SNS COLLEGE OF ENGINEERING

An Autonomous Institution

Coimbatore-107

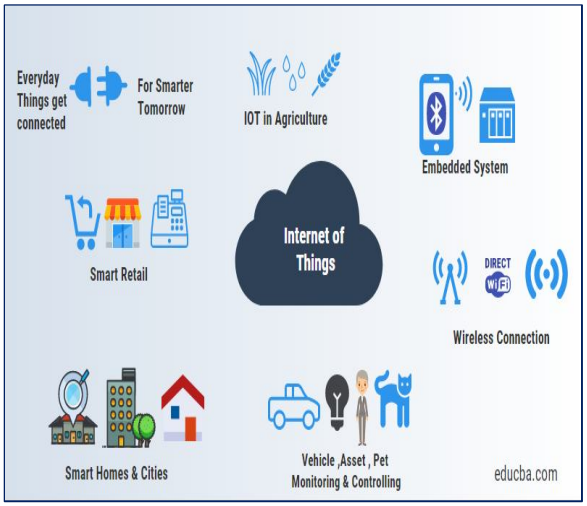
19IT503-INTERNET OF THINGS

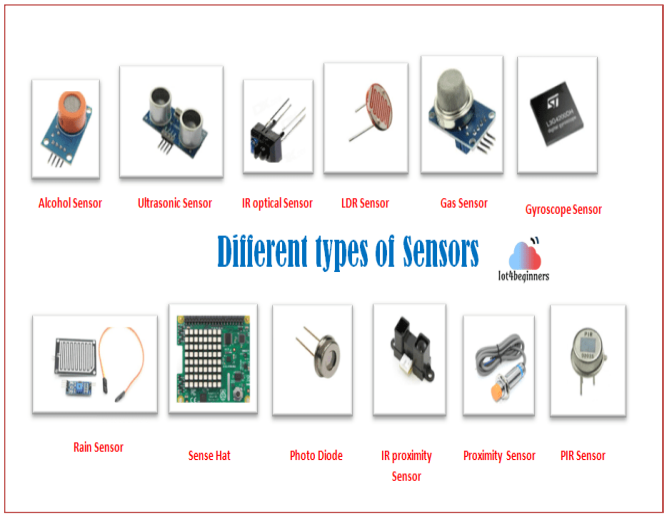
UNIT-1 IoT INTRODUCTION AND APPLICATIONS

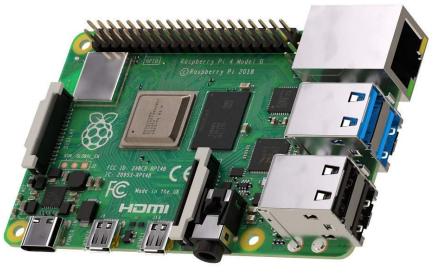
Topic:1-IOT Introduction

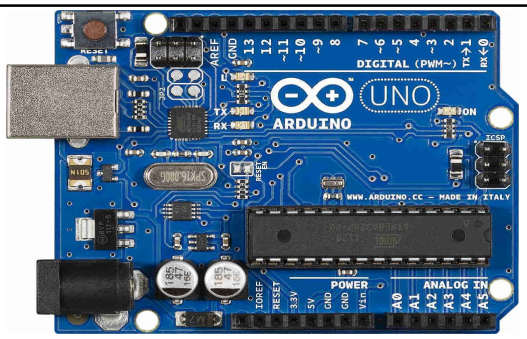
What is IOT?

