Data is Your Friend.

Using Industrial Internet of Things (IIoT) to Reveal Process Improvement Opportunities

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- Member, Mohawk College IoT Expert Board
- Member, AI Advisory Group

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Data is your friend|Agenda

1. Introduction to IoT and IIoT
2. Major IoT Trends
3. IIoT Applications and Industry Market
4. IIoT Essential Requirements
5. IoT/IIoT Design Methodology
6. IIoT Use Cases
    1. Manufacturing
    2. Healthcare
    3. Agriculture
7. IIoT Challenges

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Introduction to IoT
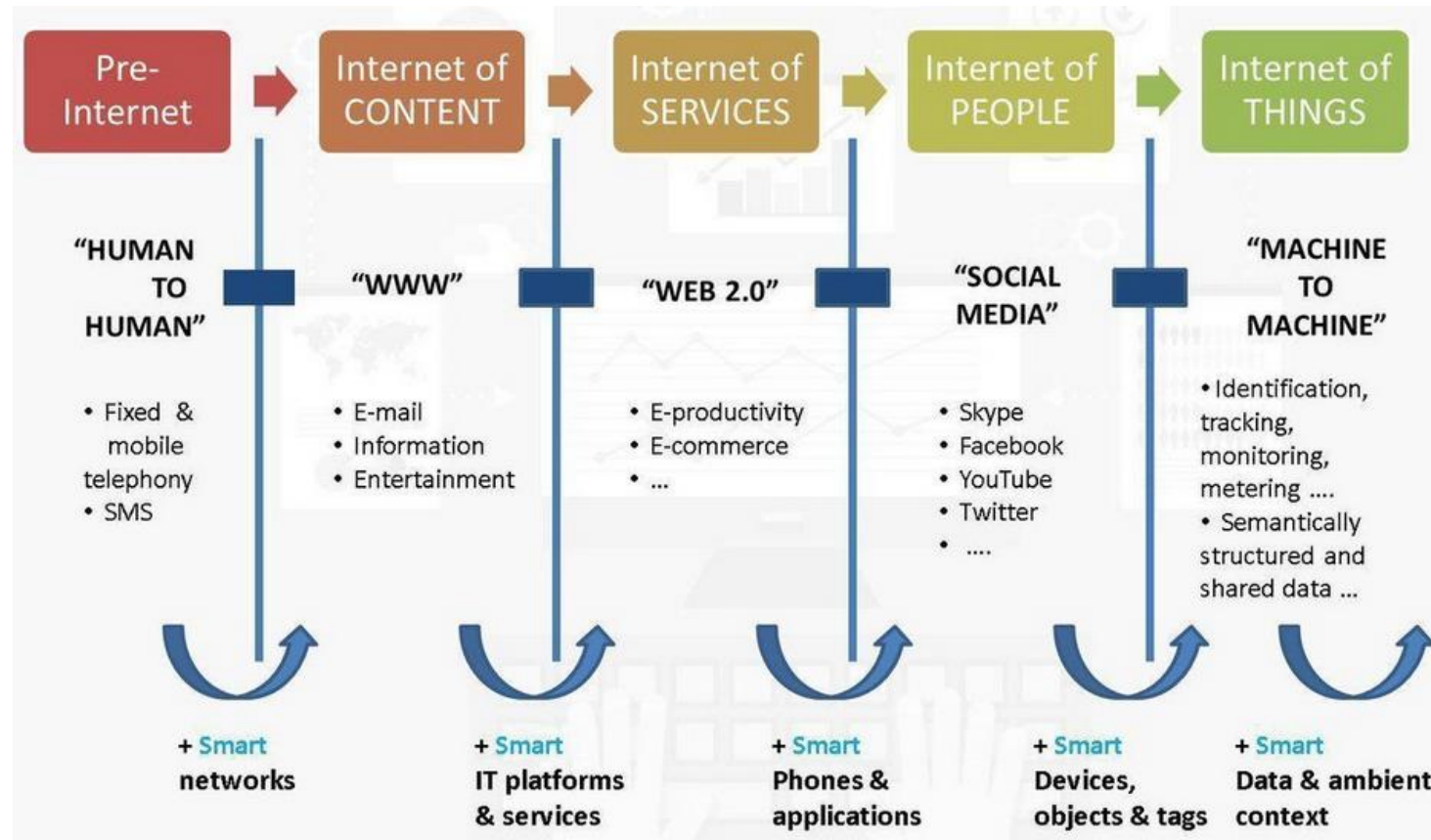
Introduction to IoT|What is IoT?

- ITU definition of IoT :
  - " A Network that is Available anywhere, anytime, by anything and anyone"
- IETF's definition of "things": "in the version of IoT,
  - 'things' are very various such as computers, sensors, people, actuators, refrigerators, TVs, vehicles, mobile phones, clothes, food, medicines, books, etc. these things are classified three scopes: people, machine (for example, sensor, actuator, etc.). These 'things' should be identified at least by one unique way of identification for the capability of addressing and communicating with each other and verifying their identities. In here, if the 'thing' should be identified, we call it the 'object.'"

Introduction to IIoT|What is IIoT?

Internet of Things — Types
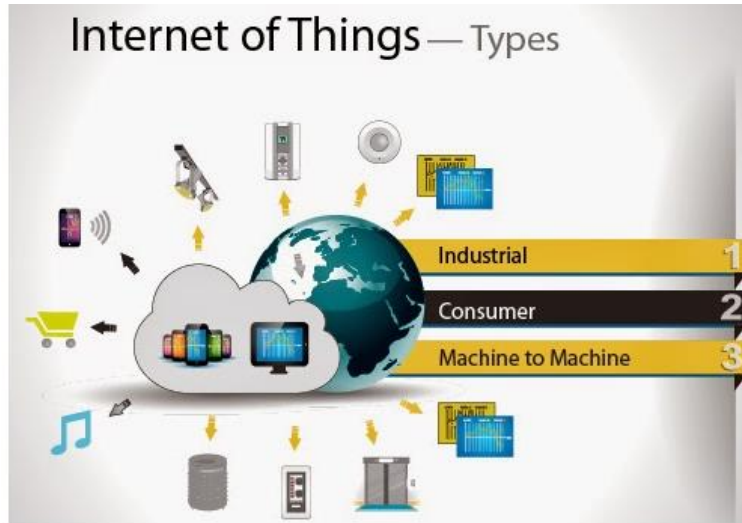
- Industrial IoT (IIoT) -
  - "Industrial Internet of Things (IIoT) or "Industry 4.0" refers to the combination of IoT technology and data with manufacturing and other industrial processes, often with the goal of increasing automation, efficiency, and productivity. This is where IoT gets applied in practice at various industries, such as:
    - Factory equipment, machines, and devices used in manufacturing
    - Health monitoring devices in healthcare
    - Sensors and Supervisory Control and Data Acquisition (SCADA) systems in oil and gas production
    - Telemetry data from autonomous vehicles"

