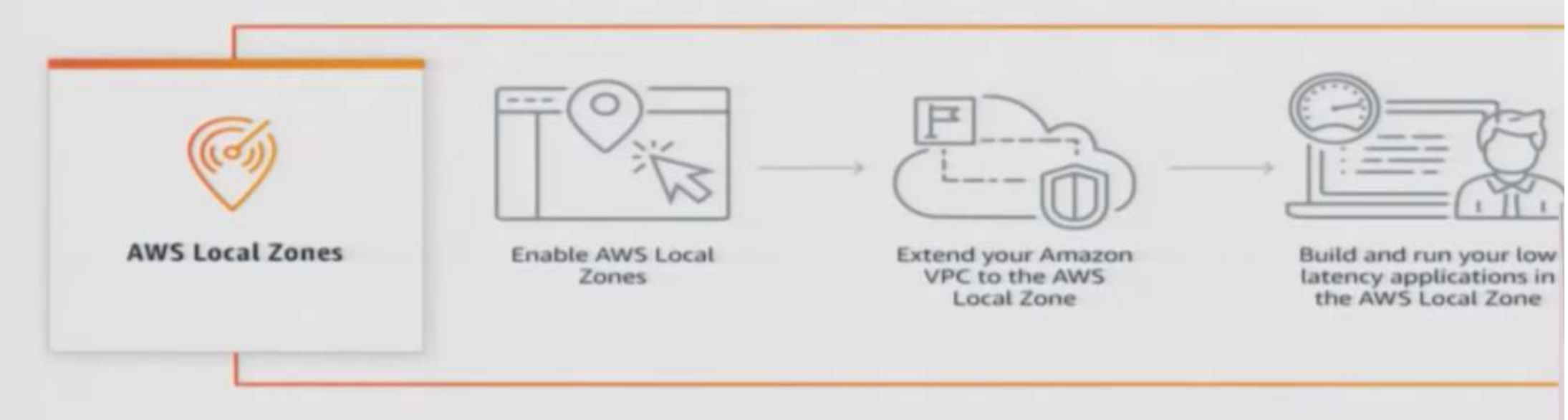
# Availability Zones

An Availability Zone (AZ) is one or more discrete data centers with redundant power, networking, and connectivity in an AWS Region. AZ's give customers the ability to operate production applications and databases that are more highly available, fault tolerant, and scalable than would be possible from a single data center. All AZ's in an AWS Region are interconnected with high-bandwidth, low-latency networking, over fully redundant, dedicated metro fiber providing high-throughput, low-latency networking between AZ's. All traffic between AZ's is encrypted. The network performance is sufficient to accomplish synchronous replication between AZ's. AZ's make partitioning applications for high availability easy. If an application is partitioned across AZ's, companies are better isolated and protected from issues such as power outages, lightning strikes, tornadoes, earthquakes, and more. AZ's are physically separated by a meaningful distance, many kilometers, from any other AZ, although all are within 100 km (60 miles) of each

# AWS Local Zones

AWS Local Zones place compute, storage, database, and other select AWS services closer to end-users. With AWS Local Zones, you can easily run highly-demanding applications that require single-digit millisecond latencies to your end-users such as media & entertainment content creation, real-time gaming, reservoir simulations, electronic design automation, and machine learning.

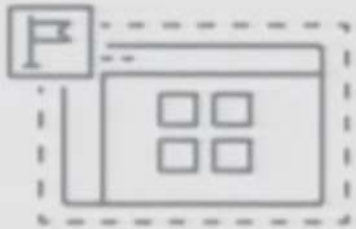
Each AWS Local Zone location is an extension of an AWS Region where you can run your latency sensitive applications using AWS services



# AWS Wavelength

AWS Wavelength enables developers to build applications that deliver single-digit millisecond latencies to mobile devices and end-users. AWS developers can deploy their applications to Wavelength Zones, AWS infrastructure deployments that embed AWS compute and storage services within the telecommunications providers' datacenters at the edge of the 5G networks, and seamlessly access the breadth of AWS services in the region.

Extend the Amazon Virtual Private Cloud (VPC) to include a Wavelength Zone and then create AWS resources like Amazon Elastic Compute Cloud (EC2) instances in the desired subnets



**AWS Region**

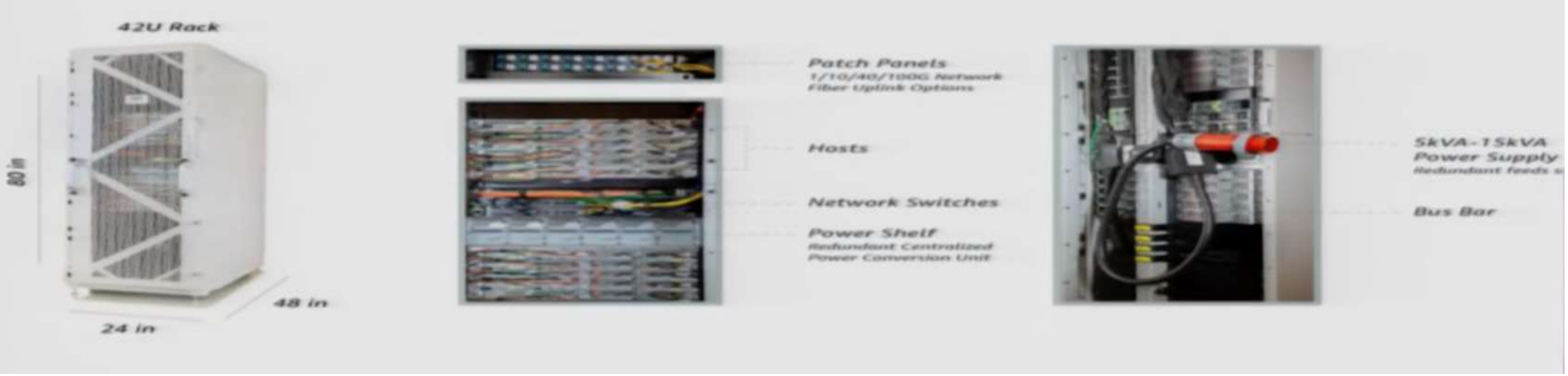
**Wavelength Zone**

Deploy the portions of an application that require ultra-low latency in a Wavelength Zone, and then seamlessly connect back to the rest of the application and the full range of cloud services running in the AWS Region

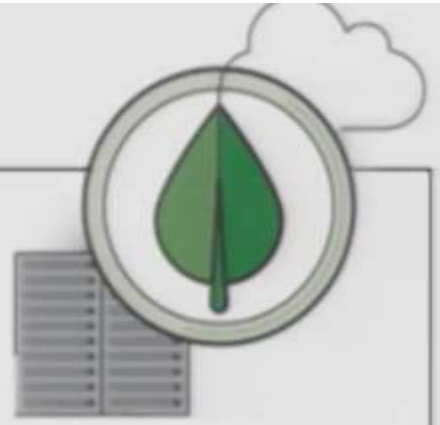
Application traffic can reach application servers.

# AWS Outposts

AWS Outposts bring native AWS services, infrastructure, and operating models to virtually any data center, co-location space, or on-premises facility. You can use the same AWS APIs, tools, and infrastructure across on-premises and the AWS cloud to deliver a truly consistent hybrid experience. AWS Outposts is designed for connected environments and can be used to support workloads that need to remain on-premises due to low latency or local data processing needs.



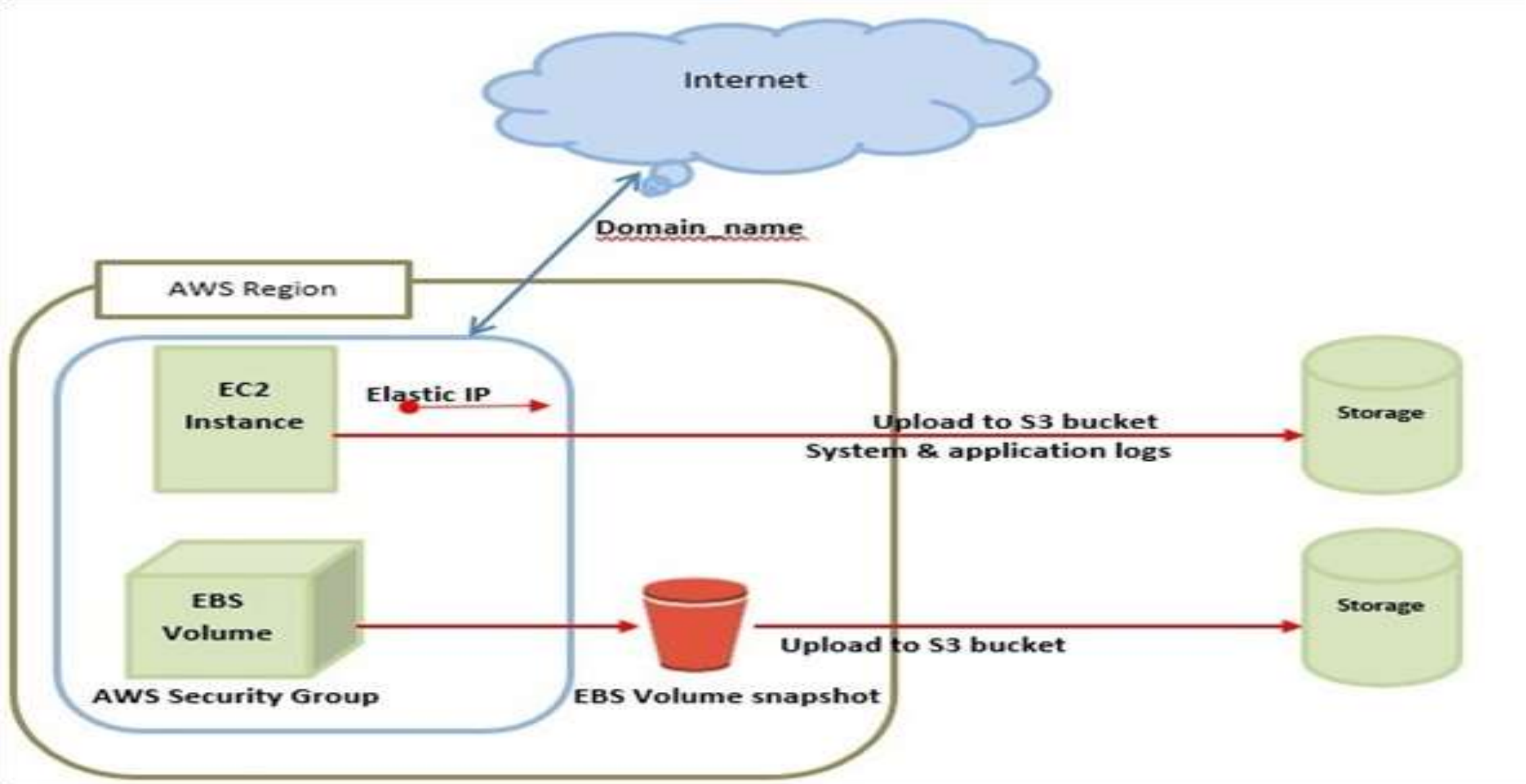
# Sustainability



In addition to the environmental benefits inherently associated with running applications in the cloud, AWS is committed to achieving 100% renewable energy usage for our global infrastructure.

This massive improvement in energy efficiency drives a huge reduction in climate impact because less energy consumed means fewer carbon emissions. The climate impact improvements get even better when you factor in that the average corporate data center has a dirtier power mix than the typical large-scale cloud provider. Large-scale cloud providers (AWS included) use a power mix that is 28% less carbon intense than the global average.

# 2.2.c AWS Architecture Diagram



# 2.3 Google Cloud platform

- Google Cloud Platform (GCP) is a suite of cloud computing services provided by Google. It is a public cloud computing platform consisting of a variety of services like compute, storage, networking, application development, Big Data, and more, which run on the same cloud infrastructure that Google uses internally for its end-user products, such as Google Search, Photos, Gmail and YouTube, etc.
- The services of GCP can be accessed by software developers, cloud administrators and IT professionals over the Internet or through a dedicated network connection.

## Google App Engine

App Engine is a fully managed, serverless platform for developing and hosting web applications at scale. You can choose from several popular languages, libraries, and frameworks to develop your apps, then let App Engine take care of provisioning servers and scaling your app instances based on demand.

# The App Engine Standard Environment

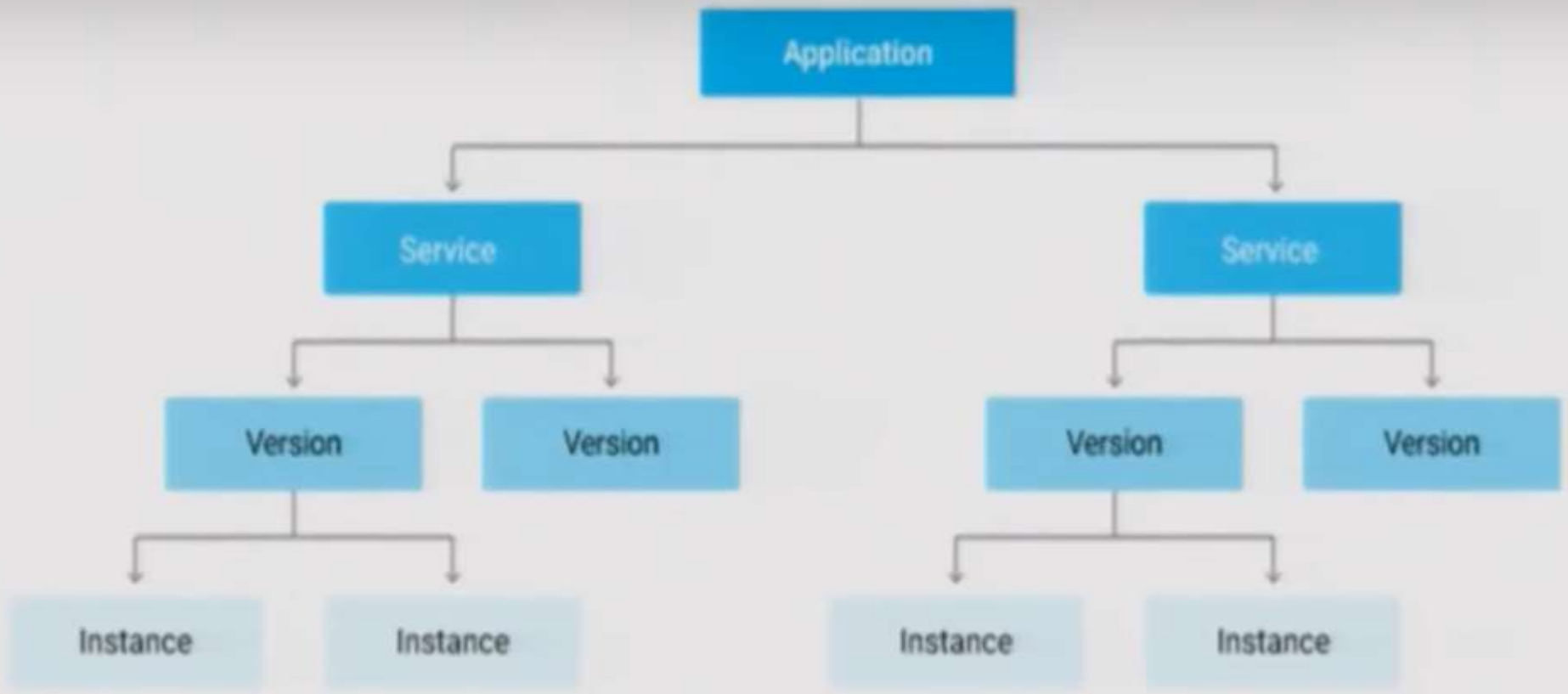
The App Engine standard environment is based on container instances running on Google's infrastructure. Containers are preconfigured with one of several available runtimes.

Applications run in a secure, sandboxed environment, allowing the App Engine standard environment to distribute requests across multiple servers, and scaling servers to meet traffic demands. Your application runs within its own secure, reliable environment that is independent of the hardware, operating system, or physical location of the server.

# App Engine Flexible Environment

App Engine allows developers to focus on what they do best: writing code. Based on Google Compute Engine, the App Engine flexible environment automatically scales your app up and down while also balancing the load.

- **Customizable infrastructure** - App Engine flexible environment instances are Compute Engine virtual machines, which means that you can take advantage of custom libraries, use SSH for debugging, and deploy your own Docker containers.
- **Performance options** - Take advantage of a wide array of CPU and memory configurations. You can specify how much CPU and memory each instance of your application needs, and the flexible environment will provision the necessary infrastructure for you.
- **Native feature support** - Features such as microservices, authorization, SQL and NoSQL databases, traffic splitting, logging, versioning, security scanning, and content delivery networks are natively supported.
- **Managed virtual machines** - App Engine manages your virtual machines




App Engine application is created under your Google Cloud project when you create an application resource. The App Engine application is a top-level container that includes the service, version, and instance resources that make up your app. When you create your App Engine app, all your resources are created in the region that you choose, including your app code along with a collection of settings credentials, and your app's metadata.

# Cloud pricing basics

It all starts with compute, storage, and network. GCP give you the options to fit your needs so that you can efficiently run your business.

Compute Storage Network

Always free products: There is no charge to use these products up to their specified free usage limit. The free usage limit does not expire, but is subject to change. Available for eligible customers.

App Engine: 28 instance hours per day -Platform for building scalable web applications and mobile back ends. 28 hours per day of "F" instances | 9 hours per day of "B" instances | 1 GB of egress per day |Only the Standard Environment offers this free usage limit

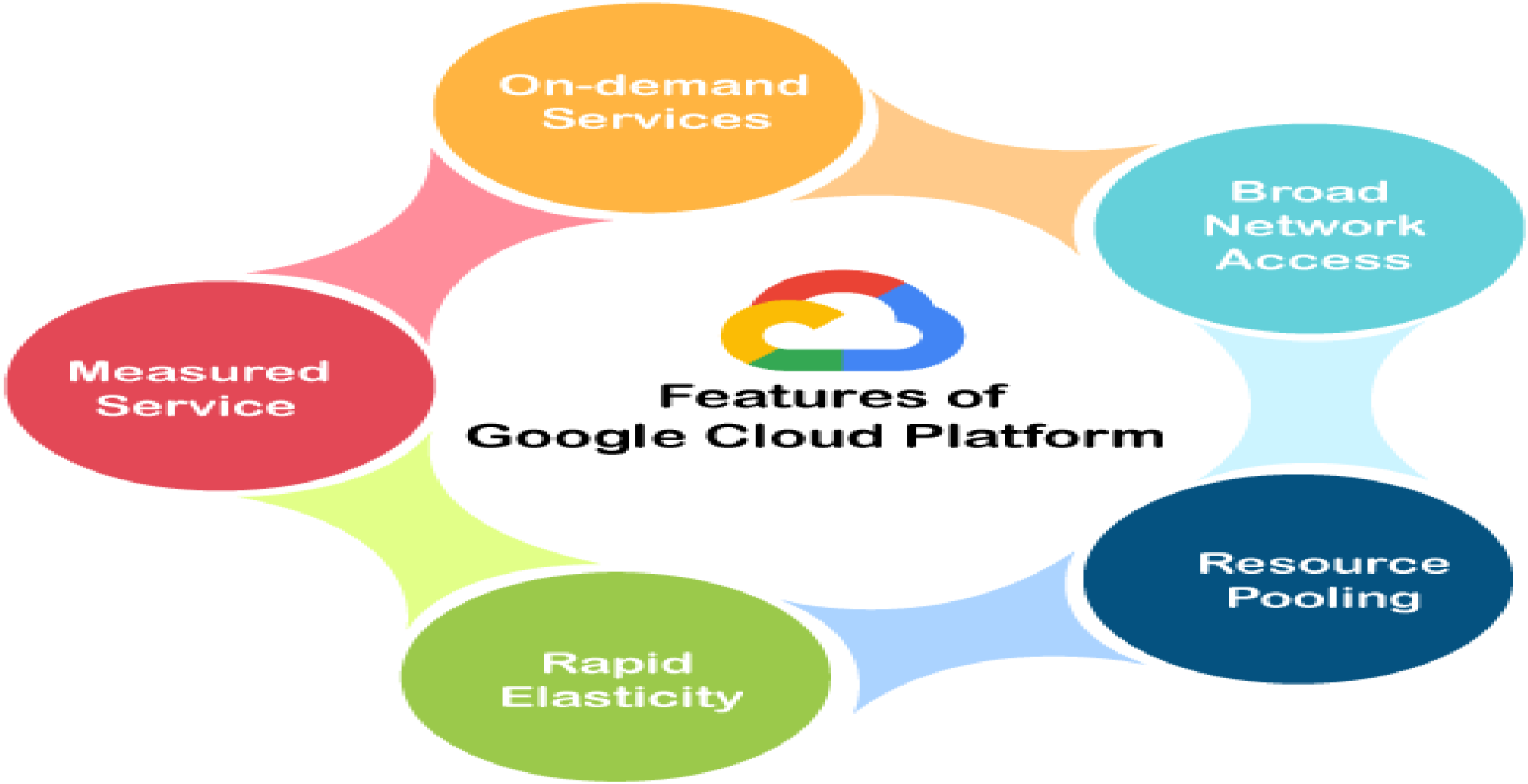
# Productivity and Collaboration

Change the way teams work with solutions designed for humans and built for impact.

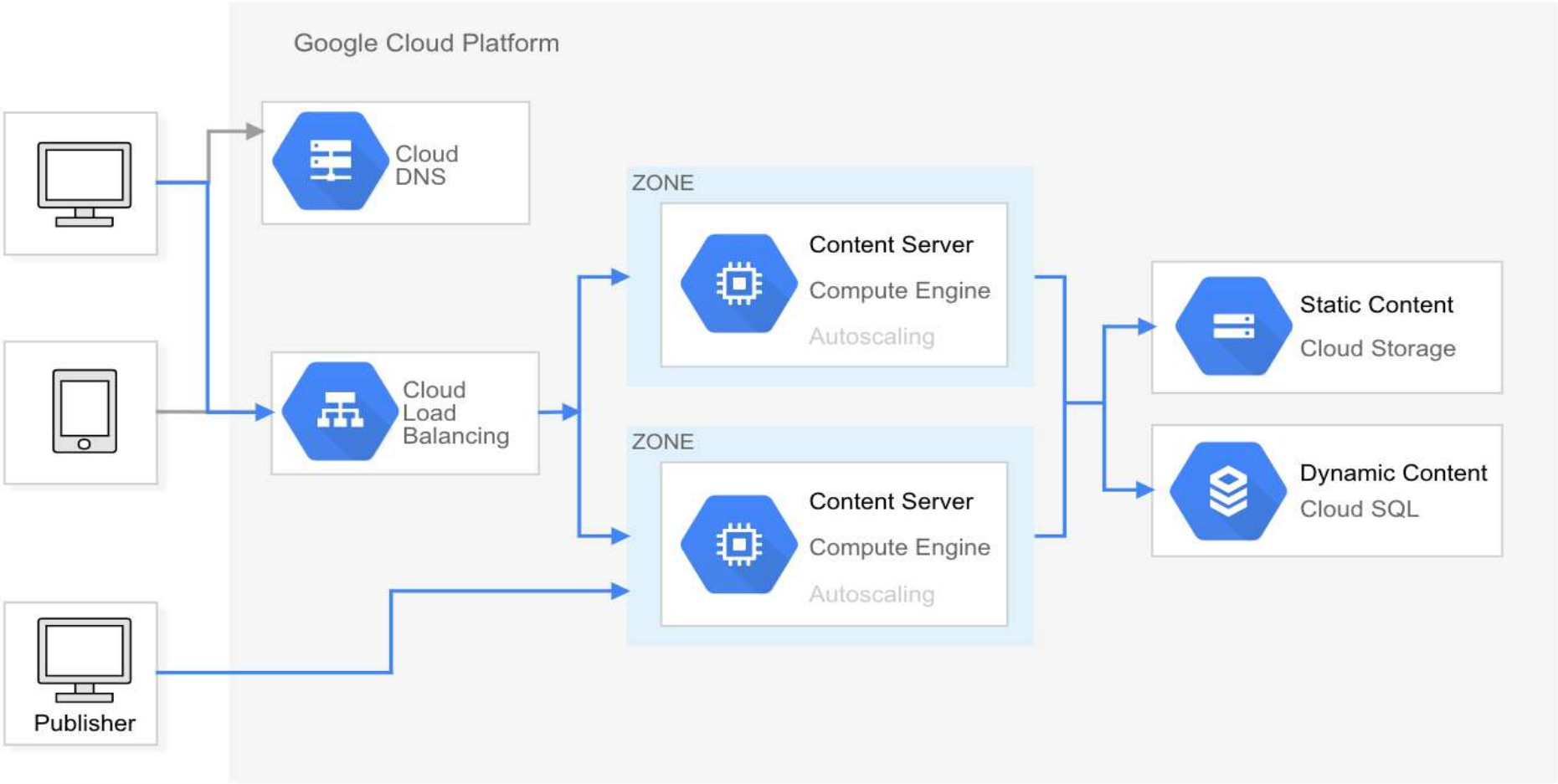
- G Suite
  - Collaboration and productivity tools for enterprises.
- Enterprise Mobility
  - Solutions for IT admins to empower mobile employees.
- Cloud Identity
  - Unified platform for IT admins to manage user devices and apps.
- Chrome Enterprise
  - Chrome OS, Chrome Browser, and Chrome devices built for business.
- Drive Enterprise
  - Cloud storage and collaboration sold separately from G Suite.
- Cloud Search
  - Enterprise search for employees to quickly find company information.

Productiv

# 2.3.a Features of GCP



# 2.3.d GCP Architecture Diagram



# Unit-2 : Cloud Computing
# Lecture-8

# Microsoft Azure

- Microsoft Azure is a growing set of cloud computing services created by Microsoft that hosts your existing applications, streamline the development of a new application, and also enhances our on-premises applications. It helps the organizations in building, testing, deploying, and managing applications and services through Microsoft-managed data centers.

## Security, responsibility, and trust in Azure

- Learn how security responsibility is shared with Azure
- Learn how identity management provides protection, even outside your network
- Learn how encryption capabilities built into Azure can protect your data
- Learn how to protect your network and virtual networks

# Potential Security Threats in Cloud Services

- DOS - Denial of service attack
- Content /Pages defacement
- Data Breach
- Malware, unpatched systems, and improperly secured systems open your environment to attacks.
- Network perimeters have become increasingly porous with the explosion of bring your own device (BYOD), mobile apps, and cloud applications.

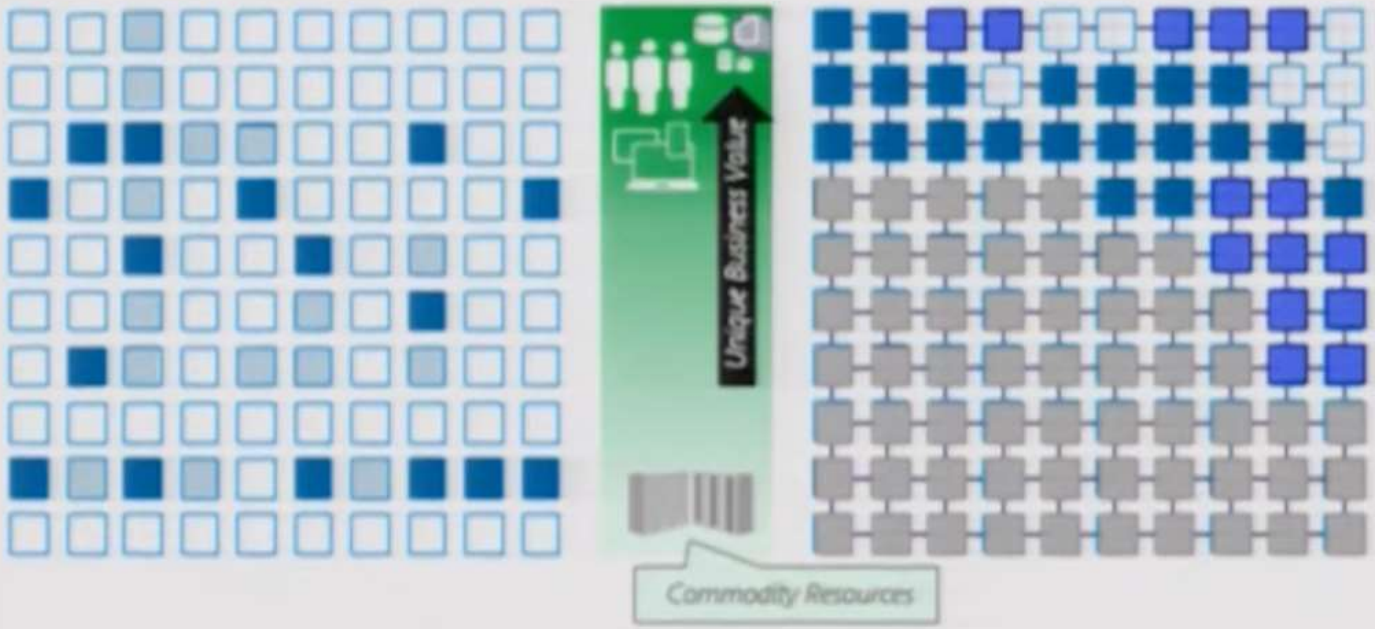
The solution is the combined efforts of administrators, developers, and IT management. It involves security experts using many security tools, and keeping pace with the volume and complexity of threats.

# Cloud security is a shared responsibility

## Security Advantages of Cloud Era

TRADITIONAL APPROACH

CLOUD-ENABLED SECURITY




*Cloud Technology enables security to:*

- Shift commodity responsibilities to provider and re-allocate your resources
- Leverage cloud-based security capabilities for more effectiveness
- Use Cloud intelligence to improve detection/response time

*Security is a challenging and under-resourced function*

- **Satisfied** responsibility
- Unmet responsibility
- Partially met responsibility
- Cloud Provider responsibility (Trust but verify)

# A layered approach to security

*Defense in depth* is a strategy that employs a series of mechanisms to slow the advance of an attack aimed at acquiring unauthorized access to information. Each layer provides protection so that if one layer is breached, a subsequent layer is already in place to prevent further exposure.

**Data**: It's the responsibility of those storing and controlling access to data to ensure that it's properly secured. Often, there are regulatory requirements that dictate the controls and processes that must be in place to ensure the confidentiality, integrity, and availability of the data.

**Application**: Integrating security into the application development life cycle will help reduce the number of vulnerabilities introduced in code.

**Compute**: Secure access to virtual machines. Implement endpoint protection and keep systems patched and current.

**Networking**: The focus is on limiting the network connectivity across all your resources to allow only what is required

**Perimeter**: Identifying these attacks, eliminating their impact, and alerting you when they happen are important ways to keep your network secure.

**Identity & Access**: Access granted is only what is needed, and changes are logged.

**Physical Security**: The intent is to provide physical safeguards against access to assets.

# Azure Security Center

- Provide security recommendations based on your configurations, resources, and networks.
- Monitor security settings across on-premises and cloud workloads, and automatically apply required security to new services as they come online.
- Continuously monitor all your services, and perform automatic security assessments to identify potential vulnerabilities before they can be exploited.
- Use machine learning to detect and block malware from being installed on your virtual machines and services. You can also define a list of allowed applications to ensure that only the apps you validate are allowed to execute.
- Analyze and identify potential inbound attacks, and help to investigate threats and any post-breach activity that might have occurred.

# Identity and access

***Authentication*** is the process of establishing the identity of a person or service looking to access a resource. It involves the act of challenging a party for legitimate credentials, and provides the basis for creating a security principal for identity and access control use. It establishes if they are who they say they are.

***Authorization*** is the process of establishing what level of access an authenticated person or service has. It specifies what data they're allowed to access and what they can do with it.

**Azure AD** is a cloud-based identity service. It has built in support for synchronizing with your existing on-premises Active Directory or can be used stand-alone.

# Encryption

Encryption is the process of making data unreadable and unusable to unauthorized viewers. To use or read the encrypted data, it must be *decrypted*, which requires the use of a secret key. There are two top-level types of encryption: symmetric and asymmetric.

Encryption at rest | Encryption at Transit |

**Azure enables Encrypt raw storage, Encrypt virtual machine disks, Disk Encryption, Encrypt databases, Encrypt secrets**

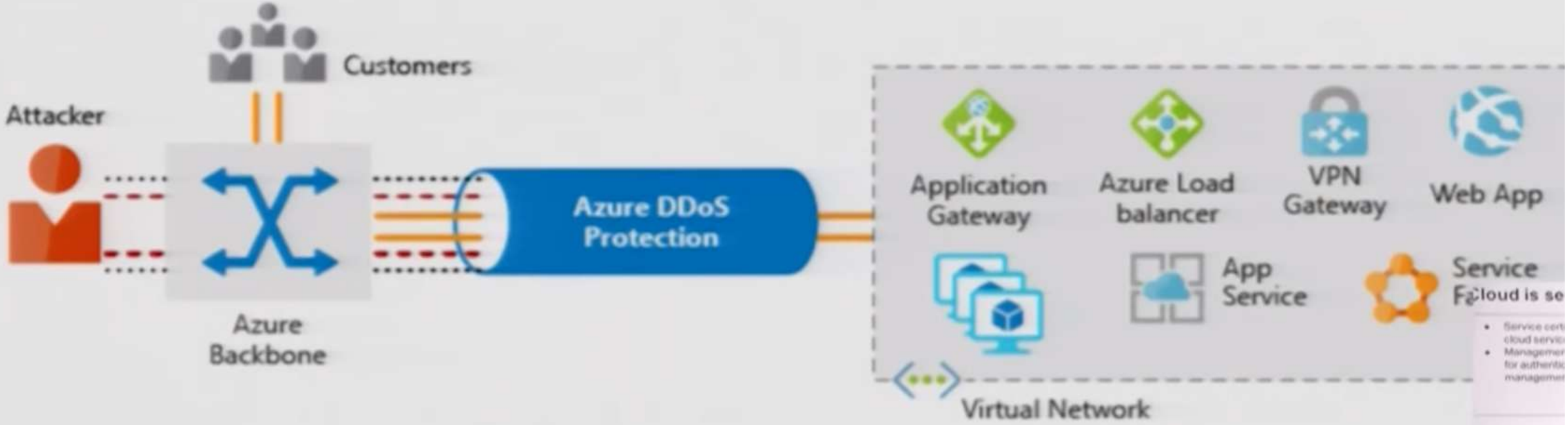
**Azure Key Vault** is a centralized cloud service for storing your application secrets. Key Vault helps you control your applications' secrets by keeping them in a single, central location and by providing secure access, permissions control, and access logging capabilities.

Encryption is often the last layer of defense from attackers and is an important piece approach to securing your systems

# Cloud is secure

- Service certificates are used for cloud services
- Management certificates are used for authenticating with the management API

- Azure Firewall
- Azure Application Gateway
- Network virtual appliances (NVAs)
- Azure DDoS Protection
- Microsoft Azure Information Protection
- Azure Advanced Threat Protection



# Technologies offered by IBM

Analytics

Artificial intelligence

Automation

Blockchain

Cloud computing

IT infrastructure

IT management

Mobile technology

Security

Software development

# Vendor Offering - IBM

- A number of vendor roles are commonplace in the mainframe shop.

- Because most mainframe computers are sold by IBM®, and the operating systems and primary online systems are also provided by IBM, most vendor contacts are IBM employees. However, *independent software vendor* (ISV) products are also used in the IBM mainframe environment, and customers use *original equipment manufacturer* (OEM) hardware, such as disk and tape storage devices, as well.

# Typical vendor roles follow:

- **Hardware support or customer engineer**
  Hardware vendors usually provide on-site support for hardware devices. The IBM hardware maintenance person is often referred to as the *customer engineer* (CE). The CE provides installation and repair service for the mainframe hardware and peripherals. The CE usually works directly with the operations teams when hardware fails or new hardware is being installed.

- **Software support**
  A number of vendor roles exist to support software products on the mainframe. IBM has a centralized Support Center that provides entitled and extra-charge support for software defects or usage assistance. There are also information technology specialists and architects who can be engaged to provide additional pre- and post-sales support for software products, depending upon the size of the enterprise and the particular customer situation.

- **Field technical sales support, systems engineer, or client representative**
  For larger mainframe accounts, IBM and other vendors provide face-to-face sales support. The vendor representatives specialize in various types of hardware or software product families and call on the part of the customer organization that influences the product purchases. At IBM, the technical sales specialist is referred to as the *field technical sales support* (FTSS) person, or by the older term, *systems engineer* (SE).

For larger mainframe accounts, IBM frequently assigns a client representative, who is attuned to the business issues of a particular industry sector, to work exclusively with a small number of customers. The client representative acts as the general "single point of contact" between the customer and the various organizations within IBM.

# Cloud computing categories offered by IBM

- Cloud database
- Cloud management
- Cloud security
- Cloud storage
- Infrastructure as a service
- Platform as a service

# TOPICS

- Principles of Blockchain
- Blockchain Process
- Blockchain Components
- Blockchain Structure
- Block Structure
- Block hash generation process
- Versions of Blockchain

# Principles of Blockchain

**Distributed**

All participants has its own copy of ledger

**Decentralized**

There is no central governing authority or 3rd party involved. It is group of nodes maintains the network.

**Immutable**

All the transactions recorded that cannot be altered and reversed

**Time Stamped and Sequenced**

Time stamp of the transactions are recorded in chronological order

**Consensus**

All the participants on network has to verify and approve transactions

**Inclusive**

Everyone is independent to participate without any discrimination.

**Cryptography**

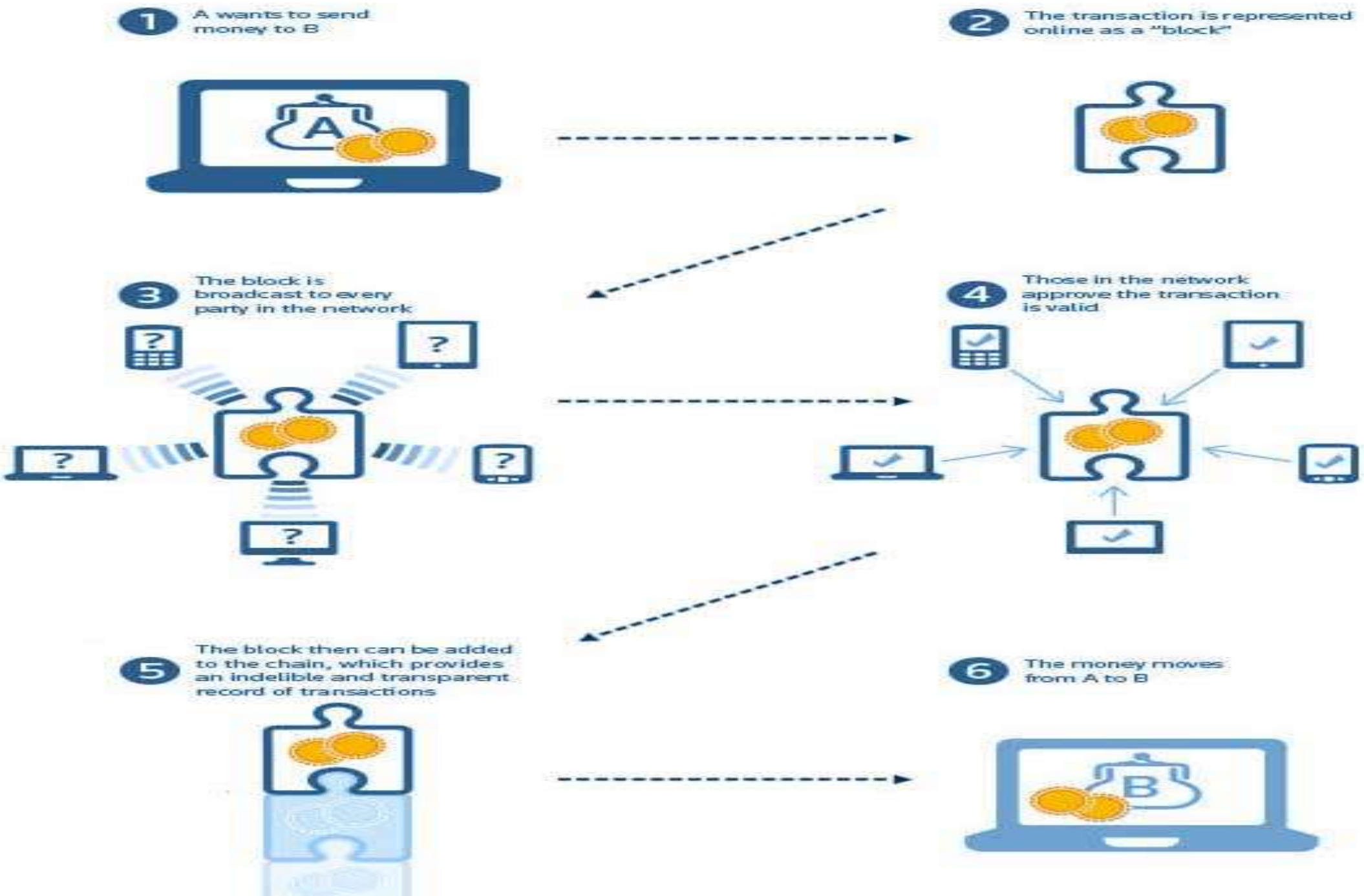
All the transactions are individually secured a and digitally signed by owner. Also each block has a hash value

**Security**

No Single central point of failure and no single person can damage the entire chain of network.

**Privacy**

Identity of participants are not compromised . It establishes a separate virtual identity for its users to protect their privacy both – online and offline.


1 A wants to send money to B
A
2 The transaction is represented online as a "block"
3 The block is broadcast to every party in the network
4 Those in the network approve the transaction is valid
5 The block then can be added to the chain, which provides an indelible and transparent record of transactions
6 The money moves from A to B
B

# Blockchain Components

## Blocks

- Consider this an page of ledger.
- IT contains Transaction information
- Block is made of header and long list of transactions.
- Each block has its own unique nonce and hash

## Ledger

- Ledger is a list (chain) of blocks of transaction.
- Distributed Ledger via nodes connect to chain
- It is also called as digital ledger.
- Participants can see only appropriate transactions - **Permissioned**

## Nodes

- Node is a computer system which has its own a copy of the ledger.
- Nodes updates its copy of ledger based upon the consensus of the network
- Nodes does transaction processing and block creation

## Miners

- Considers Miners as accountants who verify and record transactions.
- Miners run algorithms using special software on nodes secures block that must be verified by other nodes on the before adding to blockchain ledger
- Miners create new blocks on the chain through a process called mining.

## Network

- Peer-to-peer network of nodes with required installed software.