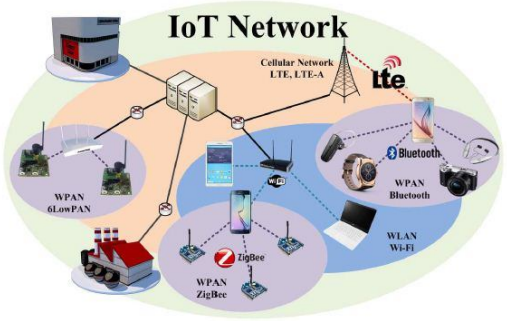
- Short Introduction Video











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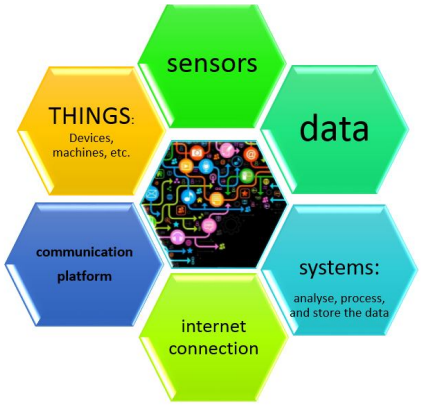
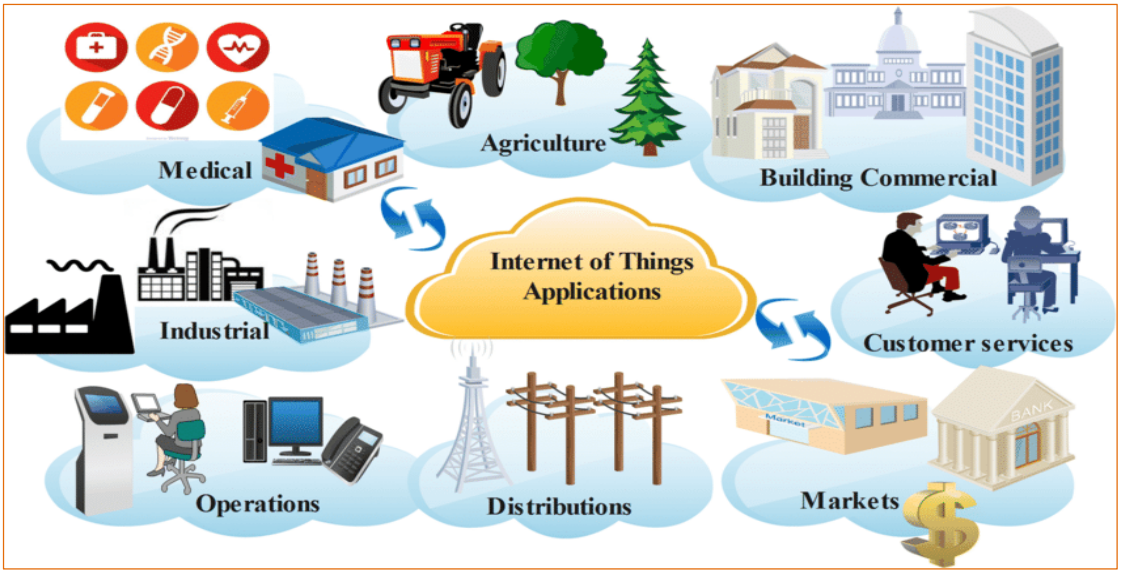
IOT-DEFINITION

