UNIT II: IoT and M2M

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.**A Market Perspective**– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT

The Vision

2.1 Introduction

- M2M, or machine-to-machine, is a direct communication between devices using wired or wireless communication channels.
- M2M refers to the interaction of two or more devices/machines that are connected to each other.
- Machine-to-machine communication, or M2M, is exactly as it sounds: two machines "communicating," or exchanging data, without human interfacing or interaction. uptake of both M2M and IoT solutions will increase dramatically.
- These devices capture data and share with other connected devices, creating an intelligent network of things or systems. Devices could be sensors, actuators, embedded systems or other connected elements.
- M2M technology could be present in our homes, offices, shopping malls and other places. Controlling electrical appliances like bulbs and fans using RF or Bluetooth from your smartphone is a simple example of M2M applications at home. Here, the electrical appliance and your smartphone are the two machines interacting with each other.
- The Internet of Things (IoT) is the network of physical devices embedded with sensors, software and electronics, enabling these devices to communicate with each other and exchange data over a computer network. The things in the IoT refer to hardware devices uniquely identifiable through a network platform within the Internet infrastructure.
- M2M and the IoT are two of the technologies that form the basis of the new world.
- Anything in the physical realm that is of interest to observe and control by people, businesses, or organizations will be connected and will offer services via the Internet.
- The physical entities can be of any nature, such as buildings, farmland, and natural resources like air, and even such personal real-world concepts as my favorite hiking route through the forest or my route to work.
- M2M is about machines, smartphones and appliances, whereas the IoT is about sensors, cyber-based physical systems, Internet and so on

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2.2 From M2M to IoT

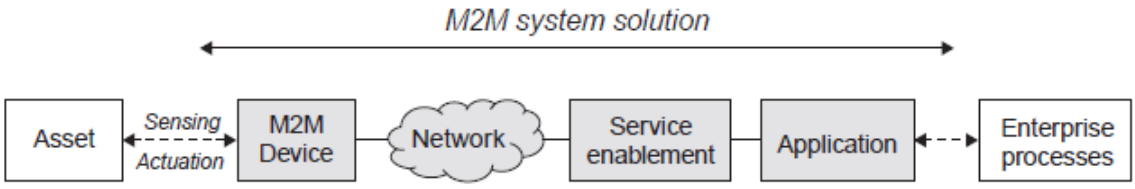
- M2M and IoT solutions will increase dramatically.
- **Reasons for using M2M and IoT**

1. An increased need for understanding the physical environment in its various forms, from industrial installations through to public spaces and consumer demands.
2. The improvement of technology
3. Improved networking capabilities.
4. Reduced costs of components and the ability to more cheaply collect and analyze the data they produce.

M2M communication

- M2M refers to those solutions that allow communication between devices of the same type and a specific application, all via wired or wireless communication networks.
- The term M2M communication describes devices which are connected to the internet using fixed/wireless networks and communicate with each other as well as with other devices on the network.
- M2M solutions allow end-users to capture data about events from assets, such as temperature or inventory levels.
- M2M can be used for sharing and storing information for administration and operational purposes, monitoring, diagnostics and notifications or alerts.
- M2M has been applied in many different scenarios, including the remote monitoring and control of enterprise assets, or to provide connectivity of remote machine-type devices.

Generic M2M Solution



- A typical M2M system solution consists of M2M devices, communication networks that provide remote connectivity for the devices, service enablement and application logic, and integration of the M2M application into the business processes provided by an Information Technology (IT) system of the enterprise.
- The M2M system solution is used to remotely monitor and control enterprise assets of various kinds, and to integrate those assets into the business processes of the enterprise in question. The asset can be of a wide range of types (e.g. vehicle, freight container, building, or smart electricity meter), all depending on the enterprise.
- The system components of an M2M solution are as follows:

• **M2M Device.**

- This is the M2M device attached to the asset of interest, and provides sensing and actuation capabilities.

• **Network.**

- The purpose of the network is to provide remote connectivity between the M2M device and the application-side servers. Many different network types can be used, and include both Wide Area Networks (WANs) and Local Area Networks (LANs), sometimes also referred to as Capillary Networks or M2M Area Networks.

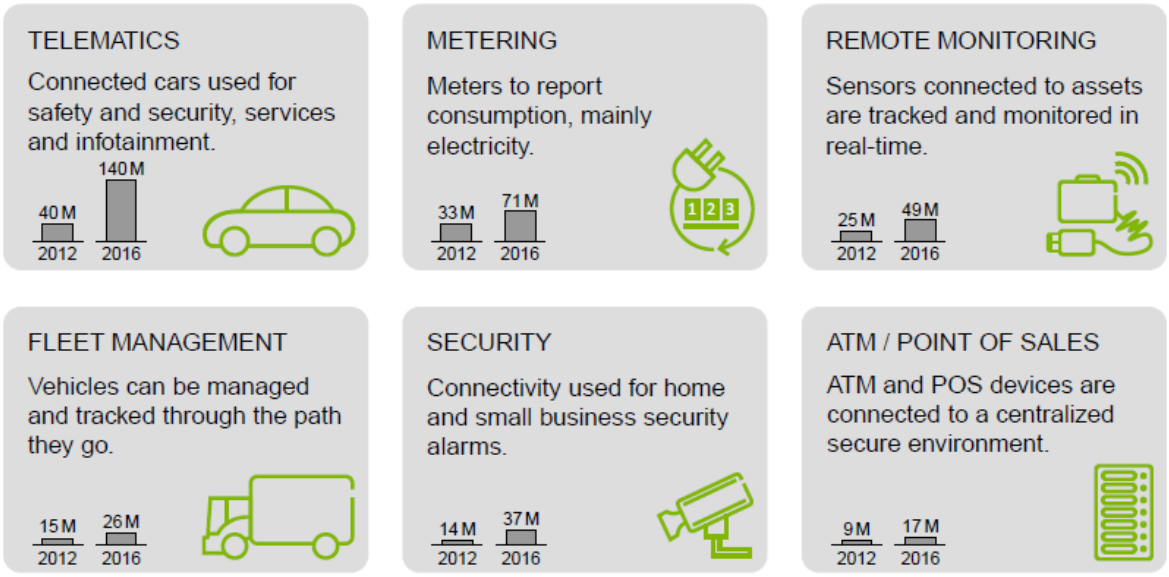
• M2M Service Enablement.