# Blockchain Structure

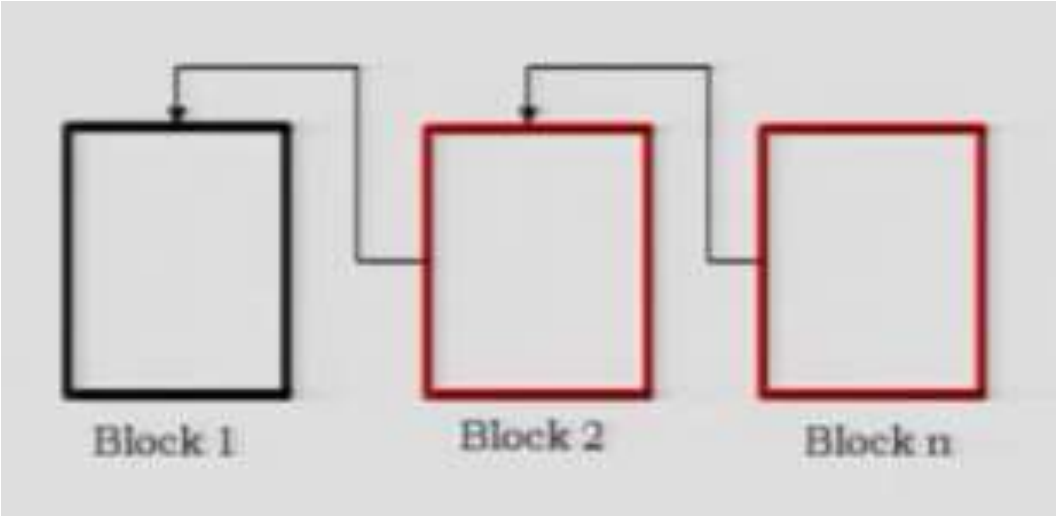
1. Blockchain is an ordered list of blocks

2. Every block refers to previous of blocks of transactions (back-linked list)

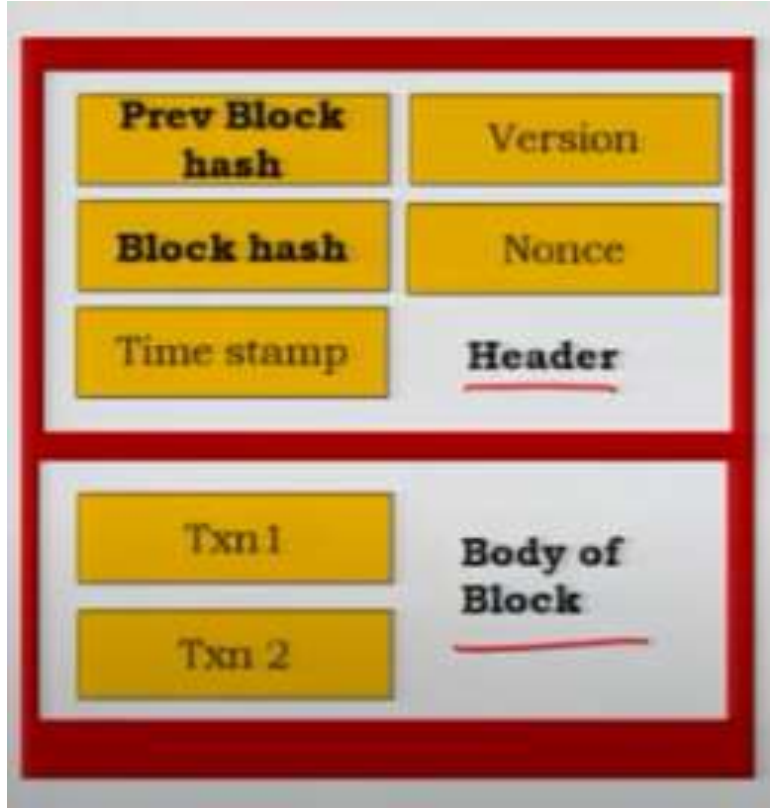
3. The first block in the chain doesn't have any previous block reference

4. **Block height** – represent no of block before the block in bock chain For e.g. height of the first block in blockchain is 0.

5. **Blockchain height** – represent the height of the highest block.



# Blockchain Structure




**Body of Block**

It contains the long list of transactions.

**Header**

- **Prev. Block hash** – it is hash value of previous block also called as Parent Block. Think it as an pointer to previous node in link list
- **Block hash** – Hash Value for this block generated using the SHA256 cryptographic hash algorithm. It identifies block uniquely. It is also called as digital fingerprint.

**Header**

- **Version** – number to track software or protocol upgrades.
- **Time stamp** – time when this block is created
- **Nonce** – 32-bit (4-byte) field value which is adjusted by miners to differentiate the block's hash address so that the hash of the block will be less than or equal to the current target of the network.

# Block Hash Generation Process

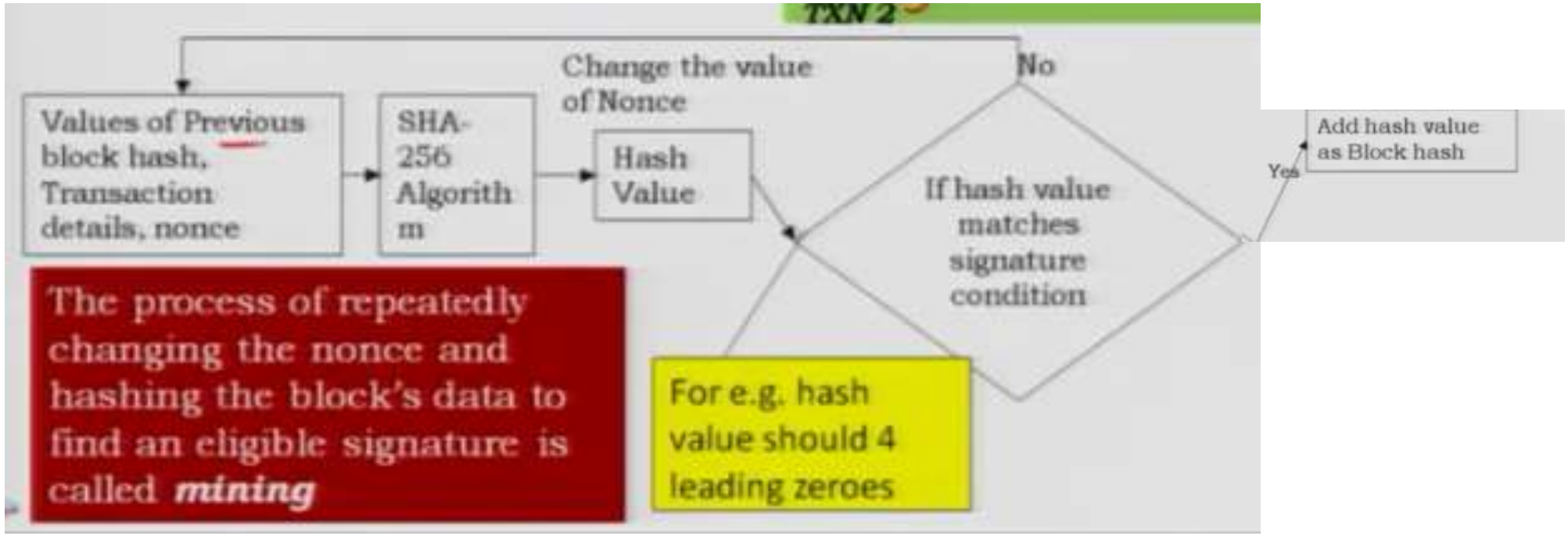
Together all the values like Previous block hash, Transaction details, and nonce etc are used in hashing algorithm to generate 256-bit, 64 character length unique block hash.

**Prev Block Hash :**
0000ebset3ycxxxxxxxx
**Timestamp**: 2020-10-04:07:30
**Nonce**:345673
**Block Hash** :
0000tg34sgecxxxxxxxx

***TXN 1***
***TXN 2***

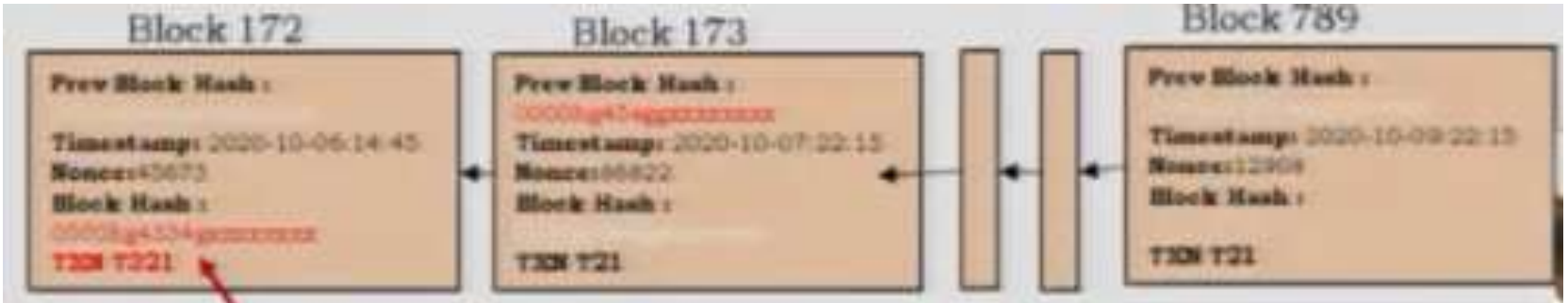
**Prev Block Hash :**
0000tg34sgecxxxxxxxx
**Timestamp**: 2020-10-06:14:45
**Nonce**:45673
**Block Hash** :

***TXN T1***



# How blockchain is secured ?

- Every transaction and block in the blockchain is digitally signed by its creator using Public Key Cryptography.
- Any change or update in old block resulted in change in Block hash, which result break of chain.




Somebody tries to change the txn value in Block 172, which results in change in block hash value and break in chain

# How blockchain is secured ?

Now hacker / corrupt miner has two option

1. Either (S)he regenerates the hash value for all child blocks till 789, which is very time consuming. Even if (S)he somehow makes changes in all subsequent blocks , then all other participants (node) will automatically reject this change (consensus process) as the block hash value of last block in their copy of ledgers is different.

2. Or Generate same how old hash value and this is not possible as Hashing technique used in blockchain is collision-resistant. It means resistance means in any case no two strings value can have same Hash value.

# Versions of Blockchain

**Blockchain 1.0**
Currency

- It works as a **simple state machine.**
- This allows financial transactions based on blockchain technology.
- Distributed Ledger technology implementation

**Blockchain 2.0**
Smart Contract

- It works as a **simple state machine + Smart contracts.**
- It is a small self-executing computer programs that exist in the blockchain.
- It is used as a replacement for traditional contracts. Ethereum is used.

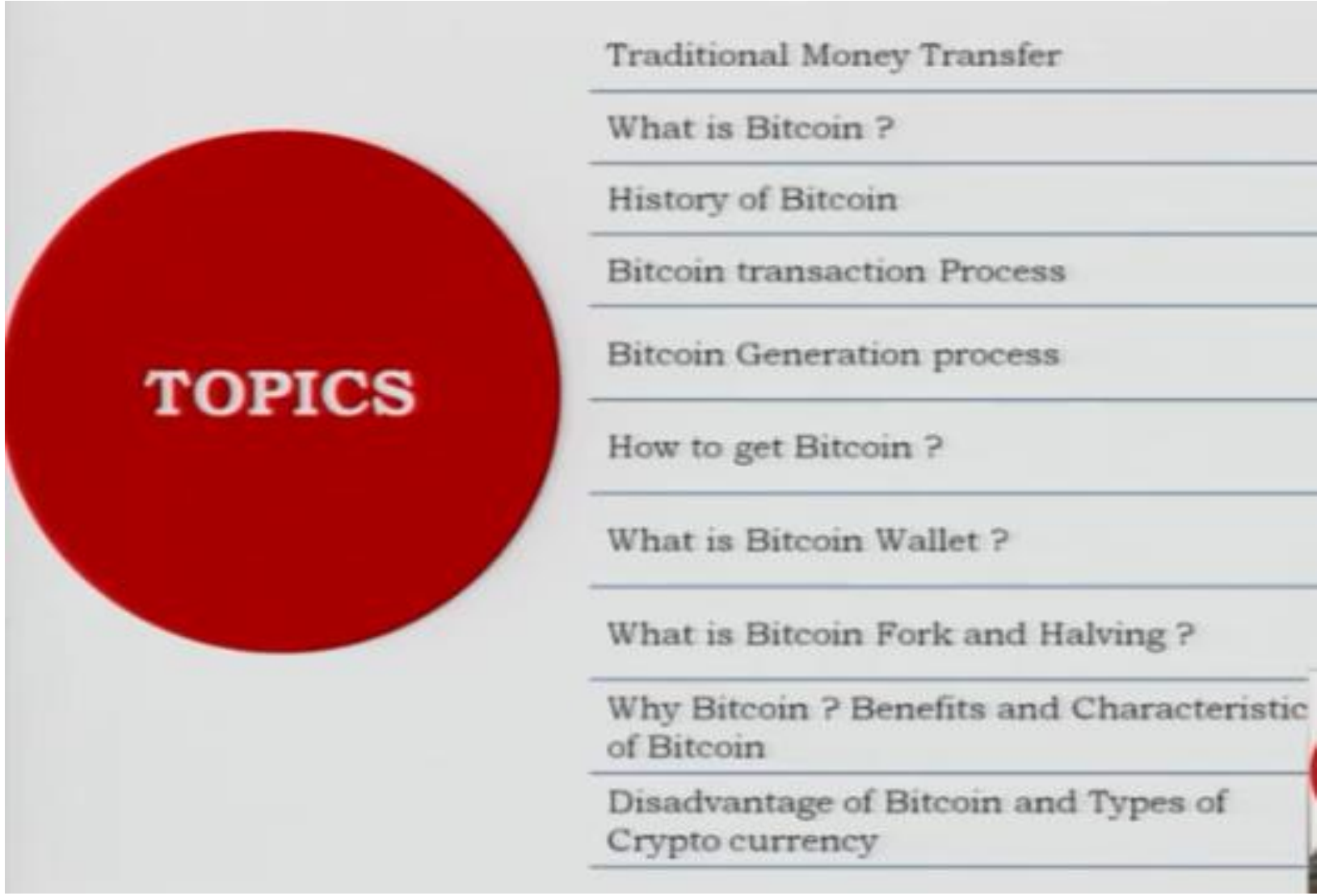
**Blockchain 3.0**
DApps

- It works as a **simple state machine + Smart contracts + Cryplets.**
- Stands for Decentralized application.
- A Dapp can have frontend that can make calls to its backend.

**Blockchain 4.0**
Industry

- Strategy and Methods to make blockchain technology available to business demands (WIP).

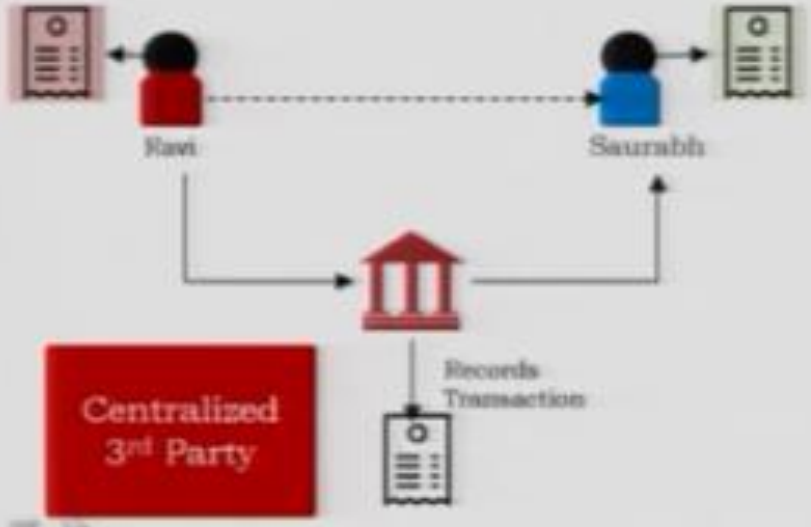
# Cryptocurrencies



# Traditional Money transfer

**Use case :** Ravi wants to Send Money to Saurabh

**Cash Transaction** – Peer to Peer




**eTransaction** - In this central agency (like banks) are involved for transaction.

# What is Bitcoin?

Bitcoin is a decentralized cryptocurrency (a.k.a digital currency) which uses peer-to-peer technology to operate with no central authority or banks. Bitcoin network (Nodes ) manages transactions and the issuing of bitcoins.

***Bitcoin*** is a ***Open source*** and its transactions are recorded in a public distributed ledger called a **blockchain**

# History of Bitcoin

**2008**

**18 Aug 2008** - "**bitcoin.org**" was registered

**31st Oct 2008** - Paper titled "***Bitcoin: A Peer-to-Peer Electronic Cash System***" By by ***Satoshi Nakamoto*** published

**2009**

**3rd Jan 2009** - **Nakamoto** release **bitcoin software as open-source** and 1st Block (Genesis Block) is mined.

**12th Jan 2009** - Hal Finneyl received 10 bitcoins from **Nakamoto**

**2010**

**1st** known **commercial transaction - Laszlo Hanyecz** bought two Papa John's pizzas for Ƀ10,000

**2011**

**Oct 2011** - **Bitcoin forks** for the first time to create **Litecoin**.

# History of Bitcoin

**2012**

**3rd June 2012** -Block 181919 created with 1322 transactions. It is the largest block to-date.

**June 2012** - Coinbase launched

**2015**

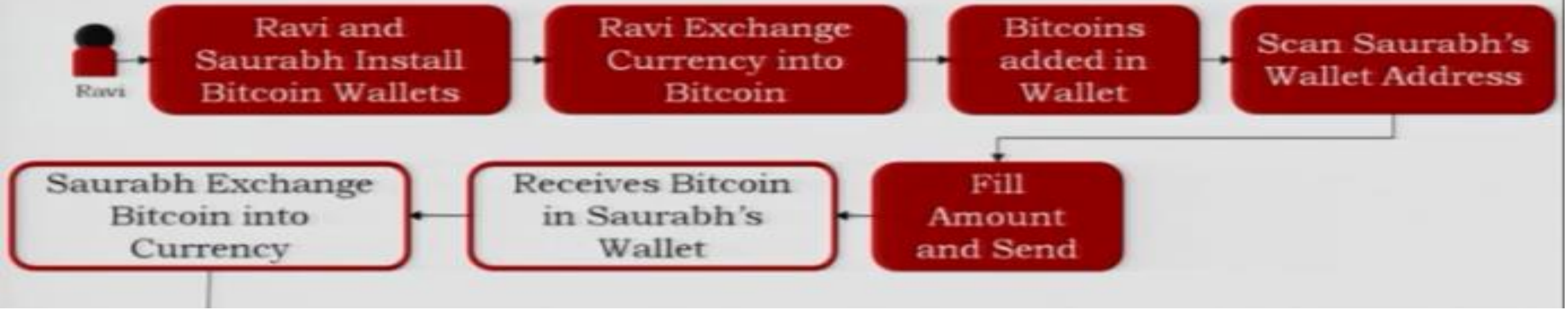
**June 2015** - Cryptocurrency regulations ***BitLicense*** gets established

**2017**

**1st Aug 2017** - Bitcoin forks again to create **Bitcoin Cash**.

# Bitcoin Transaction Process - I

**Use case :** Ravi wants to send money to Saurabh using Bitcoin



# Bitcoin Transaction Process - II

User Activity

Machine Activity

Ravi

Open its Wallet

Scan Saurabh Address

Fill Amount and Send

Ravi's wallets signs TXN using Ravi's Private Key

Txn Broadcasted on Network

Miners validated transaction

Miners compete to place in Next Block to be mined

Miner solves PoW & Broadcasted Block on Network

New Bitcoins mined and awarded to winner Miner

Nodes validates Block and Block added to blockchain

Ledger Updated

Saurabh received bitcoin in Wallet

Saurabh

# Bitcoin generation Process

- **Bitcoins are generated** by a process called "MINING".
- New bitcoins enter circulation as block rewards when miner uses software power to solve a mathematical puzzle to verify transaction that makes the blockchain more secure .
- The Bitcoin protocol is designed in a way that new bitcoins are generated at decreasing and predictable rate.

- No of Bitcoins are generated each year is automatically halved over time.
- Bitcoin generation halts completely with a total of 21 million bitcoins by 2140

# How to get bitcoin ?

## BATM

Bitcoin ATM , are connected to the Internet and connect the customer directly to a Bitcoin exchange for sale of Bitcoin for cash. For e.g. ***BitVending , cryptospace , LocalCoin***

## Bitcoin Exchange

A bitcoin exchange is an online digital marketplace platform from where traders can buy and sell bitcoins using different fiat currencies or altcoins. For e.g. *Coinbase, Binance, local bitcoin*

## Receiving Bitcoin

1. Get bitcoins from friend
2. Earn by playing games.for e.g. *Alien Run , Bitcoin Aliens, etc*
3. Buy Bitcoin from stores like ***libertyx***

## Selling Services or goods

1. Earn bitcoin by selling goods and services for
2. Earn Bitcoin by writing blogs, doing reviews, etc

## Mining Process

Earn bitcoin as reward for PoW

# What is Bitcoin Wallet ?

- A Bitcoin wallet is a software program in which Bitcoins are stored.
- It facilitates sending and Receiving of Bitcoins.
- It contain a private key for security. The key corresponds to the address of the wallet.
- There are 4 (four) types of Bitcoin wallets
  - **Web** – Allows to access wallet from any location, any browser and browser enabled devices . It stores private keys on their servers.
  - **Mobile** – Installed in Mobile as App and supports features like NFR, QR code scanning, Touch and Go. It stores your private keys in App
  - **Desktop** - Installed on Desktop. It stores your private keys on local hardisk.
  - **Hardware** – A hardware device can be connect with any computer via USB

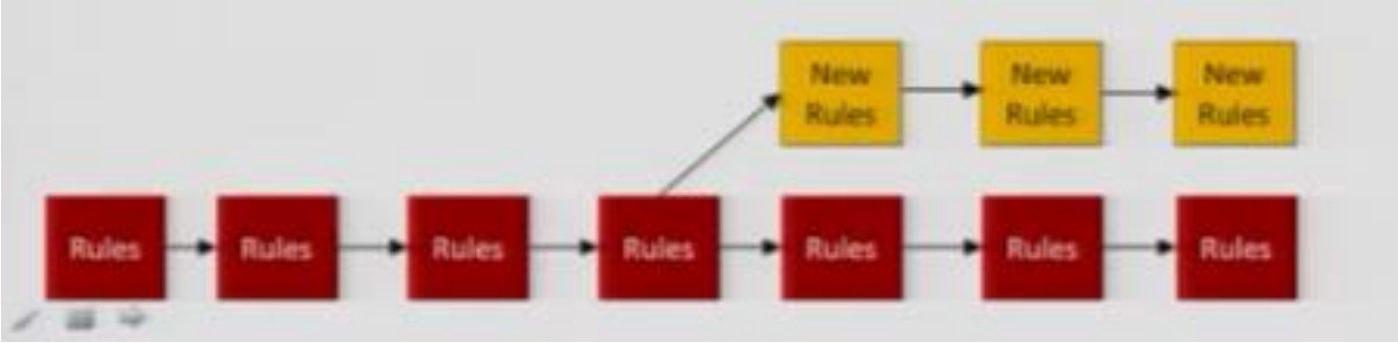
WazirX
Zebpay
Coinbase
Mycelium
Exodus

# What is Bitcoin Fork?

**Bitcoin fork** - A change to the bitcoin software /protocol that creates two separate versions of the blockchain with a shared history

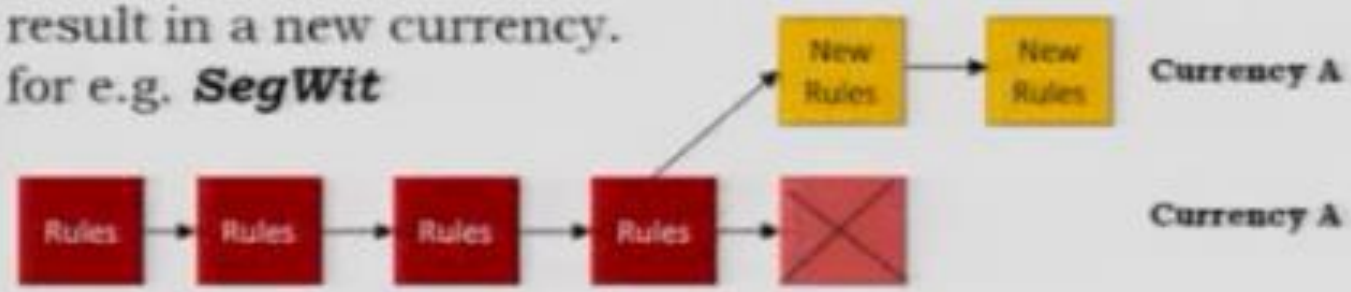
Fork happens when

- When a change is proposed **or** new features added to a digital currency protocol.
- As more and more people do sell and purchase , chain grows this brings delays in system ,makes system unreliable and transaction fees increases then bitcoin forks happens.

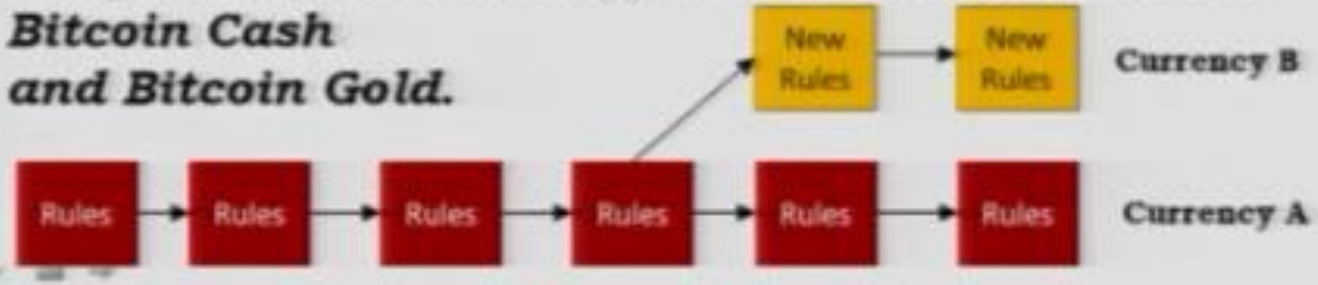


# Types of Bitcoin Fork?

**Soft Fork** - A soft fork is a change to the Bitcoin protocol and new protocol will be recognized by old nodes within the system (backward compatible) .Soft forks do not result in a new currency.
for e.g. ***SegWit***




**Hard Fork** – It is a new version of Bitocoin currency, where new bitcoins version is separate from previous and the change is permanent and there is no backward compatibility. The two biggest Bitcoin hard forks are
***Bitcoin Cash***
***and Bitcoin Gold.***



# What is the Bitcoin Halving?

**Bitcoin Halving** – it is process of cutting the mining reward to half. It means the total number of bitcoin that miners can potentially win for verifying transaction is halved.

- It is required as it reduce the number of new bitcoins being generated by the network. It's simply an demand and Supply, lesser the new bitcoins generated , higher the value for the bitcoins already in existence
- After every 210,000 (Approximately after every 4 years ) blocks produced value gets halved. The process will keep continue till 2140 till value of becomes zero.
- Initial value was 50 bitcoin
  - The 1st halving on the 28th Nov, 2012 at 210,000 and value is 25
  - The 2nd halving event on the 9th Jul 2016 at 420,000 and value was 12.50
  - The 3rd halving event on the 11th May 2020 at 630,000 and value is 6.25

# Characteristics of Bitcoin

- Bitcoin is an opensource.
- 21,000,000 (21 million )Bitcoins to ever be produced approximately by year 2140.
- Approximately every 10 minutes , new block is produced .
- Consensus based transaction validation and currency issuance .
- A decentralized peer-to-peer network (the bitcoin protocol).
- Transactions are recorded in a blockchain, which shows the transaction history for each unit
- A public transaction ledger (the blockchain).
- Bitcoin it is not issued by any central bank or backed by any government of any country.



# Why Bitcoin?

- Blockchain is a decentralized cryptocurrency (a.k.a. digital currency) with no central authority or banks involved.
- ***Transparency*** – Transaction are recorded in a public transaction ledger
- ***Consensus based Verification*** – Each transaction are verified by network participants. So it is difficult to do fraud.
- ***Secured*** – No single point of failure. No single person can damage the entire chain of network

# Benefits of Bitcoin

- International payments are easy and cheap as bitcoins are not tied up to any country currency or exchange rules.
- It can be used in emerging countries with a dysfunctional financial system.
- No credit card or transaction fees involved.
- Bitcoin users can pay(via internet) for their coins anywhere.

- Even people with no access to traditional systems like banks or credit card ,can online do transactions using Bitcoins

# How the price of bitcoin determined

Few thing which determines price of Bitcoin are

- The demand and Supply of Bitcoin.
- The rewards to bitcoin miners for verifying transactions.
- How many people want to buy or sell and for how much.
- Countries rules and regulations. Any change in policies which can impact the adoption of Bitcoin.
- Number of other cryptocurrencies and their performance.
- People having large quantities of cryptocurrency can also impact the price of Bitcoin. These people are known as **BearWhale**

***Inflation rates, monetary policy of government and financial institute that typically influence the value of currency do not apply to bitcoin***

# Disadvantages of Bitcoin

- Because the identity for person is not revealed
  - It can become a medium of transaction in illegal trade and drugs dealing
  - It can be easily used in money laundering.
- As the transaction once done on blockchain cannot be rolled back so If we lose private key, we lose all bitcoins.

- Bitcoin is a highly volatile currency and there are very frequent price movements.

- In case Bitcoin wallet hacked , Bitcoin money is unrecoverable whereas in traditional bank account the bank can refund the money back to the account holder.

# Types of Cryptocurrencies

- Bitcoin - Introduced in 2009,
- Bitcoin Cash - Introduced in 2017,
- Litecoin - Introduced by Google engineer in 2011 to improve transaction times, lower fees.
- Etherium
- Ripple

# References

https://bitcoin.org/
https://en.wikipedia.org/wiki/Bitcoin
https://blockgeeks.com/
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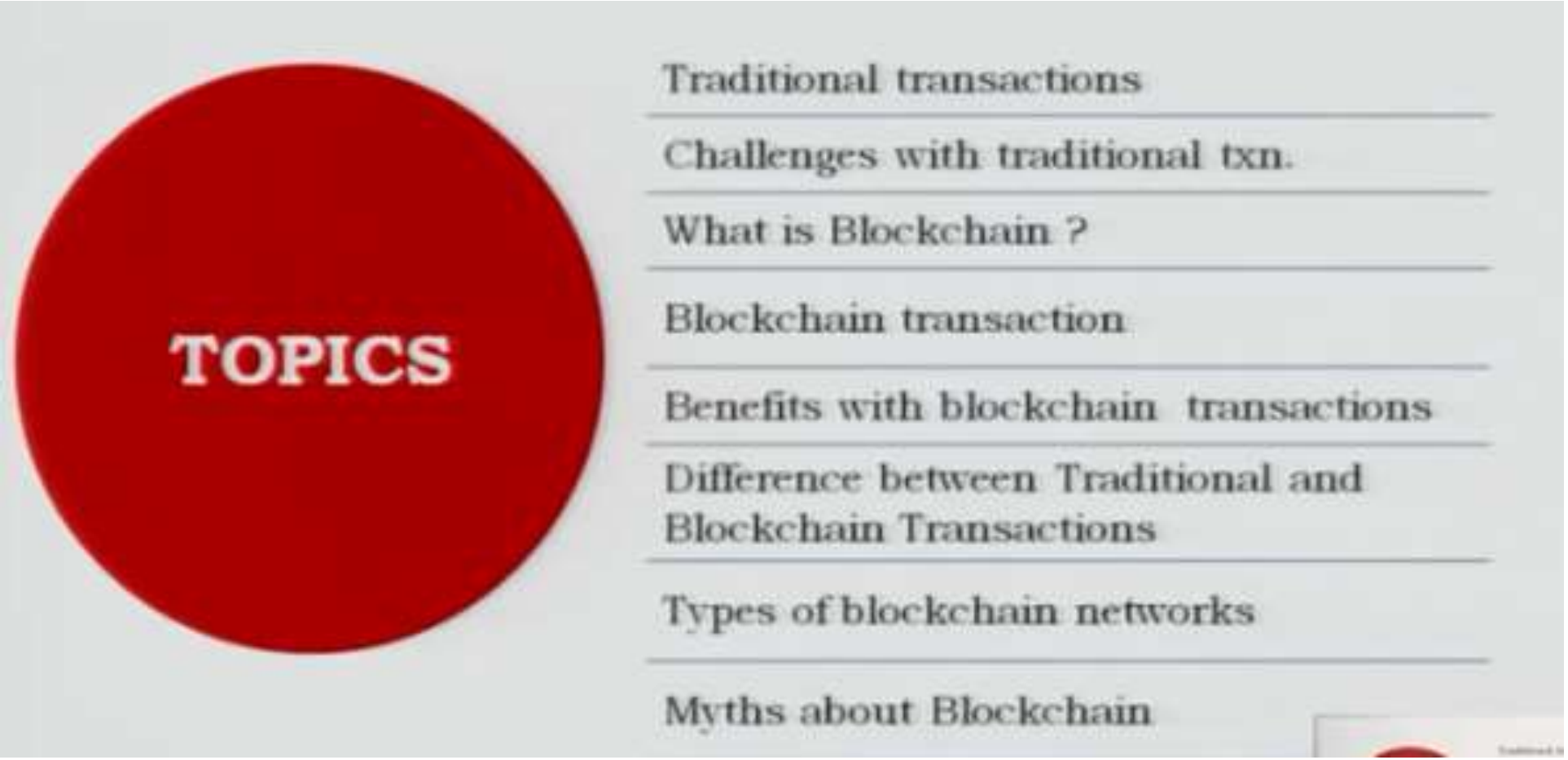
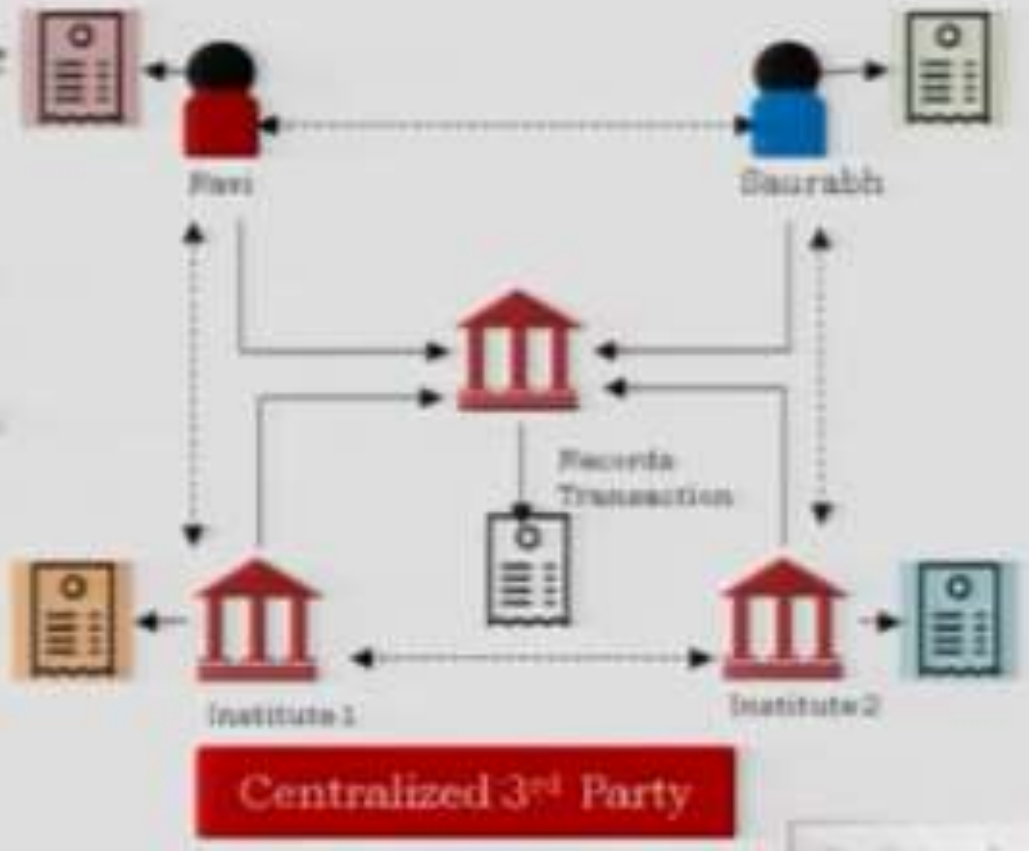
# Unit-3
# Lecture-1



# Traditional transactions

In traditional Approach whenever there is transaction happened between two parties (people or institutions) . Each party maintains their own transaction records and there is a centralized 3rd party authority which maintain records of transaction for all parties and also approves the transactions.

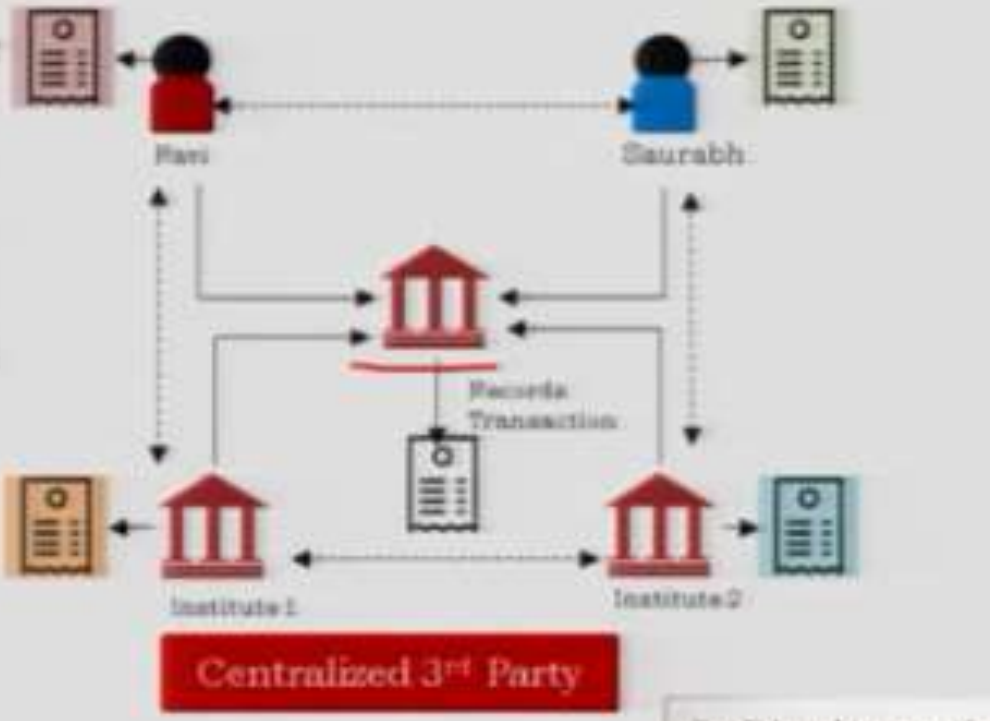


# Traditional transactions

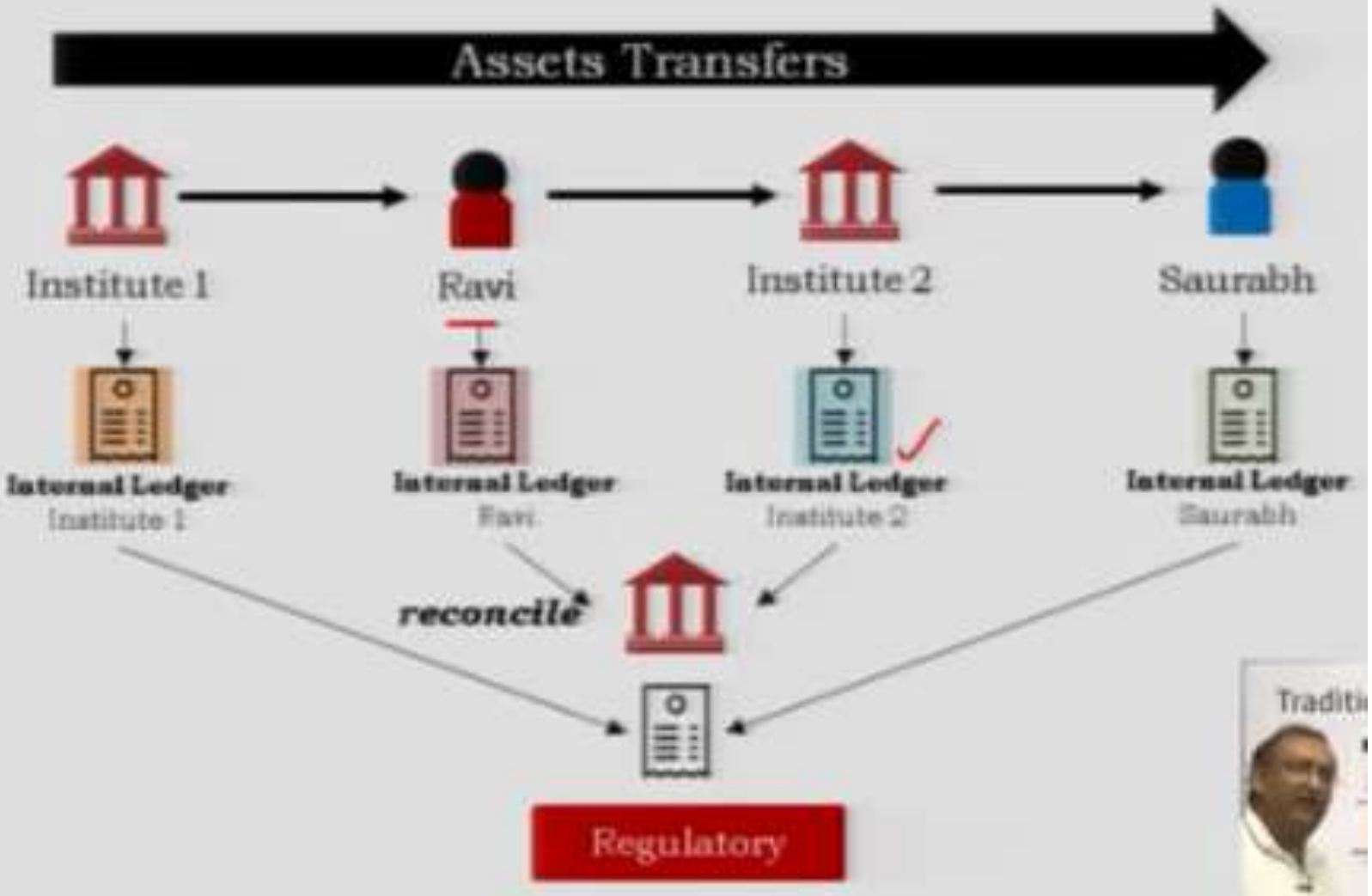
In traditional Approach whenever there is transaction happened between two parties (people or institutions) . Each party maintains their own transaction records and there is a centralized 3rd party authority which maintain records of transaction for all parties and also approves the transactions.

In this parties has to reconcile their ledger with central authority and resolve the conflicts , if there is any.

For all these 3rd party authority charges fees for validating and recording the transaction.



# Traditional transactions



# Challenges with traditional transactions

Current traditional centralized system has following challenges

- **Delays in settlement** – With the increase in complexity and volumes dependencies on 3rd party authority for in transaction and settlement can lead to inefficiencies
- **Security issues** – Any cyber attack or hack , fraud or any mis happening in centralized system lead to loss of information.
- **Inconsistent information and low transparency** – Specially in case of assets tracking as information is not shared across all the party which can lead to inconsistent information and low transparency.
- **Additional charges** – Merchants has to pay additional charges for every transactions and in some cases additional onetime charges also

# What is Blockchain

Blockchain is a system of recording information in chronological order with the use of cryptography hashing in an immutable decentralized and distributed ledger across the network of computer systems.

# What is Blockchain

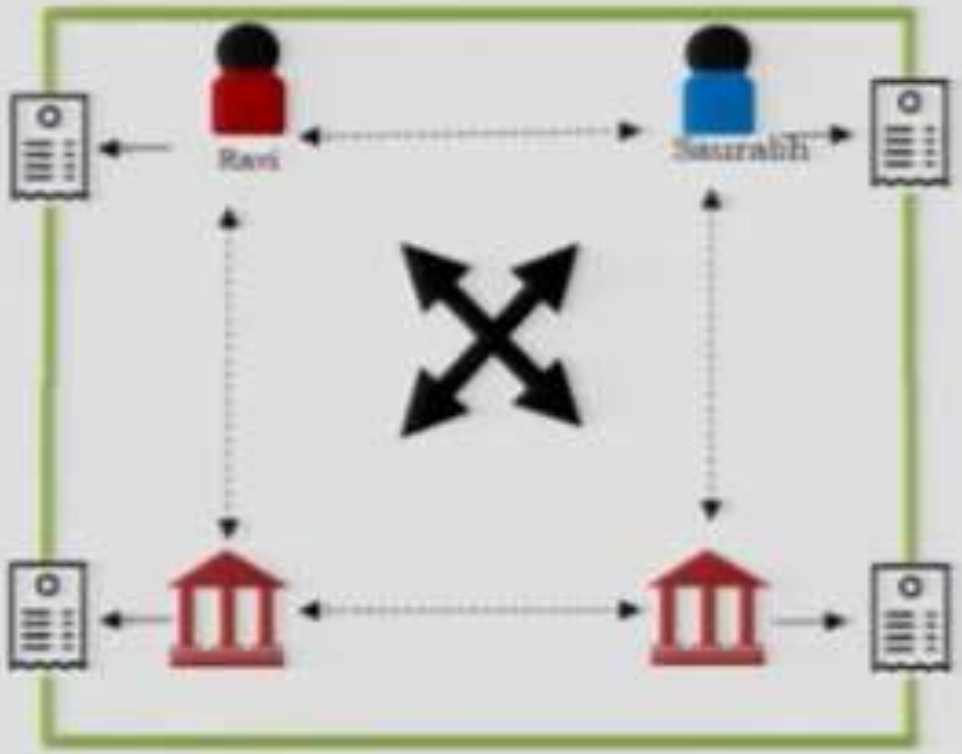
Blockchain is a system of recording information in chronological order with the use of cryptography hashing in an immutable decentralized and distributed ledger across the network of computer systems.