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Introduction to IoT|The Evolution of IoT
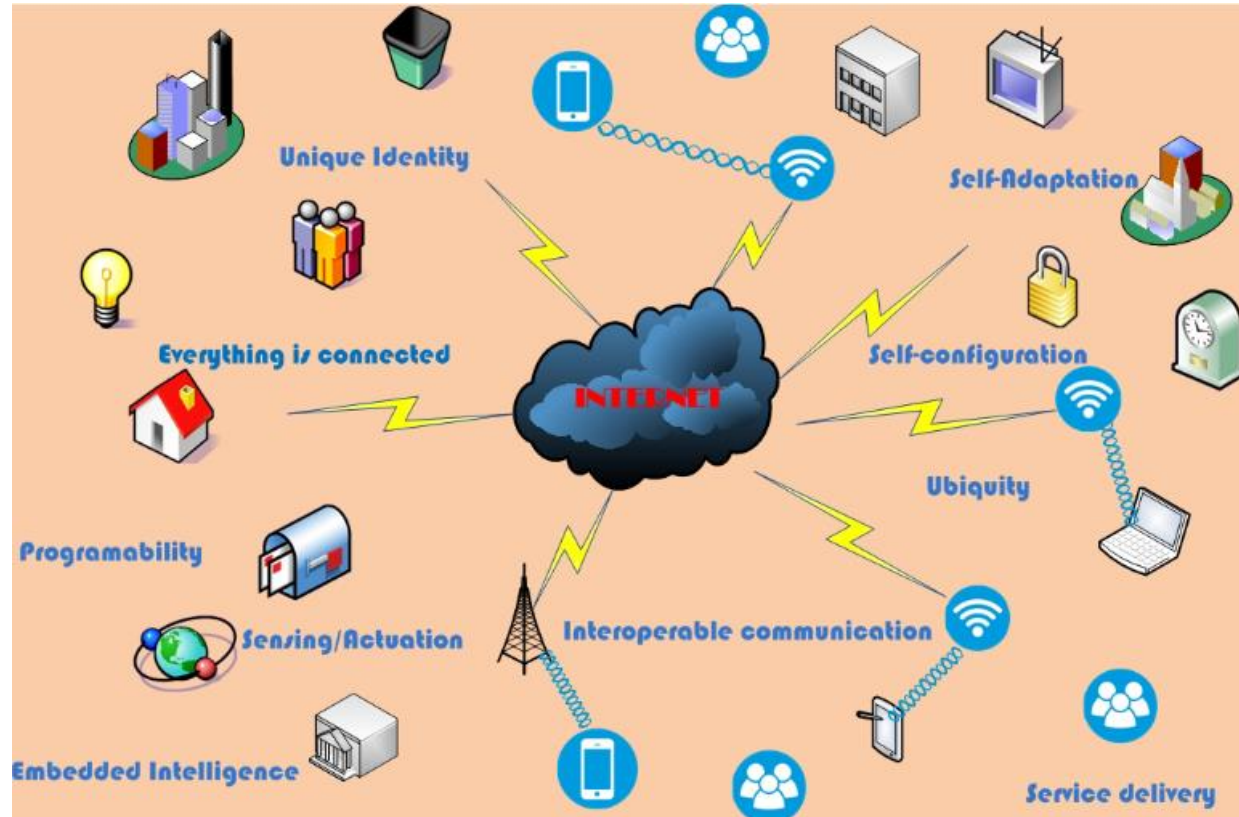
Introduction to IoT|Scope of IoT Systems

Introduction to IoT|Scope of IoT Systems
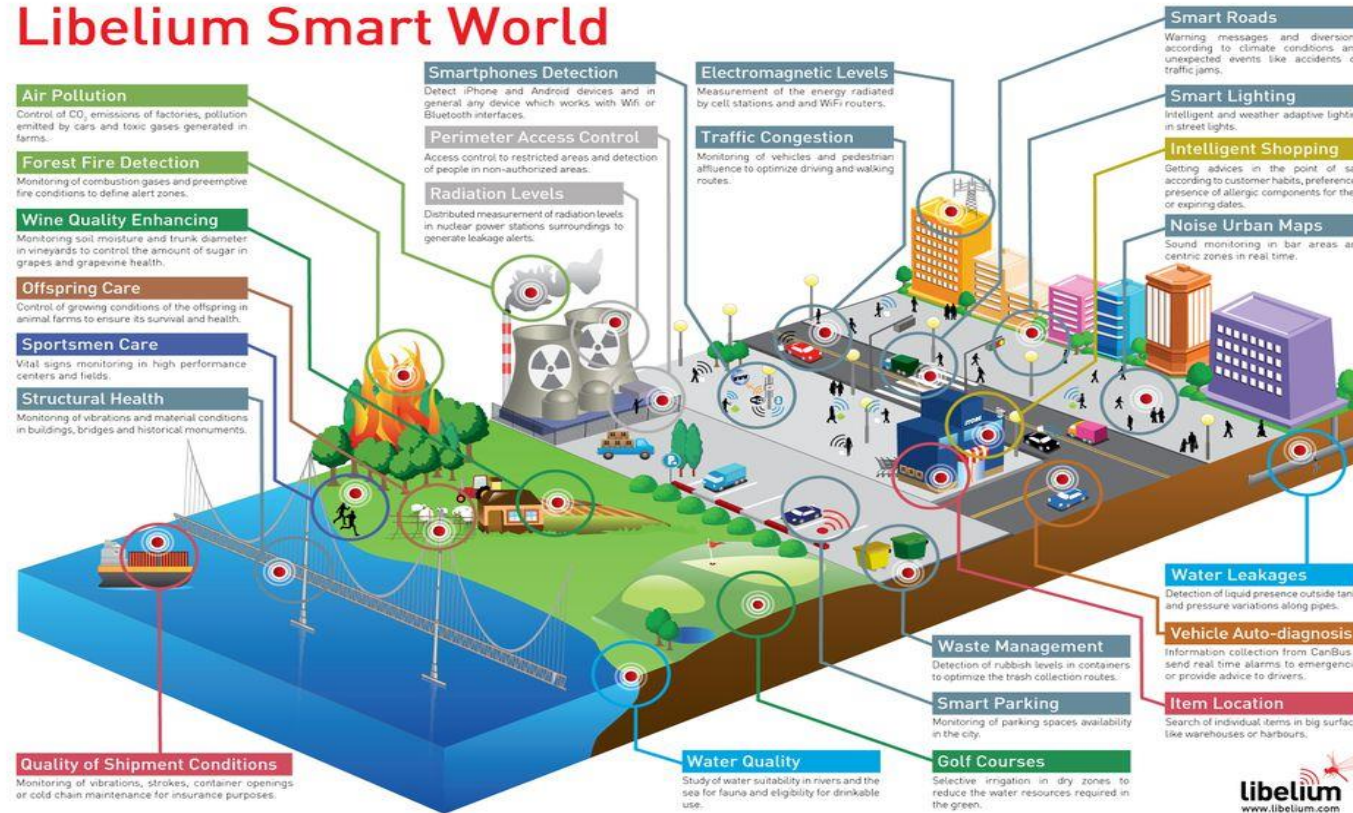
Major IoT Trends|Artificial Intelligence

"Data is the fuel that powers the IoT and the organization's ability to derive meaning from it will define their long term success."

The 4 Major AIoT Segments

1 **Wearables**
Wearable devices continuously monitor and track user preferences and habits. Applications include fitness and health trackers, heart rate monitoring, wireless headphones, and AR/VR devices.

Smart watches | AR/VR goggles | Wireless earbuds

2 **Smart Home**
Smart home devices such as thermostats, coffee makers, lights, and smart TVs learn a user's habits to develop automated home "support" for everyday tasks. Applications include energy efficiency, safety, entertainment, access control, and personal comfort.

Smart speakers | IoT appliances | Smart thermostats

3 **Smart City**
Smart cities that integrate all levels of municipal services are becoming safer, more convenient places to live. Applications include open data for better urban planning, optimized energy consumption, and increased public safety through smart traffic surveillance.

Smart energy grids | Smart streetlights | Smart public transportation

4 **Smart Industry**
Smart industry devices—the industrial internet of Things (IIoT)—use real-time data analytics and machine-to-machine sensors to optimize operations, logistics, and supply chain. Data generated from these devices helps industries foresee challenges—preventing costly errors and workplace injuries.