"The Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment." – Gartner

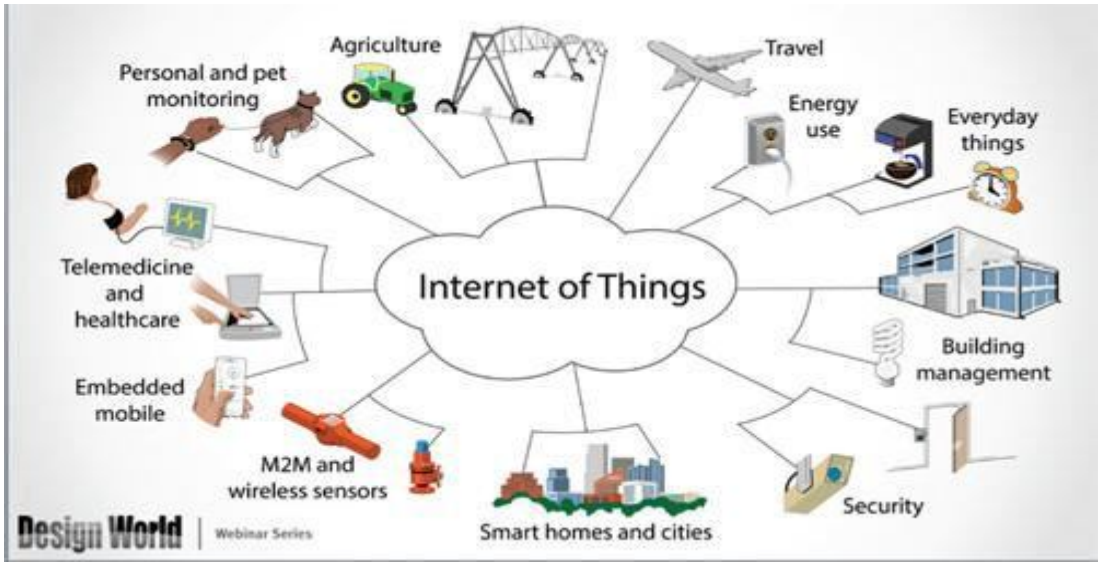


COMPONENTS AND TECHNOLOGIES

APPLICATIONS OF IOT

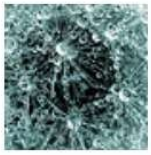


APPLICATIONS OF IOT



IMPACT OF INTERNET

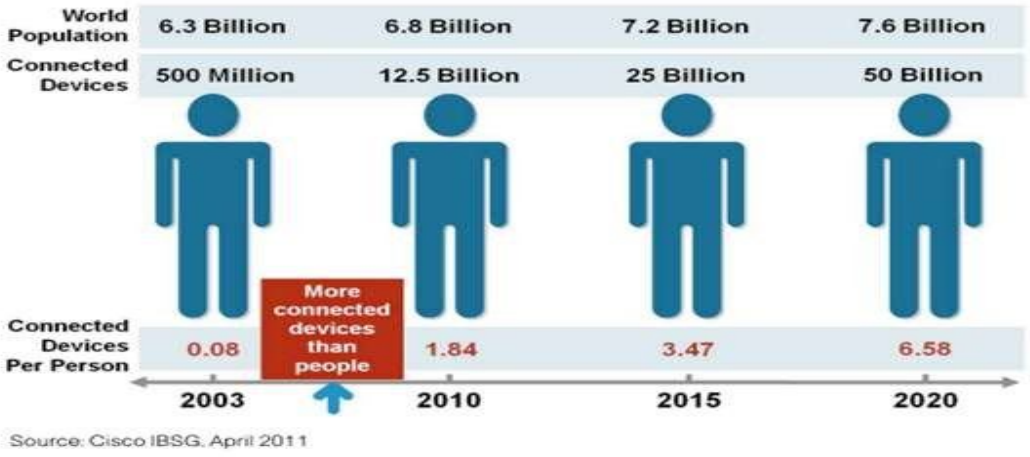
Internet Revolution

Internet of boffins	Internet of geeks	Internet of masses	Mobile Internet	Internet of things
				