Using Blockchain we can track both tangible (Property, Vehicle, etc) and Intangible (Patents , copyrights, contracts, etc.) assets.

***Blockchain*** stores the data in ***blocks*** that are linked together to form a ***chain***

# Blockchain transactions

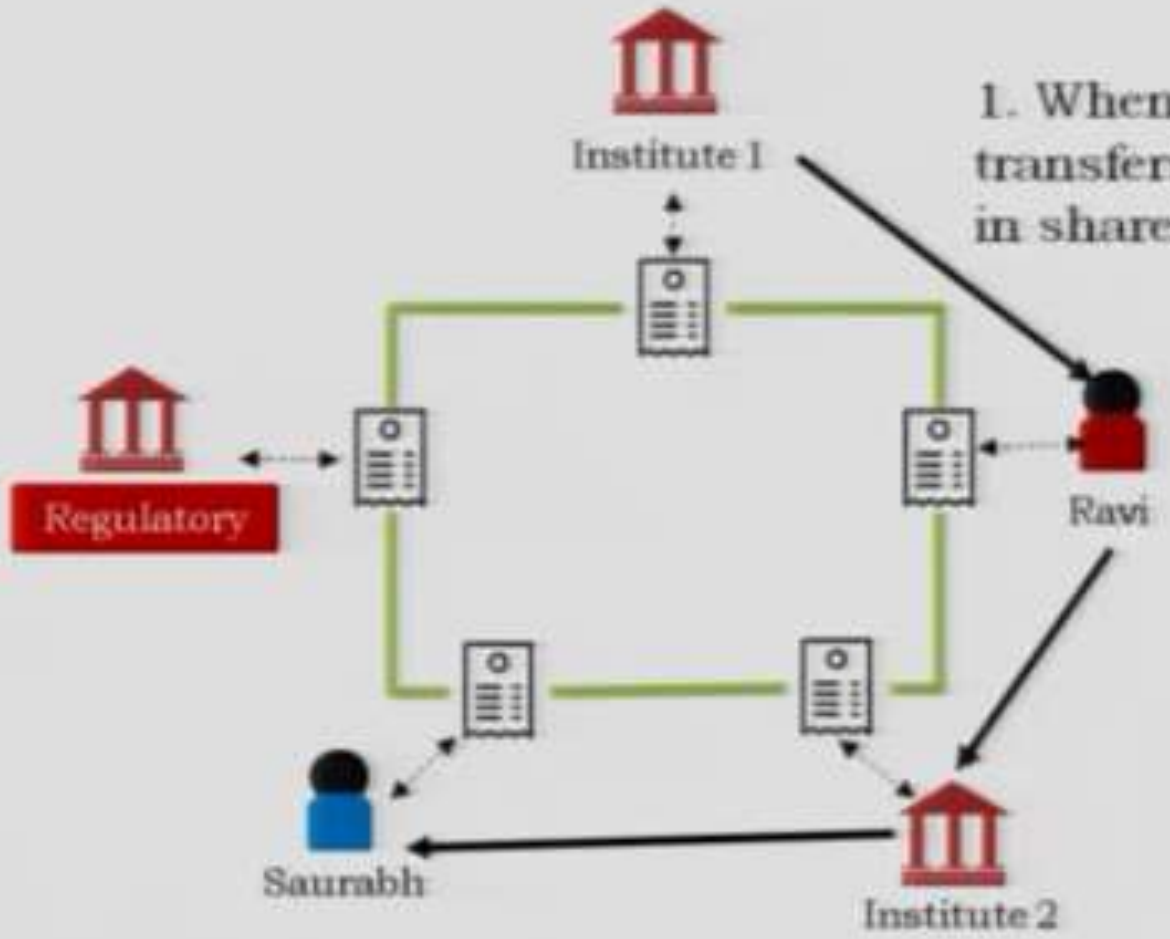
When transaction happened between two parties . The details of transaction is broadcasted in network. In Blockchain each participant in network has a copy of ledger and once transaction is approved and validated by all participants, then transaction details added to ledger and each participant gets the updated ledger with newly added transaction details.




Decentralized

Blockchain transa

# Blockchain transactions




1. When Assets transfer transfers details updated in shared ledger

2. Shared ledger get updated all places

3. Everyone has the access to updated ledger

# Benefits with Blockchain transactions

- **Improved Security** – As ledger stores information in secured way, distributed across the network, verified by all participants, so it is almost impossible to hack or temper information. Also no 3rd party , no added risk

- **Faster Settlement** – Even with the increases complexity and volumes , time taken for transaction settlement will be reduced drastically as no 3rd party needed to validate and settle transactions because it is taken care by Network participants

- **Cost effective** – Merchants doesn't have to pay additional charges for transactions, each participant has its own copy of records for reference

- **Consistency and Transparency** – As the details of transaction and assets tracking information is shared across the network and people can access information on network improves transparency and data consistency.

- **Trust** – As all the transactions are recorded on distributed ledger, so trust level in all involved parties are high

- **Less chance of Failure:** blockchain is distributed , decentralized consensus based system. So chances of failures of this system is very less. Even if somehow something goes wrong data can be recovered.

# Types of blockchain networks

Broadly blockchain network is categorised in two categories

1. Permission less - They are open for all, anyone with the internet can connect.
2. Permissioned. - Restricted access to people. Only authorised people can connect.

| Characteristics | Permissioned | Permission less |
|---|---|---|
| Participants | Only Authorized Participants | Open for Public |
| Consensus Process | Proof Of Stake or Pre-Approved Participation | Proof of Work |
| Performance | Faster, as chain is small | Slow – As chain is large and growing in enormous speed |

# Types of blockchain networks

| Characteristics | Permissioned | Permission less |
|---|---|---|
| Access | Full control on Participants access | Same Access for all Participants |
| Identity of Participants | Known. Participants know each other | Anonymous or Pseudo Anonymous. Identity is not revealed |
| Transaction Cost | Lower -as chain is small so need less time and resources for mining. | Higher -as chain is small so need less time and resources for mining. |
| Trust | Trusted Environment | Trust Free environment |
| Use of Token | Not Necessary | Yes, required |

# Types of blockchain networks

- **Public** - Permission less blockchains . They are open for all, anyone with the internet connection can send transaction and can become validator. Nobody will have complete control over the network. For e.g. Bitcoin Litecoin and Ethereum are public blockchain.
- **Private** - Permissioned blockchains. Private blockchains have a single authority or organization to look after the network and participants who wants to participate in a transaction should get permission from network administrators who controls access mgmt. Private blockchains are more centralized. These are typically used in private organizations to store sensitive information about the organization. For e.g. Hyperledger and R3 Corda
- **Hybrid** –This is a combination of Private and Public blockchains Here few nodes are Private and Few are public.
  For e,g, Dragonchain

- **Consortium or Federated –** Permissioned blockchains. Group of organizations come together and setup their own block chain network for cross-company and cross-discipline solutions. Consortium blockchains are governed by a group rather than a single entity. It has controlled user group For e.g. Corda R3 (Bank), Quorum and Hyperledger.

- **Sidechains** - A blockchain that runs parallel to a primary blockchain is called sidechain. In this entries from the primary blockchain can be linked to sidechain and vice-versa. Sidechain blockchain can operate independently of the primary blockchain.

Types of blockchain network

# Myths about Blockchain

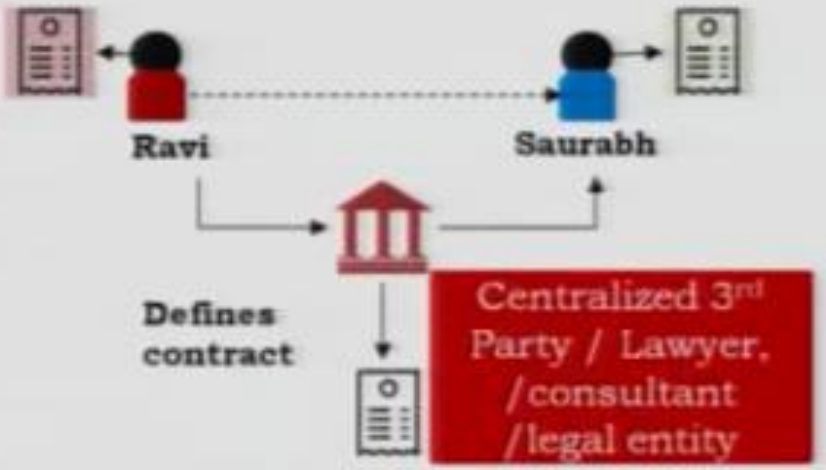
- **Blockchain and Bitcoin are same** - No they are not same instead Blockchain is underlying technology for Bitcoin.
- **Blockchain is a replacement for databases , messaging technology** – No, it is not.
- **Distributed Ledger Technology (DLT) and blockchain are same** - No Blockchain is based on Distributed ledger technology.
- **Blockchain is a database** - No Blockchain is not a database but contains transaction data.
- **Blockchains can only be public** – No, there different types of Blockchain for e.g. public , private, consortium and hybrid.
- **Blockchain is a software-** No, Blockchain not a software, instead it is protocol. Computer systems on network communicate based on rules of the service.
- **All Blockchains are the same** – No, basic fundamentals remains same, but there are a variety of blockchain implementations builts created specific to industry needs.

TOPICS
Traditional Contract Mgmt.
What is Smart Contract ?
Salient Features of Smart Contract
Characteristics of of Smart Contract
How Smart Contract works ?
How to Develop Smart Contract?
Traditional vs Smart Contract
Smart Contract use cases

# Traditional Contract Mgmt.

**Use case :** Ravi signs business deal with Saurabh

1. **Ravi and Saurabh** contact a Lawyer to define legal contract. In case it is to be registered then Legal entity also gets engaged.
2. Both have their own signed copy and Lawyer / Legal entity also keeps a copy.
3. In case of conflict / non compliance Lawyer gets involved for execution.
4. For this 3rd Party Intermediates or Legal entity charges fees.



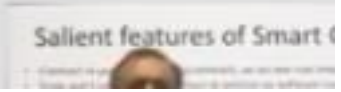
# What is Smart Contract?

A smart contract is a computer program that run on a decentralized network such as **blockchain** . It is intended to be self executing, control or document legally relevant events and actions according to the terms of a contract or an agreement between network participants, without the need of traditional legal contracts. It also automatically facilitates, verifies or enforces negotiations.

**Smart contracts** were first proposed in **1994** by ***Nick Szabo***, an American computer scientist . He also invented a virtual currency called "**Bit Gold**" in **1998**

# Salient features of Smart Contract

- Contract is part of blockchain network, so no one can temper contract.
- Term and Conditions of Contract is written as software code.
- Computer code defines all possible outcomes as if –then-else conditions.
- Contract conditions are available on Public network.
- Parties involved in contract use public key as ID to stay anonymous.
- Parties sign the contract with their private keys
- As and when the conditions meet , Contract executes itself . No Manual Process for contract verification or execution
- Regulatory monitors Blockchain for contracts activity.




- Smart contract can connect with another Smart Contract and/or App

- No one can interfere the contract execution.

# Characteristics of Smart Contract

**Trusted and Secured**

Each contract is signed by participant, encrypted and shared across the network. Confidentiality of the parties is maintained.

**Self Verifying & Executing**

When event happens, it verifies the contract clause and when conditions meet , Contract executes itself

**Transparency**

Actions in smart contracts are transparent to all

**Autonomy**

There is no central governing authority or 3rd party involved.

**Fast and Cost effective**

Absence of Manual process and absence of 3rd party makes smart contract fast and cost effective

**High degree of Availability**

No single point of failure and no single person can damage the entire chain of network.

**Immutable**

It is not possible to perform any kind of tempering with contract and it cannot be reversed also

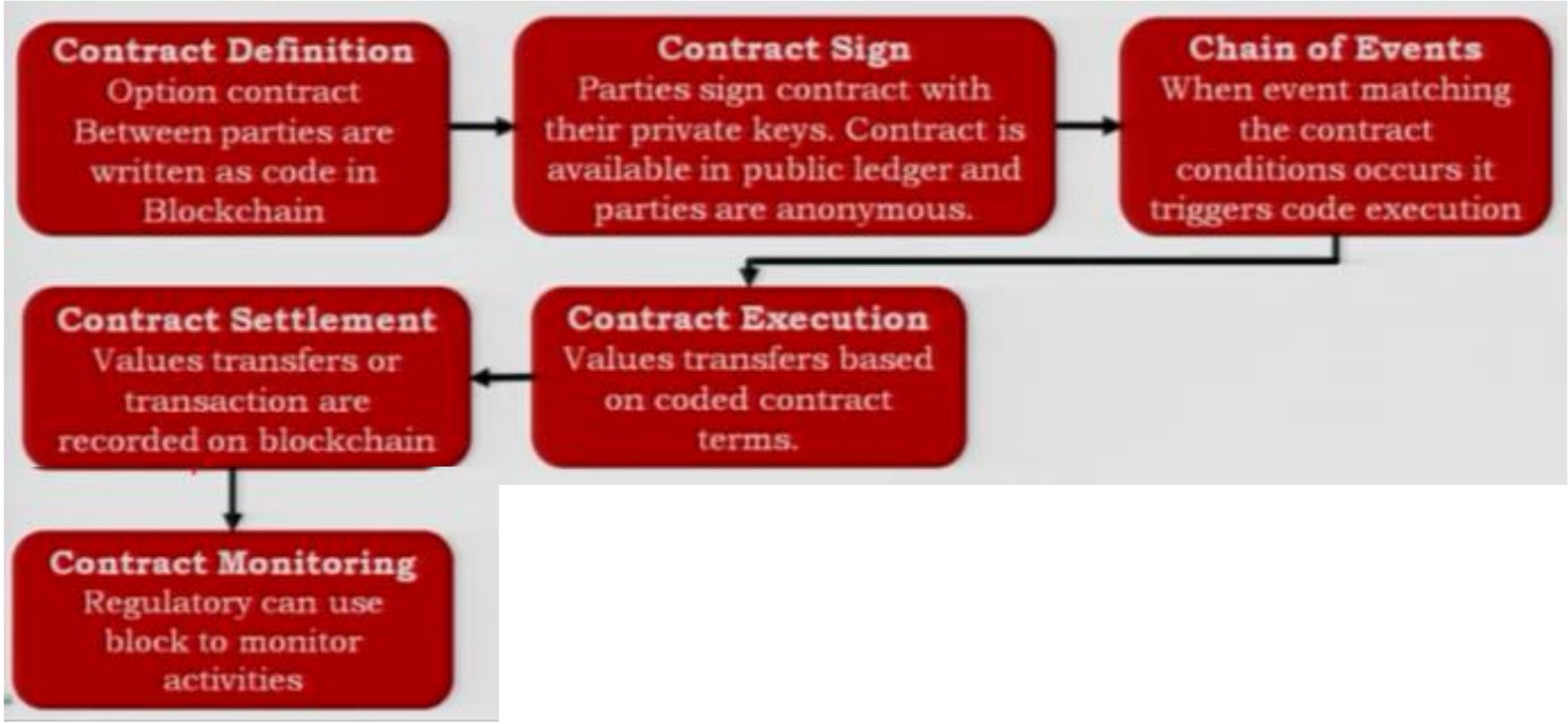
**High degree of Accuracy**

In the absence of manual process, there is no confusion and need for any litigation.

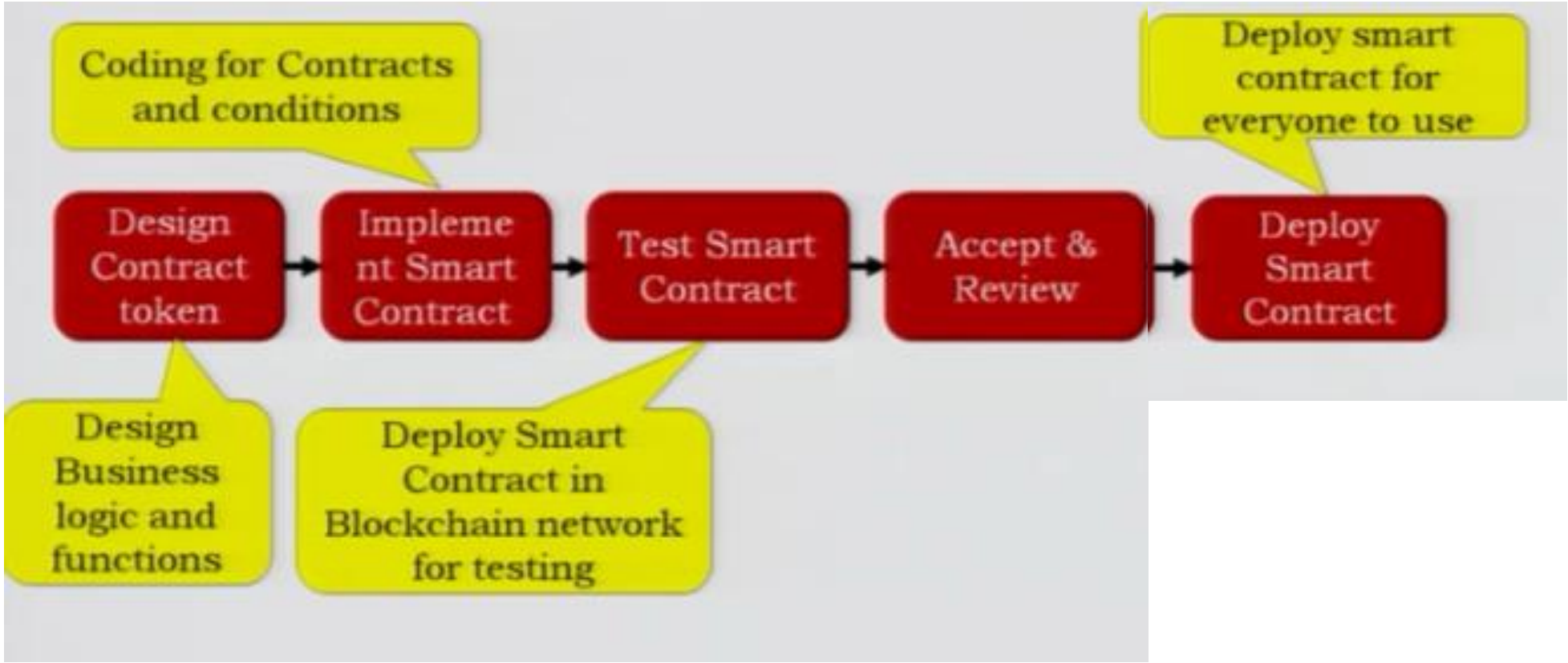
**Backup**

Multiple copies of contracts on blockchain network

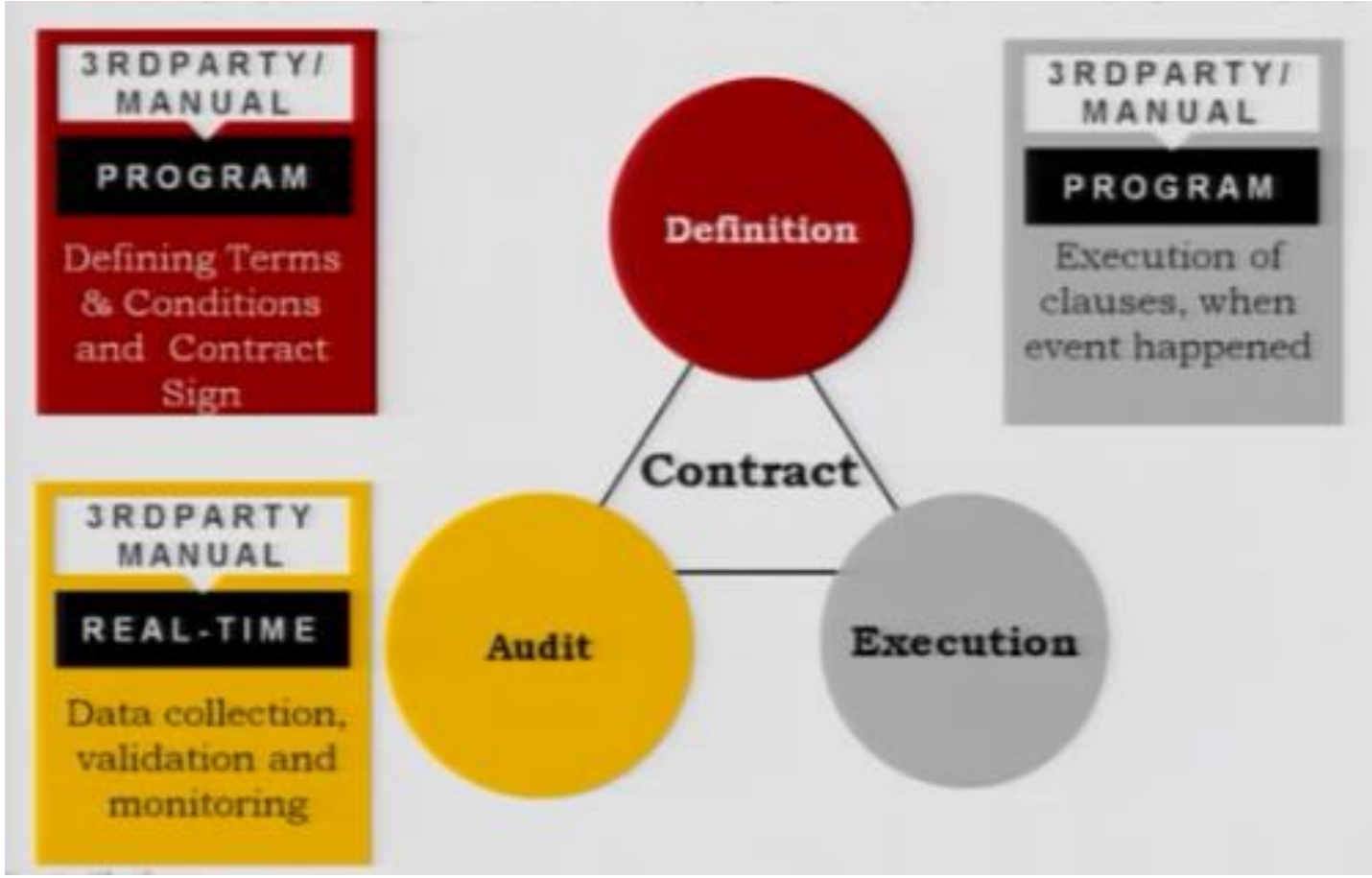
# How Smart Contract works ?



# How to develop Smart Contract ?



# Traditional vs Smart Contract



# Traditional vs Smart Contract

| | Smart Contract | Traditional Contract |
|---|---|---|
| | De centralized | Centralized |
| 3rd Party | No | Govt, Regulatories, Lawyers , etc |
| Accessibility | Publicly | Not Shared |
| Remittance or settlement | Automated | Manual |
| Execution Time | ~~High~~ Very fast | ~~Very Fast~~ HIGH |
| Archival | Easy | Difficult |
| Cost | Expensive | Cheap |

| | Smart Contract | Traditional Contract |
|---|---|---|
| Availability | High - No Single point of failure | Low - Single point of failure |
| Amendment | Difficult | Easy |
| Security | High | Low |
| Signatures | Digital Signatures | Manual Signature |
| Transparency | High | Very Low / None |

# Smart Contract Platforms

- **Etherium** - Founded in Jul 2015 . Leader in Smart contract platform. ***Solidity*** is the primary programming language used.
- **Hyperledger Fabric** –Founded in Dec 2015. It is Open source framework set up by the Linux Foundation. ***Golang*** and ***Java*** are primary language used.
- **Codius** - Ripple's smart contract platform based on the standard ***Java-Script*** programming language.
- **Cardano**: an open-source blockchain more suitable for advanced smart contracts. ***Haskell*** is primary programming language.

- **Cardano**: an open-source blockchain more suitable for advanced smart contracts. ***Haskell*** is primary programming language.
- **Stellar** - Founded 2014, is one of the oldest smart contract platforms. It support many languages incl. C/C++ Java, GO, Python, Java-script, etc.
- **NXT** is a public blockchain platform that contains a limited smart contracts templates.

# Smart Contracts Use cases

- Insurance premiums and claims.
- Patient Medical history.
- Election Voting.
- Rent Agreements
- Property Sale agreements
- Crowdfunding.
- Trade Funding
- Supply chain.

# Disadvantages

- As contract is written as code, So there is high dependency on programmers
- Problem arises from bugs in code.
- Not able to adjust contract or make corrections.
- Implementation cost - Need to experience blockchain programmer for define Smart contracts.
- As of know no government is regulating smart contracts .
- As of know no standard on how govt puts taxes on Smart contract.

- How to involve legal entity in case of conflict on contract agreement and clause . How judiciary enforce laws as judges and juries simply can't read the software code.

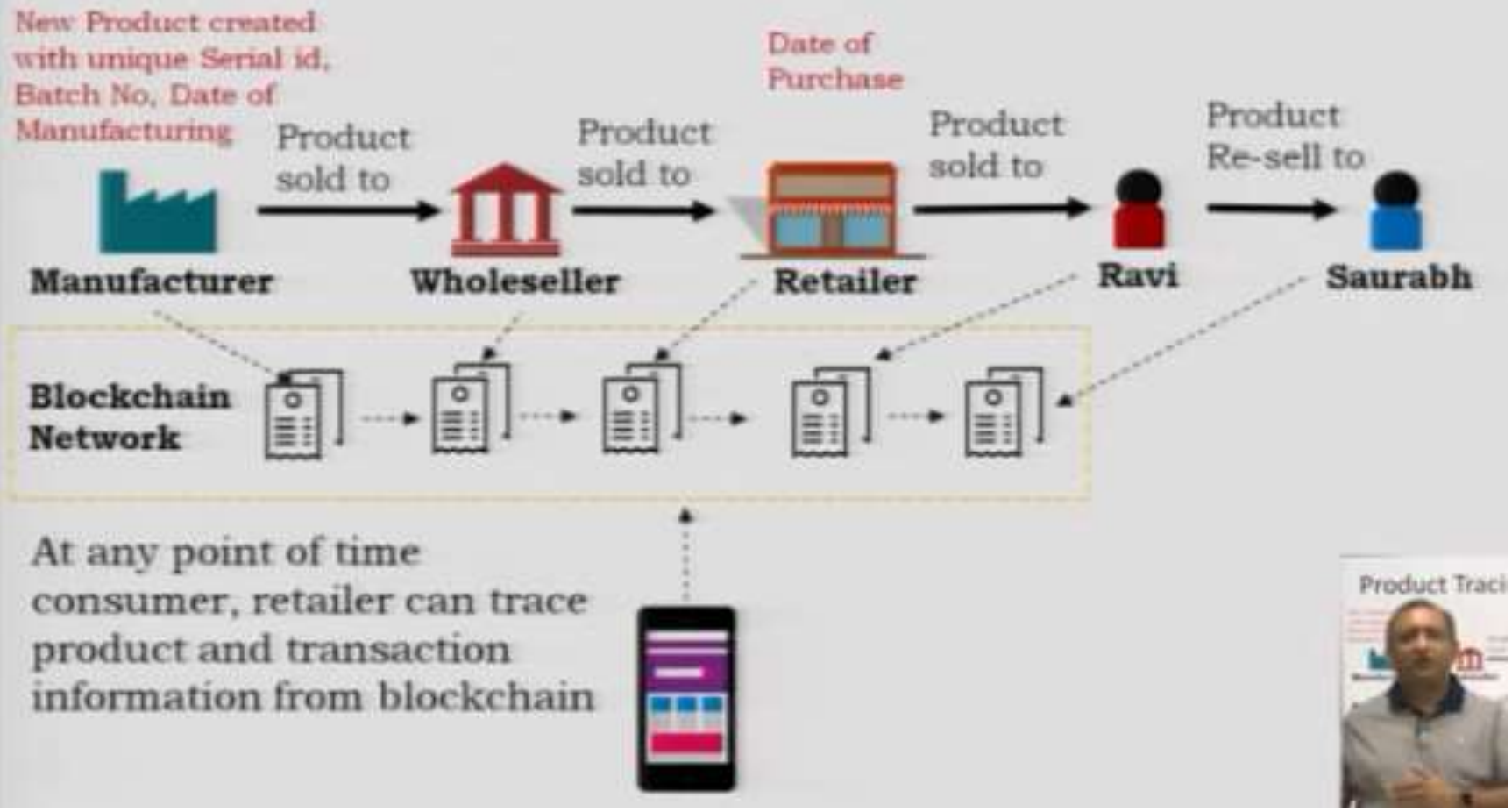
# References

https://www.ethereum.org/token
https://blockgeeks.com/guides/smart-contracts/

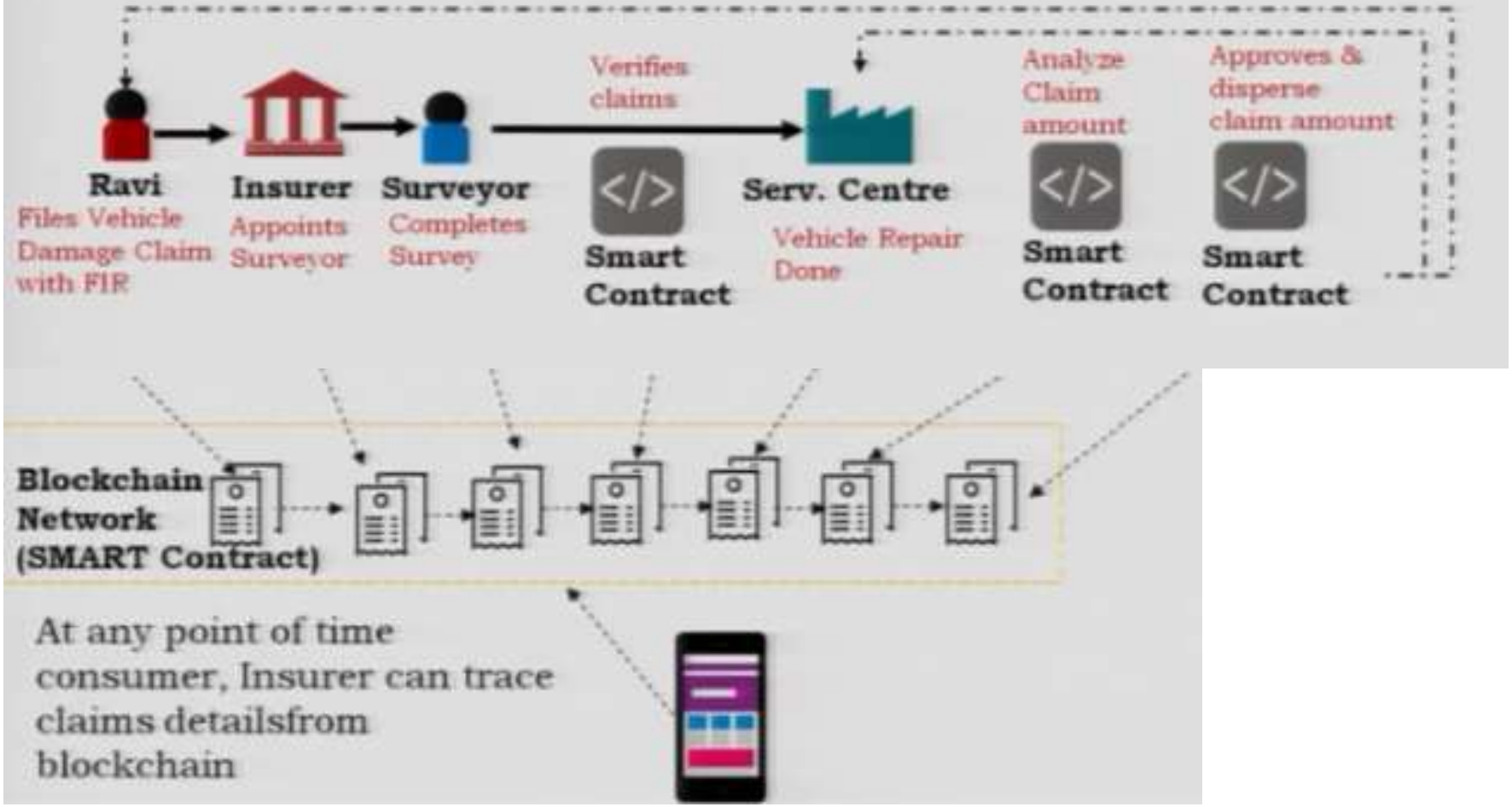
# TOPICS

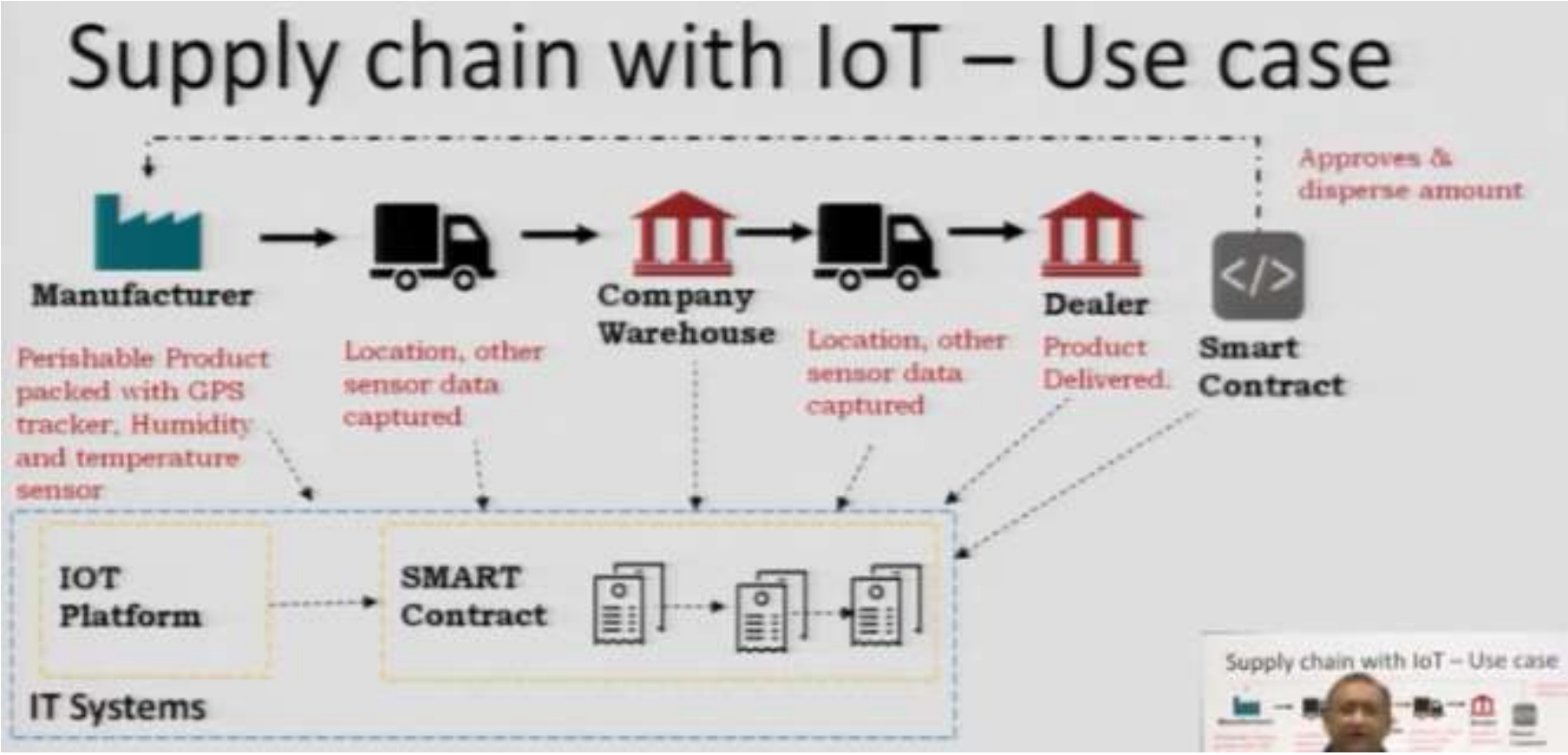
- Use cases
- Industry wise usecase
- Companies Adopting Blockchain
- Blockchain Use cases - India
- References

# Product Tracing – Use case

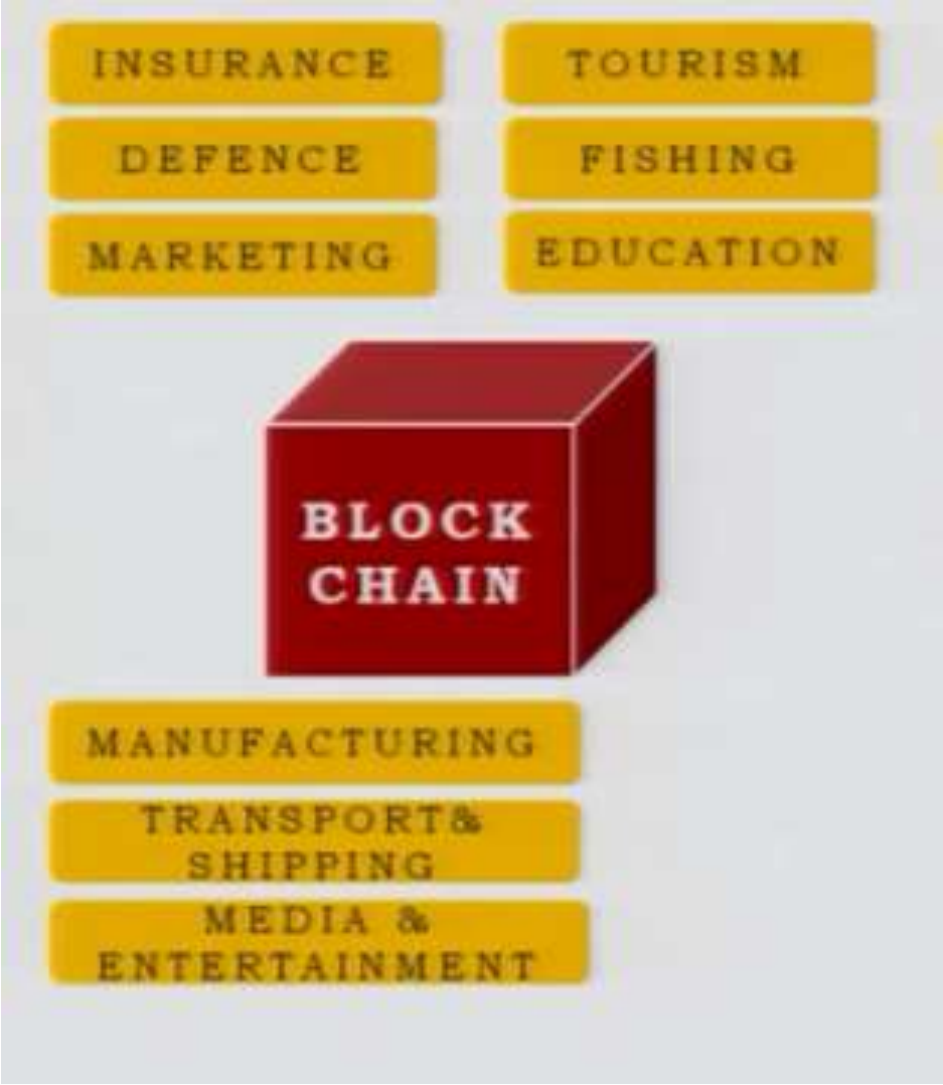


# Insurance Claim – Use case




Supply chain with IoT – Use case
Approves & disperse amount
Manufacturer
Company Warehouse
Dealer
Smart Contract
Perishable Product packed with GPS tracker, Humidity and temperature sensor
Location, other sensor data captured
Location, other sensor data captured
Product Delivered.
IOT Platform
SMART Contract
IT Systems
Supply chain with IoT – Use case

FINANCE
LEGAL
GAMING
IOT
ENERGY
SUPPLY CHAIN
ENERGY
FOOD
IT


INSURANCE
TOURISM
DEFENCE
FISHING
MARKETING
EDUCATION
BLOCK CHAIN
MANUFACTURING
TRANSPORT& SHIPPING
MEDIA & ENTERTAINMENT

AUTOMOBILE
HEALTHCARE
GOVERNMENT
REAL ESTATE
ADVERTISING
ENTERPRISE

# Industry wise possible use cases

## GOVERNMENT

- Citizen Identity.
- Taxes.
- Election Voting.
- Pension , Welfare Benefits Records.
- Passport and Visa Programs.
- Licensing.

## FINANCE

- Payments & Settlements
- Money transfer.
- Loans
- Credit History.
- Cross-border payments.
- Crowd Funding.
- Cross Currency Payments

## AUTOMOBILE

- Vehicle Sales
- Vehicle rental.
- Vehicle Registration.
- Vehicle Leasing.
- Vehicle Financing.
- Vehicle / Ride Sharing.

## ENTERPRISE

- Workflow Mgmt.
- Process Control.
- Project Scheduling
- Hiring Process
- Employment History.

## SUPPLY CHAIN

- Supply chain and logistics monitoring.

## EDUCATION

- Education history
- Professional Licenses and Certification.

# Industry wise possible use cases

## HEALTHCARE
- Patient Record Mgmt.
- Clinical Trials.
- Prescription sharing.
- Medicine Supply chain.
- Organ Registry.

## LEGAL
- Criminal history.
- Traffic mgmt.
- Evidence Mgmt.
- Anti-money laundering tracking system.
- Power of Attorney.
- Asset Mortgage.

## INSURANCE
- Insurance premium.
- Insurance claims.
- Insurance Fraud Mgmt.
- Ratings.

## DEFENCE
- Military Records.
- Asset Tracking.
- Procurement process.

## MANUFACTURING
- Product Part Tracking.
- Product Tracking.
- Maintenance Tracking.
- Procurement Process.
- Warranty and Payments.

## ENERGY
- Peer 2 Peer Energy transmission
- Distribution
- Bill settlement

## ENTERTAIMENT
- Royalty Mgmt.
- Content Copyright.
- Auction.

## TOURISM
- Customer Mgmt.
- Loyalty Mgmt.
- Luggage Mgmt.
- Ticketing.

## GAMING
- Decentralized Gaming
- Gaming Monetization.
- Peer 2 peer Gaming Payments.

## IOT
- Device 2 Device Payments.
- Device Mgmt.
- Decentralized network of IoT devices

## IT
- Module/ Product Ownership
- Individual / Company Payment
- DevOps
- Work distribution.
- Messaging Apps.
- Cloud Data

## ADVERTISING
- Advt. Insight.
- Add Click fraud Detection.
- Advt. placement.

## REAL ESTATE
- Sales Deeds & Contracts.
- Rental Agreements.

# Interesting Blockchain use case

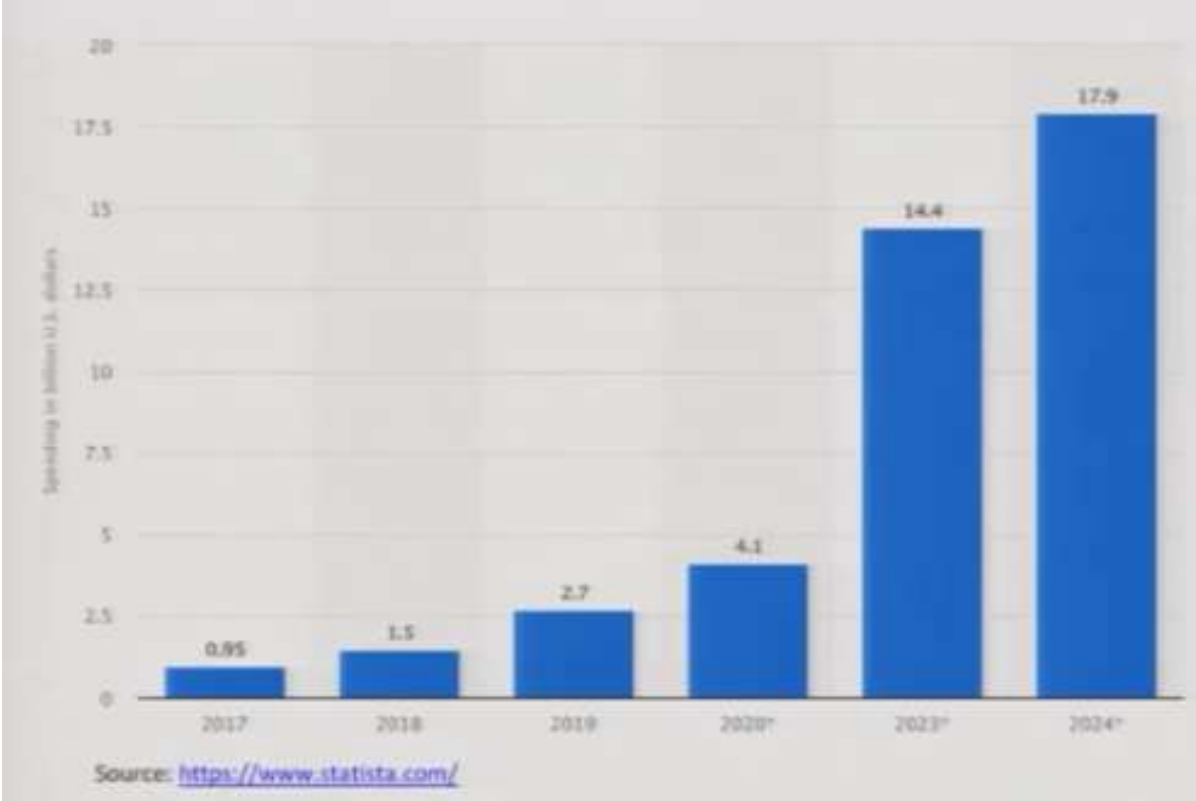
**Smart wedding contract** – Blockchain based marriage platform where couple signs marriage contract. The first couple to get married on the blockchain was David Mondrus and Joyce Bayo in **2014.**

**Cinemadrom** - It is an International Blockchain Network of Independent Filmmakers (IBNIF) based upon blockchain designed to finance, produce and distribute film projects and rights. Moviecash, Lutoken, and Lumiere crypto coins are the basis of Cinemadrom.