Autonomous manufacturing robots | Automated supply chain management | Predictive maintenance sensors

While AIoT technology is still in its infancy, these segments represent a direct impact in our daily lives.

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Major IoT Trends|Artificial Intelligence

"AI will be applied to a wide range of IoT information, including video, still images, speech, network traffic activity and sensor data."

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Major IoT Trends|Artificial Intelligence

"IoT is powered by three technologies: Artificial Intelligence (AI), 5G and Big Data. Together, AI and IoT to create AIoT – a smart, connected network of devices that seamlessly communicate over powerful 5G networks – unleashing the power of data better and faster than ever."

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Major IoT Trends|Social, Legal and Ethical IoT

The ownership of data, deductions made from it, algorithm bias, privacy, and complying with regulations. "Successful deployment of an IoT solution demands that it's not just technically effective but also socially acceptable."

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Major IoT Trends|Infonomics and Data Broking

"Infonomics is the theory of the monetizing of business data to be used as a strategic business asset within the company accounts. By 2023, the buying and selling of IoT data will become an essential part of many IoT systems."

"Organization must educate their organizations on the risks and opportunities related to data broking in order to set the IT policies required in this area and to advise other parts of the organization."

IOT DATA EXCHANGES AND MONETIZATION

The next evolution in IoT

"IoT data sharing, exchanging, and even selling initiatives will not be just additional aspects of the IoT environment. These services are actually the next evolutionary step"

data exchange

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Major IoT Trends|Intelligent Mesh

"The shift from centralized and cloud to edge architectures is under way in the IoT space. These mesh architectures will enable flexible, intelligent and responsive IoT systems — even though it is at the cost of additional complexities."

"When supporting a complex IIoT solution, a centralised cloud architecture becomes costly in terms of bandwidth cost and computing resources. Latency and network availability issues also impact cloud based IIoT."

CLOUD
Big Data processing
Business Logic
Data Warehousing

INTERNET

EDGE
Realtime data processing
At source/on premises
data visualization
Basic analytics
Data caching, buffering
Data filtering, optimization
M2tM comms

LAN/WAN

SENSORS AND CONTROLLERS

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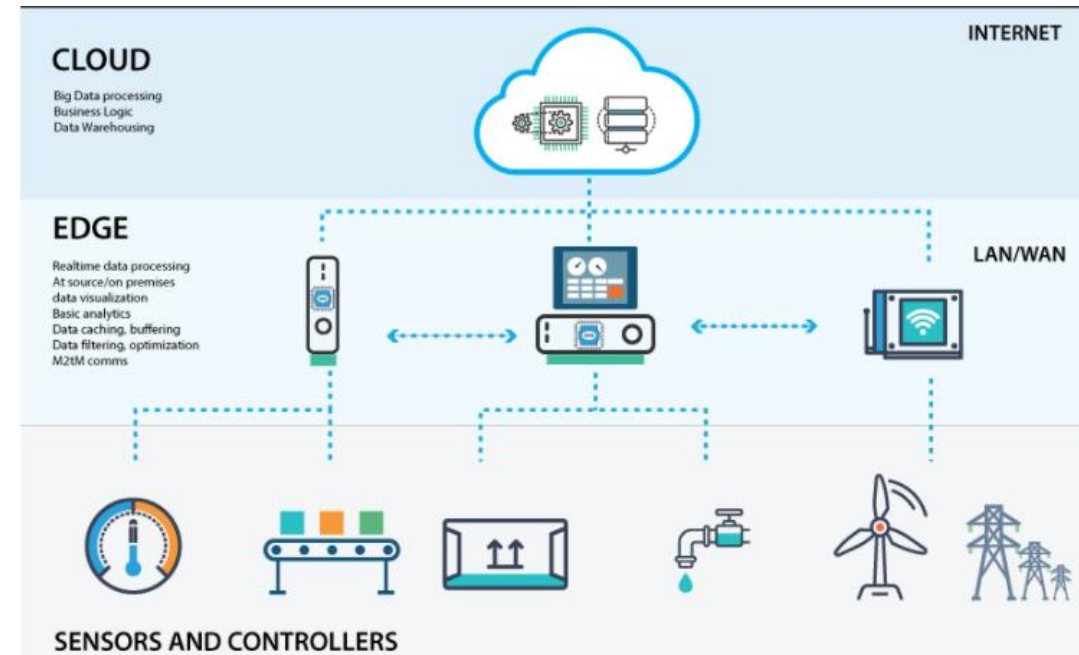
Major IoT Trends|Intelligent Mesh

"With typical network cloud systems, data is pushed up to a server and then pulled back down by clients. This works well for videos, pictures, music, documents and non-critical applications, but is not a good design for real-time IIoT data.

If data does not reside at the source, the data quality may be unreliable. Issues with the freshness, accuracy of data, and speed of delivery are potentially impacted when using a cloud architecture."
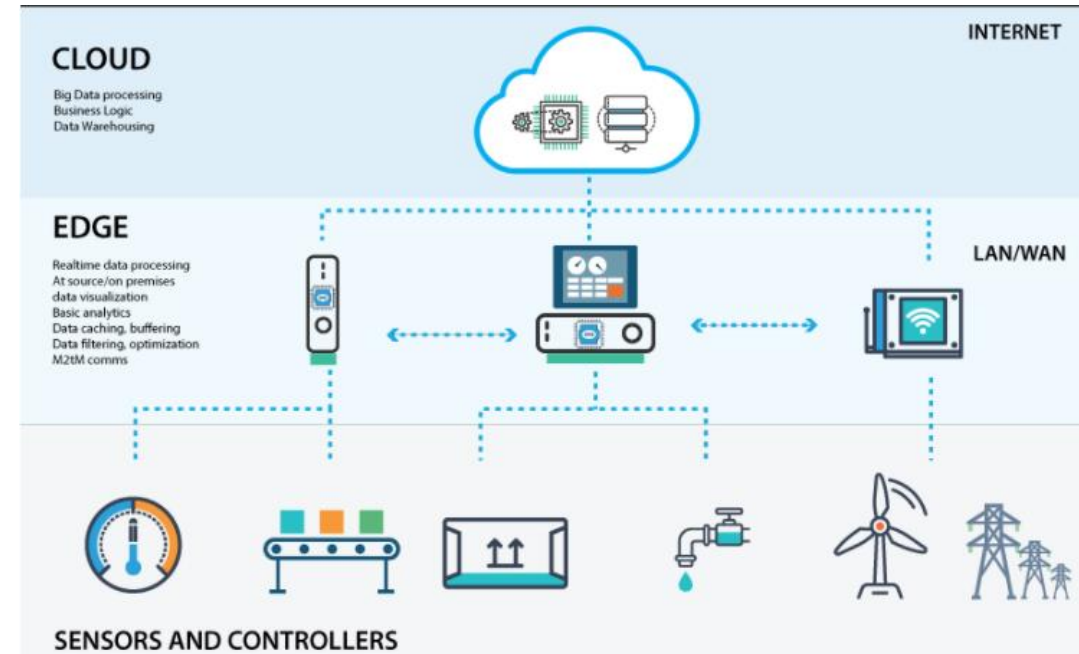
Major IoT Trends|Governance

As IoT expands, a governance framework that ensures appropriate behaviour in the creation, storage, use and deletion of information related to IoT projects is needed.

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Major IoT Trends|Governance

"When implemented correctly there are many benefits of utilising a growing network of IoT devices, including improved revenue and operational efficiency, lower costs and even the creation of new business models."