1969 - 1995	1995 - 2000	2000 - 2007	2007 - 2011	2012 & beyond

APPLICATIONS OF INTERNET

Education **Business** **Communication** **Entertainment** **Medical/Health**

Internet Usage and Population Statistics



Source: Cisco IBSG, April 2011

Evolution of Internet to IOT

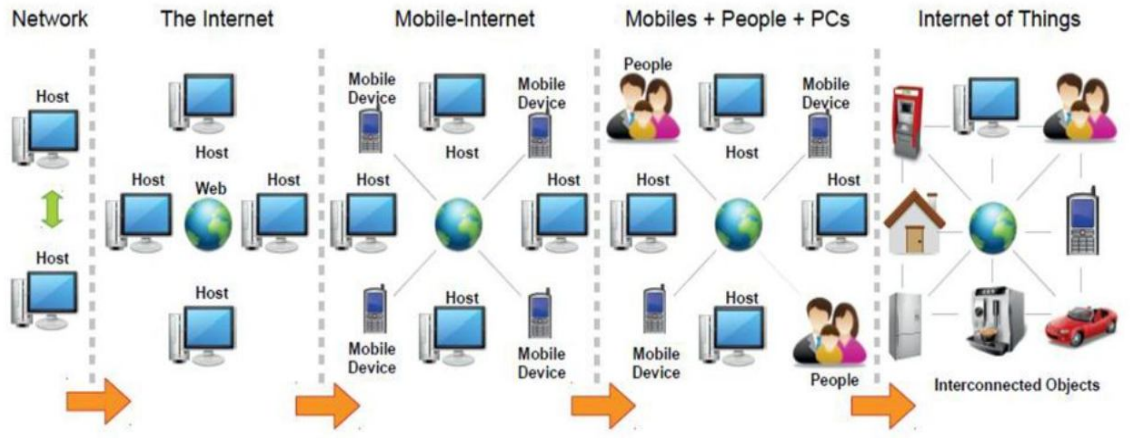


Fig. 1. Evolution of the Internet in five phases. The evolution of Internet begins with connecting two computers together and then moved towards creating World Wide Web by connecting large number of computers together. The mobile-Internet emerged by connecting mobile devices to the Internet. Then, peoples' identities joined the Internet via social networks. Finally, it is moving towards Internet of Things by connecting every day objects to the Internet.

OTHER DEFINITIONS OF IOT

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

Cont....

- 2) Internet of Things refers to the concept that the Internet is no longer just a global network for people to communicate with one another using computers, but it is also a platform for devices to communicate electronically with the world around them."

--Center for Data and Innovation

Conti…

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

------IoT 2008

Conti…

(4) “Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts”.

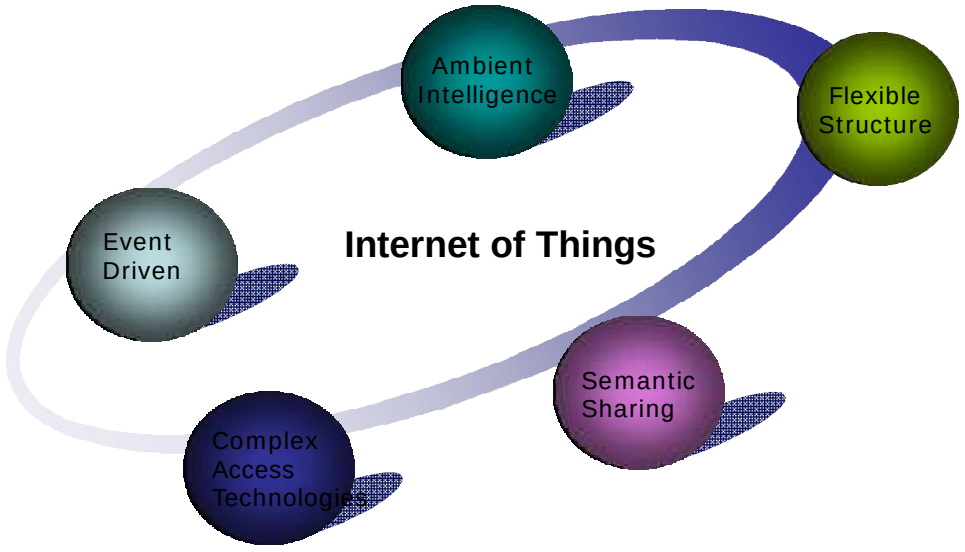
-------IoT in 2020

Father of IOT

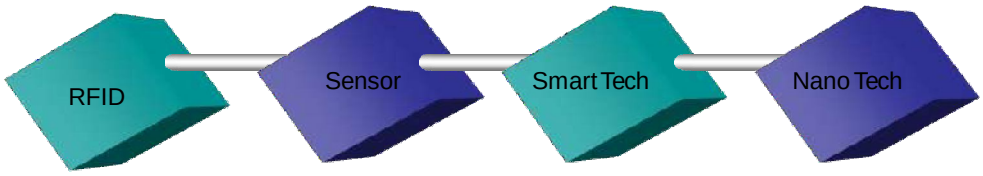
- The term Internet of Things was first used by Kevin Ashton (Father of IOT) in 1999.
- Refers to uniquely identifiable objects (things) and their **virtual representations** in an Internet-like structure

Ashton at the 2015 Texas Book Festival.
Born: 1968- Birmingham, England
Nationality: British

Characteristics



Enabling Technologies



To identify and track the data of things	To collect and process the data to detect the changes in the physical status of things	To enhance the power of the network by devolving processing capabilities to different part of the network.	To make the smaller and smaller things have the ability to connect and interact.

