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G's Technology Evolution in IOT for Industrial Automation

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ABSTRACT The G's Technology is now built very rapidly communication network and speedy wireless growing its evolution. It was the most measure part of in IoT (Internet Of Things). So many things are growing in IoT (Internet Of Things) by their newly developed technologies. Every year a new generation technology or system is launching for new features and wide area network covering to spread their network with high speed communication network. Here, we study and information about Generation of technologies development and their evolution for helping industry and automation communication system. Most of all communication systems are world wide web development systems for more area covered with wireless communication.

KEYWORDS: Cellular wireless networks · Mobile communications · Internet of Things (IoT) · Internet of medical things (IoMT) · Industrial Internet of Things (IIoT) · Wi-Fi 6 · Enhanced mobile broadband (eMBB).

I. INTRODUCTION

Mobile wireless communication system has gone through several evolution stages in the past few decades after the introduction of the first generation mobile network in early 1980s. Due to huge demand for more connections worldwide, mobile communication standards advanced rapidly to support more users. Let's take a look on the evolution stages of wireless technologies for mobile communication.

Invention of first mobile phone – The evolution begins, Martin Cooper, an engineer at Motorola during 1970s working on a handheld device capable of two-way communication wirelessly, invented the first generation mobile phone. It was initially developed to use in a car, the first prototype was tested in 1974.

This invention is considered as a turning point in wireless communication which led to an evolution of many technologies and standards in future.

II. HISTORY OF WIRELESS TECHNOLOGY

Marconi, an Italian inventor, transmitted Morse code signals using radio waves wirelessly to a distance of 3.2 KMs in 1895. It was the first wireless transmission in the history of science. Since then, engineers and scientists were working on an efficient way to communicate using RF waves.

Telephone became popular during the mid of 19th century. Due to wired connection and restricted mobility, engineers started developing a device which doesn't requires wired connection and transmit voice using radio wave.



Fig: Evolution of 1G to 5G Ref from Google rpage.com

III. COMMUNICATION SYSTEM GENERATIONS

1G First generation mobile communication system

The first generation of mobile network was deployed in Japan by Nippon Telephone and Telegraph company (NTT) in Tokyo during 1979. In the beginning of 1980s, it gained popularity in the US, Finland, UK and Europe. This system used analogue signals and it had many disadvantages due to technology limitations.

2G – Second generation communication system GSM

Second generation of mobile communication system introduced a new digital technology for wireless transmission also known as Global System for Mobile communication (GSM). GSM technology became the base standard for further development in wireless standards later. This standard was capable of supporting up to 14.4 to 64kbps (maximum) data rate which is sufficient for SMS and email services. Code Division Multiple Access (CDMA) system developed by Qualcomm also introduced and implemented in the mid-1990s. CDMA has more features than GSM in terms of spectral efficiency, number of users and data rate.

3G – Third generation communication system

Third generation mobile communication started with the introduction of UMTS Universal Mobile Terrestrial / Telecommunication Systems. UMTS has the data rate of 384kbps and it support video calling for the first time on mobile devices. After the introduction of 3G mobile communication system, smart phones became popular across the globe. Specific applications were developed for smartphones which handles multimedia chat, email, video calling, games, social media and healthcare.

4G – Fourth generation communication system

4G systems are enhanced version of 3G networks developed by IEEE, offers higher data rate and capable to handle more advanced multimedia services. LTE and LTE advanced wireless technology used in 4th generation systems. Furthermore, it has compatibility with previous version thus easier deployment and upgrade of LTE and LTE advanced networks are possible.



5G – Fifth generation communication system

5G network is using advanced technologies to deliver ultra-fast internet and multimedia experience for customers. Existing LTE advanced networks will transform into supercharged 5G networks in future. IN earlier deployments, 5G network will function in non-standalone mode and standalone mode. In non-standalone mode both LTE spectrum and 5G-NR spectrum will be used together. Control signalling will be connected to LTE core network in non-standalone mode.