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Major IoT Trends|Sensor Innovation

The sensor market will continue to evolve through to 2023. New sensors will detect a wider range of situations and events.

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Major IoT Trends|Secure Systems

'IoT devices are vulnerable largely because these devices lack the necessary built-in security to counter threats. Aside from the technical aspects, users also contribute to the devices' vulnerability to threats.'

COMMON IoT DEVICE VULNERABILITIES
TO WATCH OUT FOR

Insecure components
Outdated components or components that contain vulnerabilities

Unnecessary open ports
Unused open ports in some devices can allow hackers to exploit vulnerable services

Insufficient logging mechanisms
Lack of logging mechanism in devices makes it easier to hide malicious activities

Inadequate privacy protection and encryption
Poor data management capabilities and lack of encryption on shared data

Lack of automatic patch management
Devices lack automated patch mechanisms and integrity checks that can prevent malicious modification of patches

Hardcoded passwords
Passwords cannot be changed

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Major IoT Trends|Secure Systems

'…some of the reasons these smart devices remain vulnerable: Limited computational abilities and hardware limitations, Heterogeneous transmission technology, Components of the device are vulnerable, Users lacking security awareness'

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Major IoT Trends|Secure Systems

'.. by 2023, we expect to see the deployment of hardware and software combinations that together create more trustworthy and secure IoT systems…'.

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Major IoT Trends|User Experience

User experience is driven by 4 factors**:** new sensors, new algorithms, new experience architectures and context, and socially aware experiences.

UX in IoT

Design for data usage

Remember about your user

tested

Double check to know it works

Use the ultimate creativity

Ensure data security

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Major IoT Trends|Silicon Chip Innovation

By 2023, it's expected that new special-purpose chips will reduce the power consumption needed to run IoT devices.

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Major IoT Trends|Wireless Networking

A set of competing requirements must be balanced in IoT networking. New IoT networking technologies should particularly explore 5G, the forthcoming generation of low earth orbit satellites, and backscatter networks.

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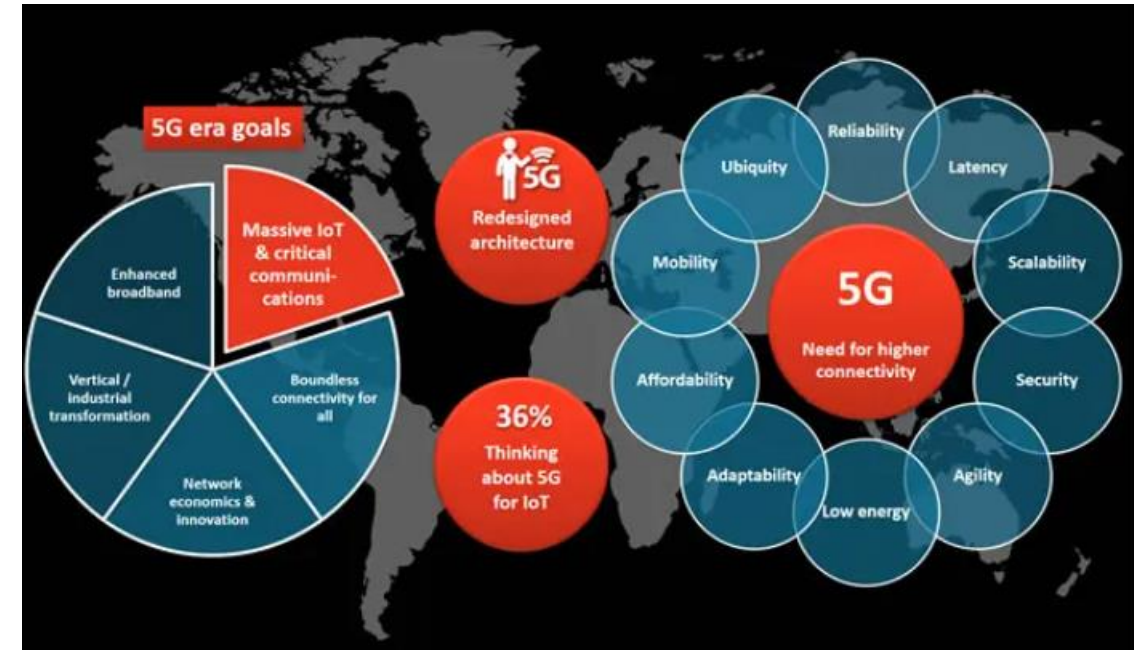
IoT Applications|Industrial
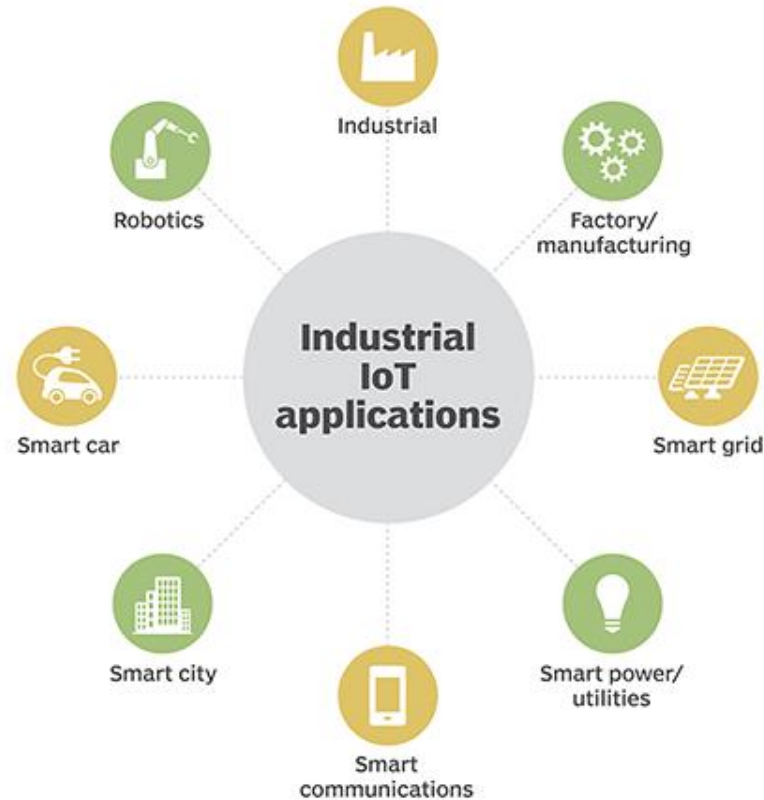
IoT Applications|Markets