- This component provides generic functionality that is common across a number of different applications. Its primary purpose is to reduce cost for implementation and ease of application development.

• M2M Application.

- The application component of the solution is a realization of the highly specific monitor and control process. The application is further integrated into the overall business process system of the enterprise.

Key application areas



- Telematics for cars and vehicles. Typical applications include navigation, remote vehicle diagnostics pay-as-you-drive insurance schemes, road charging, and stolen vehicle recovery.
- Metering applications include primarily remote meter management and data collection for energy consumption in the electricity utility sector, but also for gas and water consumption.
- Remote monitoring is more generalized monitoring of assets, and includes remote patient monitoring as one prime example.
- Fleet management includes a number of different applications, like data logging, goods and vehicle positioning, and security of valuable or hazardous goods.

- Security applications are mainly those related to home alarms and small business surveillance solutions. The final market segment is Automated
- Teller Machines (ATM) and Point of Sales (POS) terminals.
- M2M communication requires availability of constant internet connection with reasonable speed.

Benefits or advantages of M2M Communication

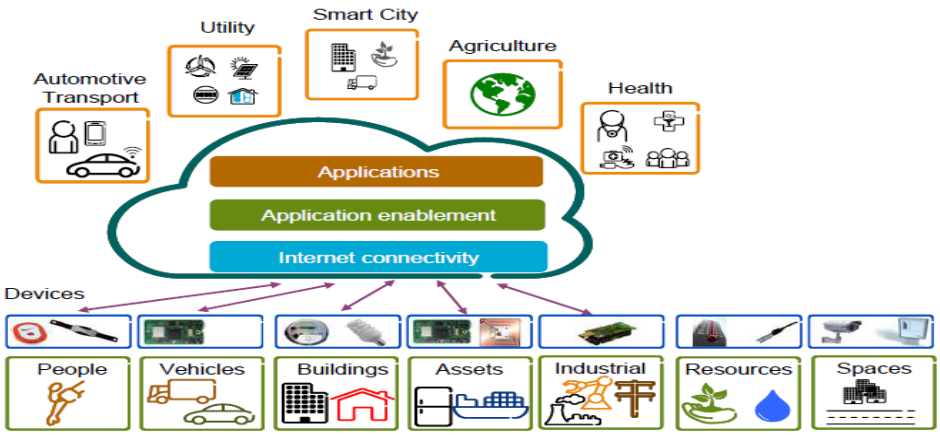
- M2M communication is supported by cellular networks either directly or through gateway.
- It is easy to roll out and maintain.
- It is available with fixed and mobile networks both indoors and outdoors.
- It offers higher range, minimum latency, higher throughput and consume less energy.
- It enables communication of smart devices without any human intervention.
- The security and privacy issues in IoT networks are resolved by using M2M communication facility.
- Large protection, data collection and data processing is possible.

Drawbacks or disadvantages of M2M Communication

- Use of cloud computing in M2M means dependence on others which could limit flexibility and innovation.
- Security and ownership of data is a big concern.
- Interoperability between cloud/M2M IoT devices is a big concern in such networks.
- It is designed and optimized for small number of network devices.

IoT

- connecting sensors and other devices to Information and Communication Technology (ICT) systems via wired or wireless networks.
- IoT also refers to the connection of such systems and sensors to the broader Internet, as well as the use of general Internet technologies.
- It allows things and real world objects to connect, communicate, and interact with one another in the same way humans do via the web today.
- Internet be only about people, media, and content,but it will also include all real-world assets as intelligent creatures exchanging information, interacting with people, supporting business processes of enterprises, and creating knowledge.
- It is an extension to the existing Internet.
- IoT is about the technology, the remote monitoring, and control, and also about where these technologies are applied.
- IoT applications will not only rely on data and services from sensor and actuators alone. Equally important is the blend-in of other information sources that have relevance from the viewpoint of the physical world.
- These can be data from Geographic Information Systems (GIS) like road databases and weather forecasting systems.



- Even information extracted from social media like Twitter feeds or Facebook status updates that relate to real world observations can be fed into the same IoT system.

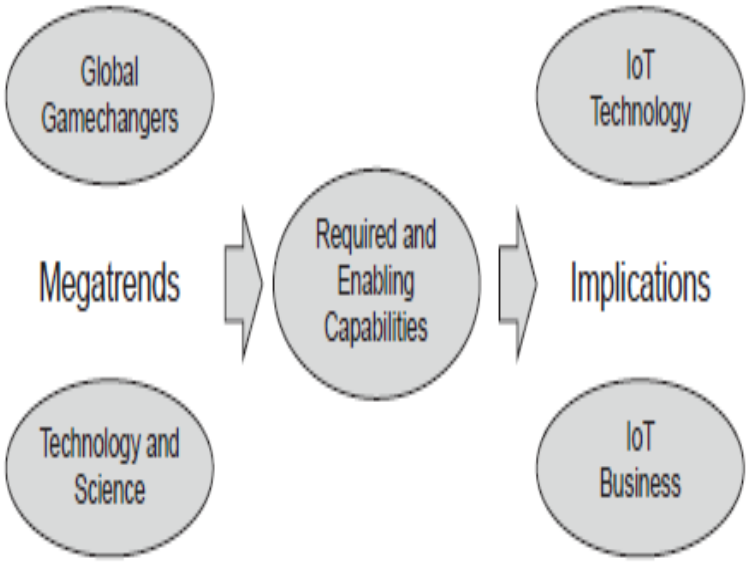
Examples : It includes applications like urban agriculture, robots and food safety tracing.

- **Urban Agriculture.**
  - Sensors and actuators can monitor and control the plant environment and tailor the conditions according to the needs of the specific specimen.

- Weather and light can be monitored, and necessary blinds that can shield and protect, as well as create greenhouse microclimates, can be automatically controlled.

➢ **Robots**

- The process chain of the mine involving blasting, crushing, grinding, and ore processing will be highly automated and interconnected.
- The heavy machinery used will be remotely controlled and monitored, mine sites will be connected, and shafts monitored in terms of air and gases.
- Sensors and actuators to remotely control both the sites and the massive robots in terms of mining machines for drilling, haulage, and processing are the instruments to make this happen.