# Blockchain use case - India

- Andhra Pradesh was the first state to implement blockchain based land records especially for farmers  and some more are following this.
- Telangana is Government is exploring blockchain for Motor Vehicle Department applications to track the vehicle lifecycle from manufacturing to end of warranty period & is evaluating.
- Zebi is implementing blockchain based certificate management for 35 universities/ colleges in Karnataka & Andhra Pradesh

# Companies adopting/Experimenting with Blockchain




Worldwide spending on blockchain solutions from 2017 to 2024(in billion U.S. dollars)

# References


- https://101blockchains.com/
- https://blockgeeks.com/
- http://blockchaincan.com/
- https://www.cbinsights.com/research/industries-disrupted-blockchain/
- https://www.packtpub.com/product/the-complete-guide-to-blockchain-use-cases-video/9781839215148
- https://www.blockchain-council.org/

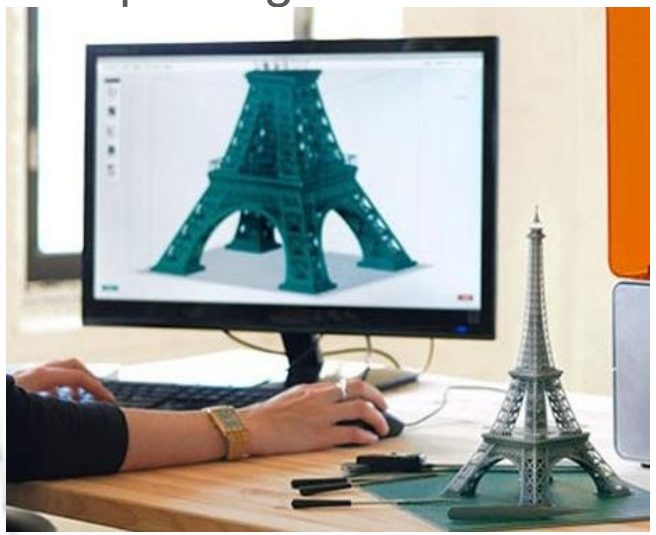
# 3D Printing Technologies

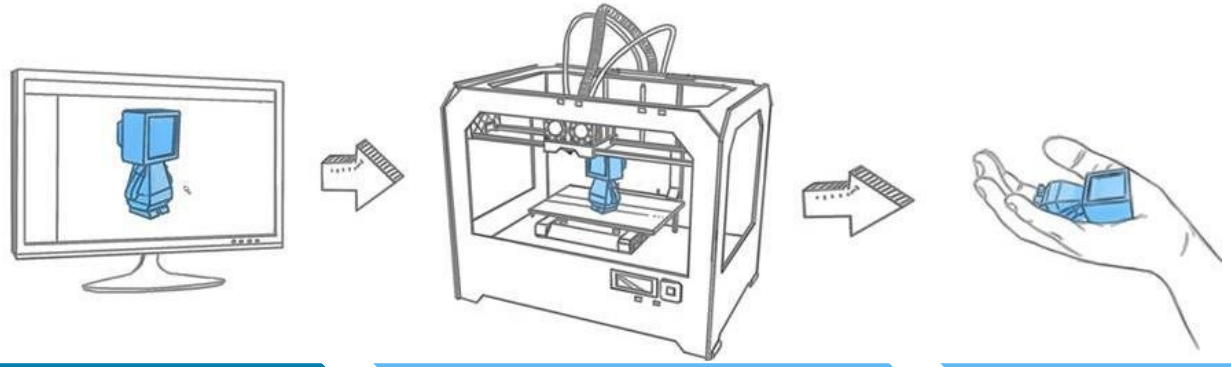
CONTEMPORARY TECHNOLOGY

# What is 3D printing?

3D + PRINTING = 3D PRINTING

The technology used for printing physical 3d objects from digital out is called 3d printing.





A person creates a 3D image of an item using a computer-aided design (CAD) software

The CAD information is sent to the printer.

The printer forms the item by depositing the material in layers—starting from the bottom layer—onto a platform

"ADDITIVE

Technologies that build 3D objects by adding layer on layer, whether the material is plastic, metal, concrete or any composite materials.

Diverse Needs

+ a visualization tool in design
+ a means to create highly customized products for consumers and professionals
+ as industrial tooling
+ to produce small lots of production parts

# History - Timeline

**1984 – 1987**
Charles Hull invents 3D printing and coins the term "Stereo Lithography"

**1992**
3D systems produce the first SLA 3D Printer machine

**1999**
Scientists manage to grow organs from patient's cells

**2000**
The first 3D inkjet printer produced by Object Geometries.

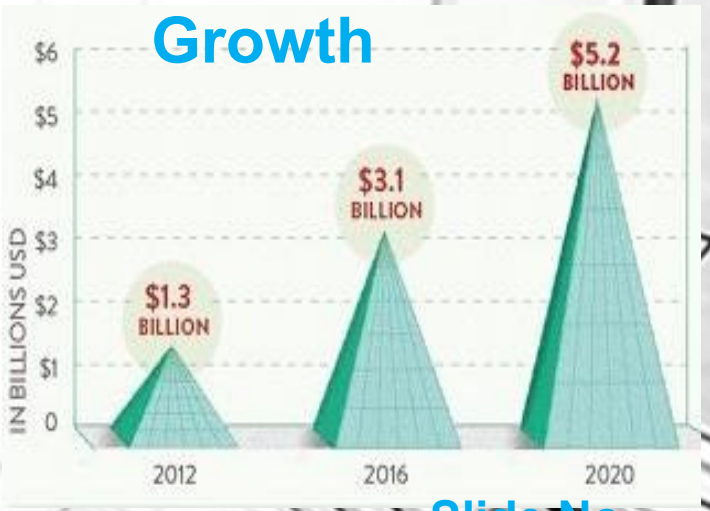
**2002**
A 3D printed miniature kidney is manufactured. Scientists aim to produce full-sized, working organs.

**2008**
The first 3D prosthetic leg is produced.

**2011**
The first 3D printed car (Urbee by Kor Ecologic).

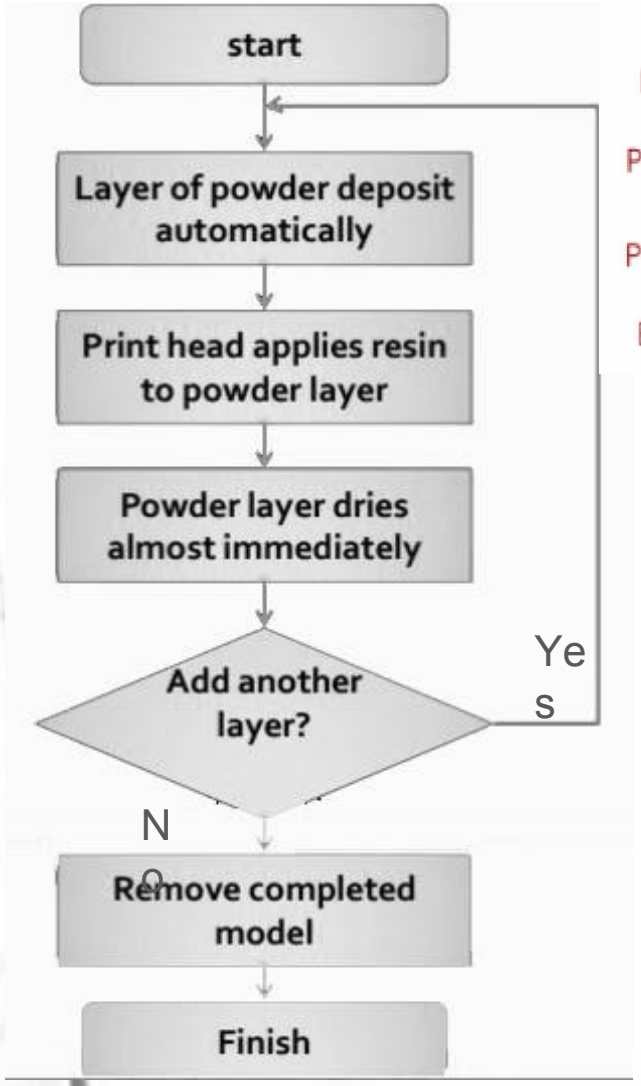
**2012**
The first 3D printed jaw is produced in Holland by LayerWise.

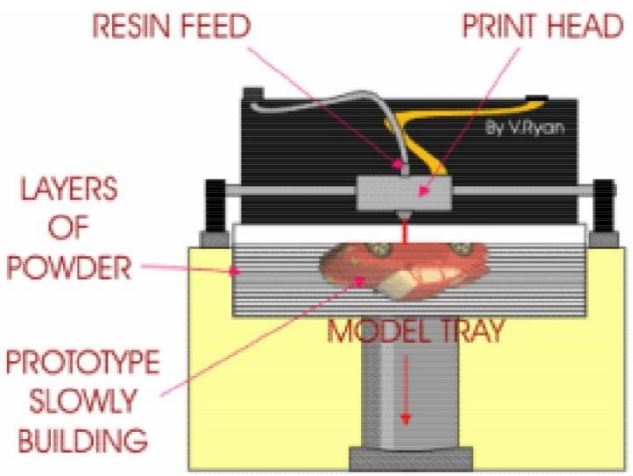
## Projected Growth

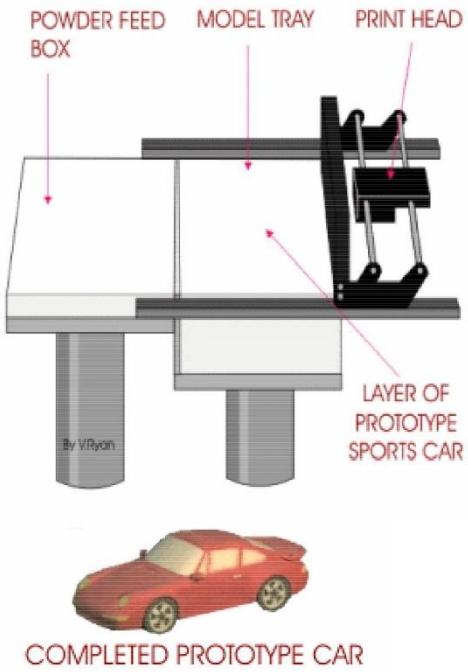


The first 3D printed  car (Urbee by Kor  Ecologic).

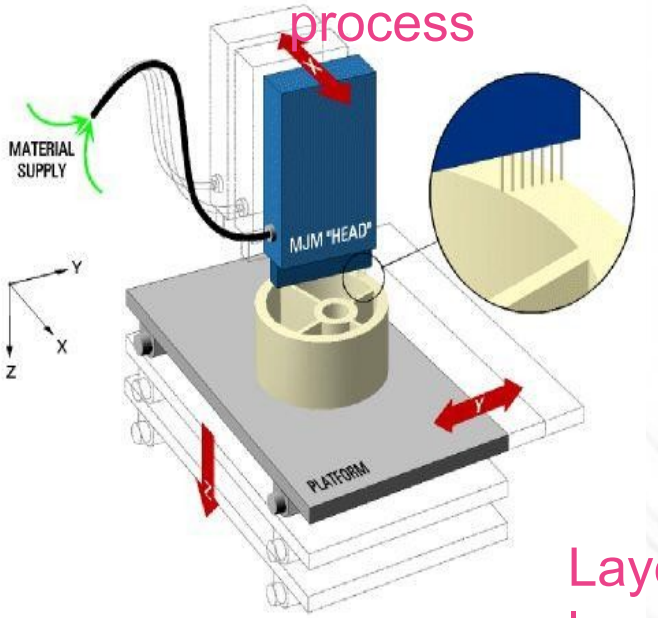
# Workin

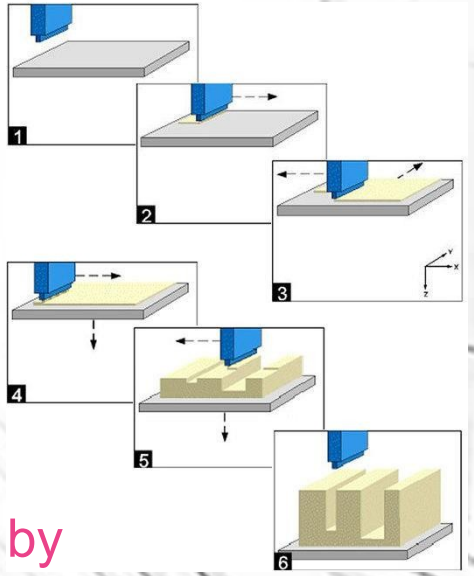


Whole manufacturing process




Layer by layer

Manufacturing a model with the 3D printer

# Types of 3D printing

There are three types of Printer.

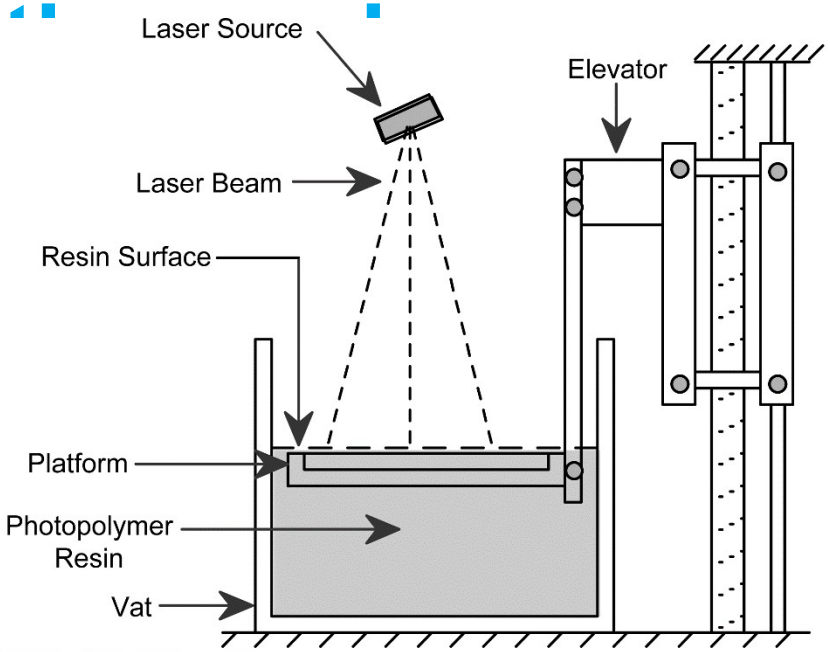
1. Stereo lithography (SLA)
2. Selective laser sintering (SLS)
3. Fused deposition modeling (FDM)

Selective laser sintering (SLS)

Fused deposition modeling (FDM)

Stereo lithography (SL)

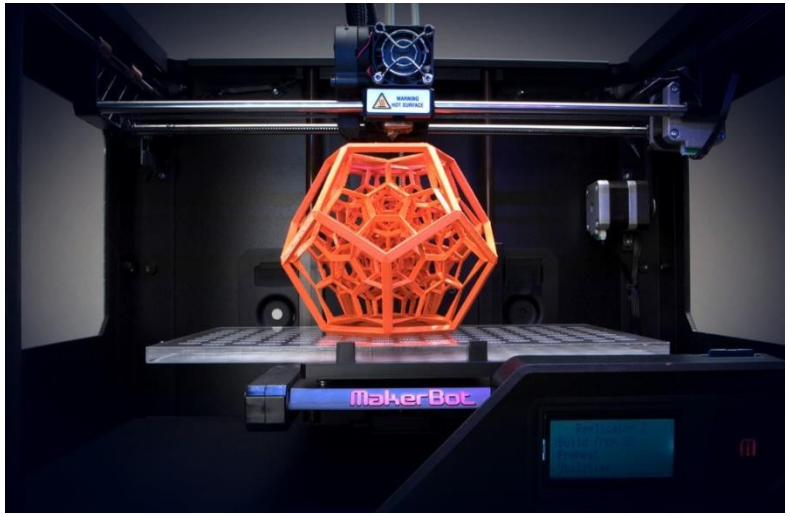
# 1. Stereo li




- Stereo lithography was the first type of 3D Printing created.

- This type of 3D Printing consists of a vertically movable vat and a horizontally movable UV light.
- Instead of ink, the vat is filled with a type of resin (photopolymer) that becomes hard when exposed to UV light.

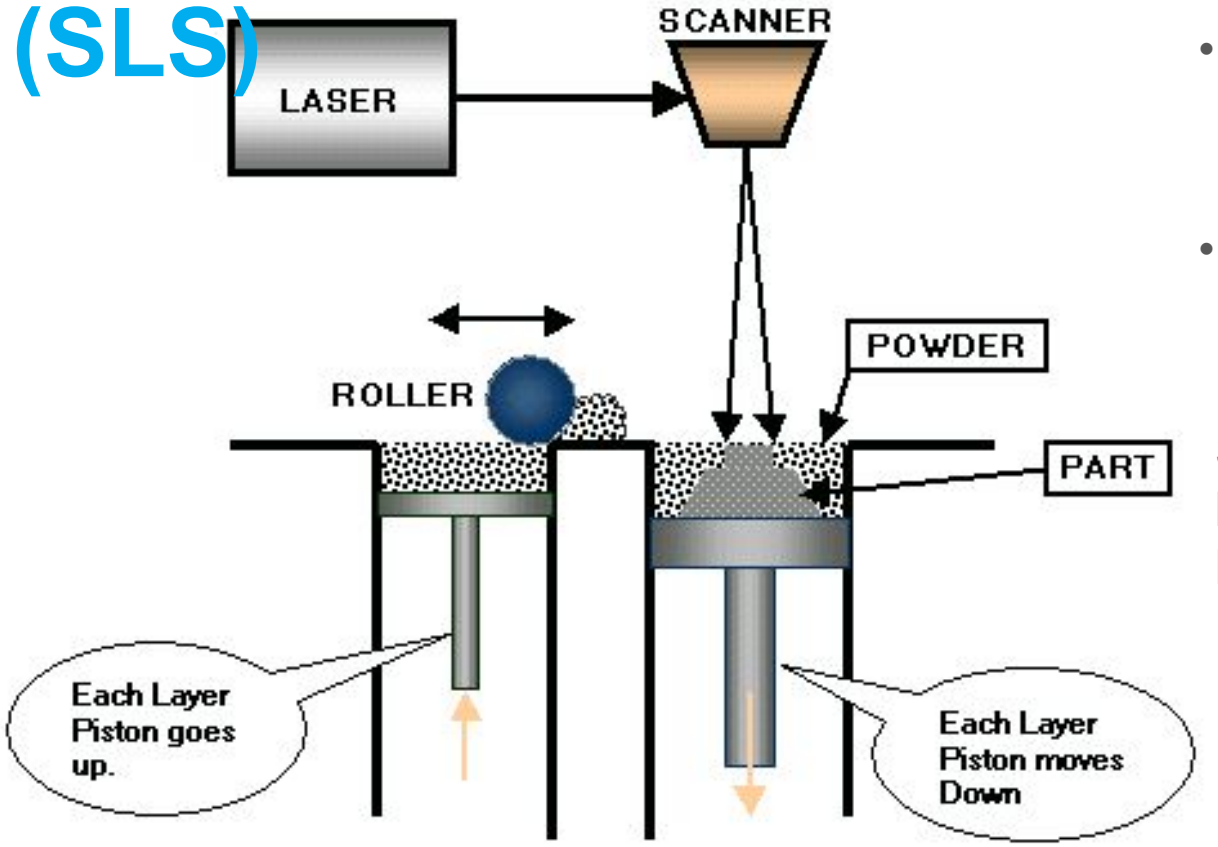
- Because photopolymers are photosensitive under UV light, the resin is solidified and forms a single layer of the desired 3D object.
- This process is repeated for each layer of the design until the 3D object is complete.




Advantages - is its speed; functional parts can be manufactured within a day.

Disadvantages - it is often costly; common photopolymers can cost about $800 per gallon and SLA machines can cost $250,000.

# 2. Selective laser sintering (SLS)



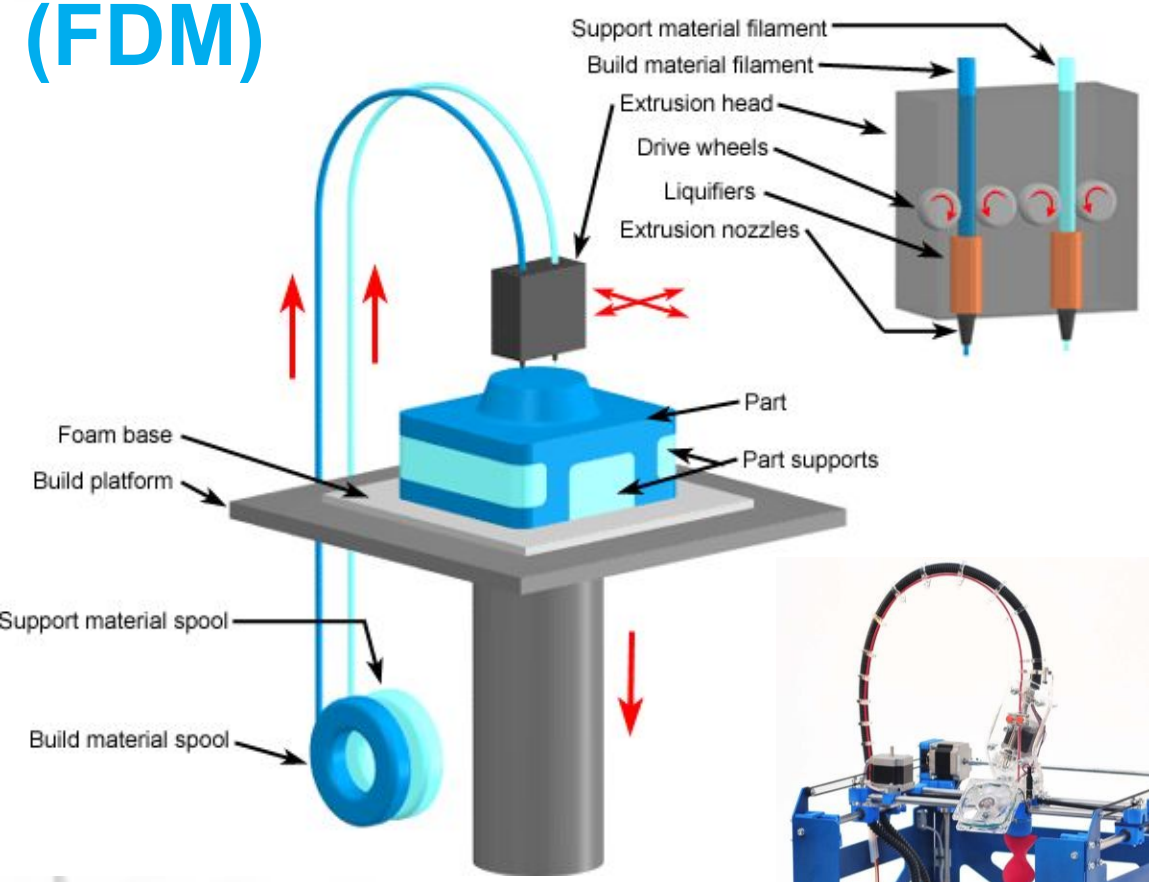

- In powder-bed SLS, a layer of powdered material is carefully laid down by a leveler or roller on the build tray.

- Layer thickness varies based on laser strength, material, or tolerance desired.

SLA liquid photopolymers cost $80 to $100 or more per liter. SLS powders costs between $300 and $600 per kilogram, and can be difficult to even purchase.

- Is an additive manufacturing technique that uses a high power laser (for example, a carbon dioxide laser) to fuse small particles of plastic, metal (direct metal laser sintering), ceramic or glass powders into a mass that has a desired 3-dimensional shape).

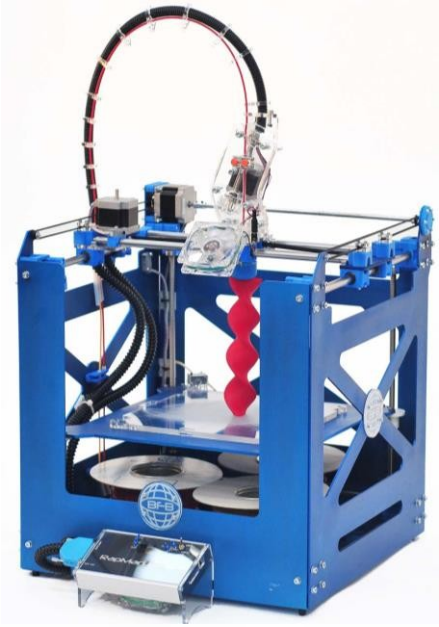
# 3. Fused deposition modelling (FDM)

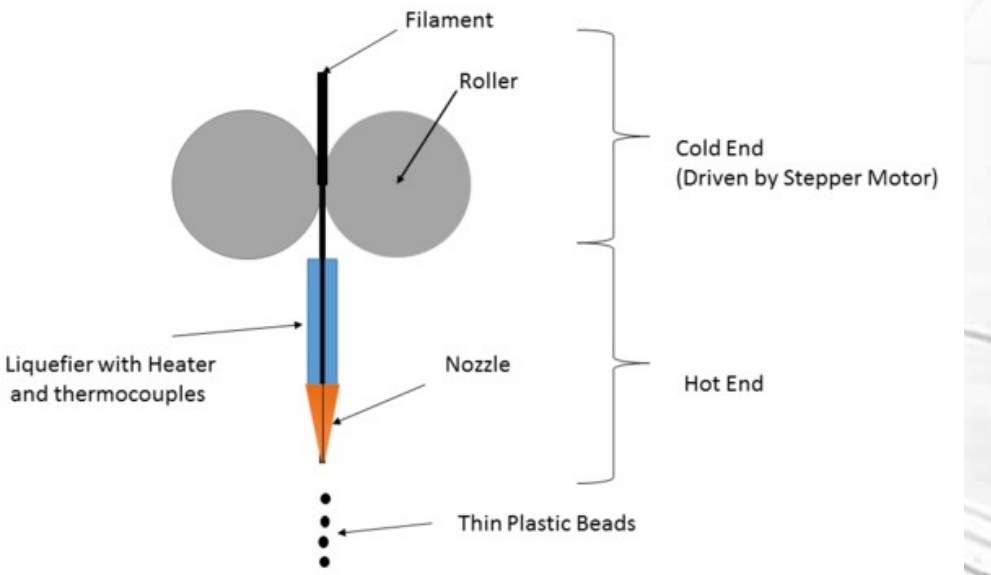



Fused Deposition Modeling is process that uses a continuous filament of a thermoplastic material.

In this type of 3D Printing, instead of a vat, there is a flat surface to build the 3D Model on,

Instead of a UV light, there is an extruder, a nozzle that melts a string of plastic that comes in one end and forces a small stream of plastic out the other end.





# Applications

**1. Design Prototypes:**

- 3-Dimensional Printing concept model, functional prototypes and presentation models for evaluating and refining design, and packaging.

**2. Education:**

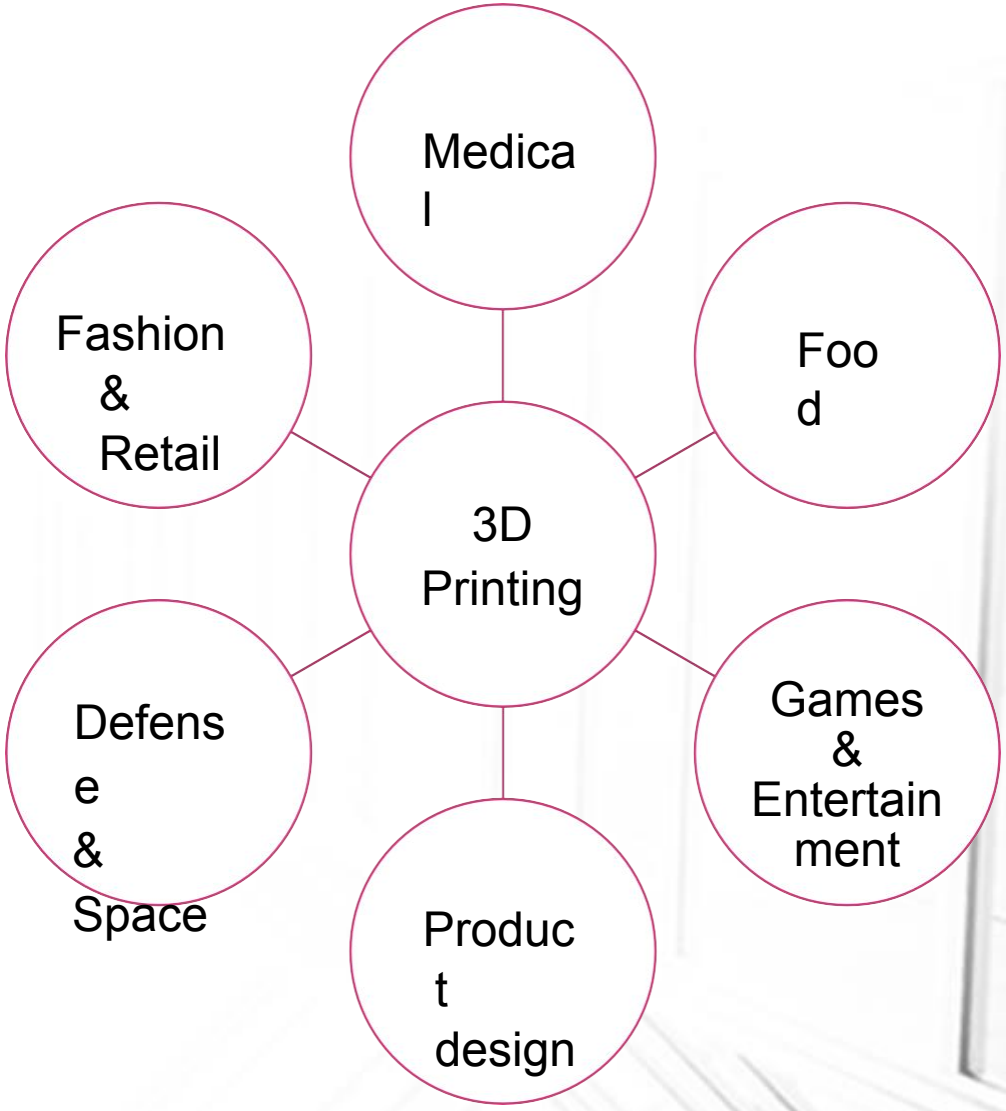
- Engage students by bringing digital concepts into the real world, turning their ideas into real-life 3D color models that they can actually hold in their hands.

**3. Healthcare:**

- Rapidly produce 3D models to reduce operating time, enhance patient and, and improve patient outcomes.

**4. Architecture:**

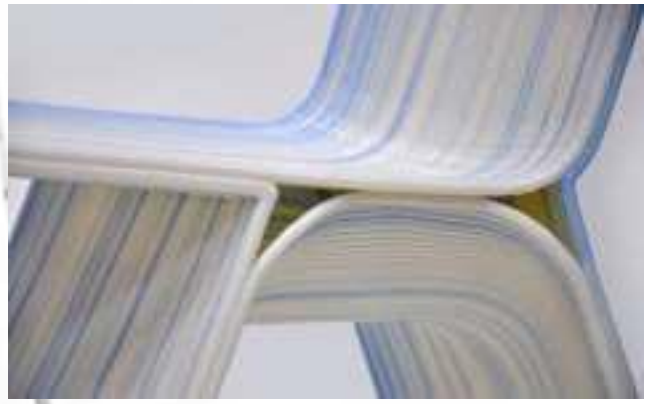
- Rapidly produce 3D models, concept models, produces smooth, detailed architectural models in an array of materials, including rigid photopolymers.



# Applications in

Architects Michael Hansmeyer and Benjamin Dillenburger printed these columns.

Architectural models



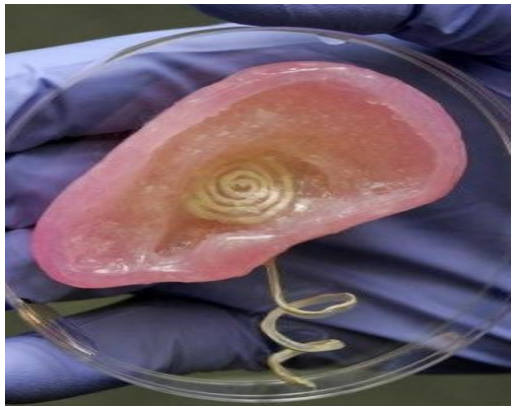
Benches, furniture

Sculpture s

Lamps for lighting

# Other

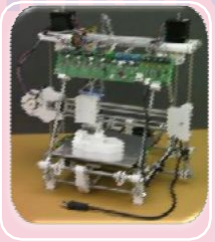
In food preparation, to apply items in liquid or paste form such as cheese, icing, and chocolate



**Medical industry - Physicians** can use 3D printing to make hearing aids, artificial teeth, and bone grafts. **3D printed Jaw**

This 3D-printed cast to help repair broken bones may be the future of medical orthopedic casts. 3D- printed casts also bring out the positive potential of this emerging technology.

# Cost of 3D printers



Rep Rap
**Model:** RepRap Pro Huxley
**Price:** $599

Eventorbot
**Model:** Delta Micro Up Afinia H-Series
**Price:** $1,500

Printrbot
**Model:** Printrbot GO
**Price:** $1,500

Makerbot
**Model:** Replicator 2x
**Price:** $2,800

The Future is 3D
**Model:** Glacier Steel
**Price:** 3000

3D Systems
**Model:** CubeX
**Price:** $3000

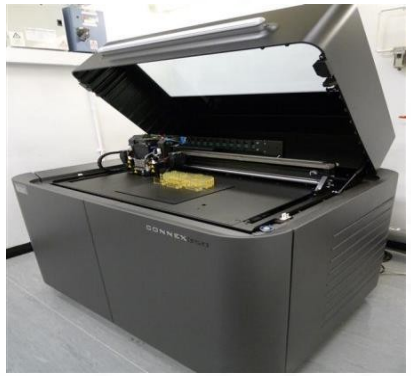
Formlabs
**Model:** Form 1
**Price:** $3,300

Stratasys
**Model:** U print SE Plus
**Price:** $15,000

| TYPE | RANGE |
|---|---|
| SLA | $ 500- $ 3000 |
| SLS | $ 1000- $ 4000 |
| FDM | $ 300- $ 5000 |

**Low End - Price : Rs 6,00,000**

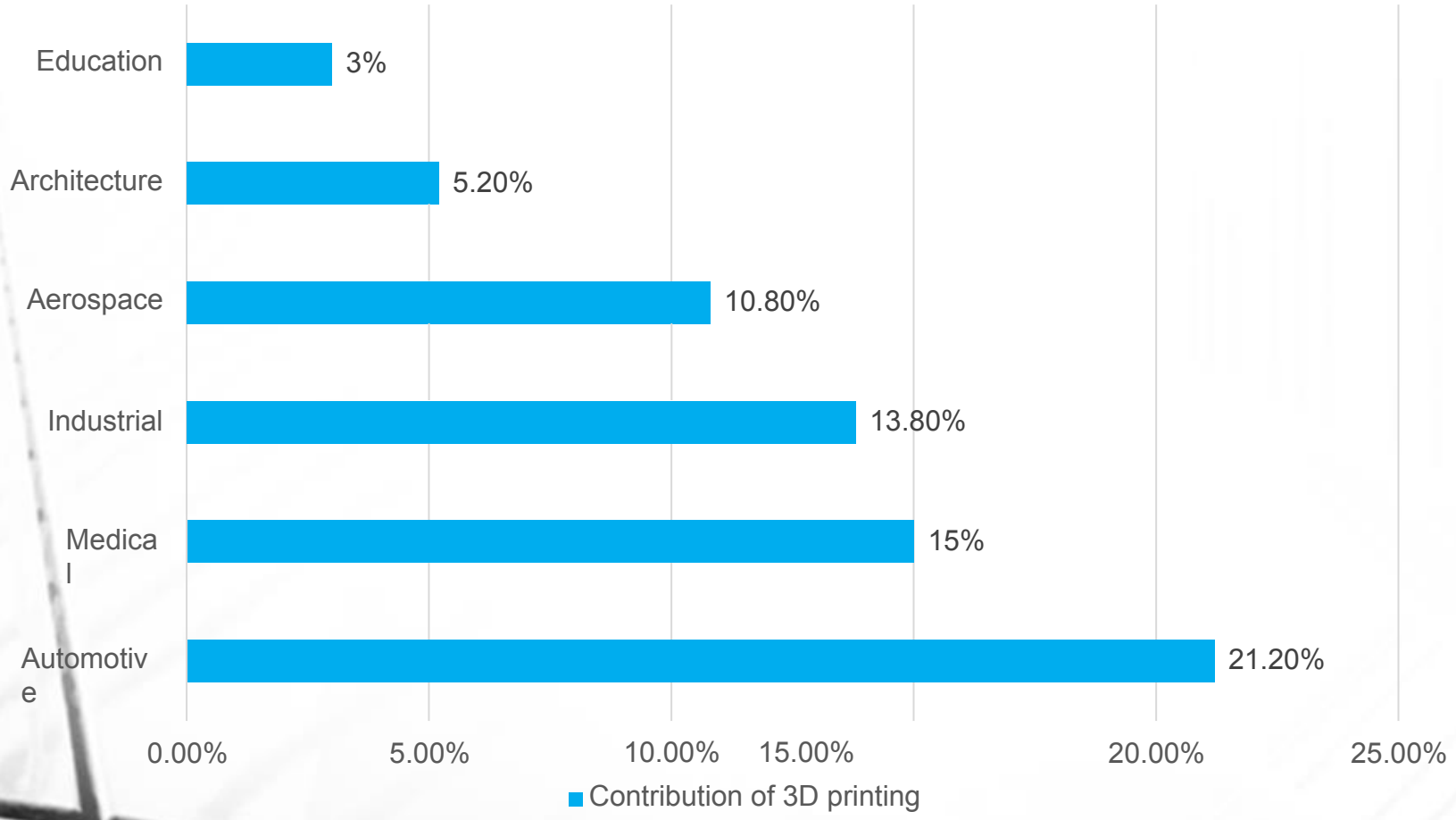
**Mid range - Price : 1 crores**



**High End - Price : 5 crores**

# Usage of 3D printing in India

The contribution of 3D printing in the various industries in the year 2013 are as follows:




The major INDIAN companies in India that are aspirants in this new field of 3D printing are:

- ALTEM Technologie s
- Imaginarium
- Brahma 3
- think3D
- JGroup Robotics

## Advantages

- RAPID PROTOTYPING: 3D printing gives designers the ability to quickly turn concepts into 3D models or prototypes (a.k.a., *rapid prototyping*).
- Clean process. Wastage of material is negligible.
- Complex shape can be produced .
- EASY TO USE No skilled person needed.
- REDUCE DESIGN COMPLEXITY
- CHEAP Cheaper process than any other process.
- People in remote locations can fabricate objects

## Disadvantages

- Process is *slow*
- Components do not have enough strength.
- COST OF RAW MATERIALS
- 3-D printers are still expensive.
- Misuse of technology
- Although 3-D printers have the potential of creating many jobs and opportunities, they might also put certain jobs at risk .
- Material limitation.

# Futur
# e

- With today's 3D printers, if you print anything you want and use. With tomorrow's, if you lose your remote, you'll be able to print a new remote.
- 3D printers are always getting cheaper and better.
- There is currently research going on to create 3D printers that could print out organs for people in need of a transplant.
- Within a decade, 3D printers will become commonplace in houses.

**The benefits of such technology are endless.**

# Conclusion

- 3D printing is an expanding technology which may soon start an industry in which everyone has the possibility of being a manufacturer.
- 3D printing has a lot of possible benefits to society, although the products created must be regulated.
- 3D printing has only been used on small scale projects in the construction industry and there are a lot of challenges that need to be dealt with prior to considering adopting it as one of the main construction technologies.

Nothing communicates ideas faster than a three-dimensional part or model. With a 3D printer you can bring CAD files and design ideas to life – right from your desktop. Test form, fit and function – and as many design variations as you like – with functional parts.

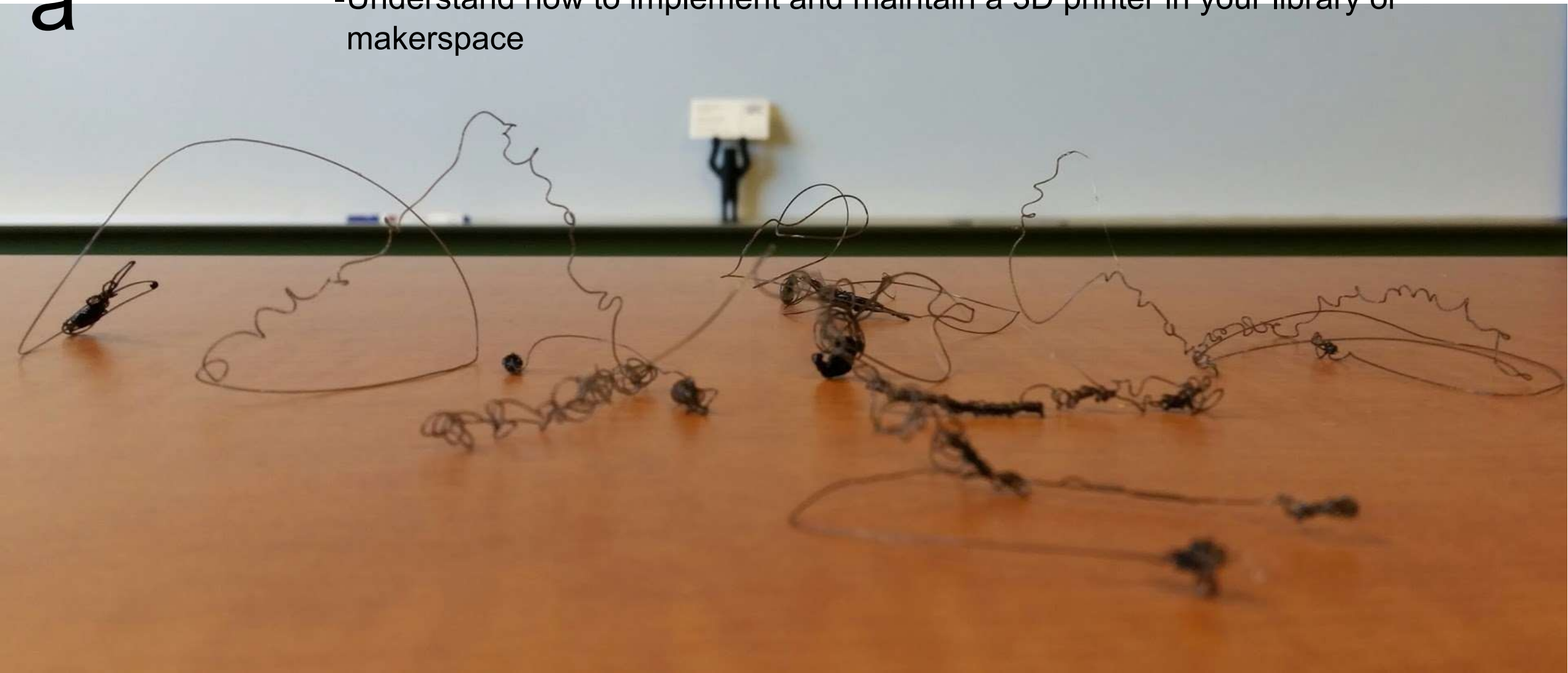
# THANK YOU !