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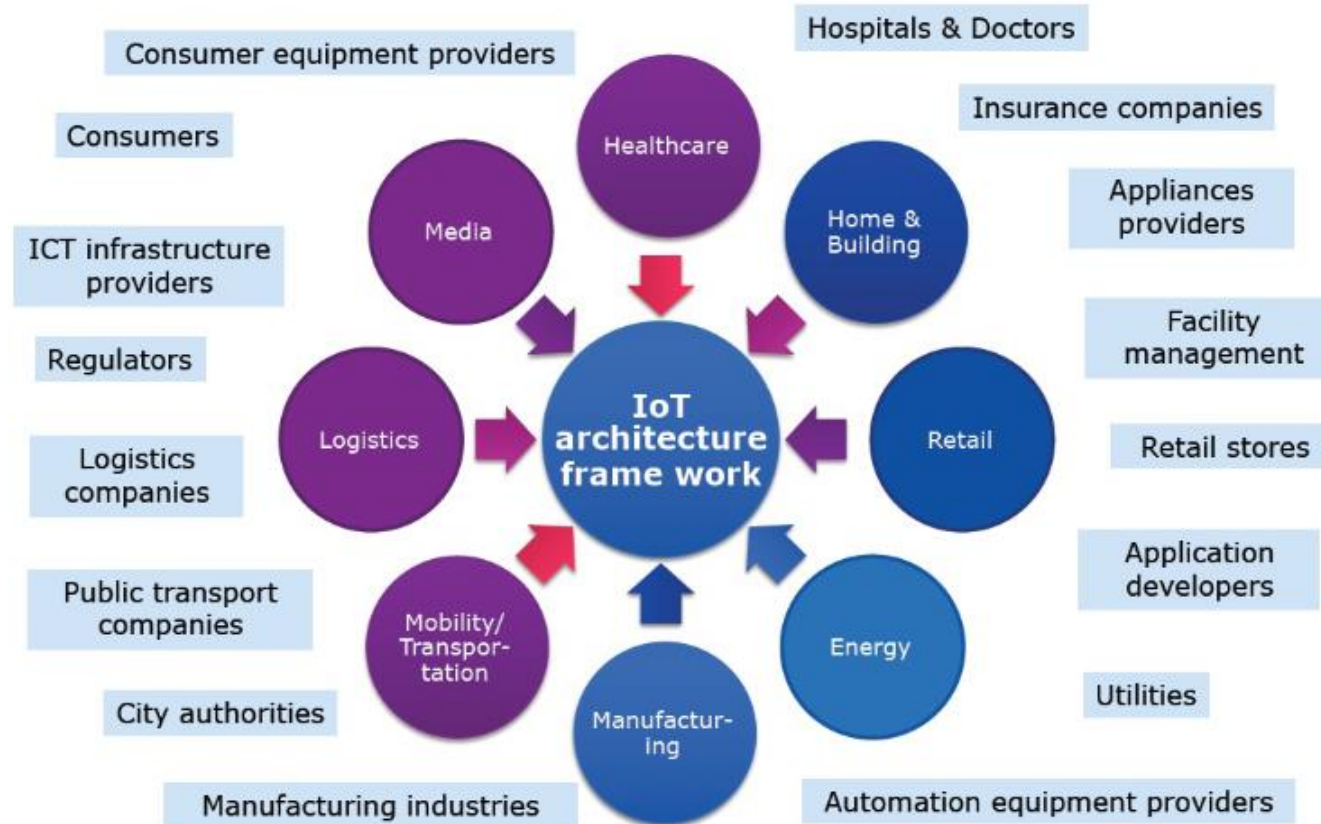
IoT Concepts|Stages of IoT
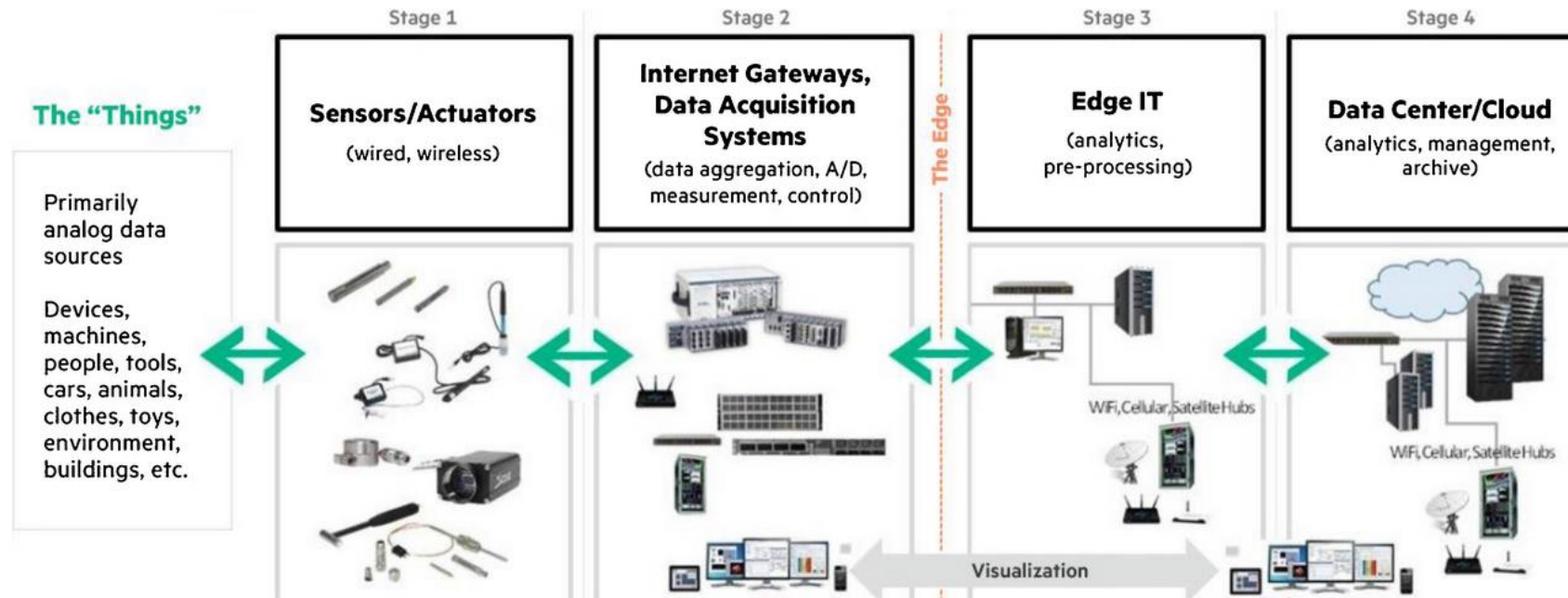
IoT Concepts|Value Proposition
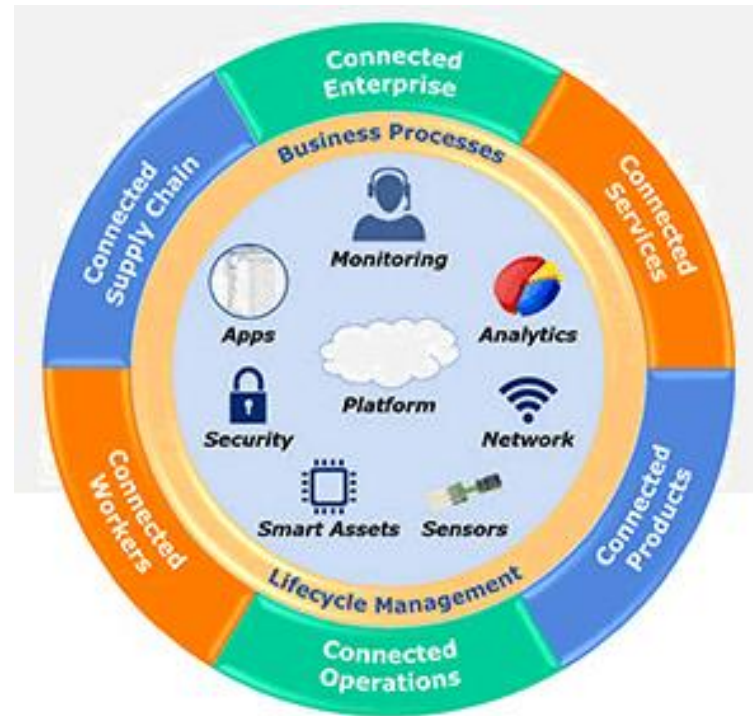
IoT Essential Requirements

Essential Requirements|Expertise

- Smart Sensor systems Integration and System on module (SOM) development.