➢ **Food Safety.**

- Sensors will provide the necessary monitoring capabilities, and tags like radio frequency identification (RFID) will be used to identify the items so they can be tracked and traced throughout the supply chain.
- From the monitoring of farming conditions for plant and animal health, registration of the use of pesticides and animal food, the logistics chain to monitor environmental conditions as produce is being transported, and retailers handling of food _ all will be connected

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2.3 M2M towards IoT - the global context

➢ A set of megatrends are combining to create needs and capabilities, which in turn produce a set of IoT Technology and Business Drivers.

- A megatrend is a pattern or trend that will have a fundamental and global impact on society at a macro level over several generations.

Game changers

- The game changers come from a set of social, economic, and environmental shifts.
- Some of the more globally significant **game changers below**, and their relationship to IoT:

1. Natural Resource Constraints.

-The use of IoT to increase yields, improve productivity, and decrease loss across global supply chains is therefore escalating.

2. Economic Shifts.

- The overall economy is in a state of flux as it moves from the post-industrial era to a digital economy.

-As technology becomes increasingly embedded and more tasks automated, countries need to manage this shift and ensure that M2M and IoT also create new jobs and industries

3.Changing Demographics.

-Many countries will need to deal with an aging population without increasing economic expenditure.

-As a result, IoT will need to be used, for example, to help provide assisted living and reduce costs in healthcare and emerging "wellcare" systems.

4.Socioeconomic Expectations.

-Lifestyle and convenience will be increasingly enabled by technology as the same disruption and efficiency practices evident in industries will be applied within people's lives and homes as well.

5.Climate Change and Environmental Impacts.

-Technology, including IoT, will need to be applied to aggressively reduce the impact of human activity on the earth's systems.

6.Safety and Security.

- Public safety and national security becomes more urgent as society becomes more advanced, but also more vulnerable. This has to do both with reducing fatalities and health as well as crime prevention, and different technologies can address a number of the issues at hand.

7.Urbanization.

-Urbanization creates an entirely new level of demands on city infrastructures in order to support increasing urban populations

- IoT technologies will play a central role in the optimization for citizens and enterprises within the urban realm, as well as providing increased support for decision-makers in cities.

General technology and scientific trends

- Material Science

-It has a large impact across a vast range of industries, from pharmaceutical and cosmetics to electronics. MicroElectroMechanical Systems (MEMS) can be used to build advanced micro-sized sensors like accelerometers and gyroscopes.

-New materials provide different methods to develop and manufacture a large range of different sensors and actuators, as well being used in applications for environmental control, water purification, etc.

- Complex and Advanced Machinery

  -It refers to tools that are autonomous or semi-autonomous. Today they are used in a number of different industries; for example, robots and very advanced machinery is used in different harsh environments, such as deep-sea exploration, or in the mining industry in solutions such as Rio Tinto's Mine of the Future.

- Energy Production and Storage

  -It relates to the global interest of securing the availability of electricity while reducing climate and environmental impacts.

  -Smart Grids, for example, imply micro-generation of electricity using affordable photovoltaic panels. In addition, smart grids also require new types of energy storage, both for the grid itself and for emerging technologies such as Electric Vehicles (EVs) that rely on increasingly efficient battery technologies.

  -Wireless Sensor Networks (WSNs) will increasingly rely on different energy harvesting technologies and also rely on new miniaturized battery technologies and ultra capacitors.

Trends in information and communications technologies

- Sensors, actuators, and tags function as the digital interfaces to the physical world.

  -Tags using technologies such as RFID provide the means to put electronic identities on any object, and can be cheaply produced.

- Embedded processing is evolving,

  -not only towards higher capabilities and processing speeds, but also extending towards the smallest of applications.

- Instant access to the Internet is available

  -rapid deployment of cellular 3G and 4G or Long Term Evolution (LTE) systems on a global scale.

  -These systems provide ubiquitous and relatively cheap connectivity with the right characteristics for many applications, including low latency and the capacity to handle large amounts of data with high reliability.

- Software architectures

  -software development techniques from what were originally closed environments towards platforms.

- Web paradigm and using a service-oriented approach (SOA)

-By extending the web paradigm to IoT devices, they can become a natural component of building any application and facilitate an easy integration of IoT device services
into any enterprise system that is based on the SOA.

- Open APIs
  -Open APIs permit the creation of a fluid industrial platform, allowing components to be combined together in multiple different ways by multiple developers with little to no
  interaction with those who developed the platform, or installed the devices.
- Cloud computing
  It is one of the greatest aspects of the evolution of ICT for IoT as it allows virtualized and independent execution environments for multiple applications to reside in isolation on the same hardware platform, and usually in large data centers.
- Data processing and intelligent software
  -It will have an increasing role to play in IoT solutions.
- Big data
  -It refers to the increasing number and size of data sets that are available for companies and individuals to collect and perform analysis on.
- Decision support or even decision-making systems
  -It become very important in different application domains for IoT, as will the set of tools required to process data, aggregate information, and create knowledge.

Capabilities

- IoT systems are multimodal in terms of sensing and control, complex in management, and distributed across large geographical areas.
- For example, the new requirements on Smart Grids involve end-to-end management of energy production, distribution, and consumption, taking into consideration needs from Demand Response, micro-generation, energy storage, and load balancing.
- Industrialized agriculture involving automated irrigation, fertilization, and climate control is another example.
- Smart City solutions is a clear need for integration of multiple disparate infrastructures such as utilities, including district heating and cooling, water, waste, and energy, as well as transportation
  such as road and rail.
- Advanced remotely operated machinery, such as drilling equipment in mines or deep sea exploration vessels, will require real-time control of complex operations, including various degrees of autonomous control systems.
- IoT will allow more assets of enterprises and organizations to be connected, thus allowing a tighter and more prompt integration of the assets into business processes and expert systems.

- Simple machines can be used in a more controlled and intelligent manner, often called "Smart Objects."
- EVs are enabled by the new battery and energy storage technologies, but also require three separate elements to be connected _ cars, road infrastructure via charging poles, and the electricity grid. In addition, there are new charging requirements that are created by the use of EVs that need new means for billing, and in turn placing new requirements on the electricity grid itself.
- share information and services across organizations in the horizontal dimension, as well as being
  able to aggregate and combine services and information to reach higher degrees of refinement and values in the vertical dimension.
- ICT solutions to monitor and control assets, physical properties of the real world require not just increased levels of cyber security, but what can be referred to as cyber-physical security.
- In an IoT, where it is possible to control assets (e.g. vehicles or moveable bridges), severe amage to property, or even loss of life, is possible.