Overview and Motivations

- The proliferation of an ever-growing set of devices able to be directly connected to the Internet is leading to a new ubiquitous-computing paradigm.
- Internet—its deployment and its use has experienced significant growth in the past four decades,
- Evolving from a network of a few hundred hosts to a platform capable of linking billions of entities globally.
- Recently, the Internet has connected servers of all kinds to users of all kinds seeking access to information and applications of all kinds.
- Now, with social media, it intuitively and effectively connects all sorts of people to people, and to virtual communities.

IPV6-Role

- **Internet Protocol version 6 (IPv6)** is the most recent version of the Internet Protocol (IP), the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet.

IPv6 provides:

- Abundant address spaces
- Globally unique object (thing) identification **(object ID (OID))**

IPV6-Role

- Connectivity can be provided in a standardized manner without additional status or address (re) processing
- Its intrinsic advantage over IPv4 or other schemes.
- For all end-point network locations and/or intermediary-point network locations to have a durable **unique network address (NAdr)**

IPV6-Role

- Some objects that have enough intelligence to (run a communication protocol stack so that they can) communicate are placed on a network, these objects can be tagged with an NAdr.
- If object is moving then OID from the NAdr and thus assign a general (OID, NAdr) tuple where the OID is completely invariant.

IPV6-Role

- For a stationary object, nonvariable, or mostly static environment, one could opt, to assign the OID to be identical to the NAdr where the object is expected to attach to the network.
- The object inherits the tuple (Nadr', Nadr').

IPV4 vs IPV6

- In IPv4 world, the 32-bit address space provides only 232∼1010 NAdr location can be identified uniquely.
- IPv6 offers a much larger 2128 space; hence, the number of available unique node addressees is 2128∼1039.
- IPv6 has more than 340 undecillion (340,282,366,920,938,463,463,374, 607,431,768,211,456) addresses, grouped into blocks of 18 quintillion addresses.

IPV4 vs IPV6

- Already today many tags operate with a 128-bit OID field that allows 2128∼1039 (≈3.4 × 1038) unique identifiers, but the tuple (OID, NAdr = OID) could not be defined uniquely in the IPv4 world.

Advantages of IPV6

Scalability and expanded addressing capabilities:

- IPv6 has 128-bit addresses versus 32-bit IPv4 addresses. With IPv4, the theoretical number of available IP addresses is 232~1010. IPv6 offers a much larger 2128 space. Hence, the number of available unique node addressees is 2128~1039.

Advantages of IPV6

Plug-and-play:

- IPv6 includes a "plug-and-play" mechanism that facilitates the connection of equipment to the network. The requisite configuration is automatic; it is a serverless mechanism.

Security:

- IPv6 includes and requires security in its specifications such as payload encryption and authentication of the source of the communication. End-to-end security, with built-in strong IP-layer encryption and authentication (embedded security support with mandatory IP security (IPsec) implementation), is supported.

Advantages of IPV6

Mobility:

- IPv6 includes an efficient and robust mobility mechanism namely an enhanced support for mobile IP, specifically, the set of mobile IPv6 (MIPv6) protocols, including the base protocol defined in RFC 3775.

IPV6 Role

- IPv6 mobility, specifically MIPv6, relies on IPv6 capabilities.
- In order to continue communication in spite of its movement, an MN (mobile nodes) could change its IP address each time it moves to a new link, but the MN would then not be able to maintain transport and higher-layer connections when it changes location.

IPV6 Role-Areas of Development and Standardization

- Despite significant technological advances in many subtending disciplines, difficulties associated with the evaluation of IoT solutions under realistic conditions in real world experimental deployments still hamper their maturation and significant rollout.
- IoT have to work with limited standardization, there are capability mismatches between different devices; also, there are mismatches between communication and processing bandwidth.

IPV6 Role-Areas of Development and Standardization

- While IoT systems can utilize existing Internet protocols, in a number of cases the power-, processing-, and capabilities-constrained IoT environments can benefit from additional protocols that help optimize the communications and lower the computational requirements.