- Design and Development of embedded and edge computing for Internet of things (IoT) and Cyber-Physical Systems.

- Smart Sensor Embedded systems and FPGA based digital prototyping

- Industry Artificial Intelligence and Predictive maintenance platforms.

- Testing of IoT wireless communication protocols.

- Energy harvesting solutions.

Essential Requirements|Architecture

IoT Architecture
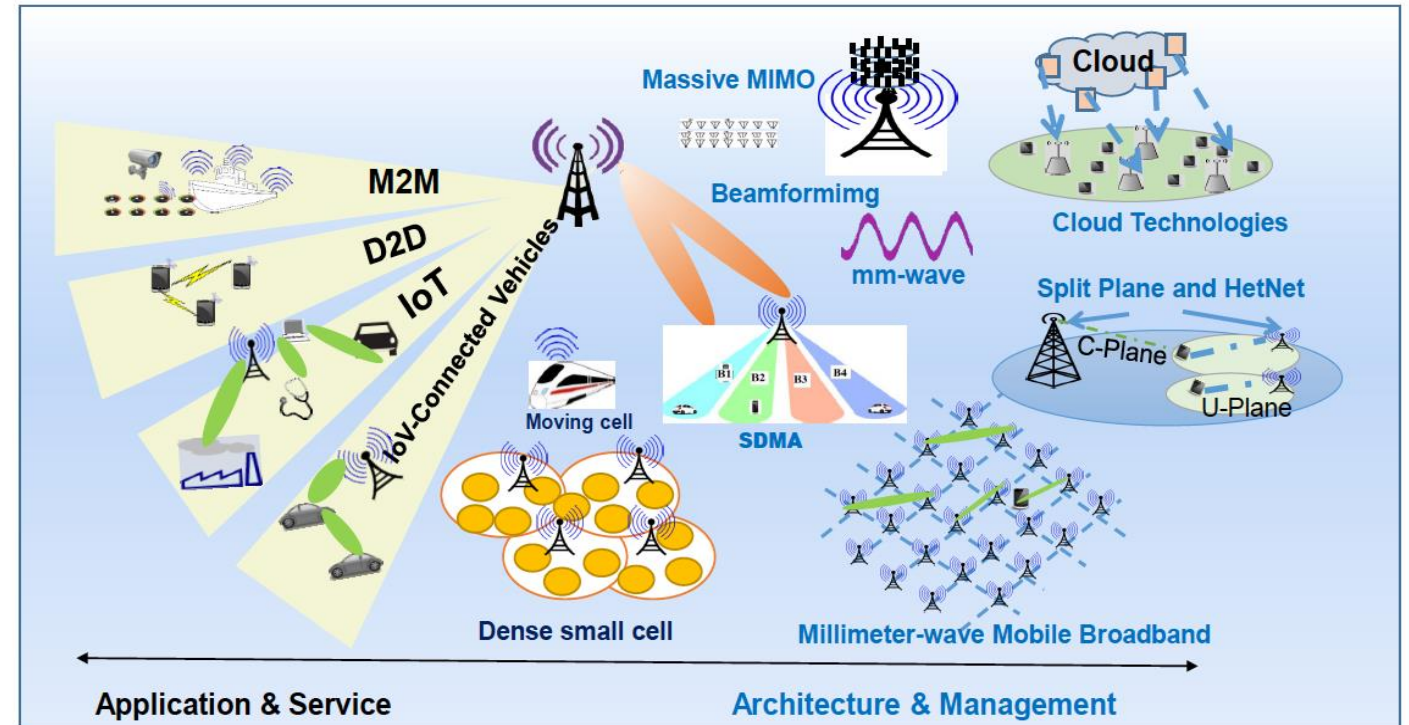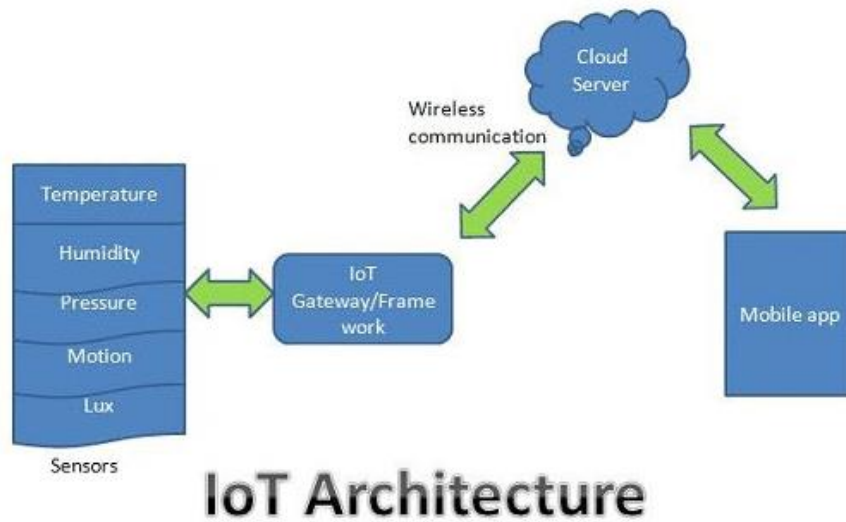
Essential Requirements|Design Methodology
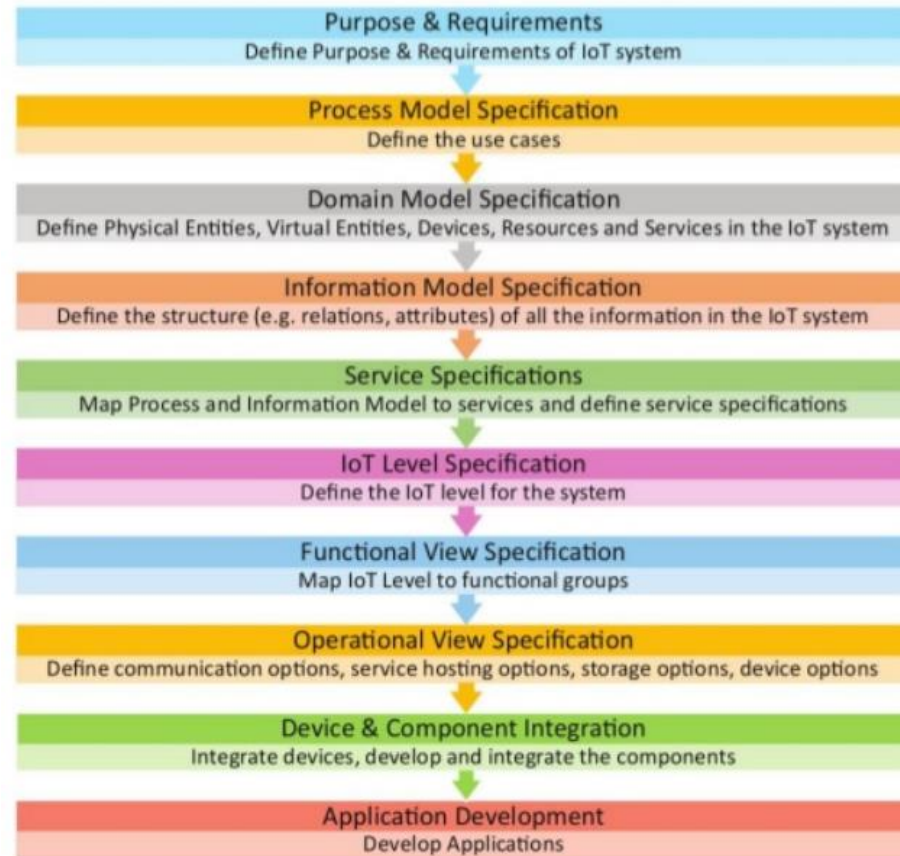
IoT in Manufacturing