Implications for IoT

- In the M2M device area, there is an emerging consolidation of technologies where solutions across different industry segments traditionally rely on legacy and proprietary technologies.
- One example being Building and Home Automation and Control with legacy technologies like BACnet, Lonworks, KNX, Z-Wave, and ZigBee.
- Requirement for integration across multiple infrastructures and of a large set of different devices, as well as data and information sharing across multiple domains, there is a clear benefit from a horizontal systems approach with at least a common conceptual interoperability made available, and a reduced set of technologies and protocols being used.
- M2M is point problem-oriented, resulting in point solutions where devices and applications are highly dedicated to solving a single task.
- M2M devices are for this reason many times highly application-specific, and reuse of devices beyond the M2M application is possible.
- It allows easy integration in SOAs and attracts a larger application developer community.
- Both devices and connectivity have become viable for many different applications, and M2M today is centered on devices and connectivity.

Barriers and concerns

Concerns

- The first concern is the compromise of **privacy and the protection of personal integrity**. The use of RFID tags for tracing people is a raised concern

- Massive deployment of sensors in various environments, including in smartphones, explicit data and information about people can be collected, and using analytics tools, users could potentially be profiled and identified even from anonymized data.
- The reliability and accuracy of data and information when relying on a large number of data sources that can come from different providers that are beyond one's own control is another concern.
- the topic of **security** has one added dimension or level of concern.

Barrier

- A perceived barrier for large-scale adoption of IoT is in costs for massive deployment of IoT devices and embedded technologies.
- From a technical perspective, what is desired is a high degree of automated provisioning towards zero-configuration

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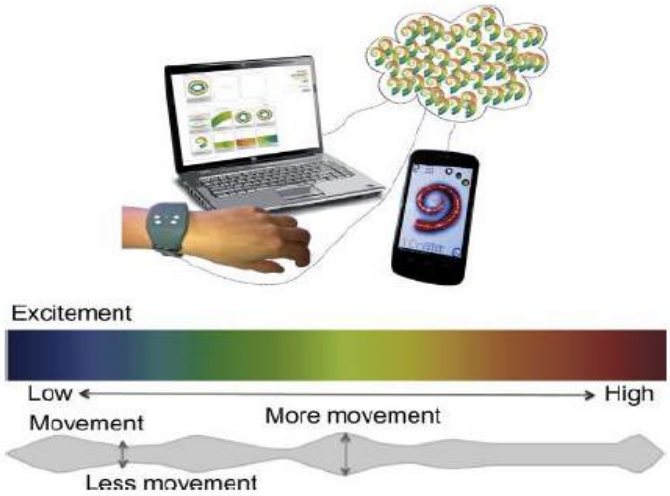
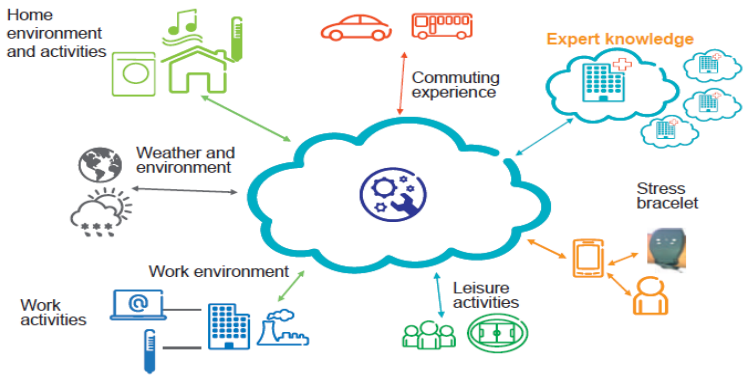
2.4 A use case example

- Studies from the U.S. Department of Health and Human Services have shown that close to 50% of the health risks of the enterprise workforce are stress related, which includes a group of factors such risks as high cholesterol, overweight issues, and high alcohol consumption
- As stress can be a root cause for many direct negative health condition.
- Measuring human stress can be done using sensors. Two common stress measurements are heart rate and galvanic skin response (GSR), and there are products on the market in the form of bracelets that can do such measurements.
- These sensors can only provide the intensity of the heart rate and GSR, and do not provide an answer to the cause of the intensity.
- The typical M2M solution would be based on getting sensor input from the person by bracelet.
- Using a smartphone as a mobile gateway to send measurements to an application server hosted by a health service provider.
- The application server hosts the necessary functionality to analyze the collected data, and based on experience and domain knowledge, provides an indication of the stress level.
- The stress information can then be made available to the person or a caregiver via smartphone application or a web interface on a computer.
- Stress measurement M2M solution is as follows

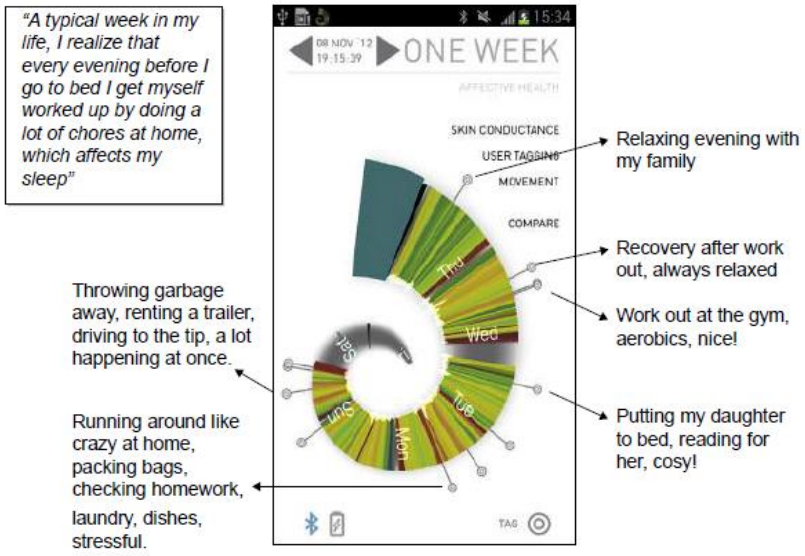


- Same problem situation from an IoT perspective would be to add data that provide much deeper and richer information of the person's contextual situation.
- The prospect is that the more data is available, the more data can be analyzed and correlated in order to find patterns and dependencies.
- Depicted is also the importance of having expert domain knowledge that can mine the available information, and that can also provide proposed actions to avoid stressful situations or environments.
- IoT-oriented stress analysis solution is as follows