# Introducing

# Design/Printing

# Agenda

- Learn what 3D printing is and how it works
- Get a snapshot of some of the best 3D printers on the market
- Discovery a variety of 3D design applications
- Study trends in digital scanning and other emerging 3D design/printing technologies
- Understand how to implement and maintain a 3D printer in your library or makerspace



# What is 3D printing?

First off, 3D printing is not new. Chuck Hull invented stereolithography (i.e., solid imaging) in the mid-1980s.

3D printing is also known as <u>additive manufacturing</u> , which is a process of making, layer by layer, three dimensional objects from a digital file. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.

**Source:**

# Seven processes are:

- Vat Photopolymerisation
- Material Jetting
- Binder Jetting
- Material Extrusion – The iLab’s Monolith printer uses Fused Deposition  Modeling (FDM) technology
- Powder Bed Fusion
- Sheet Lamination
- Directed Energy Deposition

# 3D Printing File Types

.STL – STereoLithography or Standard Tessellation Language

.OBJ – Object files define the geometry for objects. Includes textures.

.X3D – used for color printing. Also added shaders, geo-location etc.

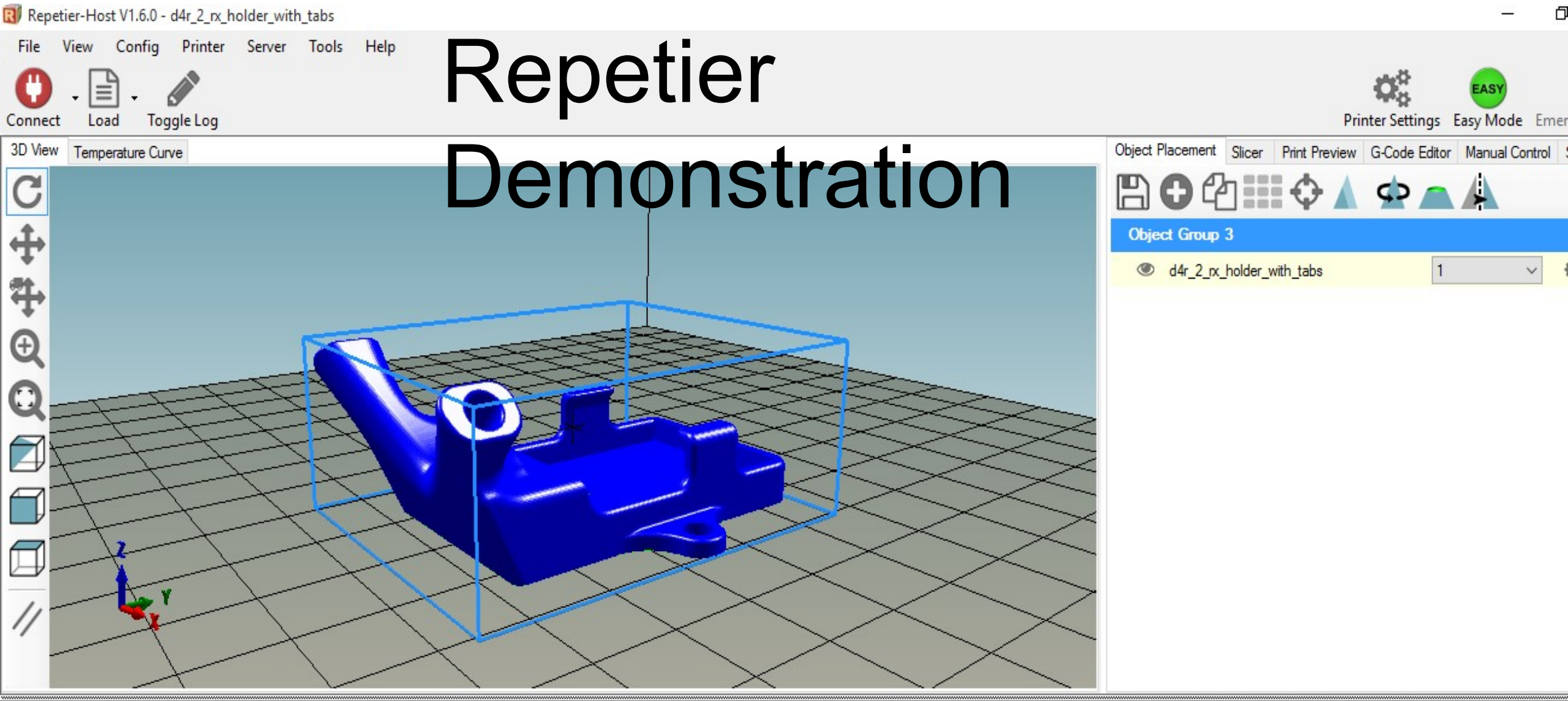
.VRML – used for color printing. Includes 3D geometry etc.

# 3D Printing Process

1. Design an object via computer aided design (CAD) or animation modeling software. Not design-oriented? Try Shapeways, Sculpteo or Thingiverse.
2. The software will export the object as an .STL file ("stereolithography" or "Standard Tessellation Language"), which will then be built (printed) layer-by-layer (i.e., Additive Manufacturing).
3. Load the .STL file into the printer. (e.g., via Repetier).
4. Slice (i.e., create layers for the object). Note: Repetier integrates Slic3r into the software.
5. 3D printing materials vary. We use PLA (Polylactic acid) filament. Visit http://reprap.org/wiki/PLA for more information.

Source:

# Repetier Demonstration

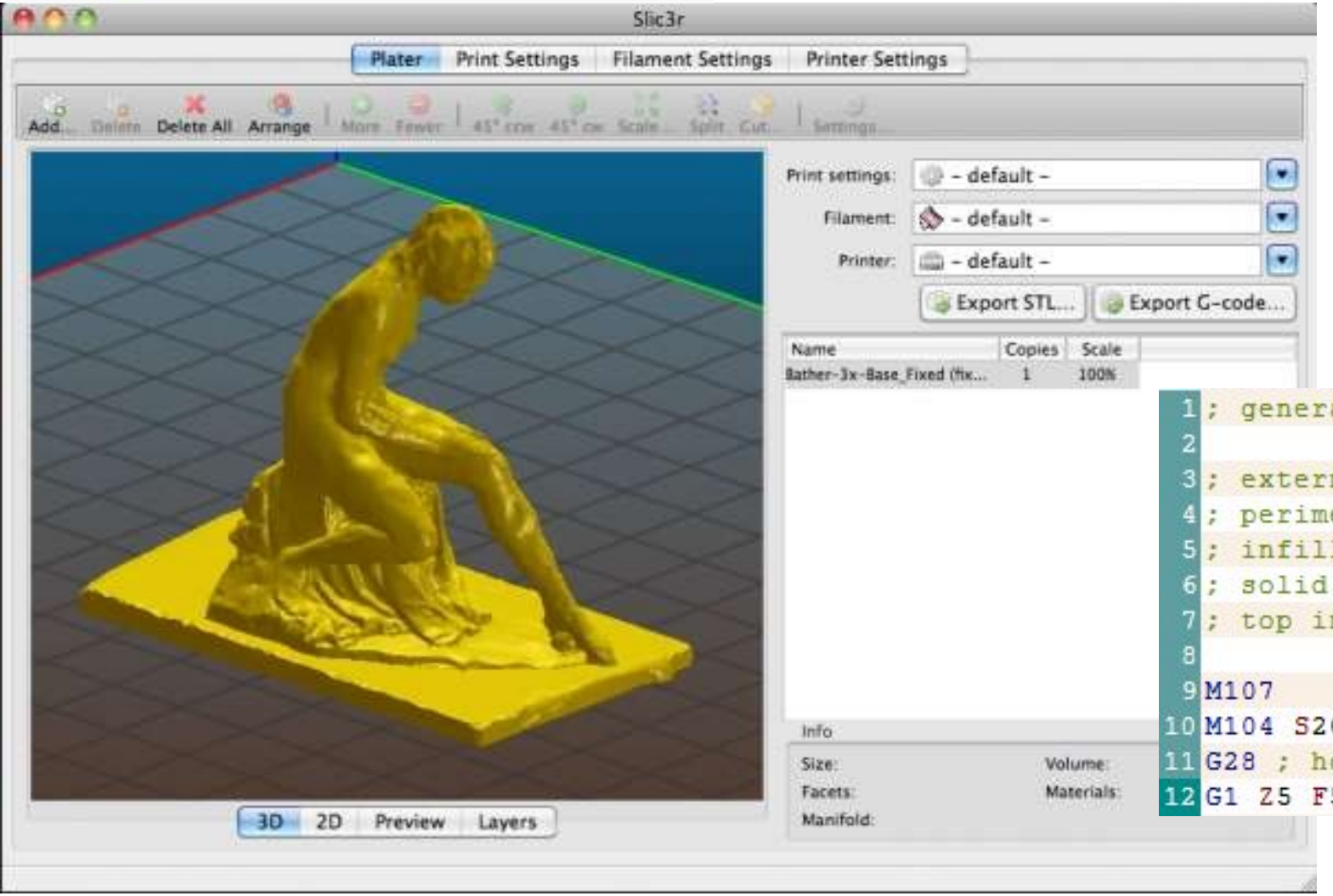



**Download it at**

Slic3r

G-code generator for 3D printers

G-code is a language in which people tell computerized machine tools how to  make something. G-code can also be used for CNC machines, knitting, tattoos etc.




```
; generated by Slic3r 1.2.9 on 2015-11-24 at 12:29:45

; external perimeters extrusion width = 0.50mm
; perimeters extrusion width = 0.72mm
; infill extrusion width = 0.72mm
; solid infill extrusion width = 0.72mm
; top infill extrusion width = 0.72mm

M107
M104 S200 ; set temperature
G28 ; home all axes
G1 Z5 F5000 ; lift nozzle
```

**Visit [http://3dprintingforbeginners.com/software-tools](http://3dprintingforbeginners.com/software-tools) for a large list of other 3D modeling, Slicer, 3D Printer Hosters**

# Fused Deposition Modeling

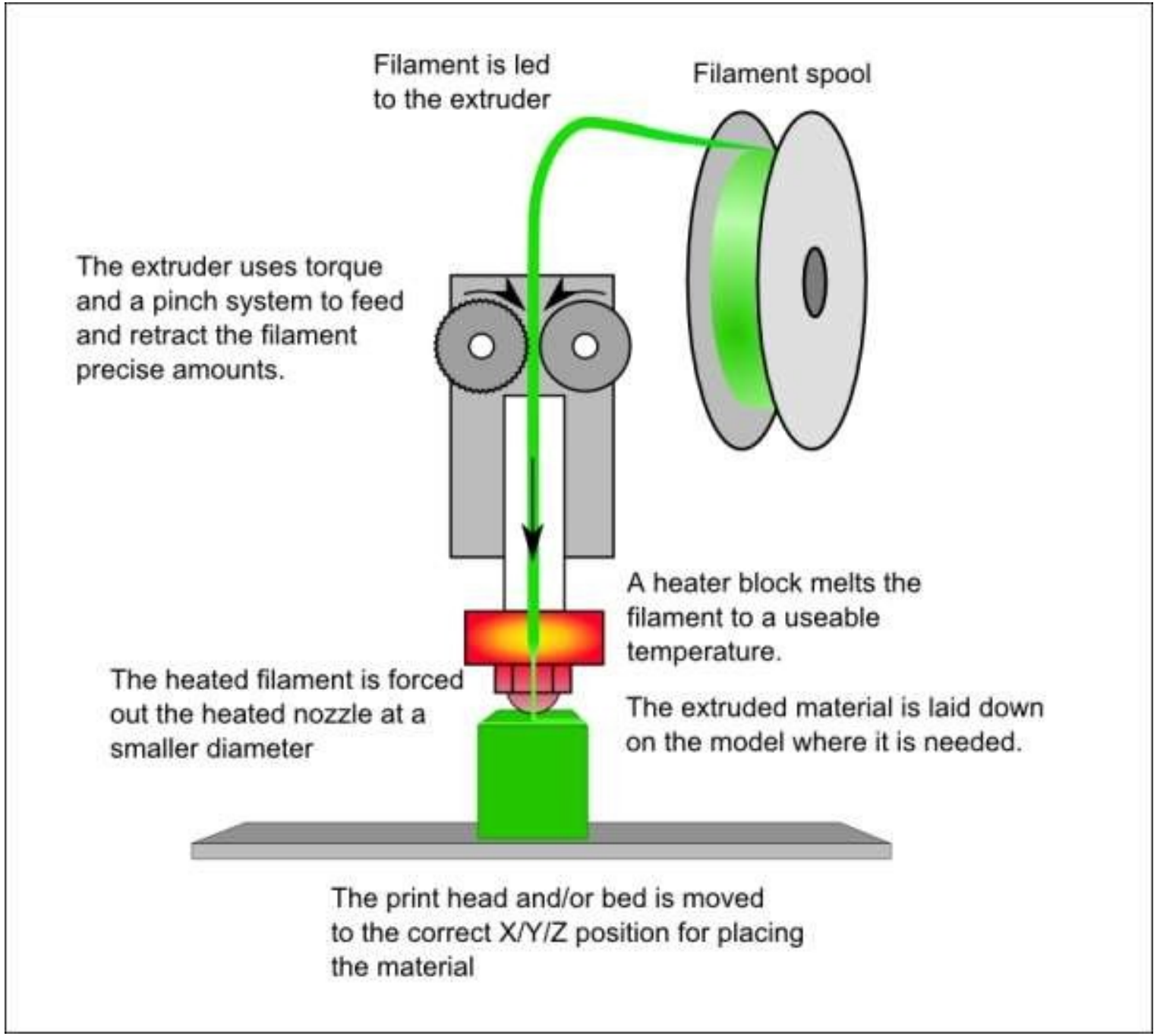



**Image source:**

# What to Expect with 3D Printing

- It is a slow process.
- It can be very frustrating.
- You will learn how to unclog the extruder and do other repairs.
- Setup a way to remotely monitor your prints (e.g., use a webcam via RealVNC or Repetier-Server etc.)
- Have a web form for print submissions with brief explanation.
- Create procedures/policies.

# The Innovation Lab [Makerspace @ SPC] has a Monolith printer.

FreeFab 3D
Swiss Designed – Florida Made
3D Printers

- Hybrid design combining the best of the Bukobot and MendelMax
- 200mm x 200mm x 200mm (8" x 8" x 8") build area
- 120mm/minute speed
- 0.1 - 0.25mm layer height
- 3mm filament-based feed stock
- Heated bed to print ABS, PLA and other plastics
- Budaschnozzle hot-end and RAMBo control board
- Flexible and advanced open-source design, including a USB interface
- LED extrusion lamps
- Compact precision aluminum frame
- Includes 1 roll of filament (black, blue, red or white)
- Fully assembled. Made locally in St. Petersburg, Florida

**Source:** http://freefab3d.com/

# Some Select 3D Printers

- LulzBot Mini, $1,350
- MakerBot Replicator, $2,899
- Ultimaker 2, $2,499
- XYZprinting Nobel 1.0, $1,500

**Visit https://www.3dhubs.com/best-3d-printer-guide the "most comprehensive 3D printer guide available!**

# Select 3D Applications/Tools:

- SketchUp - download a free trial and check out their 3D Warehouse!
- AutoCAD - free for students! You can visit this site for a list of other free software available to students.
- Tinkercad – free and easy to use online application for 3D printing/modeling.
- Blender - free open source 3D content creation suite.
- Kinect Studio - record and play back depth and color streams from a Kinect.
- Meshmixer - a free tool for making 3D stuff without too much hassle.
- Skanect – capture a full color 3D model of an object.
- ReconstructMe - 3D real-time scanning system.
- 123D Catch – free app that lets you create 3D scans of any object.

# Select 3D Printing Services etc.

- Shapeways - 3D Printing Service & Marketplace
- UPS 3D Printing - UPS Stores have expanded 3D printing services to meet the growing demands.
- i.materialize - turn your ideas into 3D printed reality
- Thingiverse - Digital Designs for Physical Objects
- Sculpteo – 3D prints your ideas/products
- Amazon.com's 3D Printing – Customization, Sandboxr etc.
- Smithsonian X 3D - print historic artifacts.

# Hands on

**Source:**

# Digital Scanning DIY style with Eureka Factory!

Do you think 3D printing will change the world?

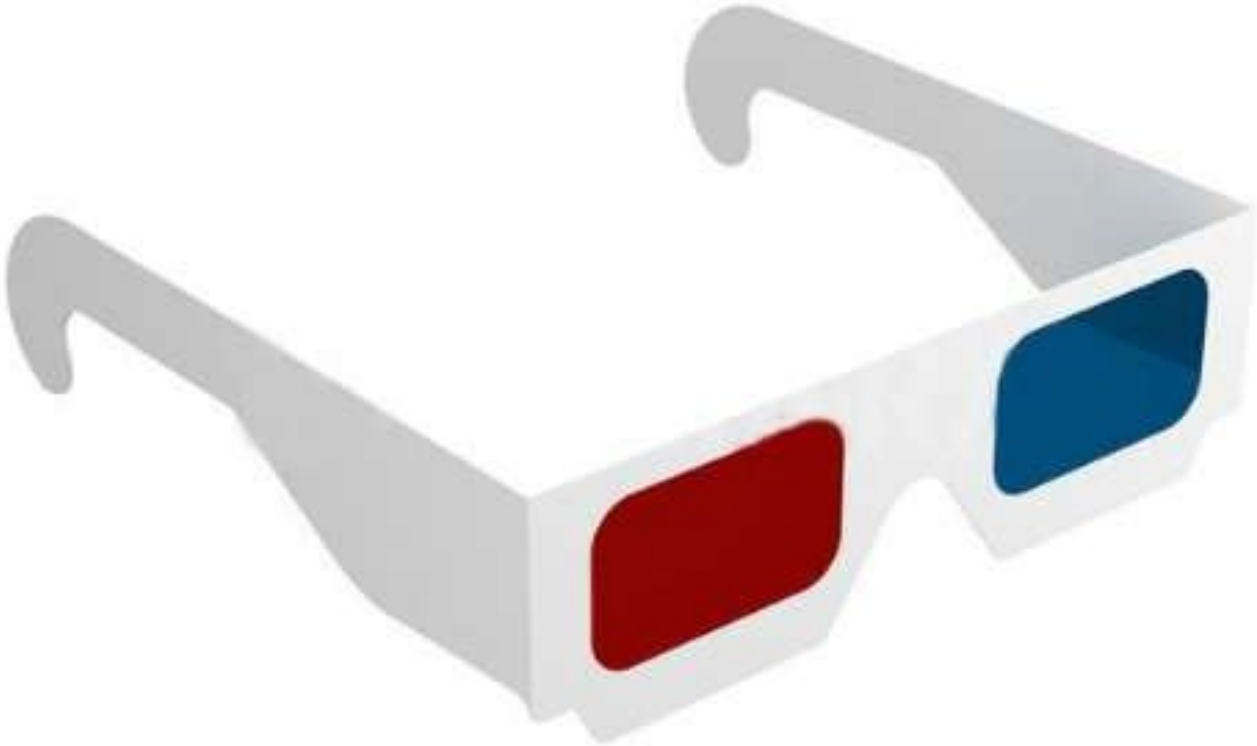
WWW.ENABLINGTHEFUTURE.ORG
x5

The road ahead for 3-D printers

| Industry sector | Some emerging and near-term future uses of 3-D printing |
|---|---|
| Automotive and industrial manufacturing | ▪ Consolidate many components into a single complex part<br>▪ Create production tooling<br>▪ Produce spare parts and components<br>▪ Faster product development cycle with rapid prototyping, form and fit testing |
| Aerospace | ▪ Create complex geometry parts not possible with traditional manufacturing • Control density, stiffness, and other material properties of a part; also grade such properties over a part • Create lighter parts |
| Pharma/ Healthcare | ▪ Plan surgery using precise anatomical models based on CT scan or MRI<br>▪ Develop custom orthopedic implants and prosthetics<br>▪ Use 3-D printed cadavers for medical training<br>▪ Bioprint live tissues for testing during drug development |
| Retail | ▪ Create custom toys, jewelry, games, home decorations, and other products<br>▪ Print spare or replacement parts for auto or home repair, for example |
| Sports | ▪ Create complex geometry and shape not possible with traditional manufacturing<br>▪ Create custom protective gear for better fit and safety<br>▪ Create custom spike plates for soccer shoes based on biomechanical data<br>▪ Create multi-color and multi-material prototypes for product testing |

**Read more at:**

Grab a pair!



And look at 3D printing in 3D!

# Connect with the iLab ...

facebook /groups/spcilab

Medium.com/innovation-lab-makerspace-spc

tumblr.
spcilab. .com

Wikispaces
spcilab. .com

iLab@spcollege.edu

# The Potential of 3D printing

*an overview of the current state of rapid prototyping*
*the manufacturing revolution*

## ITS MAIN CHARACTERISTICS

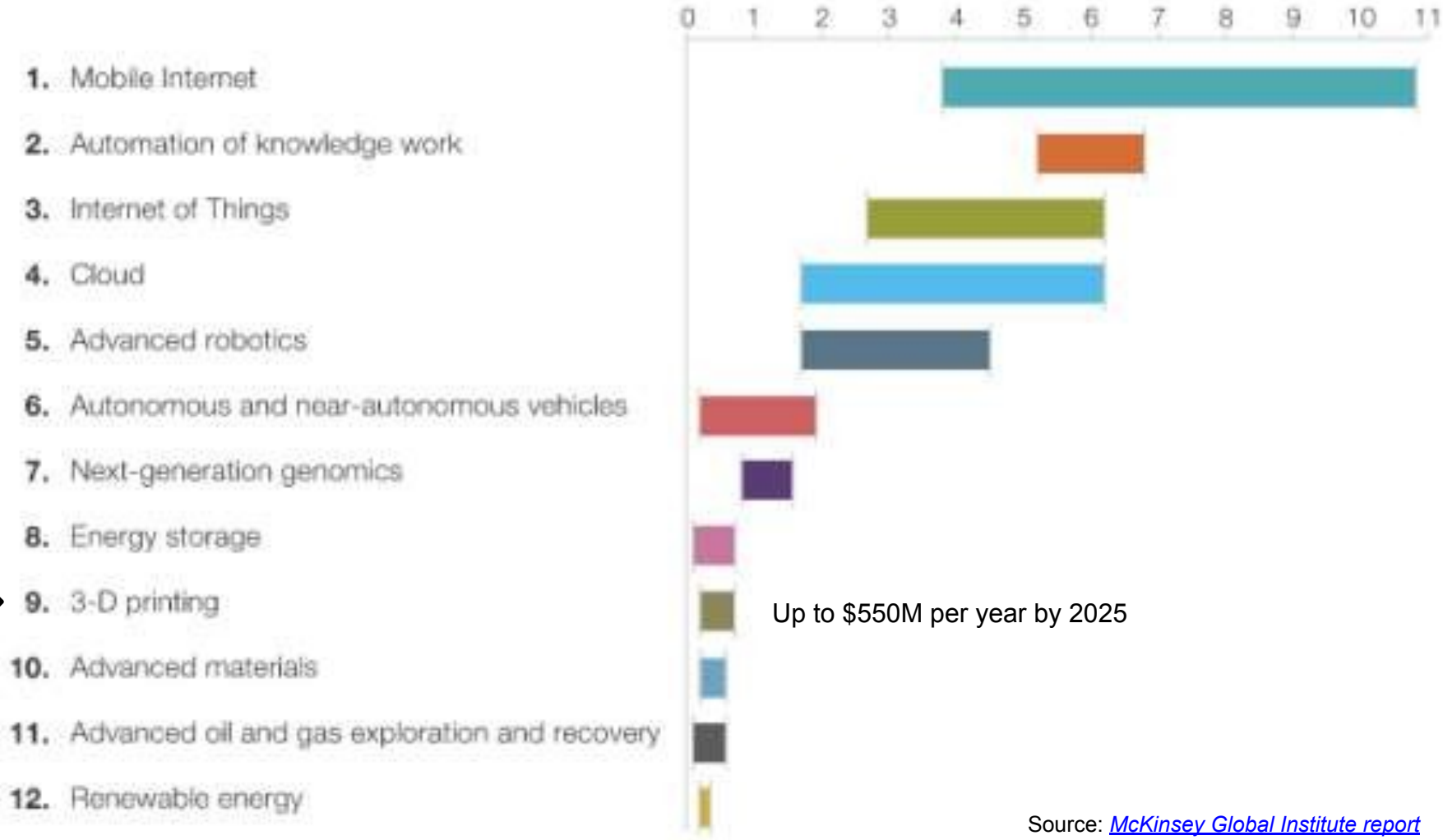
Customizable production
Small batches production
Local production
Production on demand (real-time need)
Complex design (Mold free production)
Combination of materials

## ITS ADVANTAGES

Custom made solutions
Affordable customization
Market responsiveness (agile/easy adjustments)
Management of demand uncertainty
Reduction in required inventory
Efficient use of raw materials (zero waste)
Shorten maintenance & repair cycle
Distributed production
Safe on production costs
Zero cost of increased complexity
Allows manufacture of more efficient designs — lighter, stronger, less assembly required
One machine, unlimited product lines
Very small objects (nano)
Pay by weight — complexity is free
Batches of one, created on demand
Print at point of assembly/consumption
Manufacturing accessible to all — lower entry barriers

# A gallery of **disruptive technologies**

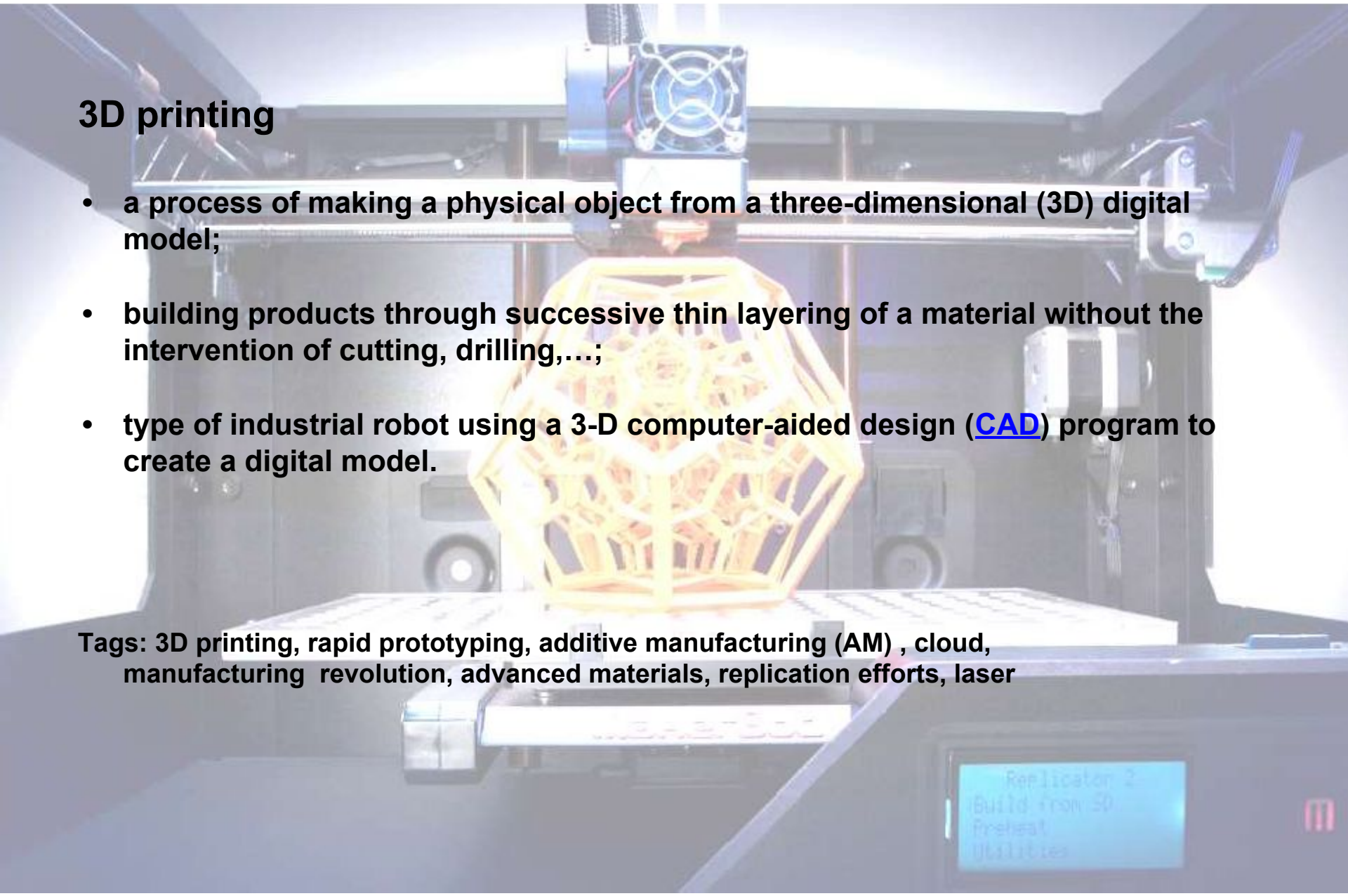
**Estimated potential economic impact of technologies across sized applications in 2025**, $ trillion, annual




Up to $550M per year by 2025

Source: *McKinsey Global Institute report*

# Definition



## 3D printing

- a process of making a physical object from a three-dimensional (3D) digital model;
- building products through successive thin layering of a material without the intervention of cutting, drilling,…;
- type of industrial robot using a 3-D computer-aided design (CAD) program to create a digital model.

Tags: 3D printing, rapid prototyping, additive manufacturing (AM) , cloud, manufacturing revolution, advanced materials, replication efforts, laser

# The benefits

LTC

## BENEFITS

- Mold free manufacturing
- Fast turnaround
- High quality products in short runs
- Complex designs
- Light weight functional parts
- Parts consolidation
- Save on production cost
- Customize the same products according to your needs
- Adaptive quality control

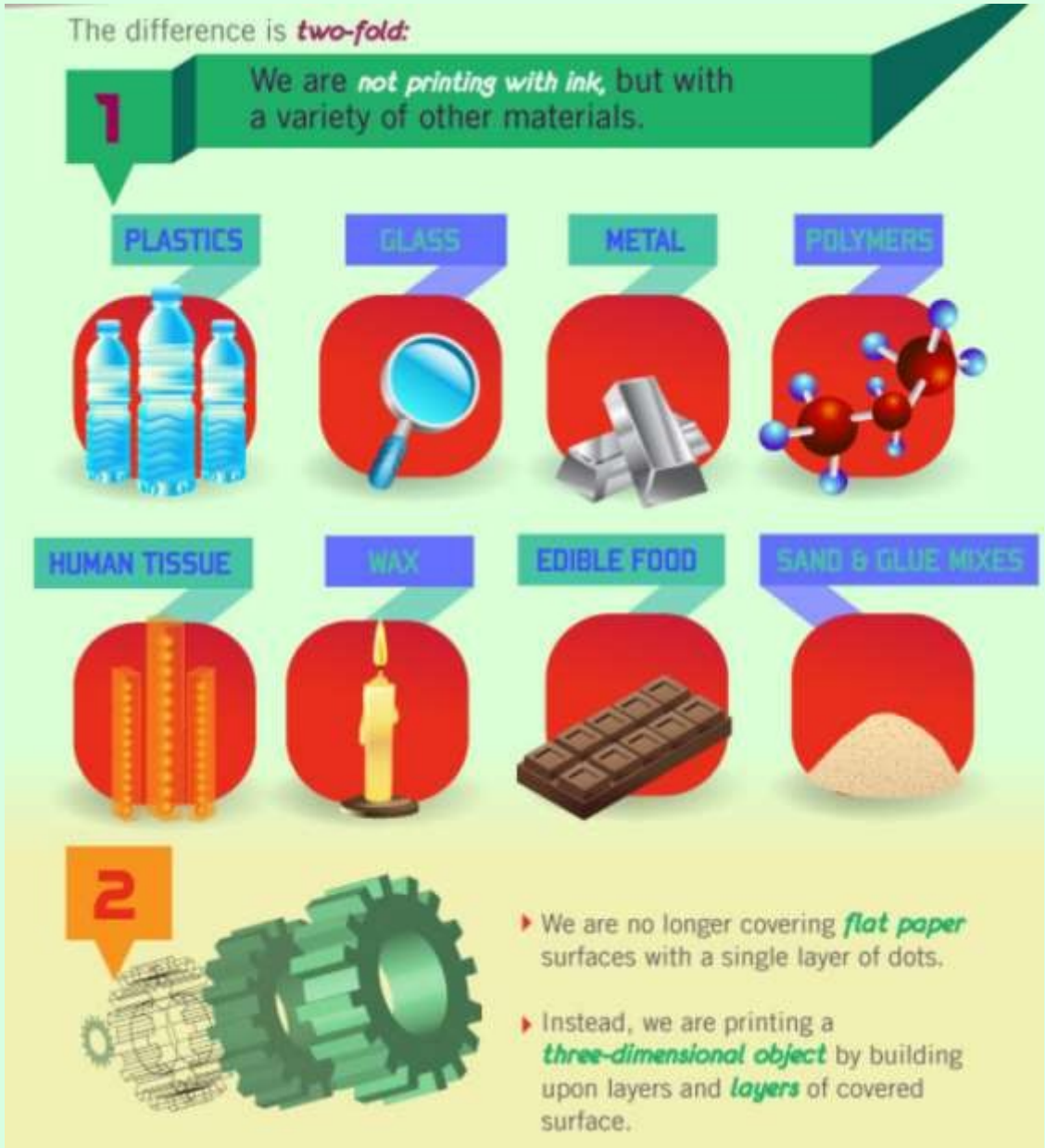
Personalise products

Reduce Development Costs

Speed Time to Market

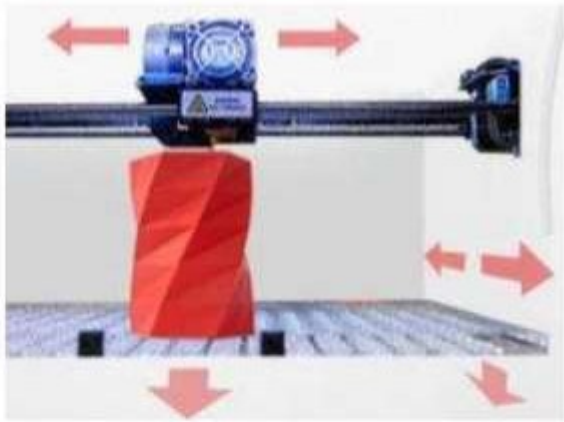
Source: Anubis3D

# 2D printing versus 3D printing




Source: 3D printing

# How does it works?



A person creates a 3D image of an item using a computer-aided design (CAD) software program.

The CAD information is sent to the printer.

The printer forms the item by depositing the material in layers—starting from the bottom layer—onto a platform. In some cases light or lasers are used to harden the material.



Source: UXTrendspotting

# 3D Printing impact on core costs of products & services

LTC

## Creation

- Raw material prize
- Quality
- Customization

## Information

- Social networks
- Blogging
- Reviews

 easy access to near-perfect market information

## Experiment

- Environments optimized for collaboration
- Design
- “Cost of Combine”

# Types of Use & Applications

1. **Test of ideas and concept**
   Prototyping in research and development (Prototypes / Models difficult)

2. **Internal manufacturing**
   Manufacturing of parts/ office tools. Custom tooling: manufacture fully functional tools (sensors for monitoring/ filters, etc)

3. **External Manufacturing**
   Manufacturing of production goods for sale to consumers and manufacturing of supplies to be used by customers

4. **Mass customization**
   Print customized pieces at industrial quantities and rates. Hence, products can be redesigned for both one-off and mass customization.

5. **Use of multifunctional materials**
   Future new materials : self-reconfiguring, self-healing, programmable, multifunctional (conduting), changing shape and behaviour over time (smart materials/ 4D printing)

6. **Manufacture at point of use**
   Manufacturing will no longer be centralized. Any piece will be printable anywhere around.

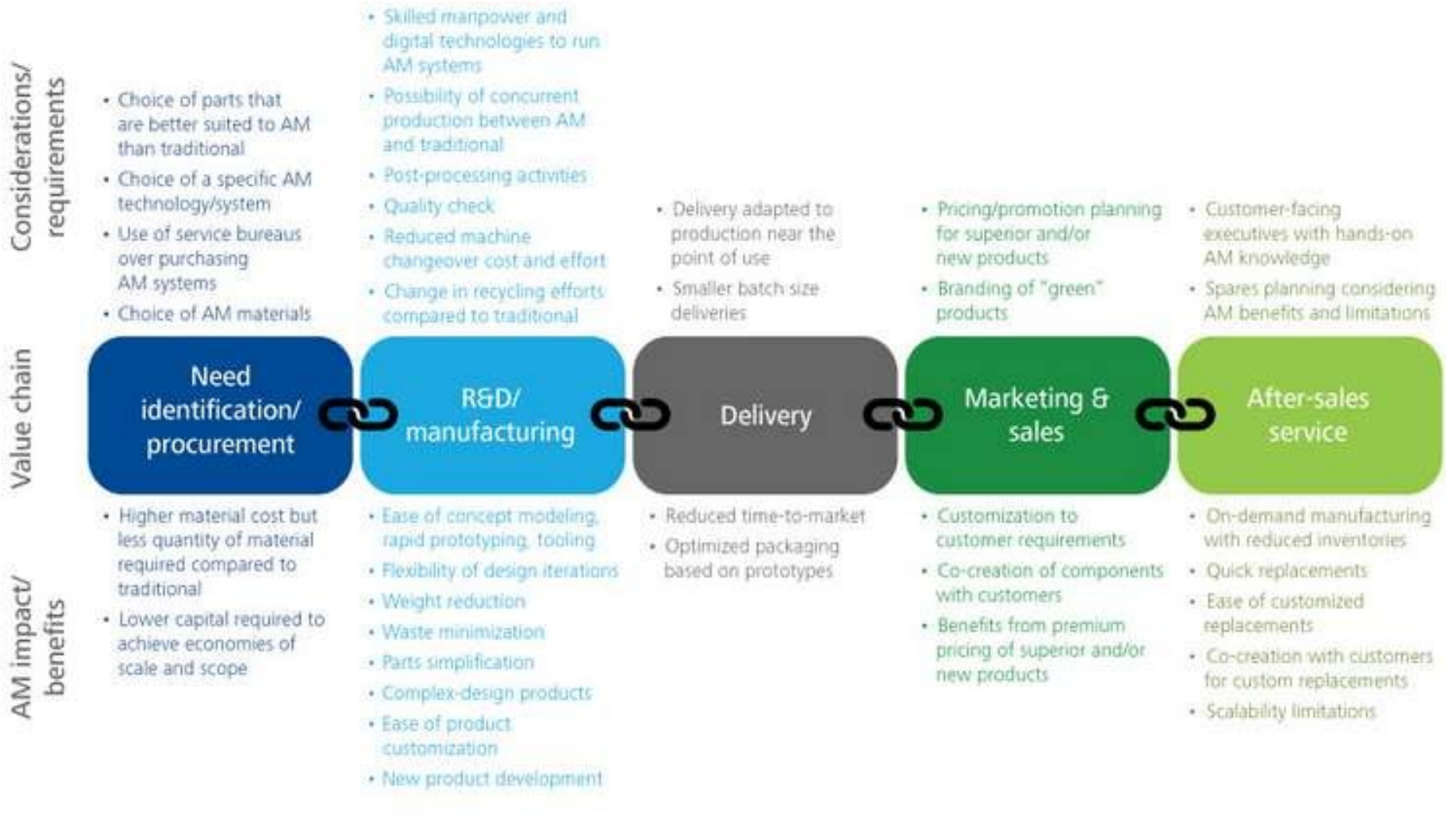
7. **Reinvent warehouse/ reduce inventory** (from products to raw materials)
   The promise of immediate ‘on-the-spot’ production signals the end of keeping large inventories in warehouses. It facilitates supplementary or “insurance” capability.

8. **Complex design**
   Complexity free production method due to zero cost of increased complexity. No molds and high degree of structure flexibility. This will lead to a shift from restrictive design for manufacturing to manufacturing of the ideal design.