IoT In Manufacturing
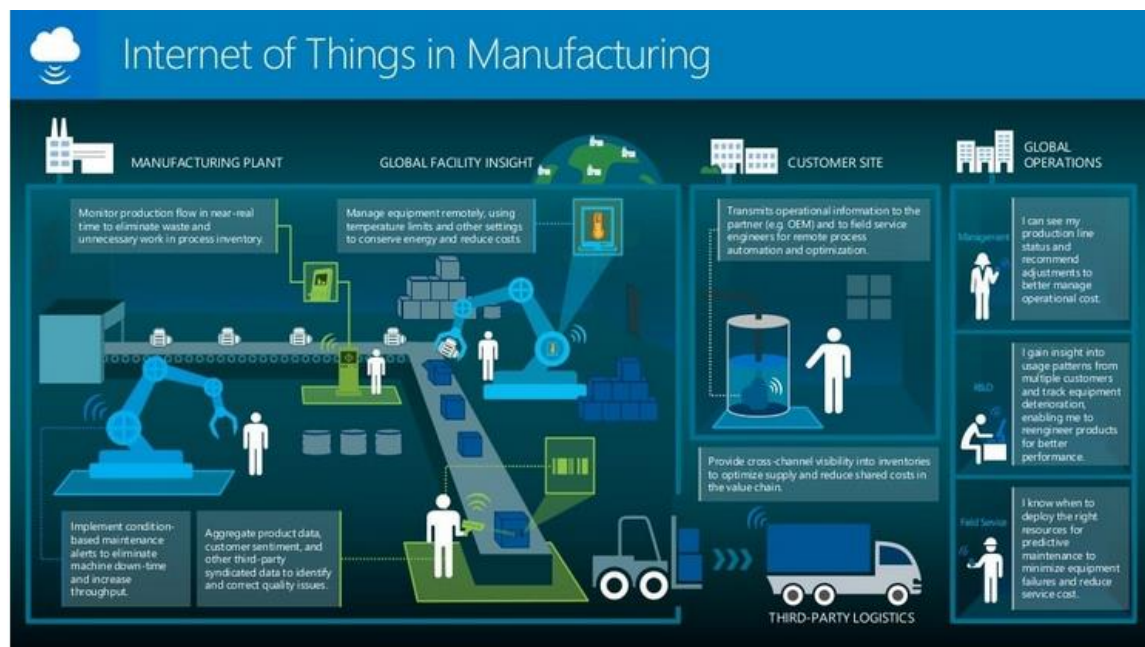
- Digital/Connected Factory
- Facility Management
- Production Flow Monitoring
- Inventory Management
- Plant Safety and Security
- Quality Control
- Packaging Optimization
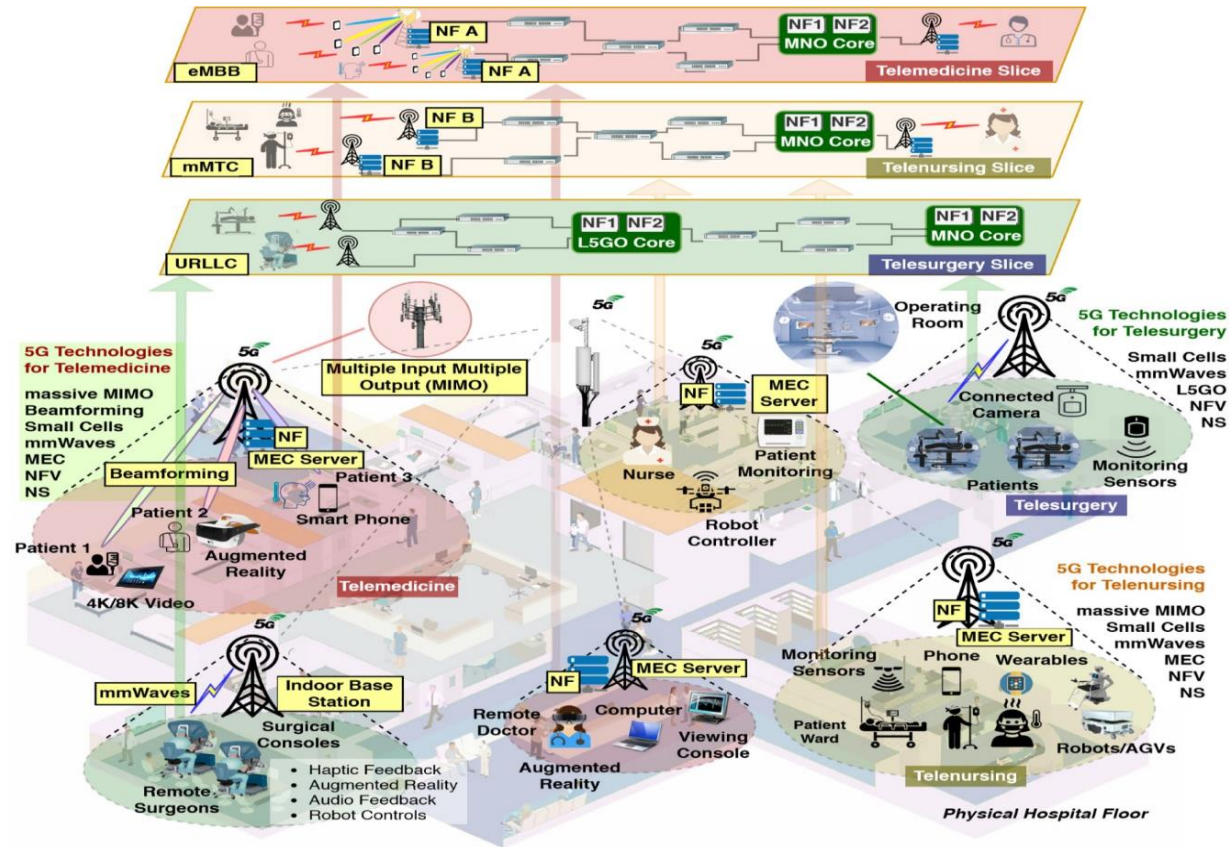- Logistics and Supply Chain Optimization