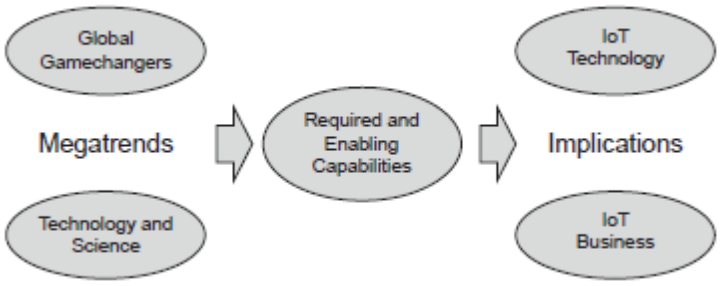


- smartphone application that provides stress analysis feedback.

- an IoT-oriented solution t



o solving a particular problem could provide much more precision in achieving the desired results.

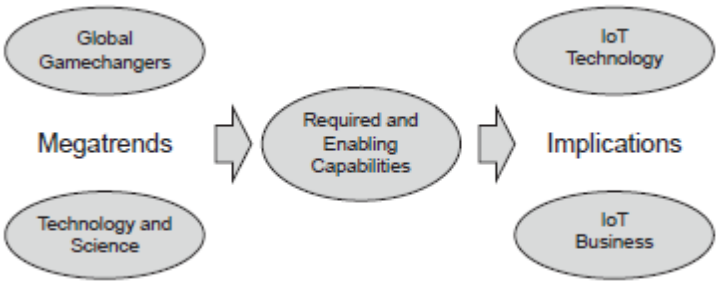


2.5 Differing characteristics

Characteristics of M2M

- It is generally focused on solving a problem at a particular point for one company or stakeholder.
- It does not typically take a broad perspective on solving a larger set of issues
- most M2M devices are special purpose devices that are application-specific

- M2M solutions are therefore also vertical siloes with no horizontal integration or connection



to adjacent use cases

- M2M applications are built by very specialized developers, and deployed inside enterprises.
- M2M is also very device- and communication-centric

A Comparison of the Main Characteristics of M2M and IoT

M2M	**IoT**
M2M is about direct communication between machines	IoT is about sensor automation and internet platform
It supports point to point communication	It supports cloud communication
Devices do not necessarily rely on an internet connection	Devices rely on an internet connection
It is mostly hardware based technology	It is both hardware and software based technology
Machine normally communicate with a single machine at a time	Many users can access at one time over the internet
A device can connected through mobile or other network	Data delivery depends on the Internet Protocol Network

Aspect	M2M	IoT
Applications and services	Point problem driven	Innovation driven
	Single application - single device	Multiple applications - multiple devices
	Communication and device centric	Information and service centric
	Asset management driven	Data and information driven
Business	Closed business operations	Open market place
	Business objective driven	Participatory community driven
	B2B	B2B, B2C
	Established value chains	Emerging ecosystems
	Consultancy and Systems Integration enabled	Open Web and as-a-Service enabled
	In-house deployment	Cloud deployment
Technology	Vertical system solution approach	Horizontal enabler approach
	Specialized device solutions	Generic commodity devices
	De facto and proprietary	Standards and open source
	Specific closed data formats and service descriptions	Open APIs and data specifications
	Closed specialized software development	Open software development
	SOA enterprise integration	Open APIs and web development

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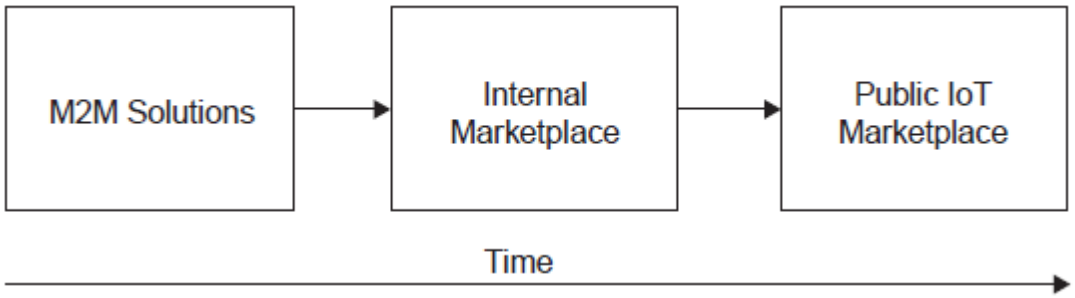
A Market Perspective

2.6 Introduction

- The increasing interest in M2M and IoT solutions has been driven by the potential large market and growth opportunities.
- In M2M and IoT, the technology used for these solutions may be very similar , even use the same base components but the data is managed will be different.
- In an M2M solution, data remains within strict boundaries ,it is used solely for the purpose.
- In IoT, data may be used and reused for many different purposes.
- Data can be shared between companies and value chains in internal information marketplaces.
- Data could be publicly exchanged on a public information marketplace.
- A Marketplace Perspective is as follows



2.7 Some definitions

Global value chains

- Simplified global value chains as follows

- A value chain describes the full range of activities that firms and workers perform to bring a product from its conception to end use.
- It includs design, production, marketing, distribution, and support to the final consumer
- Analyzing an industry from a global value chain (GVC) perspective permits understanding of the context of globalization on the activities contained within them by "focusing on the sequences of tangible and intangible value-adding activities, from conception and production to end use

Ecosystems vs. value chains

- "an economic community supported by a foundation of interacting organizations and individuals .
- The economic community produces goods and services of value to customers.
- The member organisms also include suppliers, lead producers, competitors, and other Stakeholders
- A value chain is associated with the creation of value.
- A value chain is a useful model to explain how markets create value and how they evolve over time.

Industrial structure

- Industrial structure refers to the procedures and associations within a given industrial sector.
- It is the structure that is purposed towards the achievement of the goals of a particular industry.