# Benefits

LTC

**Figure 8. Strategic considerations and benefits for AM adoption across value chain elements**




Graphic: Deloitte University Press | DUPress.com

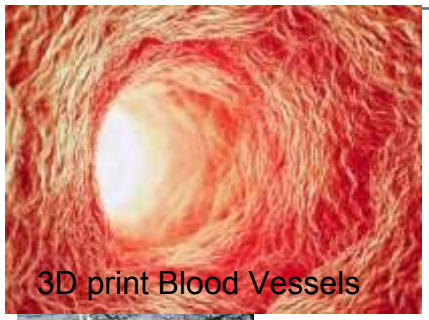
# Things to improve & hurdles on the way

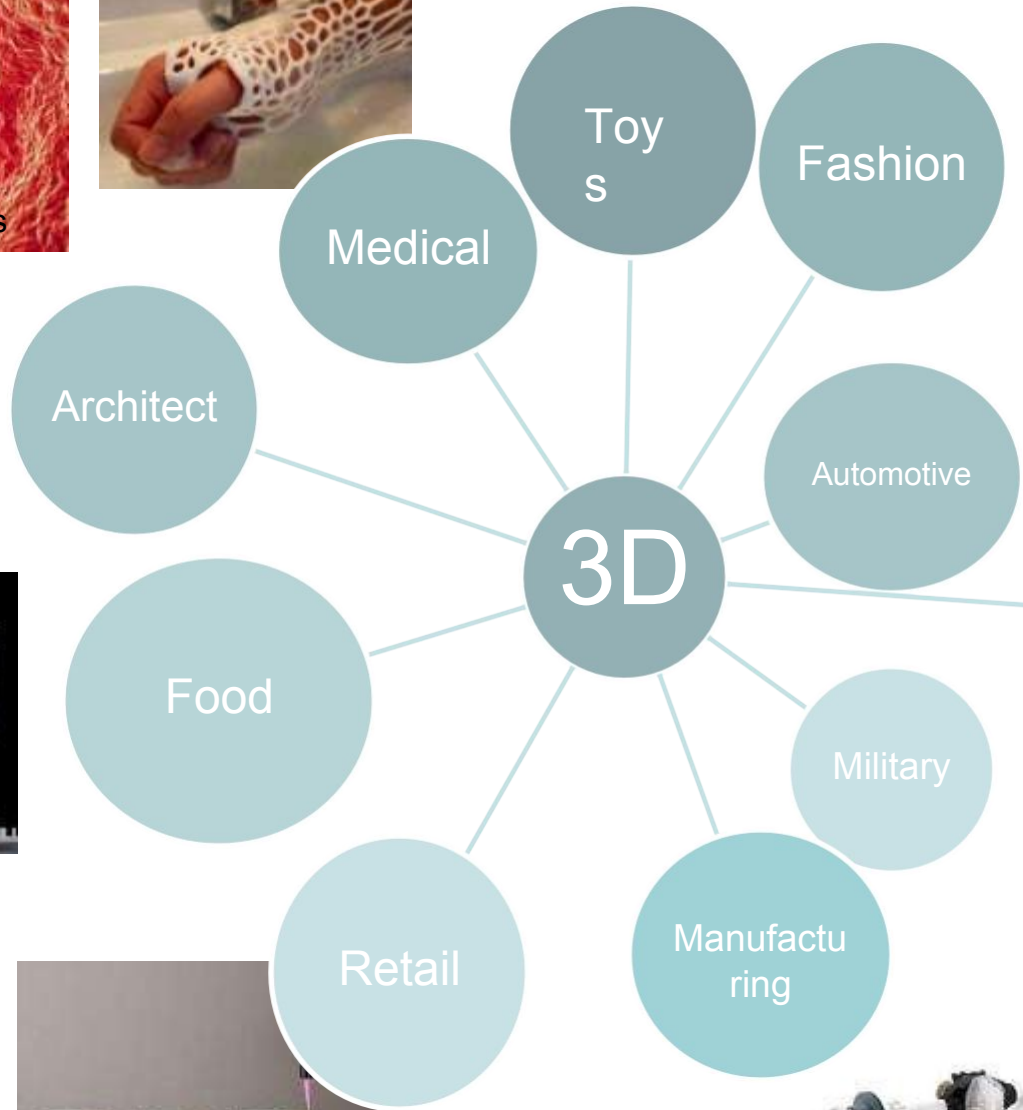
LTC

- Surface finish & resolution
- Speed of printing
- Costs of raw material
- Ink inefficiencies
- Machine range
- Potential risk from hackers and software bugs
- Misuse of technology (danger of self producing unwanted objects like guns)
- Legal restrictions & ethics
- The cost of producing large volumes of some products can be high using 3D printers

Image credit

# Sectors where applied: what can be printed? Just anything

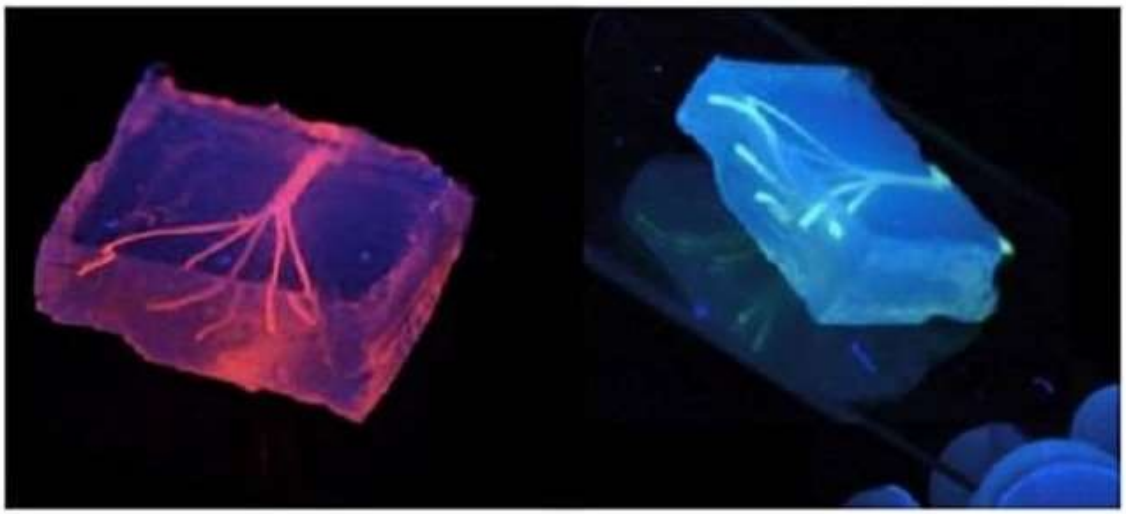





www.leadtochange.net

# Medical applications beyond imagination

## Scientists Can Now 3D Print Human Blood Vessels



Sure, we can now 3D print stem cells and even whole organs like kidneys, heart, liver and lungs. But 3D printing blood vessels? Now that was a challenge.

A team from Brigham and Women's Hospital in Boston has managed to successfully fabricate blood vessels using a three-dimensional bioprinting technique

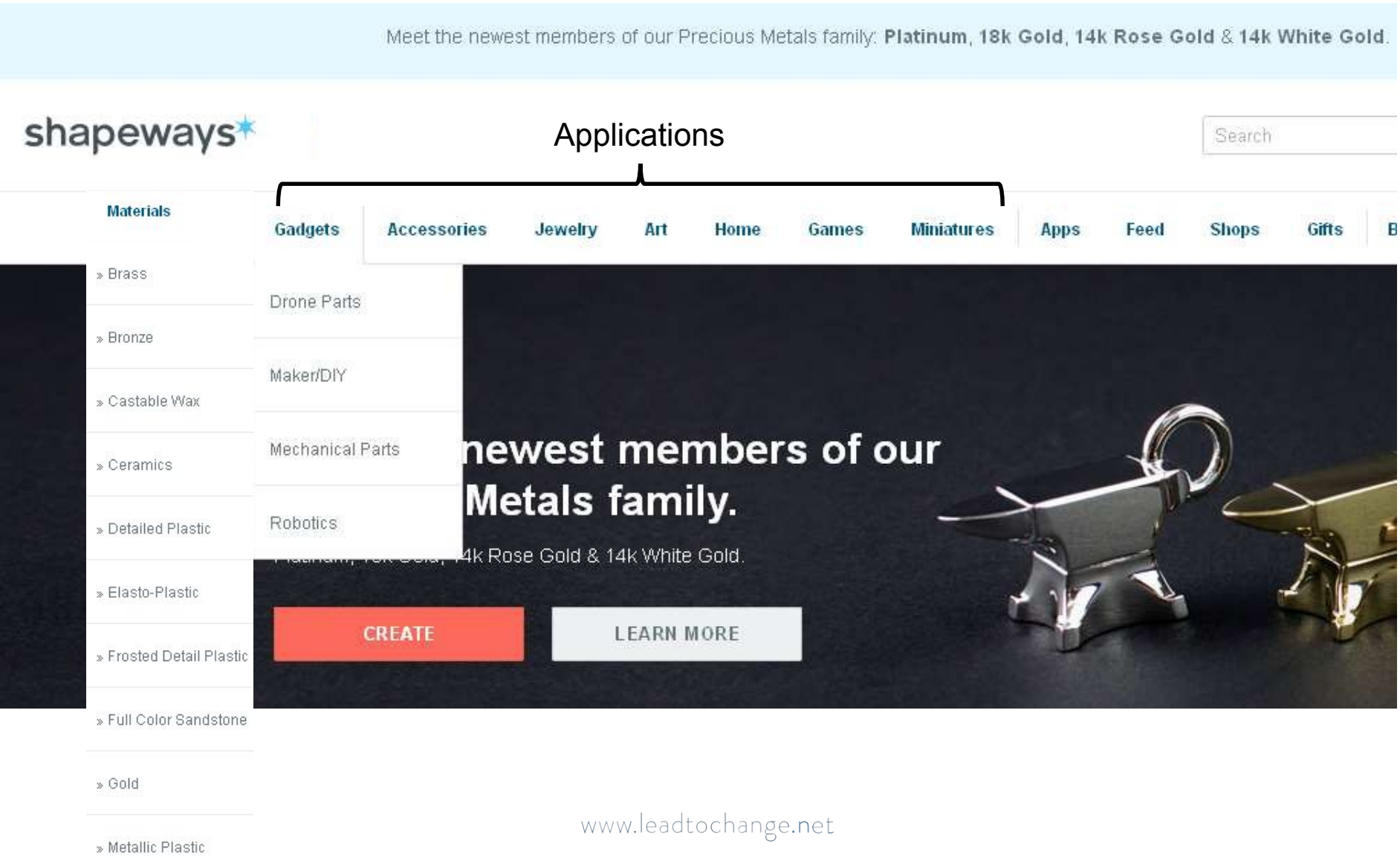
Gizmodo

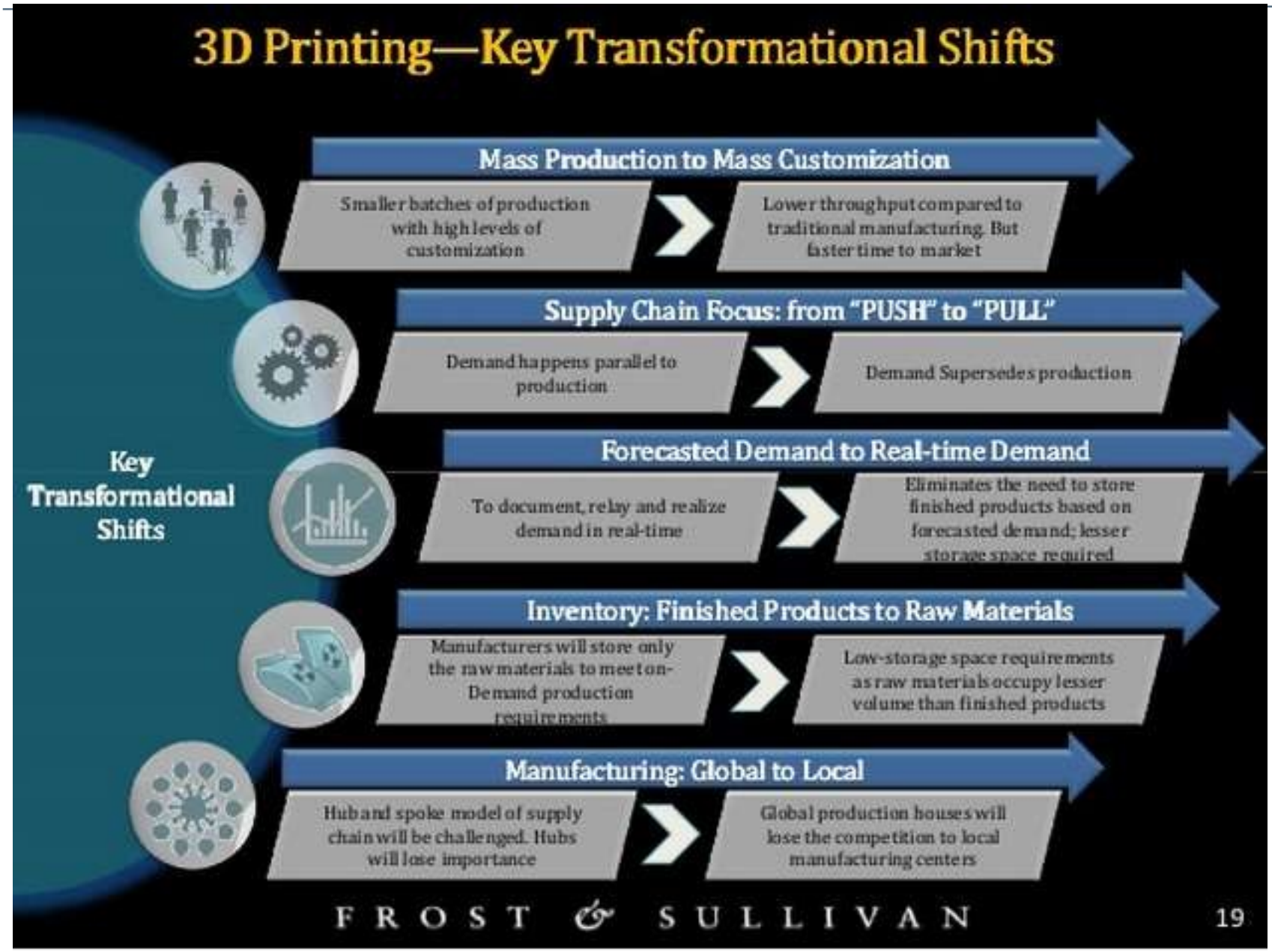
Source: CSC

# 3D printing of a house (with waste materials for >$5.000)

Source:Dialymail

# The Wide Range of Commercial Possibilities




3D Printing—Key Transformational Shifts
Key Transformational Shifts
Mass Production to Mass Customization
Smaller batches of production with high levels of customization
Lower throughput compared to traditional manufacturing. But faster time to market
Supply Chain Focus: from "PUSH" to "PULL"
Demand happens parallel to production
Demand Supersedes production
Forecasted Demand to Real-time Demand
To document, relay and realize demand in real-time
Eliminates the need to store finished products based on forecasted demand; lesser storage space required
Inventory: Finished Products to Raw Materials
Manufacturers will store only the raw materials to meet on-Demand production requirements
Low-storage space requirements as raw materials occupy lesser volume than finished products
Manufacturing: Global to Local
Hub and spoke model of supply chain will be challenged. Hubs will lose importance
Global production houses will lose the competition to local manufacturing centers
FROST & SULLIVAN
19

# Manufacturing

supply chains (e.g., warehousing and distribution of spare parts) will be transformed by the possibility to fabricate in small factories with on-site 3D printing capabilities or outsource the task to small fabricators located, say, close to airports and other hubs instead of storing stock in warehouses.

Source: DHL

Implications of 3D material supply



Source: 3D printing

# 3D Printing vs Traditional Manufacturing

3D printing saves on energy by 40 to 65 percent as it eliminates shipping and other logistics activities and enables users to produce objects with lesser material

## Traditional Manufacturing vs 3D Printing, Global, 2014

| Traditional Manufacturing | | 3D Printing |
|---|---|---|
| Higher Cost of manufacturing & shipping | Cost | Up to 70% savings due on Prototyping costs |
| Less innovative designs due to cost constraints | Design | Allows for easy yet inexpensive innovation in design |
| More time to build final product | Speed | Lesser time taken due to compressed design cycles |
| Creates more waste; subtractive process will compromise on precision | Quality | Lighter & smaller amount of waste; Higher precision with layer-by-layer manufacturing. |

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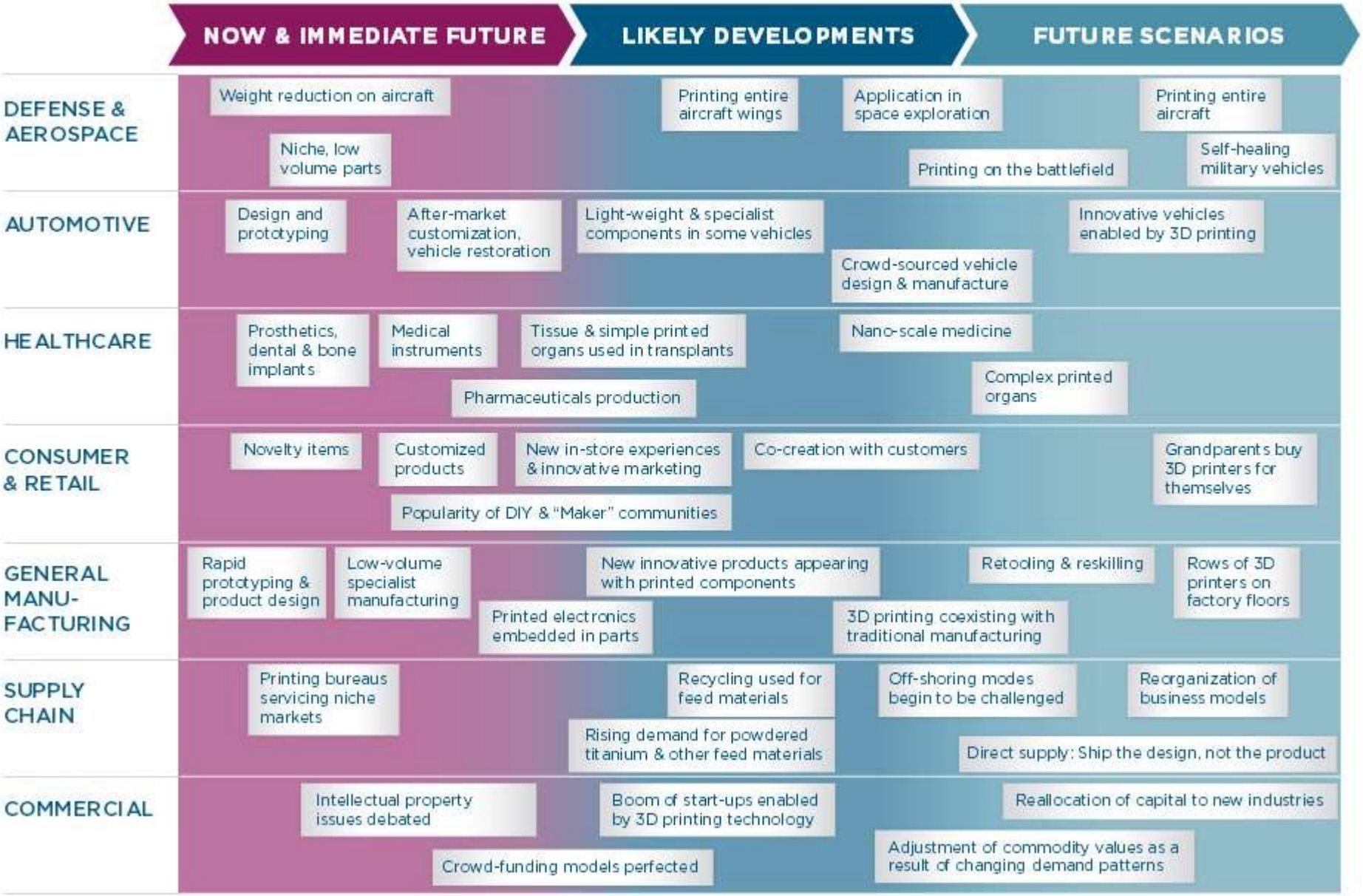
# Market Drivers for Growth of 3D potential

- Increased awareness of viability of 3D printing technologies for prototyping and manufacturing
  - implications for laboratory, product development and manufacturing operations
- Decreasing costs of 3D printers and materials
- Improved quality
- Wider range of materials
- Use case examples as reference and inspiration point
- Supporting ecosystem

3D PRINTING IMPACTS




Source: CSC

# Big Companies investing in 3D printing

Source: seekingalpha

For case examples, click here

# What are the Big Companies doing?

NASA: printing in space

NASA to launch 3D printer into space for 1st time

# Barcelona example: HP world centre for 3D printing

## HP will concentrate its global 3D Printing business in Barcelona

Posted on April 14, 2014 by Pieter Hermans

The technology giant HP today announced that the 3D printing of the multinational global business will be based in Barcelona. The news, made public by the Chief Executive Officer, Meg Whitman, in a meeting with employees on a visit to Spain, will mean a boost to the Barcelona office, sofar responsible for the large format printing business with over 2000 employees.

In particular, it will be the R & D lab in Barcelona, which will be responsible for innovations in 3D printing in addition to R&D for the large format printing products.

Responsible for leading the new project will be Ramón Pastor, current director of the center of HP in Sant Cugat.

HP estimates that worldwide sales of 3D printers and software and related services will grow almost to the $ 11 billion for 2021.



Source: 3dprintingevent

# Background material (2)

Successful_business_models_for_3d_printing_preview (Berenschot)
http://dupress.com/articles/additive-manufacturing-3d-opportunity-in-aerospace/
http://www.newscientist.com/special/3D-printing
https://www.gartner.com/doc/2663915/strategic-technology-trends--d?docdisp=share https://www.additively.com/en/learn-about/3d-printing-technologies

YouTube/ Vimeo movies:
4D printing: https://www.youtube.com/watch?v=ow5TgVTTUdY
3D printing time-lapse: https://www.youtube.com/watch?v=-gaC5BpXljU
3D printing in space:
https://www.youtube.com/watch?v=j7nrUojLePw#t=47 3D printing back and forward in time: http://vimeo.com/12768578
Gravity example: http://vimeo.com/89649904

# DRONE

# CONTENTS


- ✔ INTRODUCTION
- ✔ ARCHITECTURE
- ✔ WORKING PRINCIPLE OF UAV
- ✔ COMMERCIAL DRONE
- ✔ APPLICATIONS
- ✔ TOP BRANDS
- ✔ PRO’S AND CON’S
- ✔ CONCLUSION
- ✔ REFERENCES

# INTRODUCTION

## What is a Drone?

- The technical name of drones is “Unmanned Aerial Vehicles” (UAVs).
- They are aerial vehicles which come in wide varieties of sizes, shapes and functions, which are controlled either by remote or control systems from the ground.
- They are generally used to carry out tasks in which manned flight is considered to be risky.
- Drones mostly find use in military services, but are now days finding use in various civilian operations such as search and rescue, weather analysis etc.

# ARCHITECTURE

- Multi-spectral targeting system - camera and sensors.
- Nose camera.
- V-shaped tail.
- GPS.

# WORKING PRINCIPLE OF UAV

- A UAV system has two parts, the drone itself and the control system.
- The plane is controlled from the ground by trained combat pilots or programmers.
- The surveillance data is sent to satellites from which it is received by the ground forces to form the attack strategies and vulnerable areas in the enemy's camp.
- It can fly at extremely high altitudes to avoid detection.

# Multi Rotor Drones

# Fixed Wing Drones

# Single Rotor Dones

# Hybrid VTOL

# COMMERCIAL DRONE

- It is a Quad copter and made with composite materials for light weight and stability.
- A camera is fixed to it and a GPS is also fixed to it.

# APPLICATIONS

## DISASTER RELIEF:

- It can enter radiation-filled "hot zones" where human access would be dangerous (after a nuclear accident, for example) to searching for survivors across a debris-filled landscape.

- Its carbon fibre housing allows drones to operate successfully under testing conditions such as rain or snow and at extreme temperatures, as in the case of fires. With data transfer to the Base Station taking place in real time, it is no longer necessary for fire fighters or other support personnel to enter the danger zone in order to analyse the situation.

# CONT'D…

## SECURITY:

- With a laser scanner a comprehensive recording of the scene of a traffic accident can be made, which simplifies the drawing up of the accident report.

## AERIAL PHOTOGRAPHY AND VIDEO:

- Picture from a bird's eye view or create videos from unusual perspectives is possible with a drone.

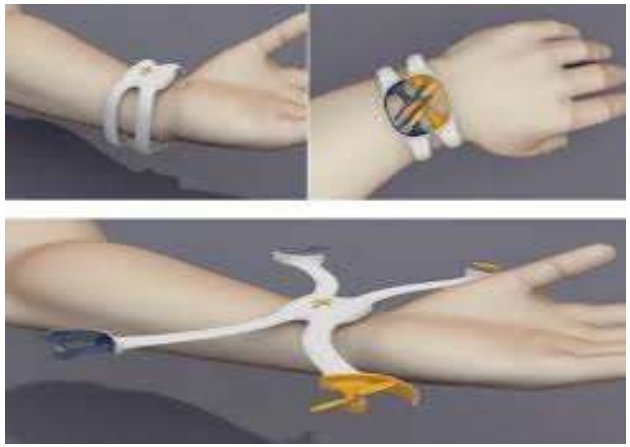
## UNMANNED CARGO SERVICE:

- for delivering parcels around the globe in safe, fast and environmental friendly transportation of goods.

# TOP BRANDS

Nixie:

- Nixie is a small camera equipped drone that can be worn as a wrist band.
- It can be activated to unfold into a quad copter, fly in one of its pre-programmed modes to take photos or a video, and then return to the user.
- It is a wearable camera drone to have applications in rock climbing, mountain biking, and other adventure sports.



# CONT'D…

**Lily:**

- Lily Camera is called as throw-and-shoot camera.
- It requires no controller as it follows the wearer's bracelet. The camera follows the user via GPS tied to a bracelet, which communicates distance, position and speed back to the camera.
- It is also equipped with an accelerometer, barometer, GPS and a front- and a bottom-facing camera.
- This camera is also completely waterproof.

# PRO'S AND CON'S

PRO'S:

- Safe intelligence gathering for military
- Able to fly under harsh conditions without risking life
- Can take pictures where humans cannot go
- Less expensive and Accurate
- Easy to deploy, etc.,.

CON'S:

- Drones could be exploited for spying purposes which would infringe on privacy rights
- Battery power could be limited

# CONCLUSION

- Drones have always risen to the occasion whenever they were needed. They are truly an engineering spectacle, containing the best of mechanical, electronics and software technology.
- Drone will play a major role in almost all fields in near future.

# REFERENCES


- http://readanddigest.com/what-is-a-drone/#sthash.bFCUGRhv.dpuf
- http://time.com/3769831/this-is-how-drones-work/
- https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle
- http://www.bbc.com/news/world-south-asia-10713898

# REMOTELY PILOTED AIRCRAFT (RPA)/DRONE PILOT

(Multi rotor Drone Assembly Course /Regulations and procedures for becoming a drone pilot)

# COURSE INFORMATION

- During the six months duration of Remotely Piloted Aircraft (RPA)/ Drone Pilot Trade a candidate is trained on professional skills and professional knowledge related to job role. In addition to this a candidate is entrusted to undertake project work and Extra-Curricular Activities to build up confidence. The broad components covered related to the trade are categorized in six months duration as below:-
- The trainee begins with learning first aid, fire fighting and various safety practices for working in industrial environment. Recognizes DGCA Safety Regulations & develop safety attitude while flying Drones. Identifies & selects different types of Drones & Fundamentals of Flight (Aerodynamics), ATC procedures & Radio Telephony, different regulations of DGCA, Civil Aviation Requirements, Weather and meteorology

# COURSE INFORMATION

- Develops & applies knowledge of Airframes, Electric motors & Propellers. Identifies & selects Electronic Speed Controllers (ESC) & flight Controllers for Drones. Recognizes application of Batteries, Chargers & Connectors, Transmitters & Receivers, Cameras, Gimbals & other payloads. Applies knowledge of Ground Control Station. Performs Assembling & battery care of Drones. Identifies & selects Basic operating features of a Drone Flight Simulator. Fly a Drone with instructor and then perform solo flight (Virtual reality training & live Drone flying). Carry out entire flying operations from pre-flight checks to after flight checks while flying a drone in simulator training & live training.

- Also the trainee will learn to Communicate with required clarity, understand technical English, environment regulation, productivity and enhance self-learning.

# TRAINING SYSTEM

- ‘Remotely Piloted Aircraft (RPA)/ Drone Pilot’ Trade under CTS is one of the newly designed courses. The CTS courses are delivered nationwide through network of ITIs. The course is of six months duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory and Trade Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite life skills. After passing out of the training programme, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

# TRAINING SYSTEM

- **Candidates broadly need to demonstrate that they are able to:**
  - Read and interpret technical parameters/ documentation, executes work, identify necessary materials and tools.
  - Perform tasks with due consideration to safety rules, accident prevention regulations.
  - Apply professional knowledge & employability skills while performing the job and maintenance work.
  - Check the circuit/ equipment/ panel as per drawing for functioning, identify and rectify faults/ defects.
  - Document the technical parameters related to the task undertaken.

# ASSESSMENT & CERTIFICATION

- The trainee will be tested for his skill, knowledge and attitude during the period of the course and at the end of the training program as notified by the DGT from time to time.

a)The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b)The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile

# PASS REGULATION

- For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%. There will be no Grace mark

# ASSESSMENT GUIDELINE

- Assessment will be evidence based comprising the following:
    - Job carried out in labs/workshop
    - Record book/ daily diary
    - Answer sheet of assessment
    - Viva-voce
    - Progress chart
    - Attendance and punctuality
    - Assignment
    - Project work

# Remotely Piloted Aircraft (RPA)/ Drone Pilot

•Remotely controls Drone/Unmanned Arial Vehicle (UAV) which is a flying robot and can fly autonomously through software-controlled flight plans in their embedded systems working in conjunction with onboard sensors and GPS.

•Can take photography for Real estate, Film Making, special events, Journalism, Agriculture etc., can apply it for liquid pesticides, fertilizers, herbicides, seeding, farm land mapping & surveying, crop theft or theft by animal etc. Provides key surveying capabilities and point the way to new excavation sites for mapping archaeological remains. Inspects infrastructure from power lines to pipelines, which are often in hard-to-reach, dangerous places to mitigate hazardous, time consuming and expensive work. Not only are they cutting costs, reducing time and decreasing injuries, but with drones, Individual can also obtain high-quality, detailed images of overhead utility lines to look for damage, corrosion and more

# Remotely Piloted Aircraft (RPA)/ Drone Pilot

- They are able to provide engineers with real-time data, images and post-inspection analysis—the benefits of which are causing a shift away from traditional utility inspection methods. Carries on commercial Inspection of Bridges, Cell & TV Towers, Wind Turbines, Power lines, Pipe Lines & even solar panels. Checks roofs, chimneys, sliding, bricks and other structures for exterior damage as Residential Home Inspection. Uses drones for wild life Management & conservation where wildlife drones can be used in many different ways, from small multi-rotor units that can scare invasive birds away from crops, to fixed- wing aircraft that fly above rainforests to spot orangutan nests. Provides more precise data than traditional ground-based techniques when it comes to monitoring seabird colonies. Individual may use it for law and order and aerial surveillance in police departments for Public Service Surveillance. Applies it in E-Commerce: for a variety of purposes: to take inventory, streamline its distribution system and use for deliveries to customers. Medical drones are the future of disaster relief, providing much-needed help to isolated areas. Can take part in Drone Aerobatics show & Aerial Advertising.

# LEARNING OUTCOME

1. **SPECIFIC LEARNING OUTCOME**
   1. Identify & select different types of Drones and illustrate Fundamentals of Flight (Aerodynamics).
   2. Identify & select different Airframes & Propellers in drone flying.
   3. Interpret DGCA Safety Regulations & observe safety guidelines, ATC procedures & Radio Telephony, Weather and meteorology as a Drone Pilot in flying a Drone.
   4. Explain & apply knowledge of Power systems viz. Electric motors, Batteries, Chargers,
   - Connectors etc. in drone flying.
   5. Identify & select various Controllers like Electronic Speed Controllers (ESC), Transmitters, Receivers & flight Controllers for Drones.

# LEARNING OUTCOME

5. Plan & estimate different payload considerations like Cameras, Gimbals & other payloads and make use of them in drone flying/maintenance.
6. Apply knowledge of Ground Control Stations & FPV.
7. Perform Assembling, MRO & battery care of Drones.
8. Identify basic operating features of a drone flight simulator and fly a Drone in simulator

- training & live training for various applications first with instructor & then solo (70% of flying practice in simulator and rest 30% in live flying).

# Virtual Reality & Augmented Reality

# Virtual Reality

What is Virtual Reality?

- The Virtual Reality is a technology that use software to generate realistic images, sound and other sensations that replicate real world environment.
- A user can interact and manipulate with the virtual objects of virtual world with the help of specialized devices like display screens or other devices.

- A person using virtual reality equipment is typically able to "look around" the artificial world.
- virtual realities are displayed either on a computer monitor, a projector screen, or with a virtual reality headset.
- Virtual reality environment is captured by using 360 degree special video camera.

# History

- 1965-The beginnings of VR.
- 1977-Interaction through body movement
- 1982-The first computer- generated movie
- 1983-First virtual environment
- 1987-Development of immersive VR
- 1993-Invention of surgery rehearsal system.
- 2007-Google introduced Street View, a service that shows panoramic views

# Immersive Virtual Reality

- An immersive Virtual Reality adds special gadgets like Head mounted displays and Boom.
- Stereoscopic viewing adds enhanced features like deep peeping through the Virtual world.
- Eliminating the real world and placing the human in a computer generated world is one of the enhancements.
- Interactions with the objects in the Virtual world are controlled by a data glove, head mounted display and other gadgets.

# Head Mounted Display

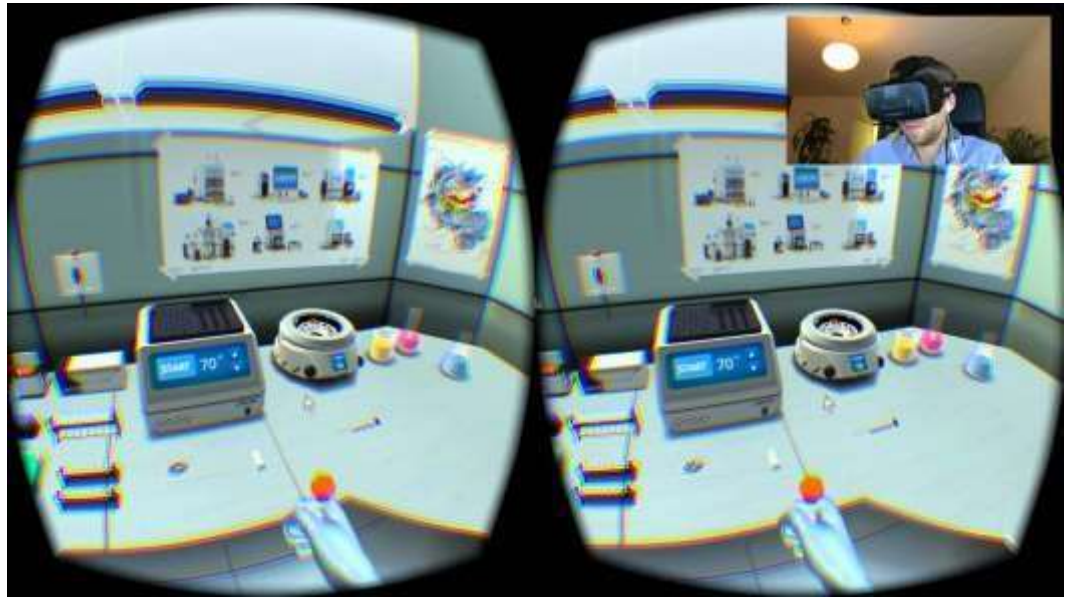
- Consists of two miniature display screens that produces the stereoscopic images and an optical position tracking system
- It tracks the orientation of the humans head in the Virtual world and that produces the impulse to the image generating large projection Areas to get more immersive feeling.
- Characteristics: walk through , look around, fly through in the 3d Virtual world Computer.

# Application of virtual reality

- Movies - Virtual reality is applied in 3-D movies to try and immerse the viewer into the movie and/or virtual setting and environments.

- Video Games - Virtual reality is evident in video games. Now you can physically interact with a game by using your body and motions to control characters and other elements of the game that years ago people would only imagine.

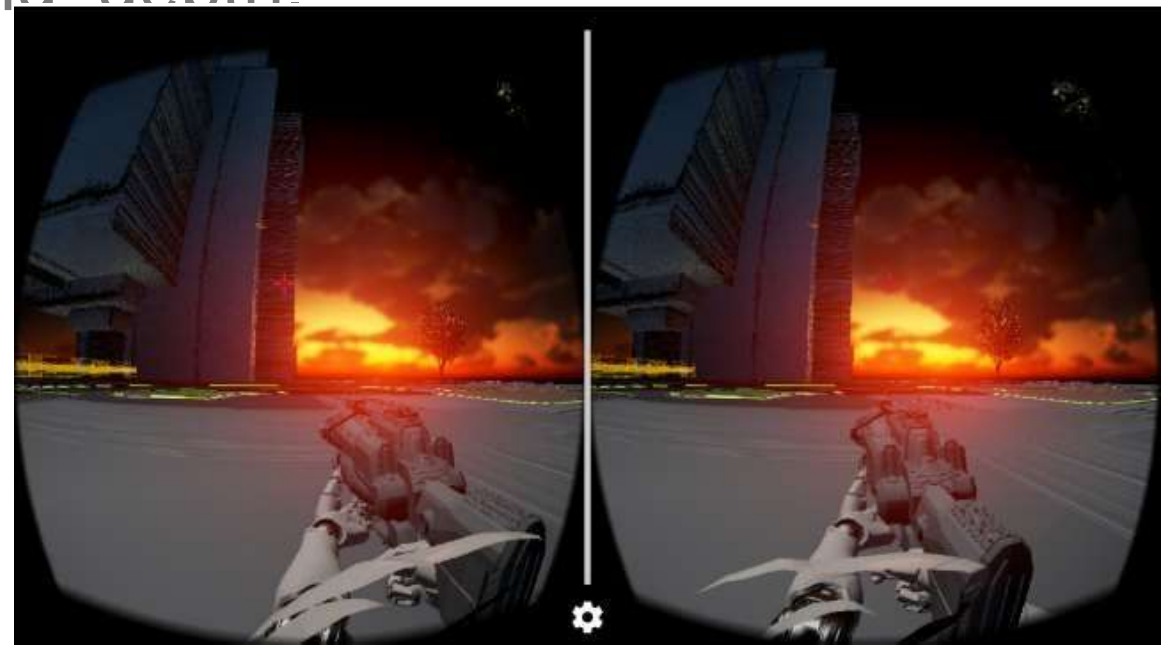
- Education -Virtual reality for teaching and learning situations. The advantage of this is that it enables large groups of students to interact with each other as well as within a three dimensional environment. Creating Virtual Labs.



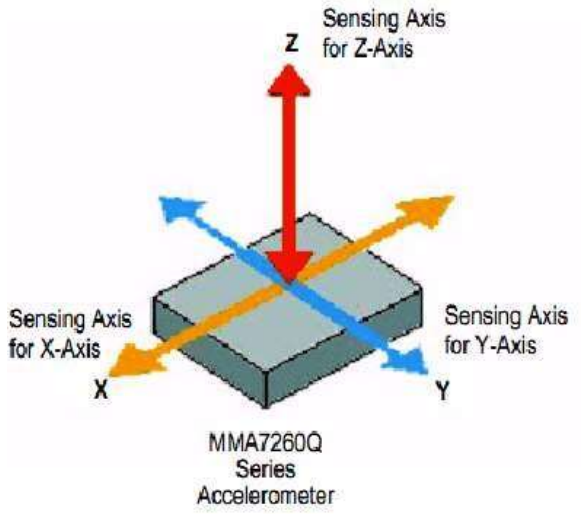
- Training- VR is used by trainers to provide learners with a virtual environment where they can develop their skills without the real-world consequences of failing.
- Architectural Design- Architectural design firms and various clients in the real estate industry to tour virtual models of proposed building designs.

# How Virtual Reality works?

- virtual reality tricks your brain into believing you are in a 3D world.  VR does this is with the stereoscopic display. This works by displaying  two slightly different angles of the scene to each eye, simulating  depth.



- On Android, your phone's accelerometer, gyroscope and magnetometer are used to achieve movement of the headset. The accelerometer is used to detect three dimensional movement with the gyroscope being used to detect angular movement.
- Using these sensors, your phone can accurately predict where you are looking at any given time while using VR.



# Advantages of VR

1) Virtual reality creates a realistic world
2) It enables user to explore places.
3) Through Virtual Reality user can experiment with an artificial environment.
4) Virtual Reality make the education more easily and comfort.

# Disadvantages of Virtual Reality

1) The equipments used in virtual reality are very expensive.
2) It consists of complex technology.
3) In virtual reality environment we can't move by our own like in the real world.

# Current Virtual Reality devices in Market

- Oculus Rift

The **Oculus Rift** is a virtual reality headset developed and manufactured by Oculus VR, a division of Facebook Inc., released on March 28, 2016.

# Google Cardboard

**Google Cardboard** is a virtual reality (VR) platform developed by **Google** for use with a head mount for a smartphone. Named for its fold-out **cardboard** viewer, the platform is intended as a low-cost system to encourage interest and development in VR applications.

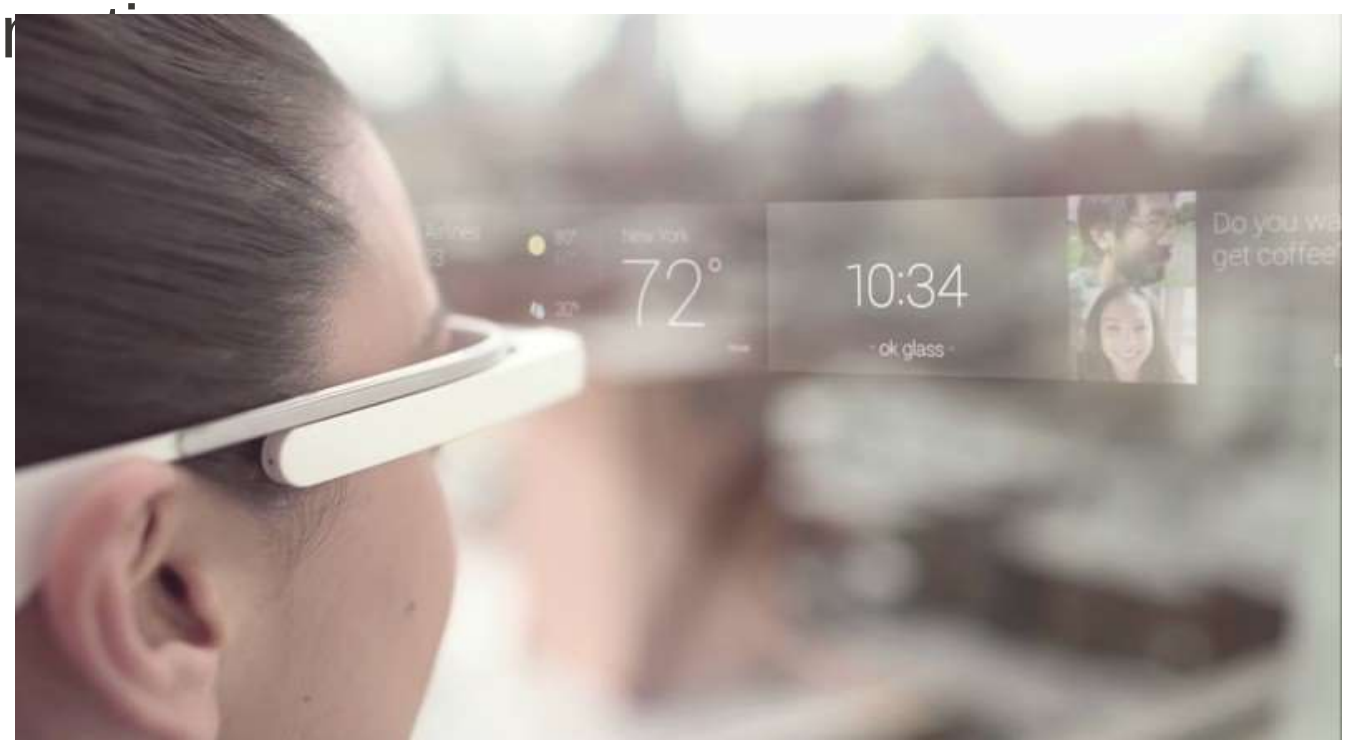
# Samsung GearVR

- The Samsung Gear VR is a mobile virtual reality headset developed by Samsung Electronics, in collaboration with Oculus, and manufactured by Samsung. When in use, a compatible Samsung Galaxy device (Galaxy Note 5, Galaxy S6/S6 Edge/S6 Edge+, or Galaxy S7/S7 Edge) acts as the headset's display and processor, while the Gear VR unit itself acts as the controller,

# Augmented Reality

# What is Augmented Reality?

- A combination of a real scene viewed by a user and a virtual scene generated by a computer that augments the scene with additional inform



- An AR system adds virtual computer- generated objects, audio and other sense enhancements to a real-world environment in real time.
- The Goal of AR is to Create a system such that a user CANNOT tell the difference between the real world and the virtual augmentation of it.

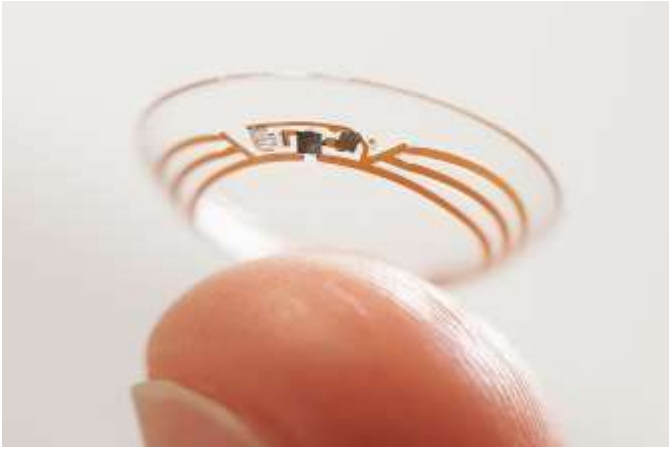
# History

- 1980: Steve Mann creates the first wearable computer, a computer vision system with text and graphical overlays on a mediated reality
- 1989: Jaron Lanier coins the phrase Virtual Reality and creates the first commercial business around virtual worlds
- 2013: Google announces an open beta test of its Google Glass augmented reality glasses.
- 2015: Microsoft announces Windows Holographic and the HoloLens augmented reality headset
- 2016: Niantic released *Pokémon Go* for iOS and Android in July 2016.

# Technology Component

- Hardware- Hardware components for augmented reality are processor display,  sensors an input devices.
- Display-Various technologies are used in  Augmented Reality rendering
  including optical projection
  systems, monitors, handheld devices, and  display systems worn on the human body.
- Eyeglasses- AR displays can be rendered on  devices resembling eyeglasses

- Contact lenses- Contact lenses that display  AR imaging are in development.