IPV6 Role-Areas of Development and Standardization

The four "pillars" supporting or defining the IoT:

(i) M2M/MTC as the "Internet of devices";

(ii) RFID as the "Internet of objects";

(iii) WSN as the "Internet of transducers"

(iv) Supervisory Control And Data Acquisition (SCADA) as the "Internet of controllers"

IPV6 Role-Areas of Development and Standardization

- **Some areas of active research include but are not limited to the following:**
- Standardization at all layers/domains
- Architectures and middlewares for IoT integration
- Protocols for smart things: end-to-end/M2M protocols and standardization
- Mobility management
- Cloud computing and things internetworking

Conti...

- Lightweight implementations of cryptographic stacks
- End-to-end security capabilities for the things
- Bootstrapping techniques
- Routing protocols for the IoT
- Global connectivity

IoT Definitions-General Observations

- Originally the term “Internet of Things” was invented by the MIT Auto-ID Center in 2001 and referred to an architecture that comprises **four elements**, as follows

1. Passive radio frequency identification (RFIDs), such as Class-1 Generation-2 UHFRFIDs, introduced by the electronic product code (EPC) Global Consortium and operating in the 860–960 MHz range1

Conti...

2. Readers plugged to a local (computing) system, which read the EPC.
3. A local system offering IP connectivity that collects information pointed by the EPC, thanks to a protocol called object naming service (ONS)
4. EPCIS (EPC Information Services) servers that process incoming ONS requests and returns physical markup language (PML) files, for example, XML documents carrying meaningful information linked to RFIDs

ITU-T Views

- ITU Telecommunication Standardization Sector (ITU-T)
- International Telecommunication Union (ITU)
- One can view the following as

Internet

- providing a number of technological capabilities or as a concept to provide an array of data exchange and linkage services.

Conti…

The infrastructure perspective

- describes the Internet as a global system of interconnected computer networks (of many conceivable technologies) that use the TCP/IP Internet Protocol Suite to communicate

The networks comprise

- millions of private, public, business, academic, and governmental servers, computers, and nodes.

ITU-T Views

- **View A:** IoT is just a concept (conceptual aspects of definition): the IoT does not refer to a network infrastructure; the IoT is not a technical term but a concept (or a phenomenon).
- **View B:** IoT is an infrastructure: The IoT refers to an infrastructure.

ITU-T Views

- IoT should be identified for all aspects of infrastructure such as service and functional requirements, architectures.

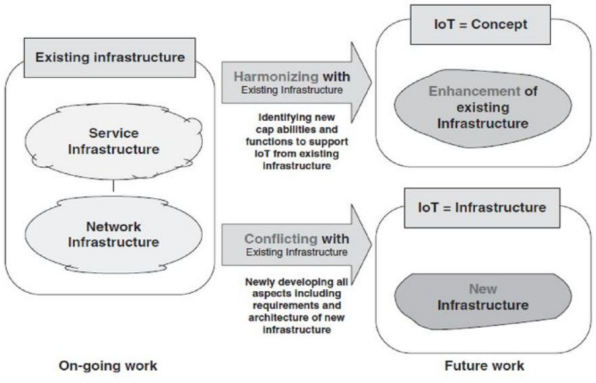


FIGURE 2.1 Direction for standardization according to IoT definition.

Working Definition

Definition:

- A broadly-deployed aggregate computing/communication application and/or application-consumption system, that is deployed over a local (L-IoT), metropolitan (M-IoT), regional (R-IoT), national (N-IoT), or global (G-IoT) geography, consisting of

(i) dispersed instrumented objects ("things") with embedded one or two-way communications and some (or, at times, no) computing capabilities,

(ii) where objects are reachable over a variety of wireless or wired local area and/or wide area networks,

(iii) whose inbound data and/or outbound commands are pipelined to or issued by a(n application) system with a (high) degree of (human or computer-based) intelligence.

Other related Working Definition

- Two other related “working definitions” are as follows:
- **Definition:** Sensors are active devices that measure some variable of the natural or man-made environment (e.g., a building, an assembly line, an industrial assemblage supporting a process).
- **Definition:** An actuator is a mechanized device of various sizes (from ultra-small to very large) that accomplishes a specified physical action, for example, controlling a mechanism or system, opening or closing a valve, starting some kind or rotary or linear motion, or initiating physical locomotion. An actuator is the mechanism by which an entity acts upon an environment.

Thank you