2.8 M2M value chains

- M2M value chains are internal to one company and cover one solution.
- Reasons for using M2M vary from project to project and company to company.
- It can include things such as cost reductions through streamlined business processes, product quality improvements, and increased health and safety protection for employees.
- Input and output of the value chains as follows:

1.Inputs: Inputs are the base raw ingredients that are turned into a product. Examples could be cocoa beans for the manufacture of chocolate or data from an M2M device that will be turned into a piece of information.

2.Production/Manufacture: Production/Manufacture refers to the process that the raw inputs are put through to become part of a value chain. For example, cocoa beans may be dried and separated before being transported to overseas markets. Data from an M2M solution, meanwhile, needs to be verified and tagged for provenance.

3.Processing: Processing refers to the process whereby a product is prepared for sale. For example, cocoa beans may now be made into cocoa powder, ready for use in chocolate bars. For an M2M solution, this refers to the aggregation of multiple data sources to create an information Component.

4.Packaging: Packaging refers to the process whereby a product can bebranded as would be recognizable to end-user consumers. For example, a chocolate bar would now be ready to eat and have a red wrapper with the words "KitKatt" on it. For M2M solutions, the data will have to be combined with other information from internal corporate databases.

5.Distribution/Marketing: This process refers to the channels to market for products. For example, a chocolate bar may be sold at a supermarket or even online. An M2M solution, however, will have produced an Information Product that can be used to create new knowledge within a corporate environment.

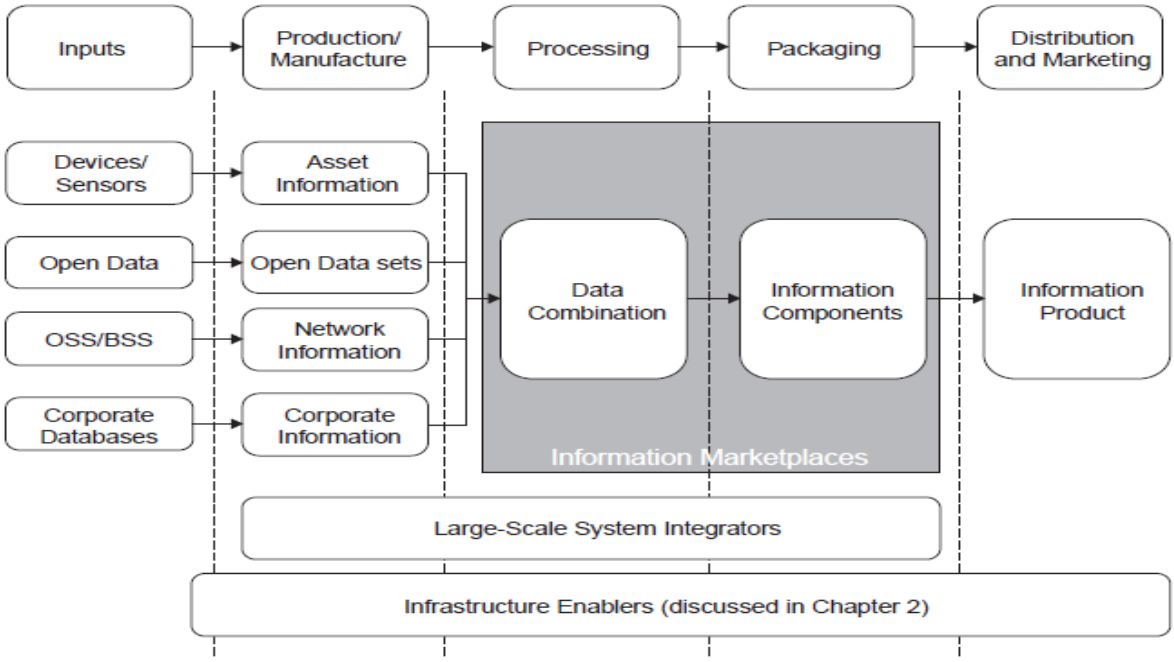
2.9 IoT value chains

- IoT Value Chains are about the use and reuse of data across value chains and across solutions
- IoT value chains based on data are to some extent enabled by Open APIs and the other open web-based technologies.
- Open APIs allow for the knowledge contained within different technical systems to become unembedded.
- Creating the possibility for many different economic entities to combine and share their data as long as they have a well-defined interface and description of how the data is formatted.

- Open APIs in conjunction with the Internet technologies mean that knowledge is no longer tied to one digital system.
- Input and output of the value chains as follows:

1.Inputs: The It has more inputs than for an M2M solution. It has the following :

- ✓ **Devices/Sensors:** these are very similar to the M2M solution devices and sensors, and may in fact be built on the same technology.
- ✓ **Open Data:** Open data is an increasingly important input to Information Value Chains. Open data defines it as: "A piece of data is open if anyone is free to use, reuse, and redistribute it.
- ✓ **OSS/BSS:** The Operational Support Systems and Business Support Systems of mobile operator networks are also important inputs to information value chains, and are being used increasingly in tightly closed information marketplaces that allow operators to deliver services to enterprises
- ✓ **Corporate Databases:** Companies of a certain size generally have multiple corporate databases covering various functions, including supply chain management, payroll, accounting, etc. . . .



2.Production/Manufacture: In the production and manufacturing processes for data in an IoT solution, the raw inputs described above will undergo initial development into information components and products. Some examples as follows:

- ✓ **Asset Information:** Asset information may include data such as temperature over time of container during transit or air quality during a particular month.
- ✓ **Open Data Sets:** Open data sets may include maps, rail timetables, or demographics about a certain area in a country or city.

- ✓ **Network Information:** Network information relates to information such as GPS data, services accessed via the mobile network, etc. . . .
- ✓ **Corporate Information:** Corporate information may be, for example, the current state of demand for a particular product in the supply chain at a particular moment in time.

3.Processing: During the processing stage, data from various sources is mixed together. The data from the various inputs from the production and manufacture stage are combined together to create information.

4.Packaging: After the data from various inputs has been combined together, the packaging section of the information value chain creates information components. These components could be produced as charts or other traditional methods of communicating information to end-users. Both the processing and packaging sections of the Information-Driven Global Value Chain (I-GVC) are where Information Marketplaces will be developed.

5. Distribution/Marketing: The final stage of the Information Value Chain is the creation of an Information Product. It has two main categories:

- ➢ **Information products for improving internal decision-making:** These information products are the result of either detailed information analysis that allows better decisions to be made during various internal corporate processes, or they enable the creation of previously unavailable knowledge about a company's products, strategy, or internal processes.
- ➢ **Information products for resale to other economic actors:** These information products have high value for other economic actors and can be sold to them.