- Handheld- Handheld displays employ a small  display that fits in a user's hand such as  Mobile phones and tablets.

- Heads up display- Is any transparent display that presents data  without requiring users to look away from their usual viewpoints.

# Applications

Augmented reality also has application in similar fields that of Virtual reality

- Medical
- Entertainment
- Military Training
- Engineering Design
- Robotics and Telerobotics
- Manufacturing, Maintenance, and Repair
- Consumer Design
- etc

# Medical

AR has application in medicals like observing the  internal body systems of  patients

# Entertainment & Games

AR has applications in  Games like and entertainments to play  game called pokemon  go in which you can  catch augmented pokemon characters in  real world

# Robotics

- AR is useful for Robots Application where robot will be able to show holographic augmented characters in real world making easier to communicate.

# Consumer Design

- A very simple example of application in consumer design would be Imagine you place a augmented sofa in your Room and  see if it fits or not before purchasing

# Advantages of AR

- Can increase knowledge and information
- People can share experiences with each other in real time over long distances
- Games can provide an even more "real" experience
- Things come to life on people's mobile

# Disadvantages of AR

- Lack of Privacy criminals can simply point their phone towards victim  and know everything about them
- Production is expensive.
- Difficult to maintain Augmented Reality Systems
- Low performance level.

# Augmented Reality vs. Virtual Reality

Augmented Reality

- System augments the real world scene
- User maintains a sense of presence in real world
- Needs a mechanism to combine virtual and real worlds

Virtual Reality:

- Totally immersive environment
- Visual senses are under control of system (sometimes aural and proprioceptive senses too)

# Conclusion

Virtual as well as Augmented Reality has very Strong Potentials And maybe they are currently in its initial stage but will have a very big role in our lives in future when these technologies are matured enough.

THANK YOU

# UNIT-5

## History, objective & global scenario of 5G Telecom,applications and use cases

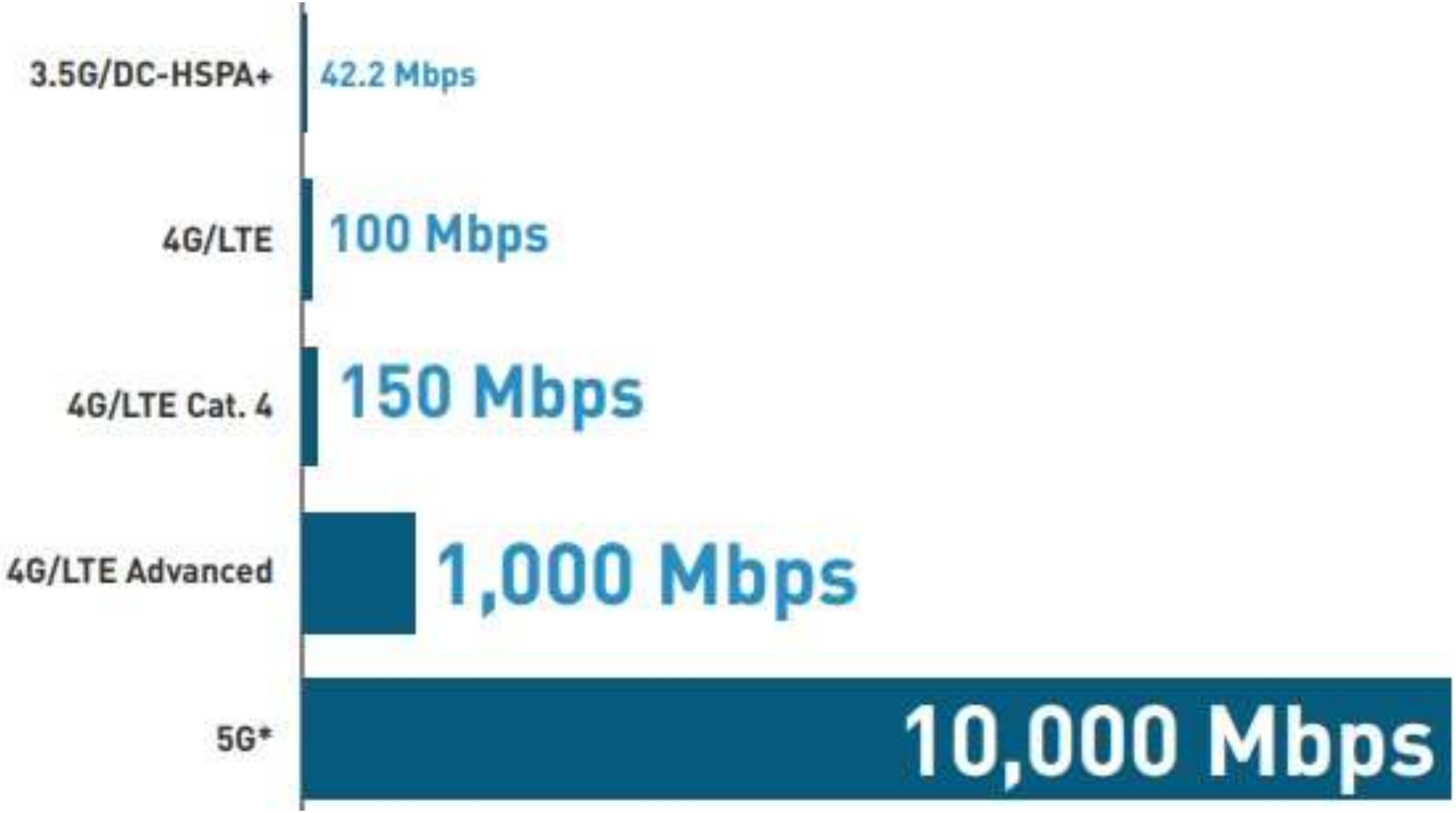
# What is 5G Technology?

# History of 5G

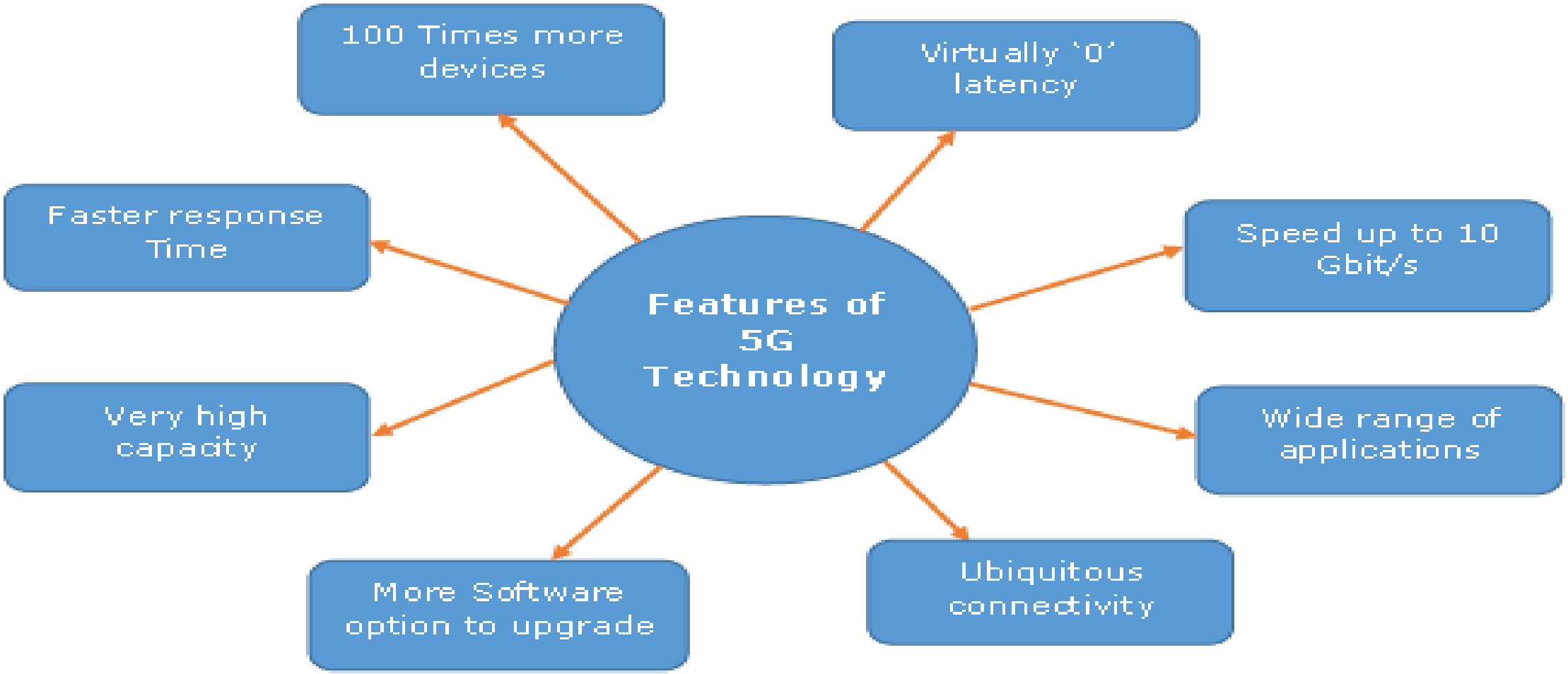
# 5G Specifications

- Data rate is up to10Gbps
- Network energy usage reduction is 90%
- Latency is 1ms (millisecond)
- Maximum coverage
- Availability is 99.999%
- 100x devices can be connected
- BW for each unit area is 1000x

# How fast is 5G?



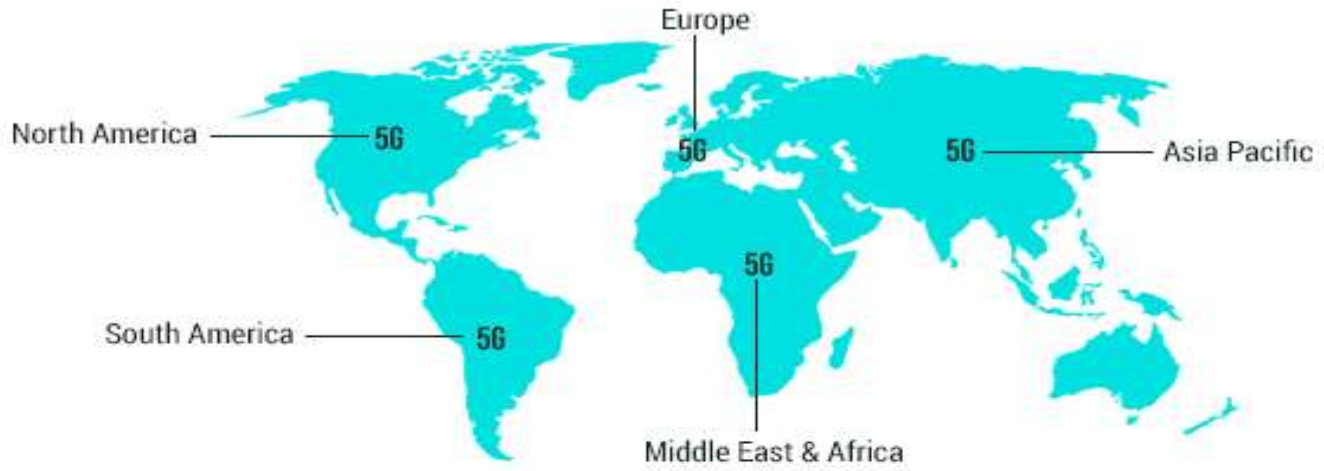
# Features of 5G



According to AMR study, the Global 5G Technology Market is accounted for **$33.67 Billion** in 2017 and is expected to reach **$3482.89 Billion** by 2026 growing at a CAGR of **67.44%** during the forecast period.

# 5G TECHNOLOGY

## GLOBAL MARKET OUTLOOK (2017 - 2026)




### TOP COMPANIES

- Broadcom Corporation
- Telecom Italia
- Ericsson
- Orange S.A
- Qualcomm Inc

### PRODUCT TYPES

- Multi-Access Edge Computing (MEC)
- Software Defined Networking (SDN)
- Fog Computing (FC)

### APPLICATIONS

- Smart Factory
- Driverless Car
- Connected Energy
- Smart Cities
- Individual Users

### SERVICES

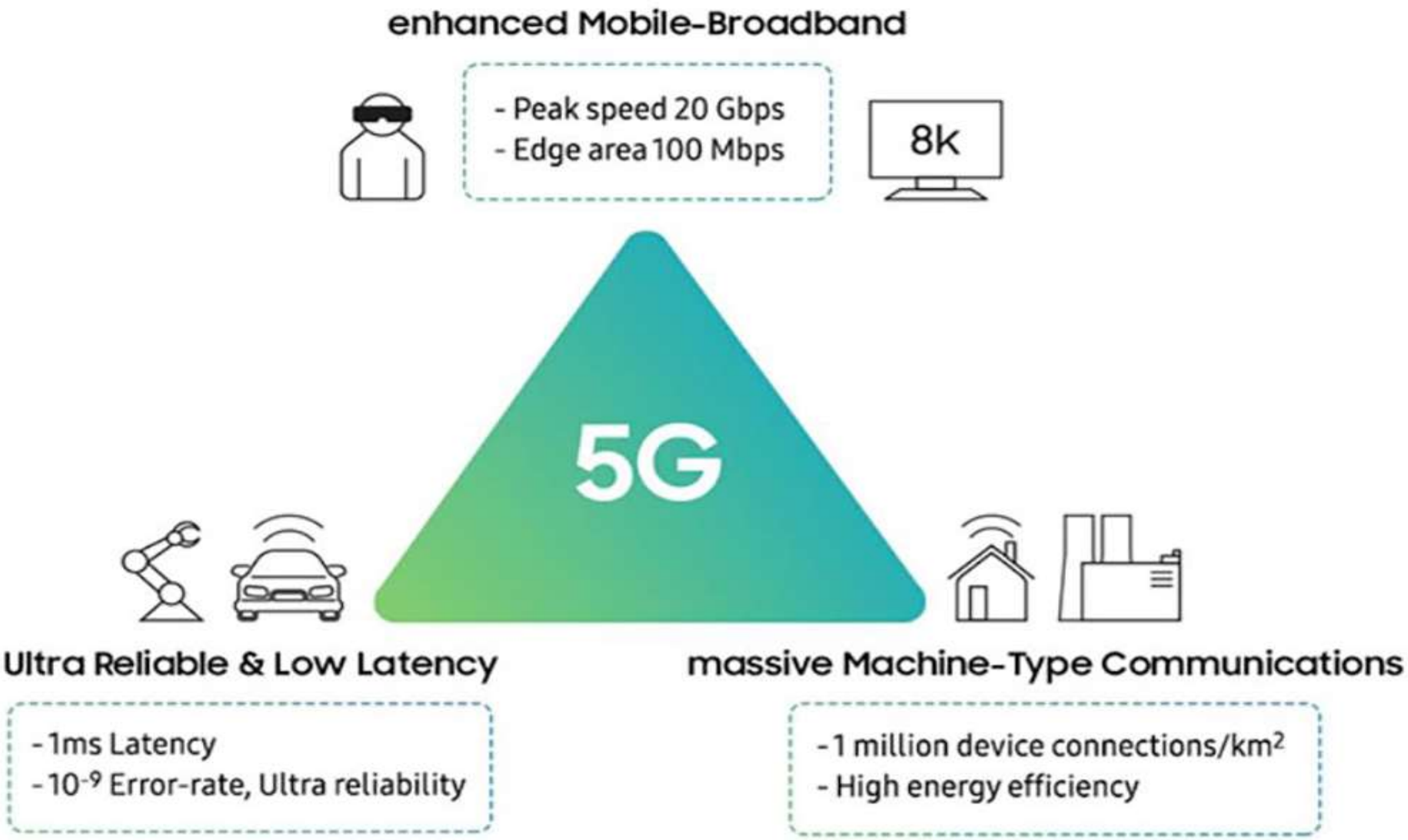
- Extreme Mobile Broadband
- Massive Machine-Type Communications (MTC)
- Professional Services

ACQUIRE MARKET RESEARCH

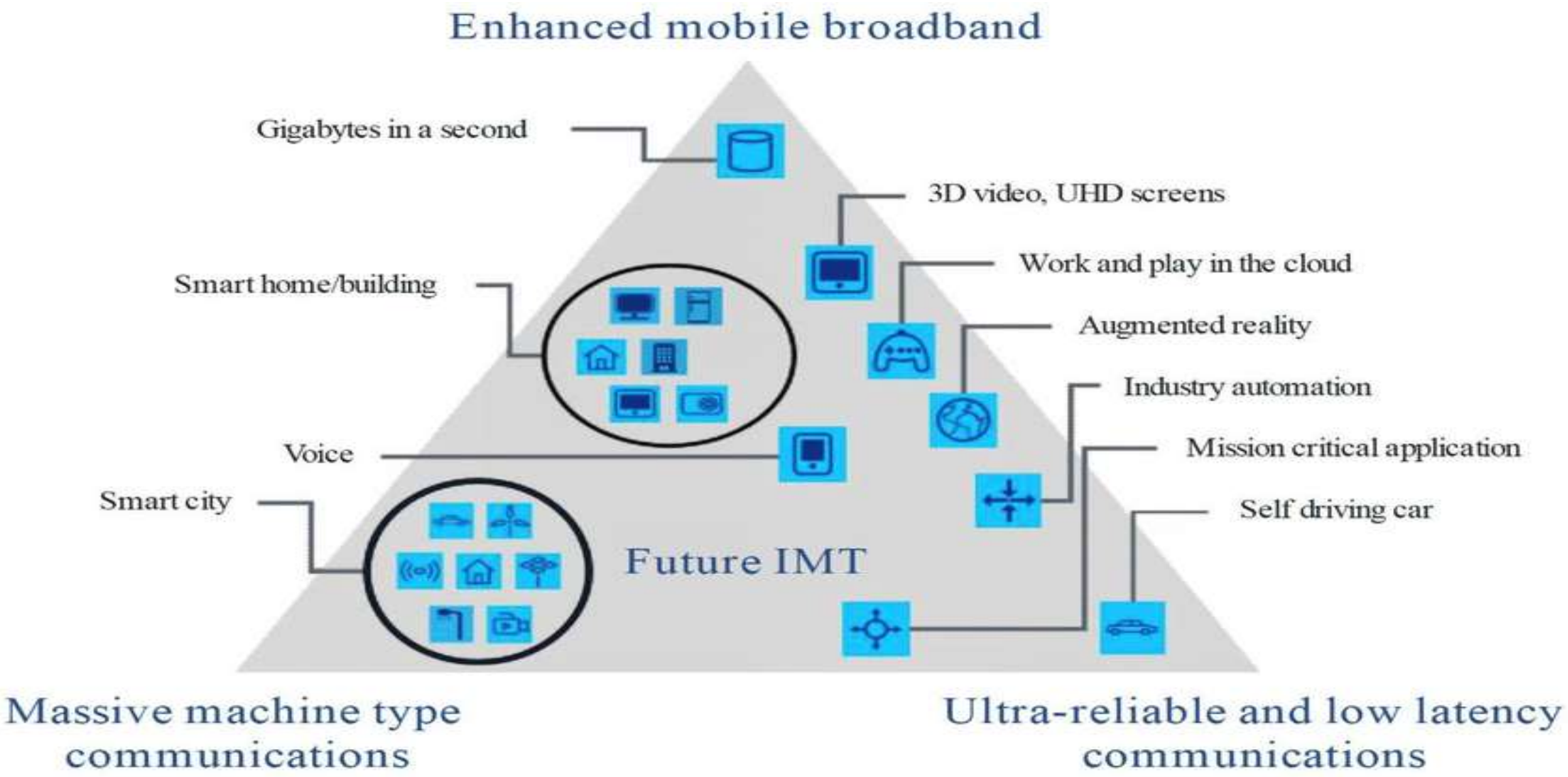
# WHAT IS 5G'S STATUS IN INDIA

- 5G spectrum auction in India is expected to only happen in 2021.
- Department of telecommunications is expected to start 5G trial soon, but with only non-Chinese vendors.
- Trials are necessary as companies need to get data to improve and optimize their 5G networks.
- India need to lay a substantial amount of fiber optic cables for true 5G experience.

# Applications for 5G



# 5G use case


Enhanced mobile broadband
Gigabytes in a second
3D video, UHD screens
Work and play in the cloud
Smart home/building
Augmented reality
Industry automation
Voice
Mission critical application
Smart city
Self driving car
Future IMT
Massive machine type communications
Ultra-reliable and low latency communications

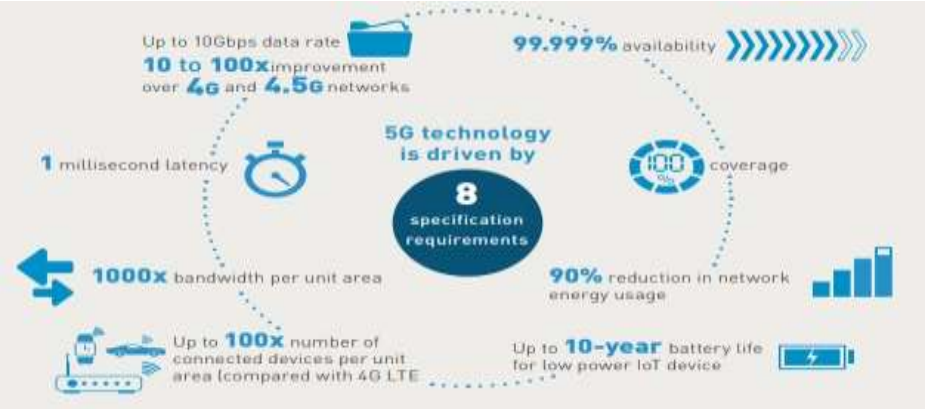
**What is 5G Technology?**

5G is the fifth generation of wireless technology. But users will know it as one of the fastest, most robust technologies the world has ever seen. That means quicker downloads, much lower lag and a significant impact on how we live, work and play. The connectivity benefits of 5G are expected to make businesses more efficient and give consumers access to more information faster than ever before. Connected cars, smart communities, industrial IoT, immersive education—they all will rely on 5G networks.

The 5th generation technology is an evolution in mobile technology from the existing 4G LTE networks. It is specially designed to accomplish the current technological demands like a huge growth in data & approximately worldwide connectivity along with the increasing interest in the IoT(Internet of Things).

Currently, it is the newest cellular technology in wireless technology which greatly enlarges the wireless network speed between other things. So, 5G based wireless broadband connections data speed will be around 20 Gbps. This technology will also give additional bandwidth & superior antenna technology so that much more data will be transmitted over wireless systems.

**5G technology is driven by 8 specification requirements:**




- Up to 10Gbps data rate - > 10 to 100x speed improvement over 4G and 4.5G networks
- 1-millisecond latency
- 1000x bandwidth per unit area
- Up to 100x number of connected devices per unit area (compared with 4G LTE)

- 99.999% availability
- 100% coverage
- 90% reduction in network energy usage
- Up to 10-year battery life for low power IoT device

## History of 5G

### 1G – First Generation Wireless Technology

The first generation wireless technology (1G) in a mobile phone was begun in the 1980s. It is the first generation in wireless cellular technology. This technology supports only voice calls and it is an analog technology. The mobile phone which supports 1G has poor battery life, less voice quality, small security, etc. The highest speed of this technology is 2.4 Kbps.

### 2G – Second Generation Wireless Technology

The major upgrade of cell phones is once they went from one generation to another like from 1G to 2G. This technology is introduced in the year 1991, Finland. This technology is introduced call as well as an encryption of text including data services such as images, SMS, MMS, picture messages, etc. Even though this technology is replaced with 1G, and it is still utilized around the globe. The highest speed of this technology using GPRS is 50 Kbps.

### 3G – Third Generation Wireless Technology

The third-generation wireless technology 3G was introduced in the year 1998. It provides faster data transmission speeds. So this technology is used for internet access in mobiles and video calling. Mobile broadband was first introduced to 3G technology.

Similar to 2G, this technology provides more features. The highest speed of 3G is approximately 2 Mbps for devices like non-moving & 384 Kbps for devices like moving vehicles.

**4G – Fourth Generation Wireless Technology**

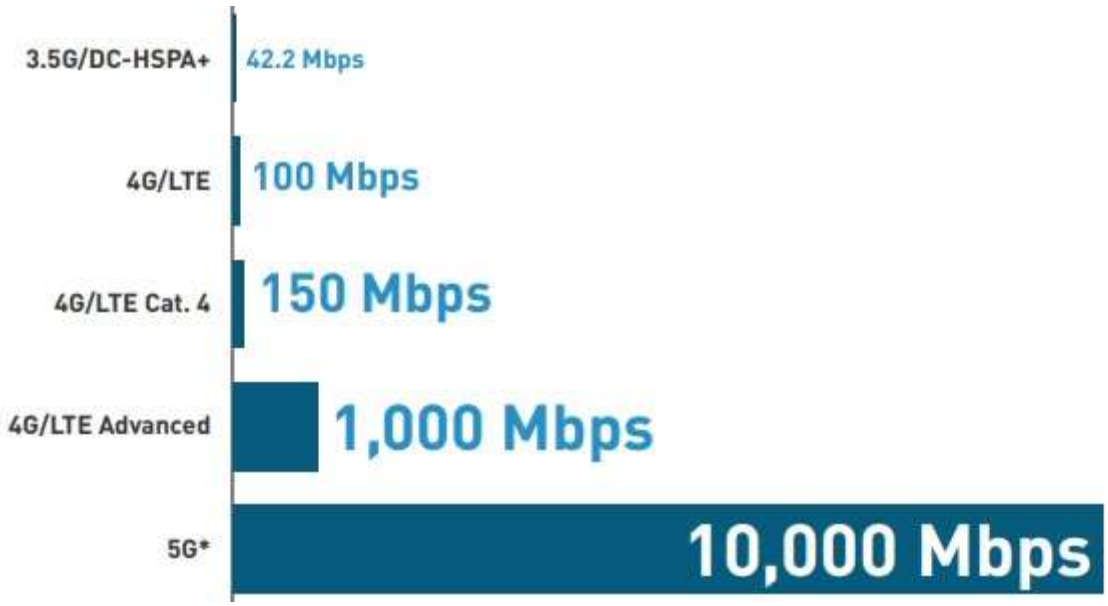
The Fourth-generation wireless technology 4G was launched in the year 2008. It supports HD mobile TV, web access for mobiles, gaming services, 3D TV, video conferencing. The highest speed of 4G is approximately 100 Mbps. For less mobility communication, when the caller is motionless otherwise walking then the speed will be 1Gbps. At present, every mobile supports this technology.

**5G – Fifth Generation Wireless Technology**

The fifth-generation wireless technology 5G is upcoming technology but it is not implemented yet. So this technology provides quick data rates, energy savings, less latency, connection density is high by improving 4G technology. The expected speed of this technology is up to 20 Gbps for every second.
Thus, from 1G to 5G refers to the generations of wireless cellular technology. From the above information finally, we can conclude that succeeding generations very fast compare with previous ones and includes enhanced features. The upcoming wireless technology like 5G is planned to launch in the year 2020.

## How fast is 5G?

5G speed tops out at 10 gigabits per second (Gbps).
5G is 10 to x100 faster than what you can get with 4G.



**What makes 5G faster?**

According to communication principles, the shorter the frequency, the larger the bandwidth.

The use of shorter frequencies (millimeter waves between 30GHz and 300GHz) for 5G networks is why 5G can be faster. This high-band 5G spectrum provides the expected boost not only in speed but also in capacity, low latency, and quality. However, 5G download speed may differ widely by area.

According to the February 2020 issue of Fortune Magazine, average 5G speed measures done in Q3/Q4 2019 range from:

220 megabytes per second (Mbps) in Las Vegas,
350 in New York,
380 in Los Angeles,
450 in Dallas,
to 550 Chicago,
and over 950 in Minneapolis and Providence approximatively.

That's 10 to 50 times more than 4G LTE.

**What is 5G low latency?**

5G technology offers an extremely low latency rate, the delay between the sending and receiving information. From 200 milliseconds for 4G, we go down to 1 millisecond(1ms) with 5G.

Just think about it.

A millisecond is 1/1000 of a second.

The average reaction time for humans to a visual stimulus is 250 ms or 1/4 of a second. People are capped at around 190-200 ms with proper training.

Imagine now that your car could react 250 times faster than you.

Imagine it could also respond to hundreds of incoming information and can also communicate its reactions back to other vehicles and road signals all within milliseconds.

At 60 mph (100km/h), the reaction distance is about 33 yards (30 meters) before you pull on the brakes. With a 1ms reaction time, the car would only have rolled a bit more than one inch (less than 3 centimeters).

Use cases associated with low latency are:

V2X (Vehicle-to-Everything) communication: V2V: (Vehicle-to-Vehicle), V2I (Vehicle-to-Infrastructure), autonomous, connected cars

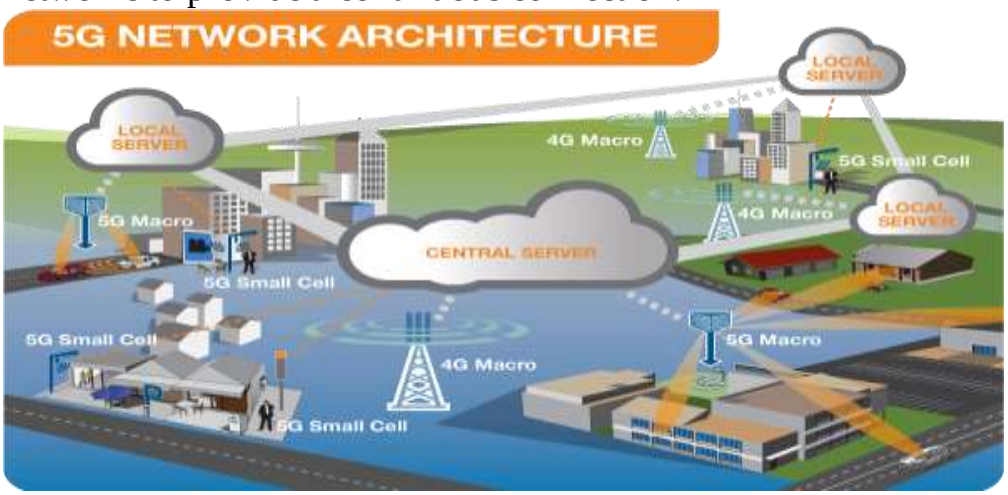
Immersive Virtual Reality Gaming (5G will bring VR to the masses.)

Remote surgical operations (aka telesurgery)

Simultaneous translating.

**HOW DOES 5G WORK?**

Most operators will initially integrate 5G networks with existing 4G networks to provide a continuous connection.




5G network architecture illustrating 5G and 4G working together, with central and local servers providing faster content to users and low latency applications.

A mobile network has two main components, the 'Radio Access Network' and the 'Core Network'.

The Radio Access Network - consists of various types of facilities including small cells, towers, masts and dedicated in-building and home systems that connect mobile users and wireless devices to the main core network.

Small cells will be a major feature of 5G networks particularly at the new millimetre wave (mmWave) frequencies where the connection range is very short. To provide a continuous connection, small cells will be distributed in clusters depending on where users require connection which will complement the macro network that provides wide-area coverage.

5G Macro Cells will use MIMO (multiple input, multiple output)

antennas that have multiple elements or connections to send and receive more data simultaneously. The benefit to users is that more people can simultaneously connect to the network and maintain high throughput. Where MIMO antennas use very large numbers of antenna elements they are often referred to as 'massive MIMO', however, the physical size is similar to existing 3G and 4G base station antennas.
The Core Network - is the mobile exchange and data network that manages all of the mobile voice, data and internet connections. For 5G, the 'core network' is being redesigned to better integrate with the internet and cloud based services and also includes distributed servers across the network improving response times (reducing latency).
Many of the advanced features of 5G including network function virtualization and network slicing for different applications and services, will be managed in the core. The following illustration shows examples of local cloud servers providing faster content to users (movie streaming) and low latency applications for vehicle collision avoidance systems.

Example of a local server in a 5G network providing faster connection and lower response times
Network Slicing – enables a smart way to segment the network for a particular industry, business or application. For example emergency services could operate on a network slice independently from other users.
Network Function Virtualization (NVF) - is the ability to instantiate network functions in real time at any desired location within the operator's cloud platform. Network functions that used to run on dedicated hardware for example a firewall and encryption at business premises can now operate on software on a virtual machine. NVF is crucial to enable the speed efficiency and agility to support new business applications and is an important technology for a 5G ready core.

# BRAIN COMPUTER INTERFACING: MODEL AND APPLICTI0N

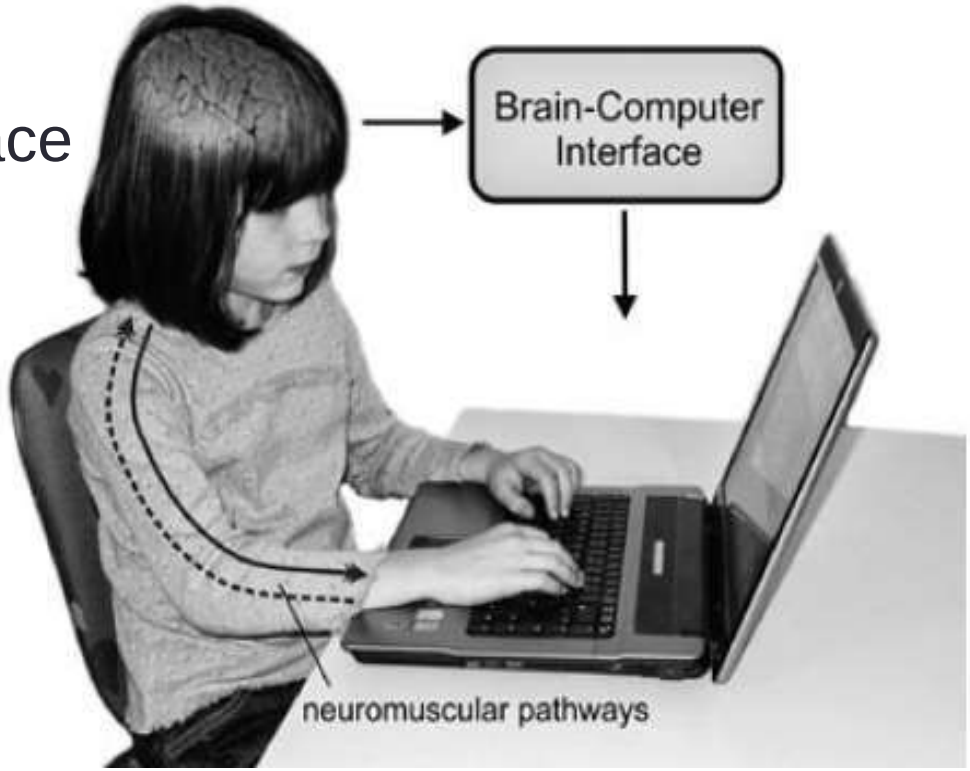
# INTRODUCTION

- ***Brain-Computer Interfaces (BCI) -***

- Communication or control systems that allow real time interaction between the human brain and external devices without the need of peripheral nerve or muscle activation.

- BCIs are able to translate brain activity
- Predict a user's intents
- Convert them into commands which control external devices

- Mind-Machine Interface (MMI)
- Direct Neural Interface
- Brain–Machine Interface (BMI)




BCI bypasses the normal neuromuscular output channels

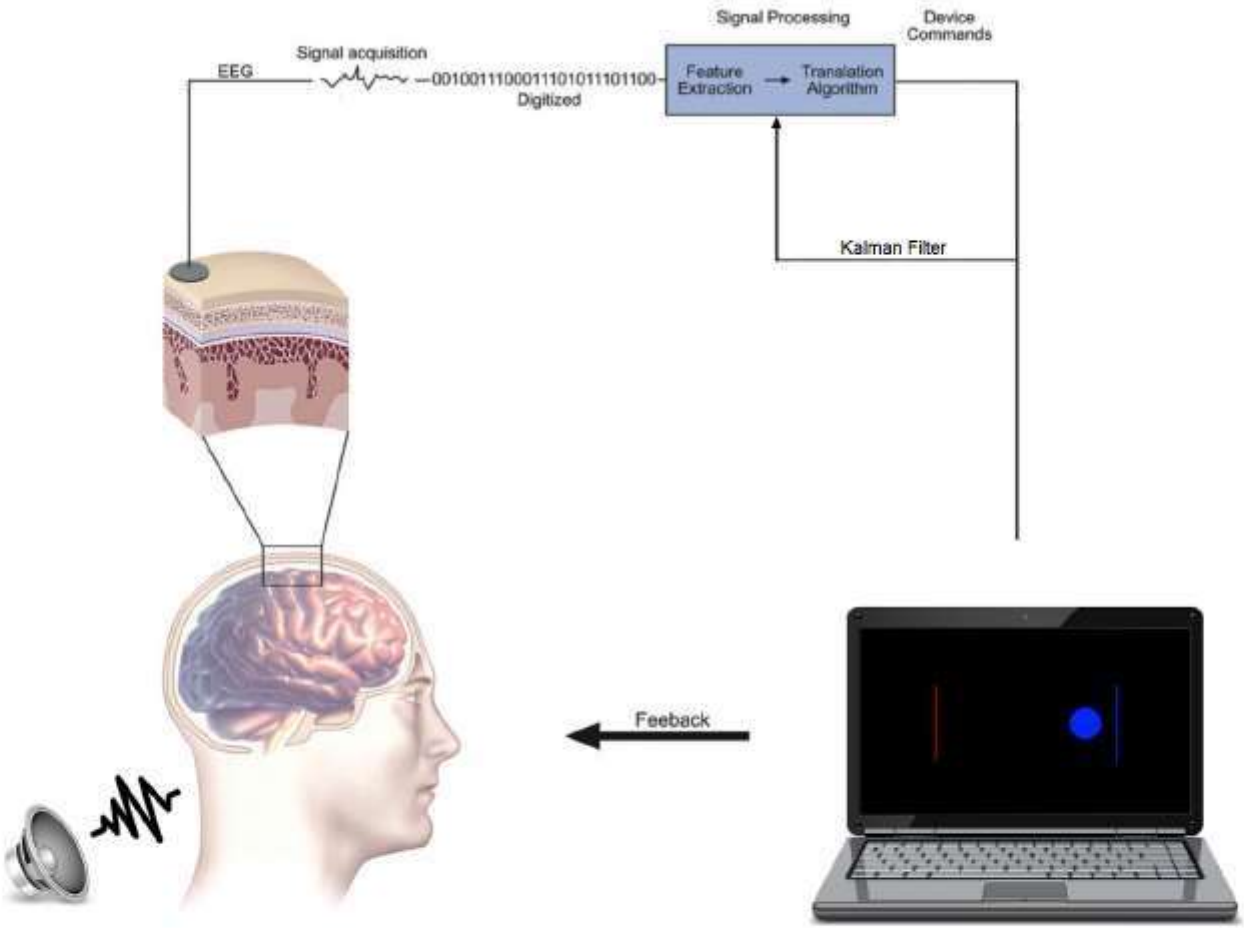



Fig. 7. **General organisation of the online experiment.** At the beginning of each trial, an auditory stimulus indicated the subject which vowel he or she should imagine. Subsequently, the ball on the computer screen changed its colour to match the one of the target the subject should reach. Electrodes placed on the scalp will record vowel encoding brain signal, which will be processed and classified using a previously trained classifier. Classification output results in commands that control ball movement on the computer screen, constituting a visual feedback to the subject. Moreover, features collected for new trials are fed back to the classifier, thus adapting the model through Kalman filtering.

# HOW ADVANCED TECHNOLOGY?

- Brain-computer interface (BCI) is an upcoming technology which aims to convey people's intentions to the outside world directly from their thoughts enhancing cognitive capabilities

- BCIs are often directed at assisting, augmenting or repairing human cognitive or sensory-motor functions

- BCI can be used for people who are unable to express through speech.

- BCI research and development has been focused on neuroprosthetics applications.
- Neuroprosthetics is an area of neuroscience concerned with neural prostheses
- Difference between BCI and neuroprosthetics are:
- Neuroprosthetics connect nervous system to a device where as BCI connects the brain to a computer system
- BCI systems are  targeted towards improving functional independence for individuals with severe motor limitations
- “A major goal of a BMI (brain-machine interface) is to provide a command signal from the cortex.
- This command serves as a new functional output to control disabled body parts or physical devices, such as computers or robotic limbs”

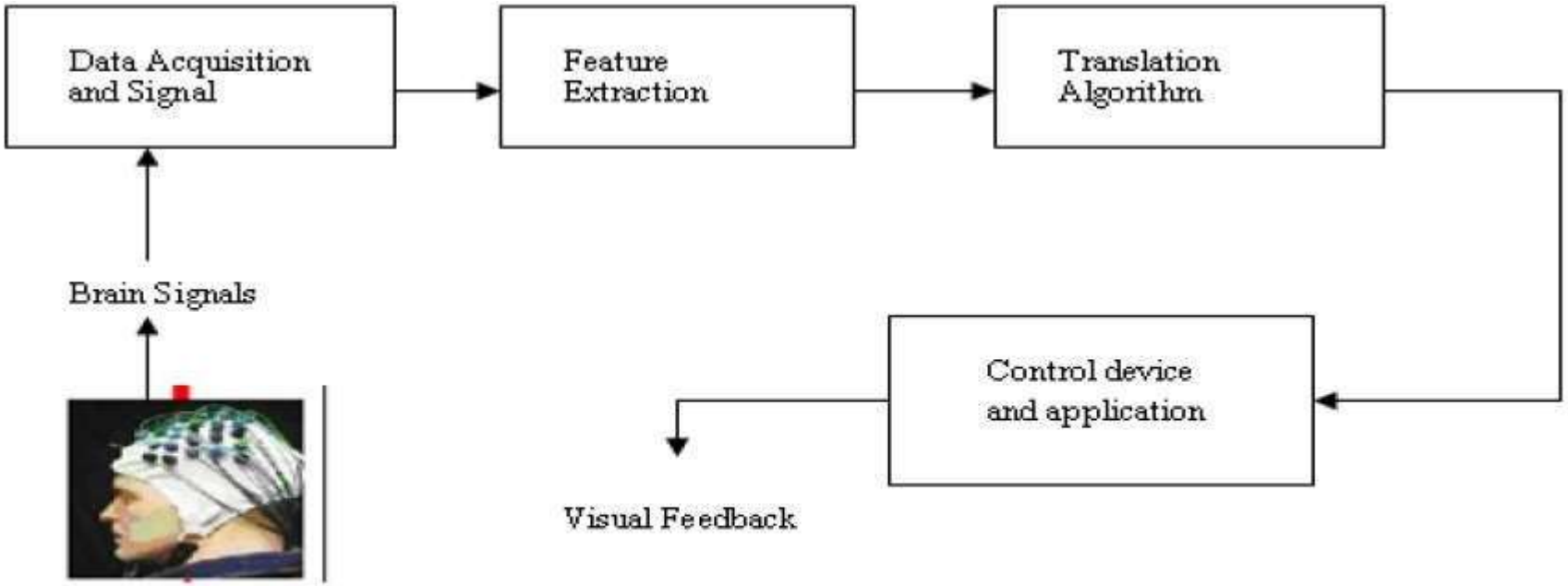



**Fig 1:** Representation of a BCI

# How Do BCIs Work?

- BCIs measure brain activity, process it, and produce control signals that reflect the user's intent
- Any natural form of communication or control requires peripheral nerves and muscles
- Process begins with the user's intent.
- This intent triggers a complex process in which certain brain areas are activated,
- Signals are sent via the peripheral nervous system (specifically, the motor pathways) to the corresponding muscles

- Activity resulting from this process is often called motor output or efferent output.
- which in turn perform the movement necessary for the communication or control task.
- For motion control, the motor (efferent) pathway is essential.
- BCI offers an alternative to natural communication and control.
- BCI is an artificial system that bypasses the body's normal efferent pathways (motor pathways) ,which are the neuromuscular output channels
- Instead of depending on peripheral nerves and muscles,

- BCI directly measures brain activity associated with the user's intent and translates the recorded brain activity into corresponding control signals for BCI applications

- This translation involves signal processing and pattern recognition, which is typically done by a computer.

- Since the measured activity originates directly from the brain and not from the peripheral systems or muscles, the system is called a Brain–Computer Interface.