| Generation | Speed | Technology | Key Features |
|-----------------------------------|---|--------------------------------------|---|
| 1G (1970 –1980s) | 14.4 Kbps | AMPS,NMT, TACS | Voice only services |
| 2G (1990 to 2000) | 9.6/ 14.4 Kbps | TDMA,CDMA | Voice and Data services |
| 2.5G to 2.75G (2001-2004) | 171.2 Kbps 20-40 Kbps | GPRS | Voice, Data and web mobile internet, low speed streaming services and email services. |
| 3G (2004-2005) | 3.1 Mbps 500- 700 Kbps | CDMA2000 (1xRTT, EVDO) UMTS and EDGE | Voice, Data, Multimedia, support for smart phone applications, faster web browsing, video calling and TV streaming. |
| 3.5G (2006-2010) | 14.4 Mbps 1-3 Mbps | HSPA | All the services from 3G network with enhanced speed and more mobility. |
| 4G (2010 onwards) | 100-300 Mbps, 3-5 Mbps 100 Mbps (Wi-Fi) | WiMax, LTE and Wi-Fi | High speed, high quality voice over IP, HD multimedia streaming, 3D gaming, HD video conferencing and worldwide roaming. |
| 5G (Expecting at the end of 2019) | 1 to 10 Gbps | LTE advanced schemes, OMA and NOMA | Super fast mobile internet, low latency network for mission critical applications, Internet of Things, security and surveillance, HD multimedia streaming, autonomous driving, smart healthcare applications. |

www.rfpage.com

Fig.Comparison of 1g to 5G Technology Ref from cdn.ttgtmedia.com

IV. IOT INTRODUCTION

What is the internet of things (IoT)?

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

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.

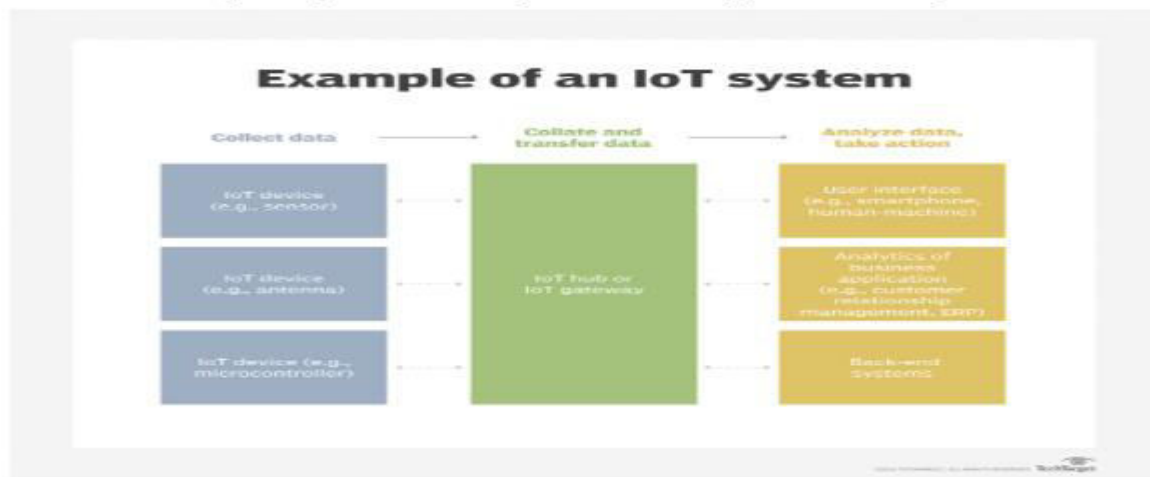


Fig.Examples of an IOT System Technology Ref from Google

How does IoT work?

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

Why is IoT important?

The internet of things helps people live and work smarter, as well as gain complete control over their lives. In addition to offering smart devices to automate homes, IoT is essential to business. IoT provides businesses with a real-time look into how their systems really work, delivering insights into everything from the performance of machines to supply chain and logistics operations.

IoT enables companies to automate processes and reduce labor costs. It also cuts down on waste and improves service delivery, making it less expensive to manufacture and deliver goods, as well as offering transparency into customer transactions.

As such, IoT is one of the most important technologies of everyday life, and it will continue to pick up steam as more businesses realize the potential of connected devices to keep them competitive.

What are the pros and cons of IoT?

- Some of the advantages of IoT include the following:
- ability to access information from anywhere at any time on any device;
- improved communication between connected electronic devices;
- transferring data packets over a connected network saving time and money; and
- automating tasks helping to improve the quality of a business's services and reducing the need for human intervention.

Some disadvantages of IoT include the following:

- As the number of connected devices increases and more information is shared between devices, the potential that a hacker could steal confidential information also increases.
- Enterprises may eventually have to deal with massive numbers -- maybe even millions -- of IoT devices, and collecting and managing the data from all those devices will be challenging.
- If there's a bug in the system, it's likely that every connected device will become corrupted.
- Since there's no international standard of compatibility for IoT, it's difficult for devices from different manufacturers to communicate with each other.

V. IOT AUTOMATION

What Is Automation InIoT?

Industrial automation's main aim is to reduce the necessity of people in manufacturing processes. This allows production to speed up, increase in safety, and better utilize their resources and industrial analytics in manufacturing. Achieving this goal is accomplished by fully mapping out the industrial process and understanding sub-process relationships so machines can be assigned to work and automate certain process tasks.