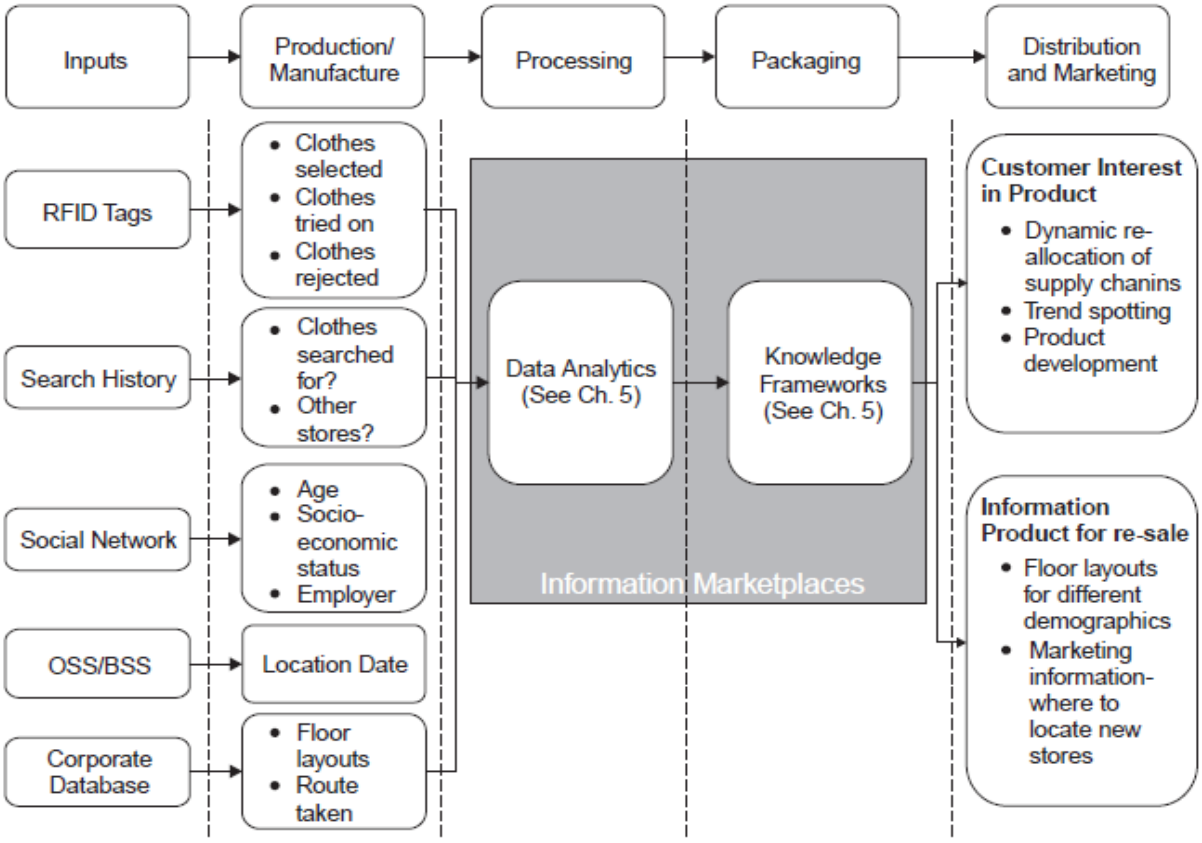
2.10 An emerging industrial structure for IoT

- ➢ M2M and IoT are about rapidly integrating data and workflows that form the basis of the global economy at increasing speed and precision.
- ➢ Combined, these two technologies create a platform that will rapidly redefine the global economy.
- ➢ In IoT, new sets of system integrator capacity are required for two main reasons:
  - ✓ **Technical:** The factors driving the technical revolution of these industries means that the complexity of the devices in question require massive amounts of R&D; as do semiconductors with large amounts of functionality built into the silicon. partnerships between vendors.
  - ✓ **Financial:** Only those companies that are able to capture the added value created in the emerging industrial structure will recoup enough money to re-invest in the R&D required to participate in the systems integration market.
- ➢ A new type of value chain emerging _ one where the data gathered from sensors and radio frequency identification (RFID) is combined with information from smartphones

that directly identifies a specific individual, their activities, their purchases, and preferred method of communication.

- Search queries can be localized based on where a person is, and advertising can be targeted directly to the end-user in question based on personalized information about their age, level of education, employment, and tastes.
- Actors that perform this data collection, storage, and processing are forming the basis of what may be viewed as an Information-Driven Global Value Chain (I-GVC), a value chain where the product is information itself.
- Example. if I was in a clothing store searching for a new outfit for work, through a combination of information about myself and the RFID tags on the different clothes, I could be guided to the correct clothing selection for my age group, my education level, and also my current employer.

An Information-Driven Value Chain for Retail as follows:

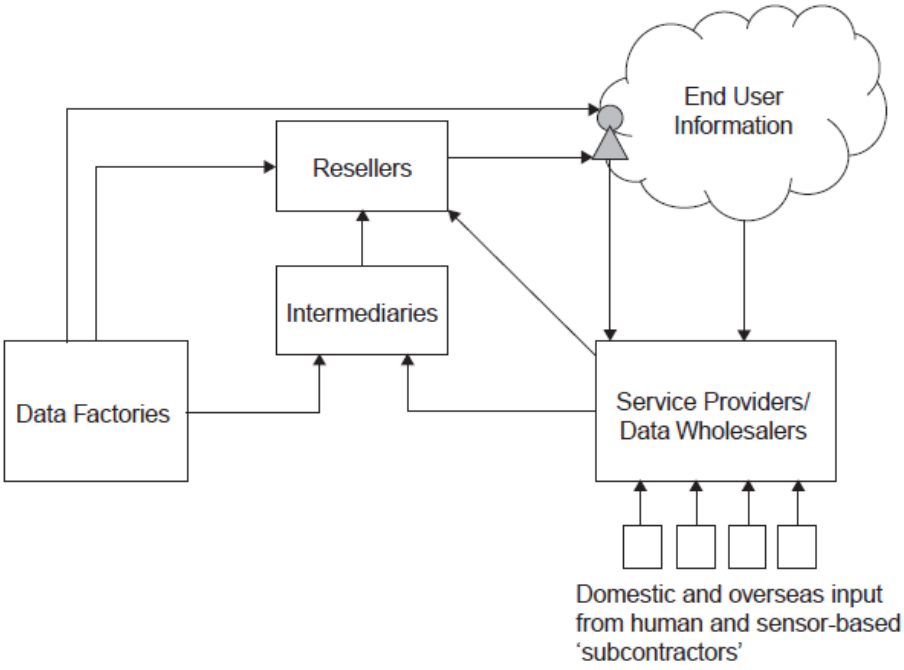


- This streamlining could also be extended into the processes of production, changing orders based on consumer interest in products, and not just their purchasing patterns.
- This would result in less wasted stock and a much closer understanding of seasonal trends and an increased level of control for those companies working as system integrators.