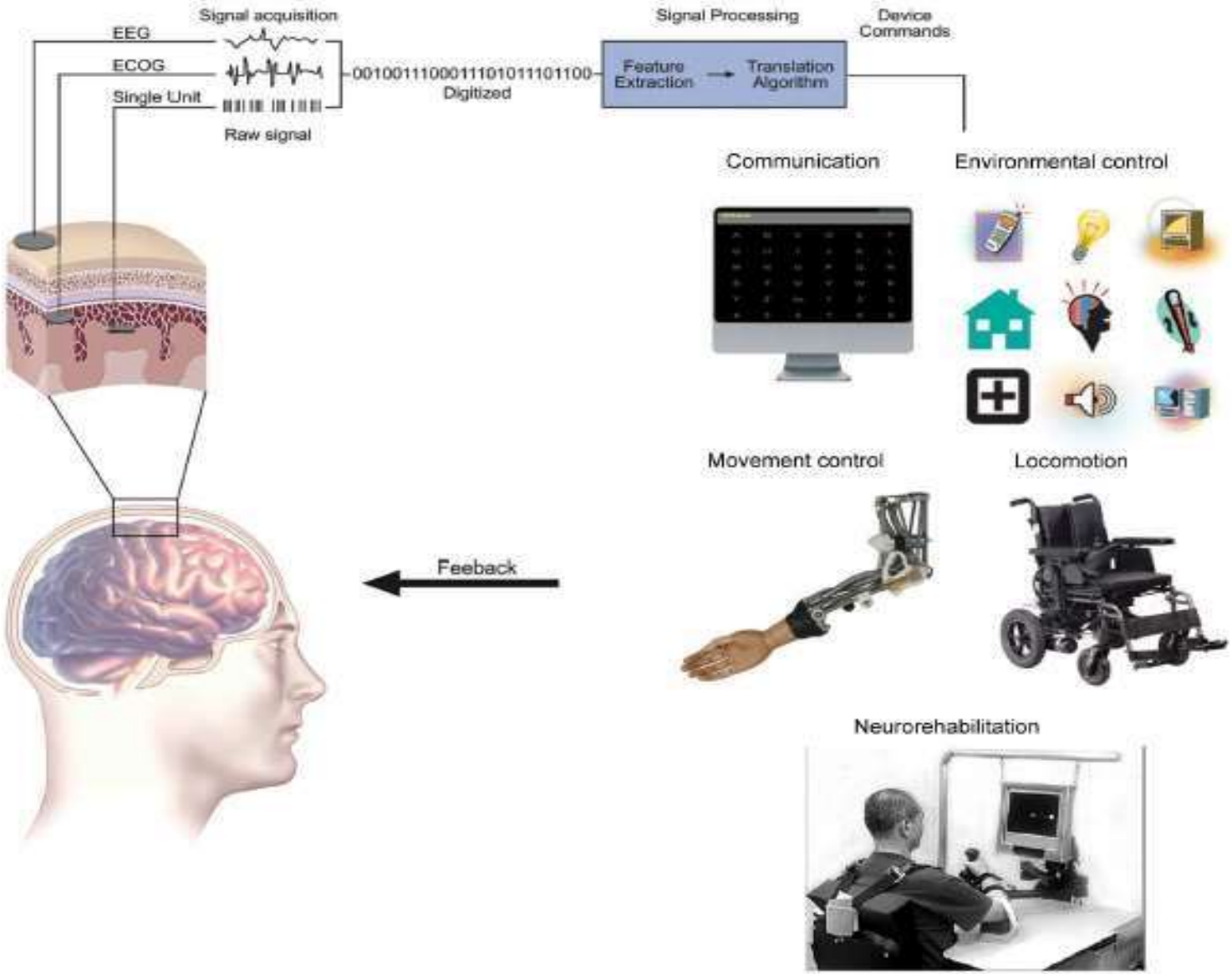
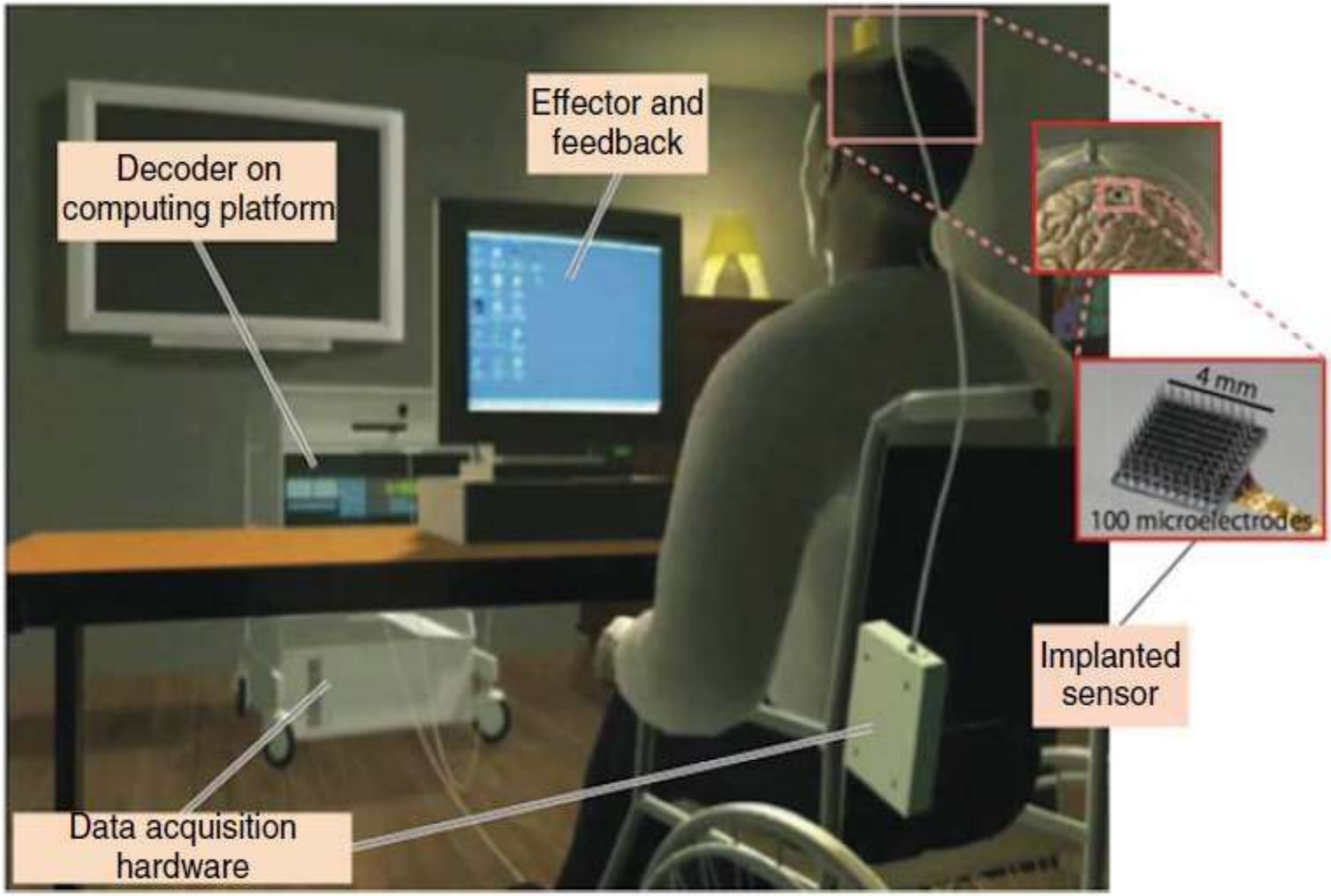



Fig. 2. Essential elements and operation of a BCI system. (Modified from [14] and [36] with permission from Elsevier and Wolters Kluwer, respectively.) Brain signals that carry the intent of the user are first acquired by electrodes placed on the scalp (EEG), beneath the skull and over the cortical surface (ECoG), or within brain tissue (intracortical). These brain signals are digitized, and specific signal features are extracted. The extracted signal features are translated into device commands that activate and control assistive technology used for communication (e.g., spelling on a computer screen); movement control (e.g., robotic arm) [Credit: Copyright Fraunhofer IPA)]; environmental control (e.g., TV, light, temperature, etc); locomotion (e.g., electric wheelchair); or neurorehabilitation. (Adapted from [129] with permission from the *Journal of Rehabilitation Research and Development*.)

# COMPONENTS OF BCI SYSTEM

Three major components-

- **Sensor** - to record neural activity or its proxy
- **Decoder** - that converts neural activity into command signal
- **Effector** -such as a computer cursor or robotic arm


Effector and feedback
Decoder on computing platform
4 mm
100 microelectrodes
Implanted sensor
Data acquisition hardware

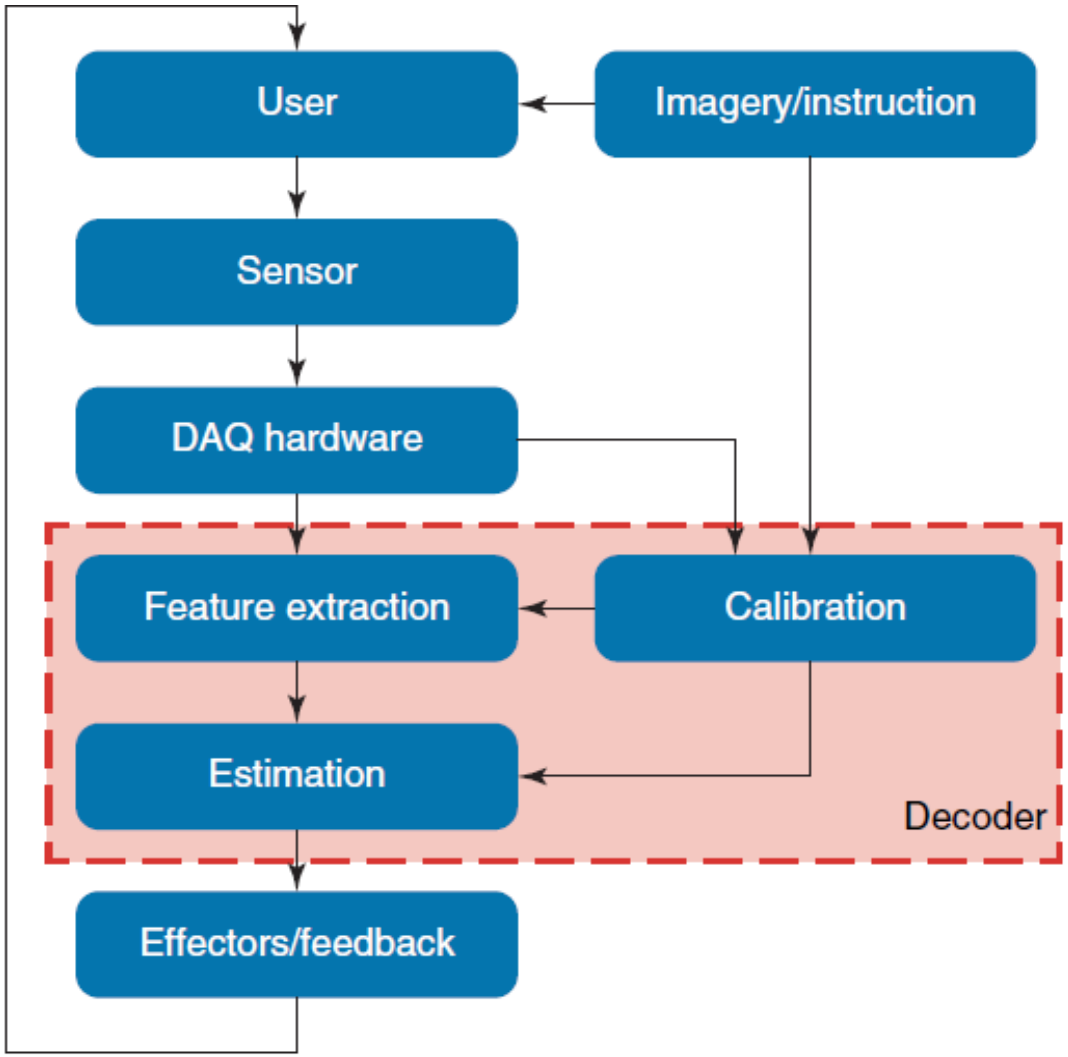



**Figure 9.2** Block diagram of iBCI architecture (from Homer *et al*. 2013, with permission).

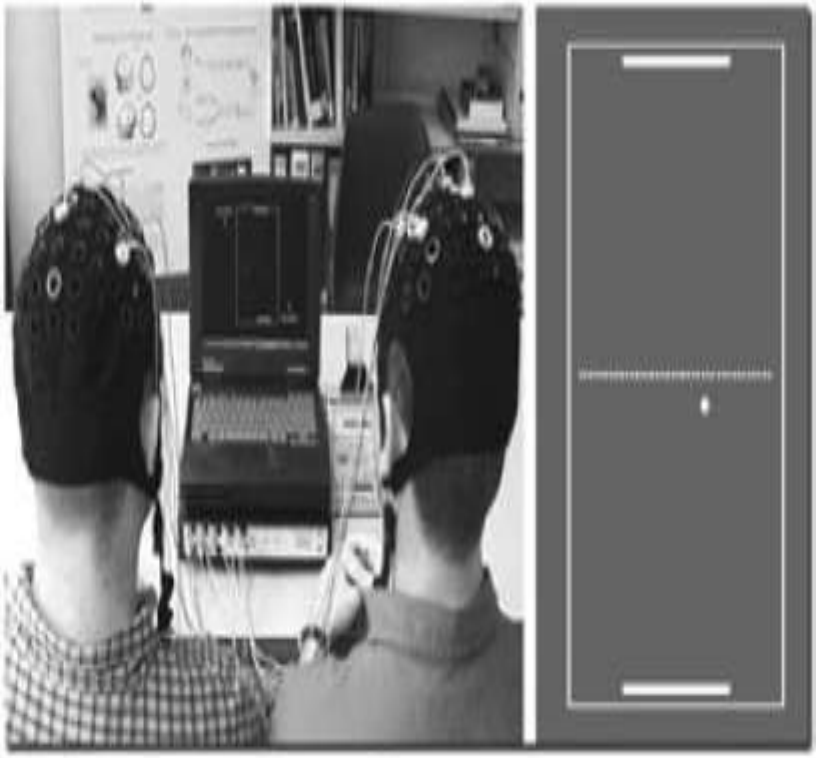
# Applications of BCI

- Individuals who are severely disabled by disorders such as
  - ALS
  - Locked In state
  - Cerebral palsy
  - Brainstem stroke
  - Spinal-cord injuries
  - Muscular dystrophies
  - Chronic peripheral neuropathies

# *Communication*

- Yes/No Communication
- Spellers

C) Number Dialling



D) Computer Game Pong

# Recreation

- Games
- Virtual Reality
- Music

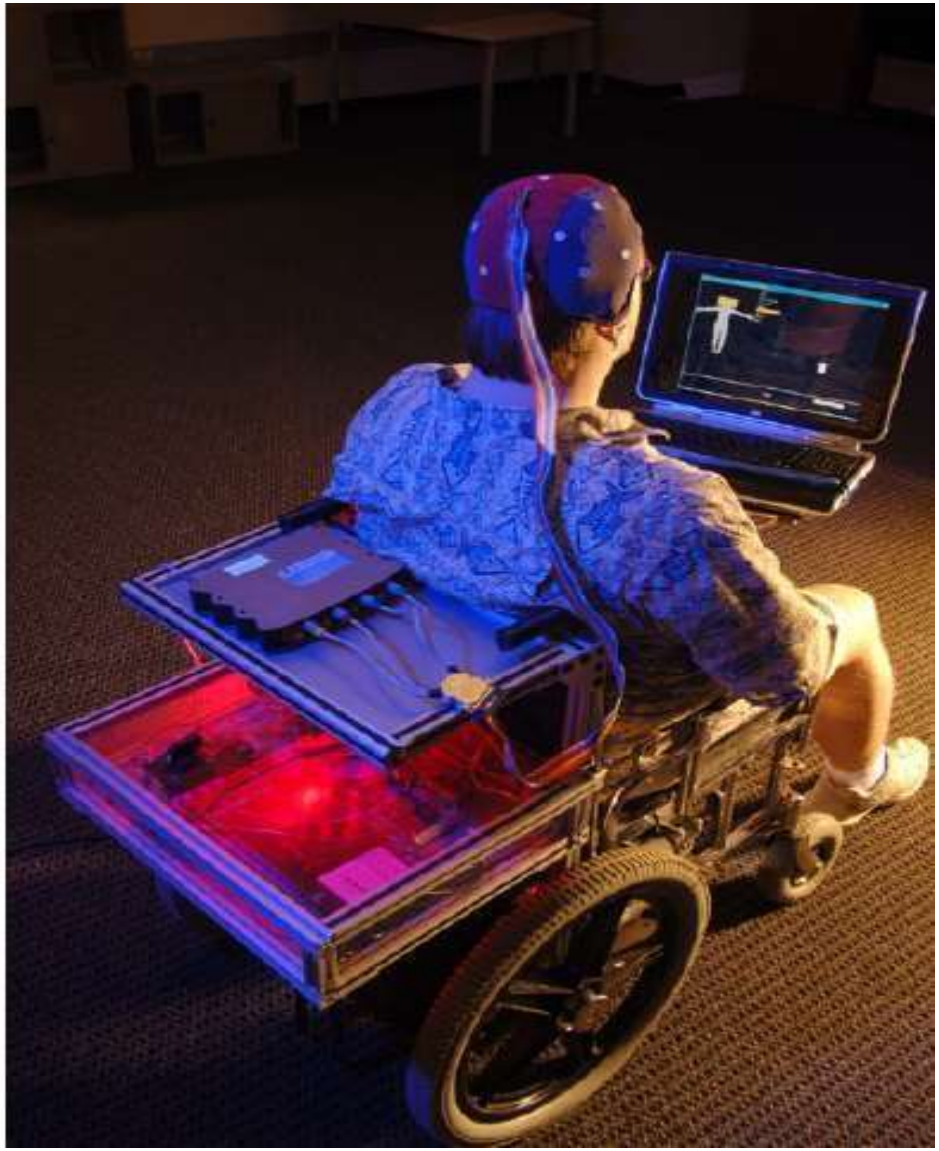
# *Movement Control*

- Restoration of independent locomotion is another important issue for paralyzed people.

- *Tanaka et al.* developed an electric wheelchair controlled by EEG

- Directional commands were detected by EEG and were then applied to direct control of the wheelchair

# *Locomotion*



KINARM™robot for upper limb movement controlled by a BCI as described in Moore Jackson (2008)

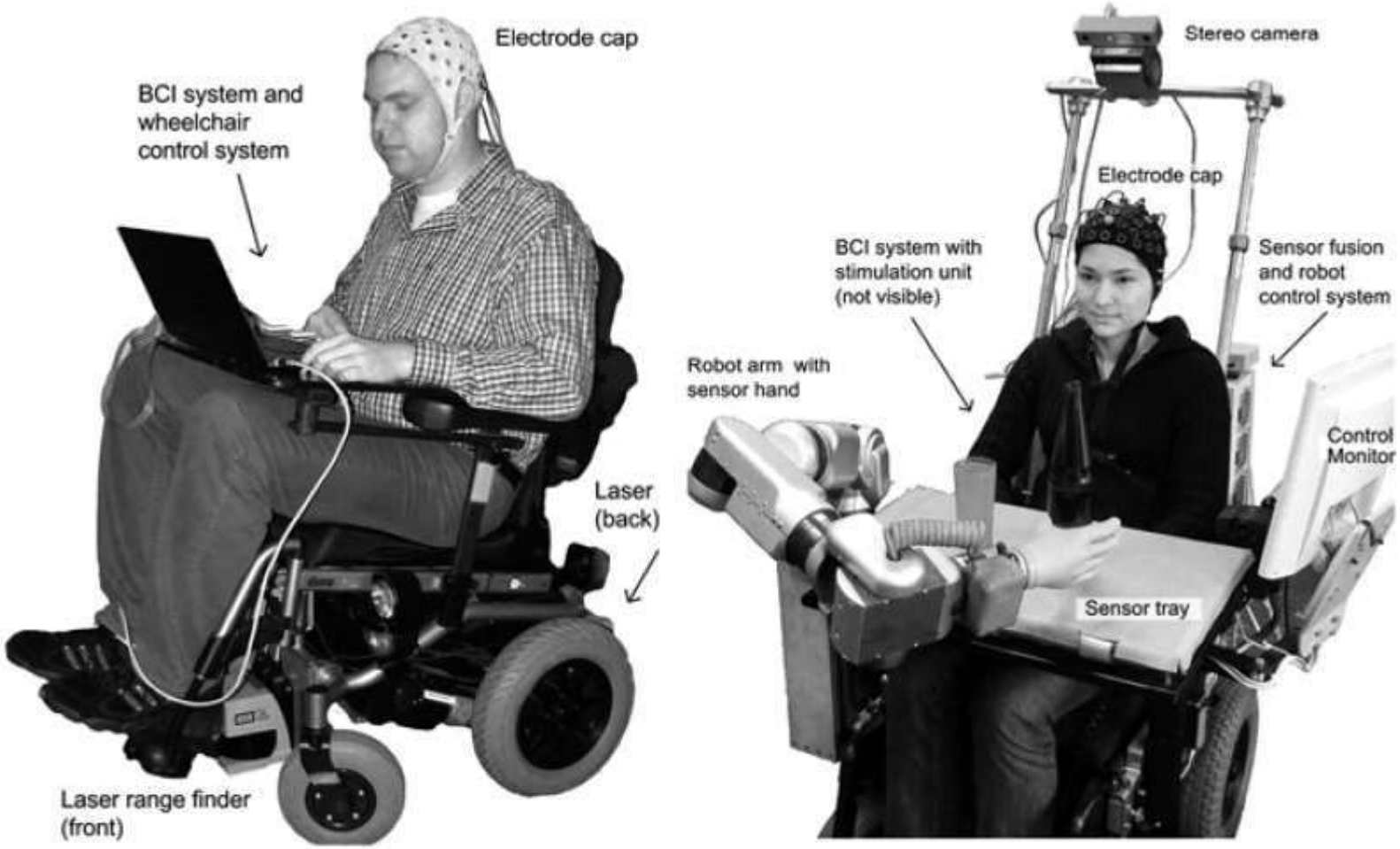



**Fig. 8** Semi-autonomous assistive devices developed at the University of Bremen that include high level control: Intelligent wheelchair Rolland III, and rehabilitation robot FRIEND II (modified from [35])

# *Environmental Control*

- BCI-based environmental control could greatly improve the quality of life of severely disabled people.

- People with severe motor disabilities are often home-bound.

- Effective means for controlling their environments-
- **like controlling room temperature, light, power beds, TV** would increase their well-being and sense of independence

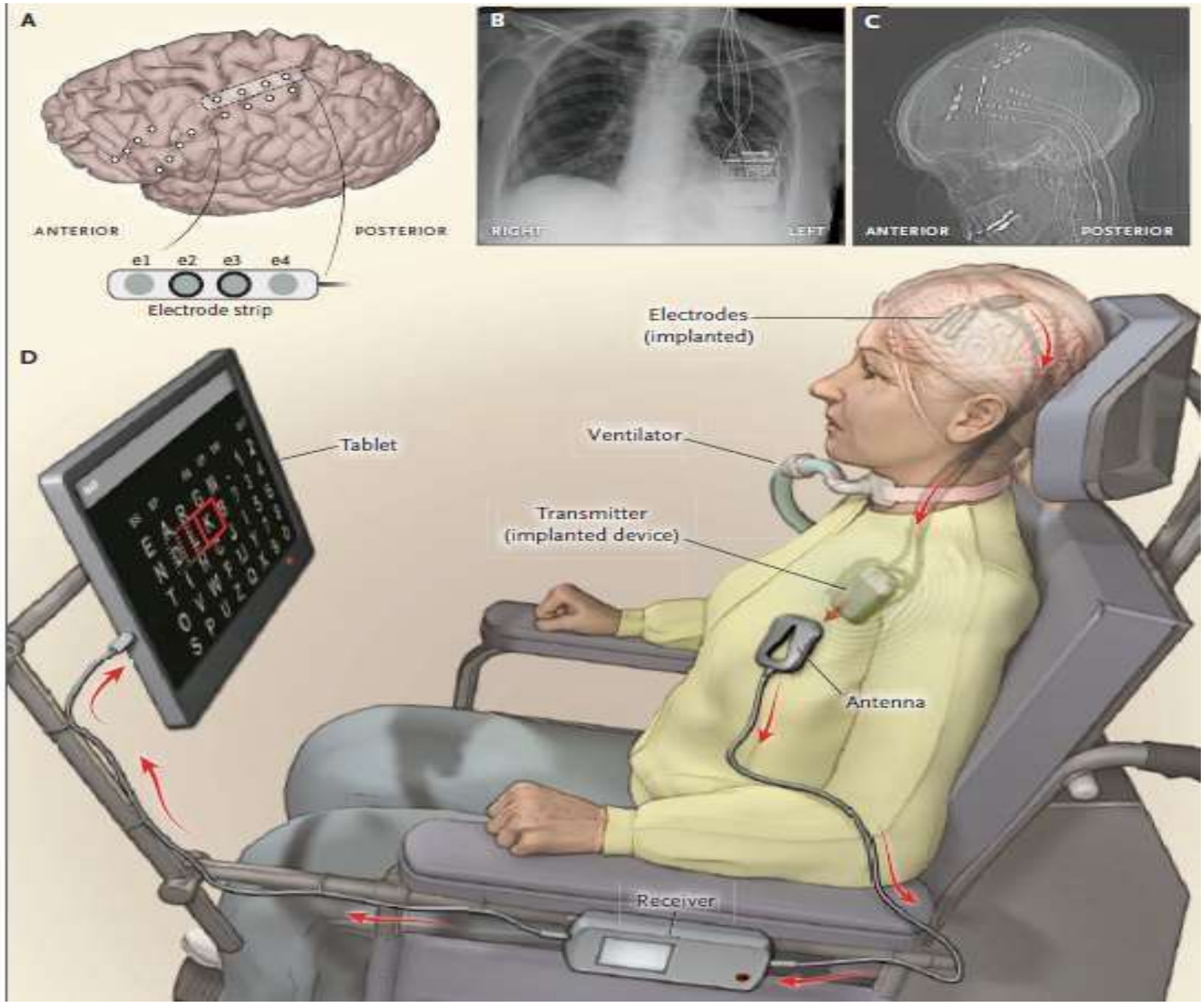
A) Environmental Control

B) Speller

# *Neurorehabilitation*

- Control of prosthetic limb
- Grasp restoration

Fully implantable multichannel recording device
Wireless link
Portable controller
Mechanical actuators with both power and accuracy
Touch and position sensors


A
ANTERIOR
POSTERIOR
e1
e2
e3
e4
Electrode strip
B
RIGHT
LEFT
C
ANTERIOR
POSTERIOR
D
Electrodes
(implanted)
Tablet
Ventilator
Transmitter
(implanted device)
Antenna
Receiver

E) Navigation in VR

F) Grasp Restoration

# Limitations

- Getting a good signal is hard
- Interpretation of signals is hard
- BCIs are currently fairly inaccurate in terms of classifying neural activity
- Surgery needed for electrode placement
- Invasive BCI prone to develops scar tissue

# Ethical Considerations

- How can you obtain consent for a BCI from someone that can’t communicate?
- Do the benefits outweigh the risks?
- What happens if someone wants to keep a thought secret and BCI detects it?
- What is the limit of what we will do with BCI?
- Could people use BCI to interrogate someone?

- Reading people's inner thoughts comes with a massive amount of ethical issues

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INCEPTION
EXPERIENCE IT JULY 16 IN THEATERS AND IMAX

# Future

- BCI technology seems very applicable in a wide variety of areas whether it be medically or commercially
- Possibilities of how far the systems can go is virtually limitless
- Control of sub vocalization and more advanced EEG processing could lead to telepathic communication and active learning mechanisms
- Virtual Gaming
- Mind Reading

# Virtual Reality & Augmented Reality

# Virtual Reality

What is Virtual Reality?

- The Virtual Reality is a technology that use software to generate realistic images, sound and other sensations that replicate real world environment.
- A user can interact and manipulate with the virtual objects of virtual world with the help of specialized devices like display screens or other devices.

- A person using virtual reality equipment is typically able to "look around" the artificial world.
- virtual realities are displayed either on a computer monitor, a projector screen, or with a virtual reality headset.
- Virtual reality environment is captured by using 360 degree special video camera.

# History

- 1965-The beginnings of VR.
- 1977-Interaction through body movement
- 1982-The first computer- generated movie
- 1983-First virtual environment
- 1987-Development of immersive VR
- 1993-Invention of surgery rehearsal system.
- 2007-Google introduced Street View, a service that shows panoramic views

# Immersive Virtual Reality

- An immersive Virtual Reality adds special gadgets like Head mounted displays and Boom.
- Stereoscopic viewing adds enhanced features like deep peeping through the Virtual world.
- Eliminating the real world and placing the human in a computer generated world is one of the enhancements.
- Interactions with the objects in the Virtual world are controlled by a data glove, head mounted display and other gadgets.

# Head Mounted Display

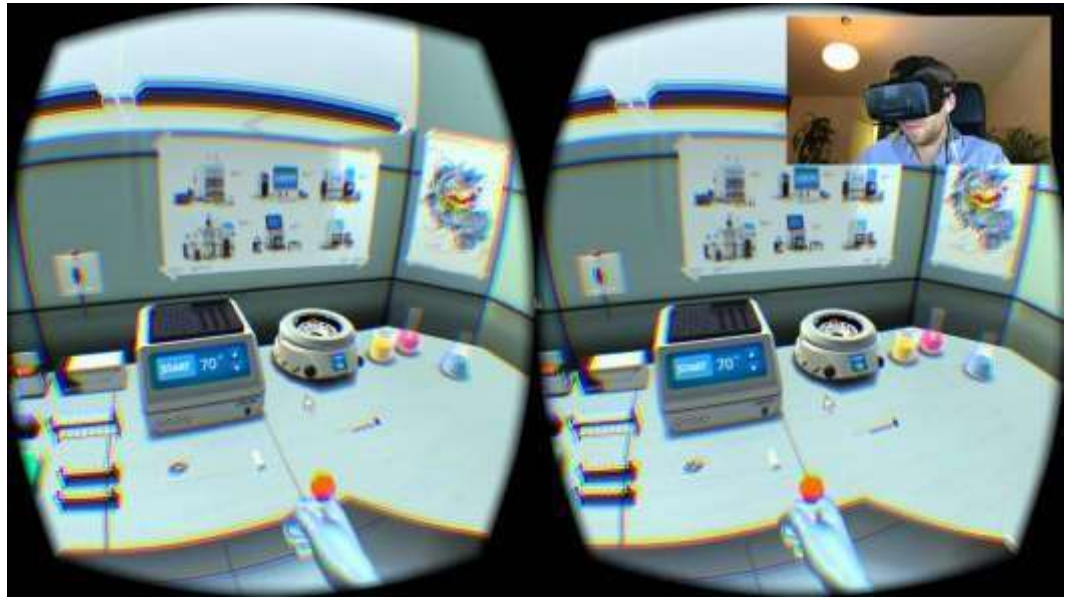
- Consists of two miniature display screens that produces the stereoscopic images and an optical position tracking system
- It tracks the orientation of the humans head in the Virtual world and that produces the impulse to the image generating large projection Areas to get more immersive feeling.
- Characteristics: walk through , look around, fly through in the 3d Virtual world Computer.

# Application of virtual reality

- Movies - Virtual reality is applied in 3-D movies to try and immerse the viewer into the movie and/or virtual setting and environments.

- Video Games - Virtual reality is evident in video games. Now you can physically interact with a game by using your body and motions to control characters and other elements of the game that years ago people would only imagine.

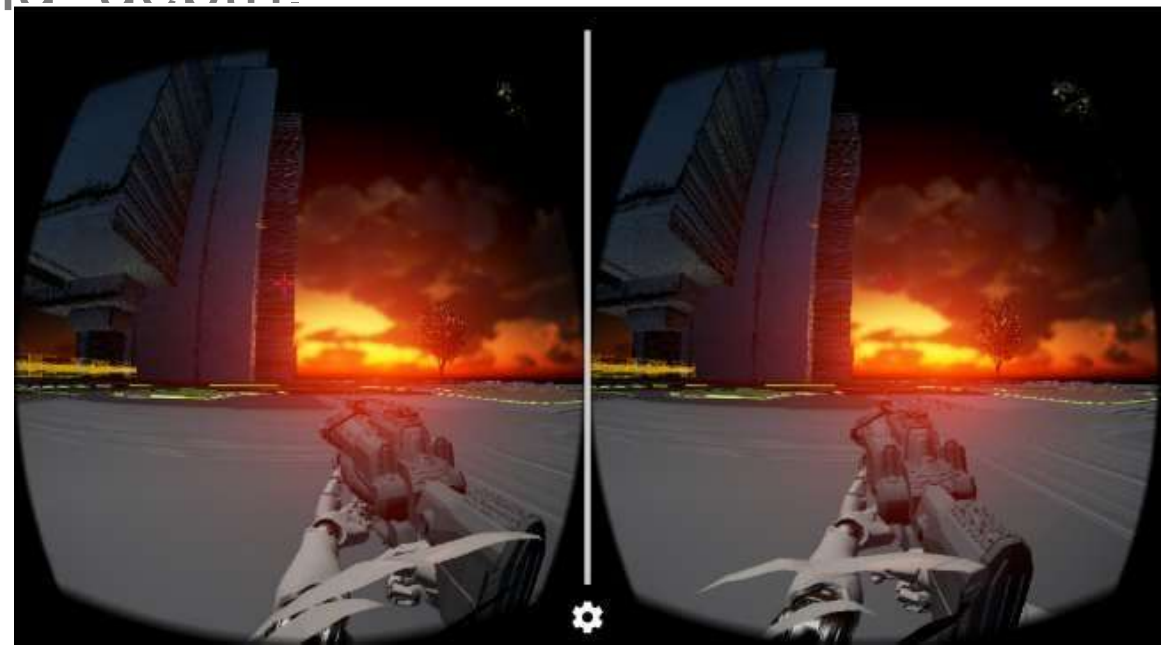
- Education -Virtual reality for teaching and learning situations. The advantage of this is that it enables large groups of students to interact with each other as well as within a three dimensional environment. Creating Virtual Labs.



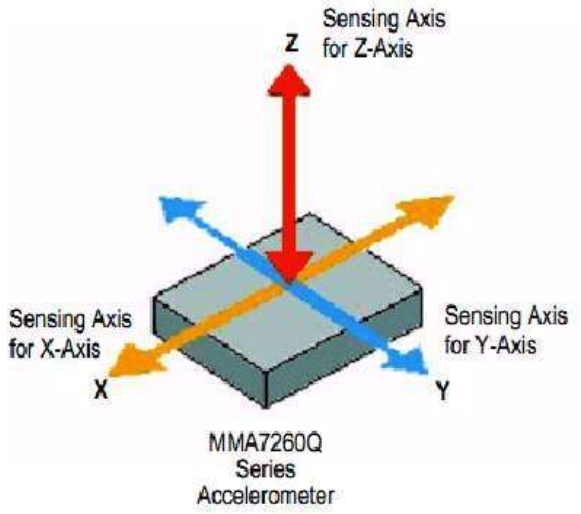
- Training- VR is used by trainers to provide learners with a virtual environment where they can develop their skills without the real-world consequences of failing.
- Architectural Design- Architectural design firms and various clients in the real estate industry to tour virtual models of proposed building designs.

# How Virtual Reality works?

- virtual reality tricks your brain into believing you are in a 3D world.  VR does this is with the stereoscopic display. This works by displaying  two slightly different angles of the scene to each eye, simulating  depth.



- On Android, your phone's accelerometer, gyroscope and magnetometer are used to achieve movement of the headset. The accelerometer is used to detect three dimensional movement with the gyroscope being used to detect angular movement.
- Using these sensors, your phone can accurately predict where you are looking at any given time while using VR.



# Advantages of VR

1) Virtual reality creates a realistic world
2) It enables user to explore places.
3) Through Virtual Reality user can experiment with an artificial environment.
4) Virtual Reality make the education more easily and comfort.

# Disadvantages of Virtual Reality

1) The equipments used in virtual reality are very expensive.
2) It consists of complex technology.
3) In virtual reality environment we can't move by our own like in the real world.

# Current Virtual Reality devices in Market

- Oculus Rift

The **Oculus Rift** is a virtual reality headset developed and manufactured by Oculus VR, a division of Facebook Inc., released on March 28, 2016.

# Google Cardboard

**Google Cardboard** is a virtual reality (VR) platform developed by **Google** for use with a head mount for a smartphone. Named for its fold-out **cardboard** viewer, the platform is intended as a low-cost system to encourage interest and development in VR applications.

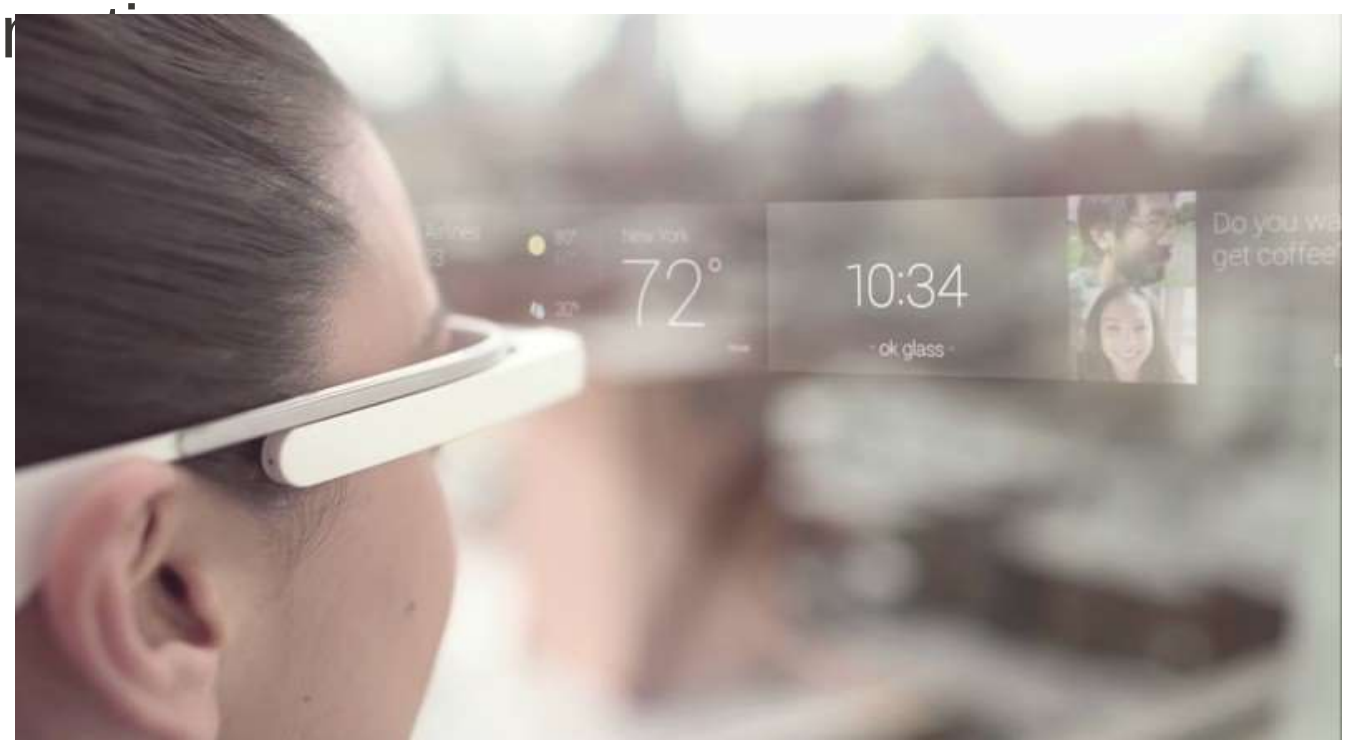
# Samsung GearVR

- The Samsung Gear VR is a mobile virtual reality headset developed by Samsung Electronics, in collaboration with Oculus, and manufactured by Samsung. When in use, a compatible Samsung Galaxy device (Galaxy Note 5, Galaxy S6/S6 Edge/S6 Edge+, or Galaxy S7/S7 Edge) acts as the headset's display and processor, while the Gear VR unit itself acts as the controller,

# Augmented Reality

# What is Augmented Reality?

- A combination of a real scene viewed by a user and a virtual scene generated by a computer that augments the scene with additional inform



- An AR system adds virtual computer- generated objects, audio and other sense enhancements to a real-world environment in real time.
- The Goal of AR is to Create a system such that a user CANNOT tell the difference between the real world and the virtual augmentation of it.

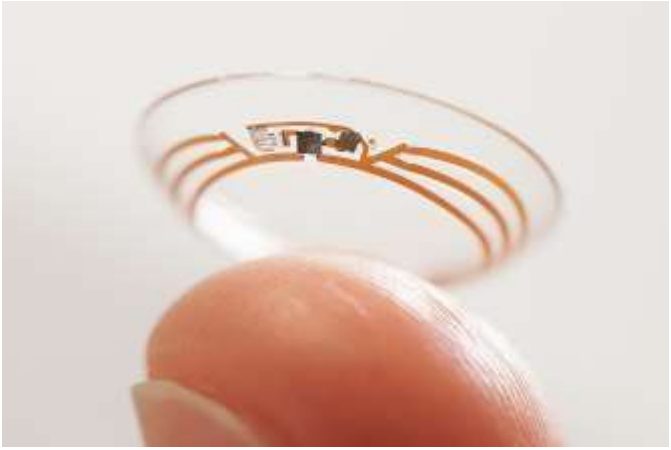
# History

- 1980: Steve Mann creates the first wearable computer, a computer vision system with text and graphical overlays on a mediated reality
- 1989: Jaron Lanier coins the phrase Virtual Reality and creates the first commercial business around virtual worlds
- 2013: Google announces an open beta test of its Google Glass augmented reality glasses.
- 2015: Microsoft announces Windows Holographic and the HoloLens augmented reality headset
- 2016: Niantic released *Pokémon Go* for iOS and Android in July 2016.

# Technology Component

- Hardware- Hardware components for augmented reality are processor display,  sensors an input devices.
- Display-Various technologies are used in  Augmented Reality rendering
  including optical projection
  systems, monitors, handheld devices, and  display systems worn on the human body.
- Eyeglasses- AR displays can be rendered on  devices resembling eyeglasses

- Contact lenses- Contact lenses that display  AR imaging are in development.



- Handheld- Handheld displays employ a small  display that fits in a user's hand such as  Mobile phones and tablets.

- Heads up display- Is any transparent display that presents data  without requiring users to look away from their usual viewpoints.

# Applications

Augmented reality also has application in similar fields that of Virtual reality

- Medical
- Entertainment
- Military Training
- Engineering Design
- Robotics and Telerobotics
- Manufacturing, Maintenance, and Repair
- Consumer Design
- etc

# Medical

AR has application in medicals like observing the  internal body systems of  patients

# Entertainment & Games

AR has applications in  Games like and entertainments to play  game called pokemon  go in which you can  catch augmented pokemon characters in  real world

# Robotics

- AR is useful for Robots Application where robot will be able to show holographic augmented characters in real world making easier to communicate.

# Consumer Design

- A very simple example of application in consumer design would be Imagine you place a augmented sofa in your Room and  see if it fits or not before purchasing

# Advantages of AR

- Can increase knowledge and information
- People can share experiences with each other in real time over long distances
- Games can provide an even more "real" experience
- Things come to life on people's mobile

# Disadvantages of AR

- Lack of Privacy criminals can simply point their phone towards victim  and know everything about them
- Production is expensive.
- Difficult to maintain Augmented Reality Systems
- Low performance level.

# Augmented Reality vs. Virtual Reality

Augmented Reality

- System augments the real world scene
- User maintains a sense of presence in real world
- Needs a mechanism to combine virtual and real worlds

Virtual Reality:

- Totally immersive environment
- Visual senses are under control of system (sometimes aural and proprioceptive senses too)

# Conclusion

Virtual as well as Augmented Reality has very Strong Potentials And maybe they are currently in its initial stage but will have a very big role in our lives in future when these technologies are matured enough.

THANK YOU