Machine automation technology can be set to work as fixed applications, programmable applications, or flexible/adaptable applications. Each of these types of machine automation has certain advantages and disadvantages. Recent advancements in machine automation are due to a better understanding of machine automation and the adoption of new machine capabilities such as feedback controllers, robotics, networking, digital computers, and interconnectivity.

Fixed automated machines for example, only work to carry out repetitive and mundane tasks but newly-interconnected, programmable machines can enable manufacturers to offload many process decisions to high speed controllers, oftentimes operating completely without human intervention.

What Does IoT Do for Industrial Automation?

The Internet of Things (IoT) describes a phenomenon where more and more IoT devices are connected to the Internet, such as smart homes, smart fridges, and industrial manufacturing machines. These interconnected smart devices are significant in enabling automation across industries.



To understand the difference between the growth of IoT from non-IoT devices (non-IoT devices include PC, mobile phone, tablets, laptops, or landlines), in 2010, the total active non-IoT connections was 8 bn devices, compared to only 0.8 bnIoT devices. Estimates predict that by 2025, non-IoT device connections will grow by only 2 bn, reaching approximately 10.3 bn, whereas, in the same time, IoT device connections will exceed 38.6 bn. A dizzying growth rate that has been in tandem with the adoption of automation practices.

It is difficult to separate IoT and automation because automation has been a tremendous driver for IoT devices as it has given applicable purpose to many IoT technologies. Industrial devices like sensors, connectors, actuators, IoT gateways, interfaces, motion controllers, lightbulbs, locks, etc., today, have the capability to share information about their condition and performance, while offering remote access and control. Combined with cloud computing and advanced data analytics, automation IoT software can manage these devices and learn to adapt accordingly to accommodate new ones as necessary.



Fig.Industrial IOT Application Ref from cdn.ttdmedia.com

What Is The Impact Of Iot On Industrial Automation?

The Internet of Things (IoT) is a key driving factor in enabling the development of industrial automation systems. IoT coupled with computer automation controls helps streamline industrial systems and improve data automation, with the aim of removing errors and inefficiencies, primarily from the people. To achieve this at the industrial level, several layers of devices are used. IoT devices from the field (plant floor), analyzers, actuators, robotics, etc. communicate data upwards to local process control units, which in turn send data to top-level Supervisory Control and Data Acquisition (SCADA) software. While field level machines may perform tasks automatically, at every level a human monitor can step in and interface with the system (provided they have access).

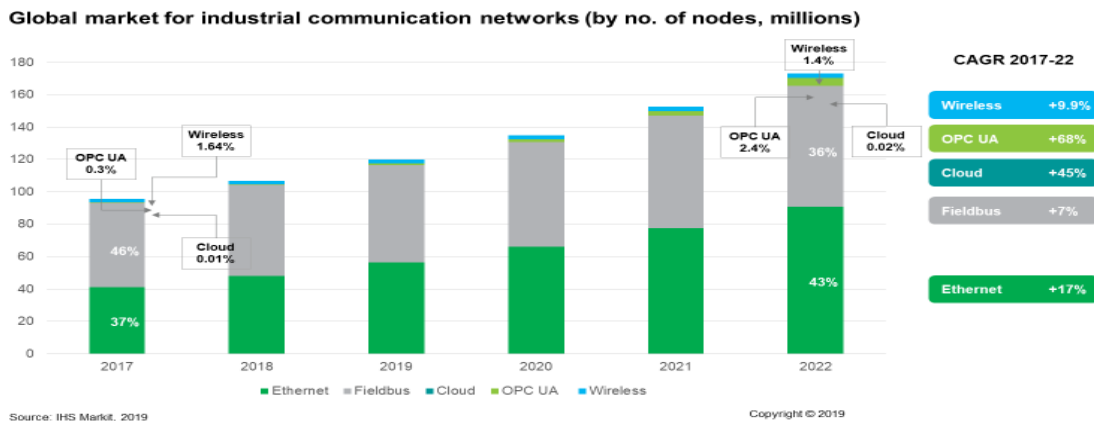


Fig. Global Market Of Industrial Communication Ref from omdia.tech.informa.com



VI. THREE LEADING TECHNOLOGIES

Three major industrial network technologies are in place today: industrial Ethernet, Fieldbus, and wireless. As the medium through which multiple protocols transfer data, the three in 2018 accounted for approximately 85% of the global market for industrial communication networks, as shown in the chart below. The remainder of the market belonged to cloud-related technologies as well as open-source protocols like OPC UA.