IoT in Healthcare

IoT in Healthcare|Virtual Care
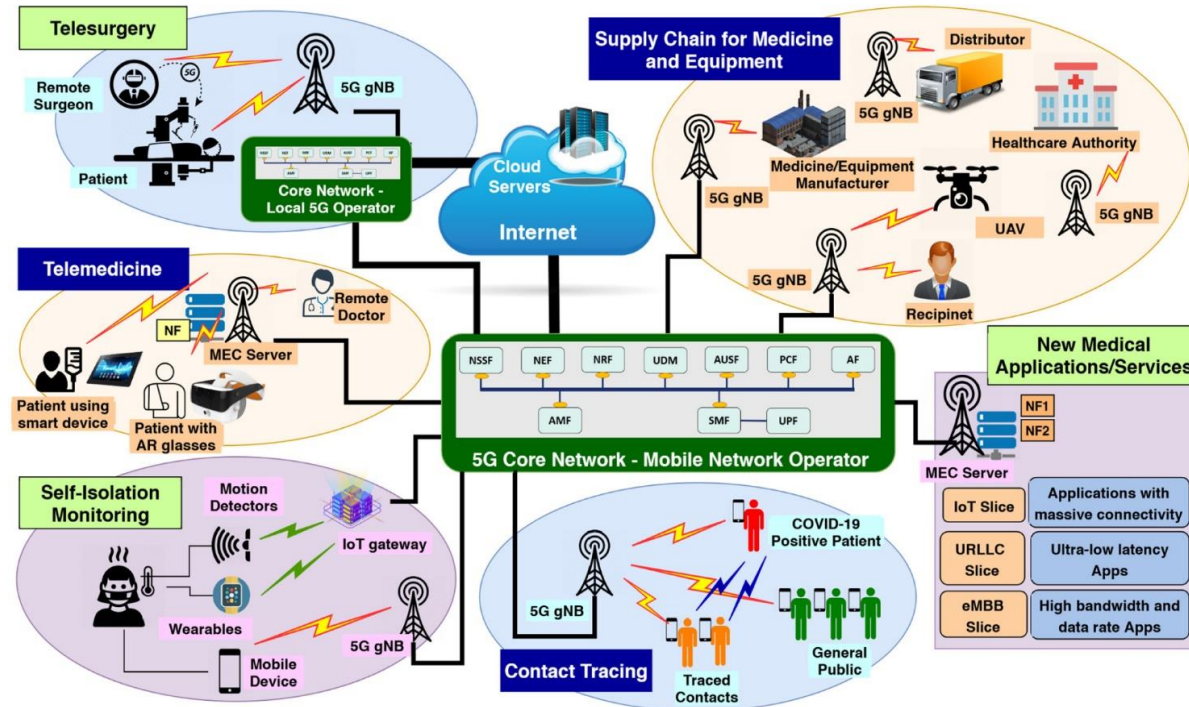
- Telemedicine
- Telenursing
- Telepharmacy
- Telesurgery

IoT in Healthcare|Supply Chain

- Smart manufacturing technologies to meet demand and safety consideration

IoT in Healthcare|Implementation Challenges

| Use Case	Application	Deployment Challenges							
		Privacy Issues	Security Challenges	Scalability Issues	QoS Provisioning	Limited Connectivity	Societal Impact	Legal Issues	Regulatory Restrictions
Telehealth	Telemedicine	H	H	H	M	H	H	M	H
	Telenursing	M	M	M	L	L	H	M	M
	Telesurgery	M	H	L	H	L	H	H	H
	Telepharmacy	L	H	H	L	H	L	L	M
Supply Chain	Connected Goods	M	H	H	L	L	M	L	L
	Manufacturing	L	M	H	H	L	L	L	L
Containment	Contact Tracing	H	M	H	L	H	H	H	H
	Self Isolation	H	M	H	L	H	H	H	H

L = Low Impact, M = Medium Impact, H = High Impact

- Privacy protection issues
- Security challenges
- Scalability and QoS provisioning in massive connectivity regime
- 5G deployment and limited connectivity challenges
- Societal issues and the human factor

IoT in Healthcare|Technical Requirements

Use case	Application	Expected capacity	Expected latency	Number of devices	Other requirements
Telehealth	Telemedicine	>500 million visits per year	<1–100 ms	1–10 per appointment	Real-time backhaul connectivity Streaming data type
	Telenursing	<50 Mbps	<1–100 ms	1–10 per appointment	Real-time backhaul connectivity Streaming data type
	Telesurgery	30–50 Mbps >1 Gbps for holographic rendering	<1 ms	10–100 per surgery	Real-time backhaul connectivity Streaming data type >99.999% availability required >99.999% reliability required
	Telepharmacy	<50 Mbps	<1000 ms	1–10 per appointment	Real-time backhaul connectivity Streaming data type
Supply chain	Connected goods	Small-data (<1 kbps) per device, >1–10 Gbps of data per supply chain	<10000 ms	Up to millions per supply chain	Intermittent backhaul connectivity Streaming/historical data >95% availability required
	Manufacturing	>1–10 Gbps of data per plant	wide range: <1 ms for time-critical (e.g.robotics), <10000 ms for non-time-critical optimizations (e.g. asset localization)	1000–one million per plant	Real-time backhaul connectivity Streaming data Indoor connectivity and high availability
Contact tracing	Using sensor data for contact tracing	>10–100 GB of data per city per day	<1 ms	1000–one million per city	Real-time backhaul connectivity Streaming data type Low power consumption
	Self isolation	<1 GB of data per isolated person per day	<1000 ms	1–10 per isolated person	Real-time/intermittent backhaul connectivity Streaming data type

IoT in Agriculture

IoT in Agriculture|Smart Farming
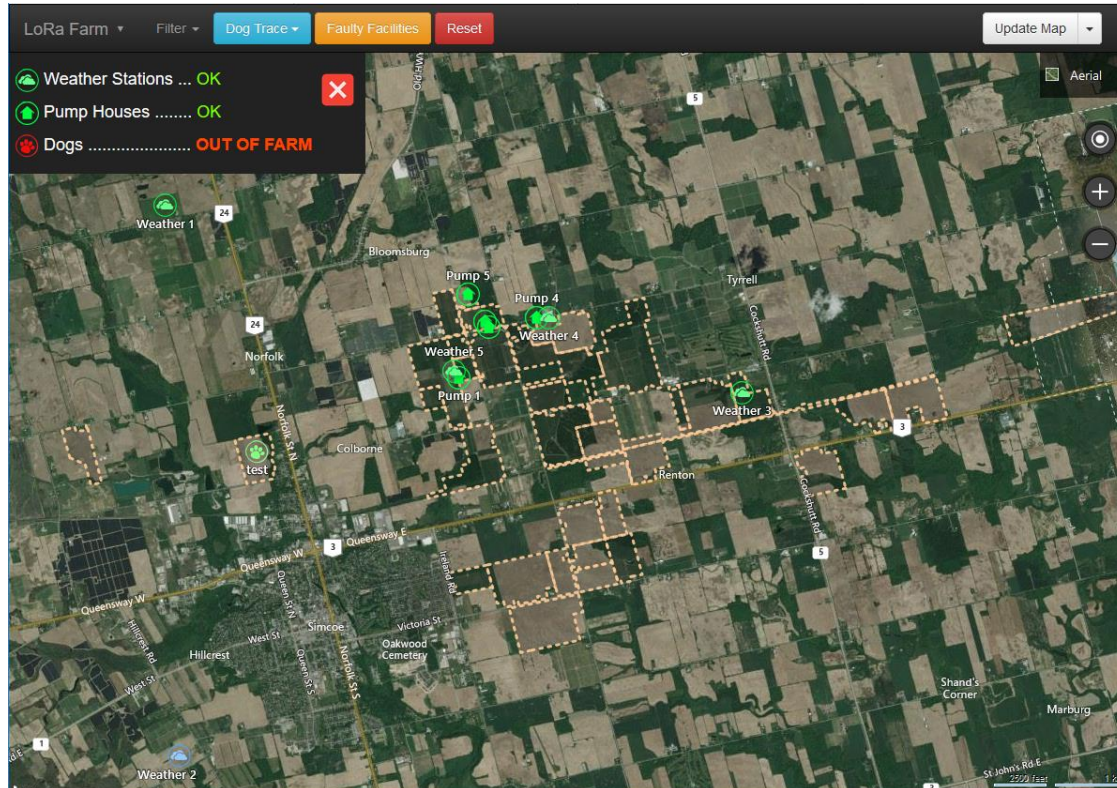
- Localized Environmental Monitoring
- Power and Temperature Monitoring
- Tracking position of guard dogs
- Live, web-accessible display of data

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IoT Challenges

IoT Challenges|Barriers to Adoption

- High-investment cost.
- Secure Data Storage and Management.
- Connectivity Outages.
- Reliability and stability
- Connectivity of all the systems in IIoT setup.
- Blending legacy systems.

Thank you.