Industrial Ethernet includes all protocols that use Ethernet IEEE 802 as their physical media. Examples of industrial Ethernet protocols include PROFINET, EtherNet/IP, Modbus TCP/IP, Power Link, SERCOS III, and EtherCAT. As an Internet Protocol (IP)-based networking technology, Ethernet is well suited to supporting IIoT. It provides better bandwidth than Fieldbus, an important factor when large amounts of data that must be rapidly transmitted are involved. The increasing use of Ethernet protocols in conjunction with other technologies also supports vertical communication with industrial control systems, including Supervisory Control and Data Acquisition (SCADA) and Manufacturing Execution Systems (MES).

For its part, Fieldbus is any wired networking protocol that does not fit into Ethernet; examples include PROFIBUS, DeviceNet, Modbus, and Foundation Fieldbus. While Fieldbus-enabled devices still account for most of the current installed base, a transition to industrial Ethernet is taking place.

The third technology, wireless, transfers information between two or more points not connected by an electrical conductor. Wireless communication network technologies include consumer solutions like Wi-Fi and Bluetooth, cellular technologies such as LTE, and industrial solutions exemplified by Wireless HART and ISA 100.11a.

The report examines the industrial internet of things market in depth, segmenting it into manufacturing, energy and power, oil and gas, healthcare, logistics and transportation, agricultural, and others based on end-use. Over the projected period, the manufacturing category is expected to lead the market, accounting for approximately 28.4% of total revenue by 2030.

Manufacturing companies are rapidly adopting digital manufacturing technologies, and the Internet of Things (IoT) plays a critical role in these cutting-edge technologies. The market is expected to develop significantly in the near future, owing to the strategic partnerships and alliances that stakeholders are forming, as well as the growing demand for a linked supply chain to provide flexibility, operational efficacy, and regulatory compliance.

From 2022 to 2030, the logistics and transportation segment is expected to grow at a CAGR of more than 26.5%. The considerable emphasis that logistics and transportation businesses are placing on improving asset management and, as a result, on the implementation of smart transportation, can be linked to the rise.

Traditionally, the logistics industry has relied on RFID tags, which are being phased out in favor of internet-connected trackers that can support a wide range of functions. Modern options, such as Bluetooth tags and beacons, are also becoming more widely adopted. These types of solutions allow data to be tracked in smaller, more constrained regions, but they can also help to improve operational management

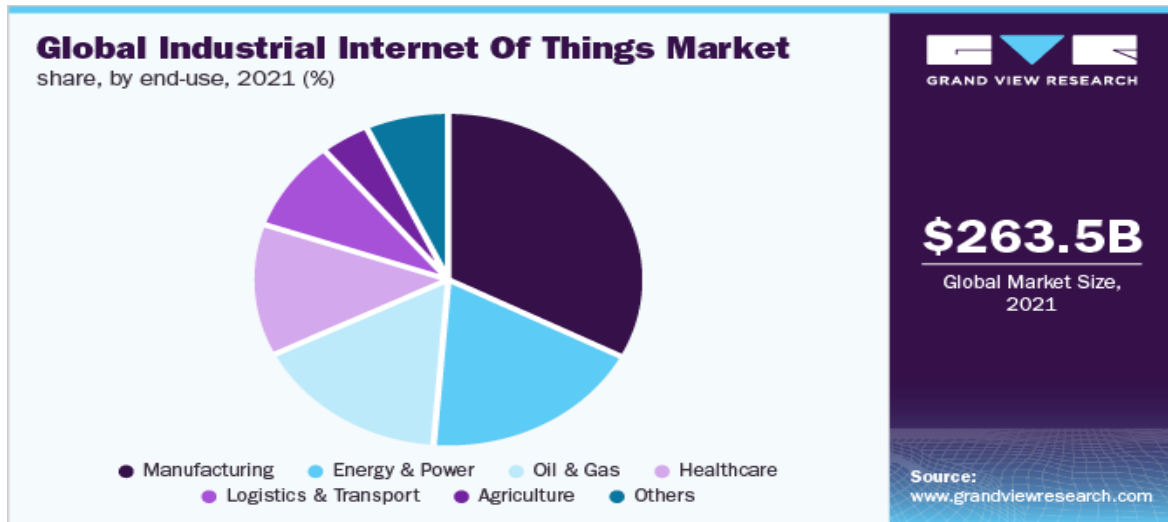


Fig.Global Market Ref from grandviewreaserch.com

VII. CONCLUSION

With more industrial adoption, IoT in industrial automation has become a mainstay in both small-scale and heavy industries. With IoT developers helping startups and scaleups with optimal solutions to better their operations, it's always best to figure out new ways to automate business processes with IoT.

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