- A strong link between the I-GVC and physical goods, it is therefore clear that there is an information product in and of itself, one that relates to the development of aggregation databases that collect data from both sensors and people.
- The second change in the nature of the economy is the fundamental embedding of human beings into the very foundation of these technology platforms.
- Example of this is Google's search engine, which is improved with every search query that is performed using it. Every search that every individual makes is tracked, and every click someone makes through Google's products is recorded and used to refine the algorithms that form the basis of the platform.
- Social networks such as Facebook and LinkedIn, and content sharing sites such as YouTube or Blogger, allow end-users to store information about their lives in a manner. Consumers now store their photos, their contact lists, videos, documents, and financial data online.
- My location, level of education, employment status, health records, tax data, credit rating, purchasing patterns, search history, social networks, relationship status, even how often I call my mother are recorded, stored, and interconnected in a vast array of disparate systems that are now linked together through the platform of a converged communications industry.

The information-driven global value chain

- There are five fundamental roles within the I-GVC that companies and other actors are forming around.
- The Information-Driven Global Value Chain is as follows:



- Inputs:
  - ✓ Sensors, RFID, and other devices.
  - ✓ End-Users.
- Data Factories.
- Service Providers/Data Wholesalers.
- Intermediaries.
- Resellers.

Inputs to the information-driven global commodity chain

- There are two main inputs into the I-GVC:
  1. Sensors and other devices (e.g. RFID and NFC).
  2. End-users.
- Both of these information sources input tiny amounts of data into the I-GVC chain, which are then aggregated, analyzed, repackaged, and exchanged between the different economic actors that form the value chain.
- Sensor devices and networks, RFIDs, mobile and consumer devices, Wi-Fi hotspots, and end-users all form part of a network of "subcontractors" in the value chain, all contributing to the increased value of the information products.

1. Sensors and radio frequency identification

✓ Sensors and RFID are helping to smooth supply and demand in various supply chains worldwide and gathering climate and other localized data that is then transmitted back to a centralized information processing system.

✓ These devices are working as inputs to the I-GVC through the capture and transmission of data necessary for the development of information products.

✓ Smartphones allow mobile devices to interact with sensors and RFID. This allows for a two-way interaction between a mobile terminal and the sensor technology.

✓ The sensor networks, and NFC and RFID technologies may be viewed as subcontractors to the I-GVC, workers that constantly gather data for further processing and sale.

2. End-users

✓ The second main inputs to the I-GVC are the end-users.

✓ End-users are no longer passive participants in the digital economy, with a role only to purchase those physical products that companies develop and market to them.

✓ End-users that choose to use and participate within the digital world are now deeply embedded into the very process of production.

✓ Every human that enters a search query into a search engine, every human that agrees to allow the mobile broadband platform to inform a service of their location, every human that uses NFC to allow a bank to establish and confirm their identity are also functioning as subcontractors to the global information systems that form the basis of the I-GVC.

✓ In fact, the creation of the I-GVC would not be possible without the contribution of many millions of individuals worldwide.

- ✓ The data about individuals can be collected from any person in any language, in almost any data format. Each individual's data can be treated as unique within this value chain.
- ✓ Every person worldwide that has to use digital technologies to do their banking, their taxes, their information searches, and to communicate with friends and colleagues, are constantly working on behalf of the I-GVC, contributing their individual profile data and knowledge to the value chain.

Production processes of the information-driven global value chain

1. Data factories

- ✓ Data factories are those entities that produce data in digital forms for use in other parts of the I-GVC.
- ✓ With the move to the digital era, however, these companies now also provide this data via digital means; for example, OS now makes maps and associated data available in digital format.
- ✓ Products can now be combined, reused, and bundled together with other products by actors in the commodity chain as the foundation of other services.
- ✓ For example, maps from OS can be combined with other data from travel services such as TFL to provide detailed travel applications on mobile devices.
- ✓ SMHI has a large number of weather stations across Sweden through which it collects weather and environmental information. SMHI therefore produces raw data, but it also processes the data, and bundles it in different ways based on customer requests and requirements.
- ✓ SMHI functions not only as a data factory, therefore, but also a reseller.

2. Service providers/data wholesalers

- ✓ Service Providers and Data wholesalers are those entities that collect data from various sources worldwide, and through the creation of massive databases, use it to either improve their own information products or sell information products in various forms.
- ✓ Examples are Twitter, Facebook, Google, etc
- ✓ Google "sells" its data assets through the development of extremely accurate, targeted, search-based advertising mechanisms that it is able to sell to companies wishing to reach a particular market.
- ✓ Twitter is able to collate customer sentiment about different products and world events, from service at a restaurant to election processes across the globe; through what Twitter refers to as a "data hose," companies and developers can access 50% of end-user Tweets for $360,000 USD per annum.
- ✓ Companies that handle the massive amount of data that is produced by sensor networks and mobile devices worldwide. These companies are collating those transactions that are made by the millions of devices worldwide that utilize communications networks to transmit data.

3. Intermediaries

- ✓ In the emerging industrial structure of the I-GVC, there is a need for intermediaries that handle several aspects of the production of information products.
- ✓ In Europe, the manner in which Facebook collects and uses the data of the individuals that participate in its service may actually be in contravention of European privacy law.
- ✓ Google, Facebook, and Twitter may therefore require the creation of entities that are able to "anonymise" data sufficiently to protect individuals' privacy rights in relevant regional settings.
- ✓ These corporations will provide protection for the consumer that their data is being used in an appropriate manner, i.e. the manner in which the consumer has approved its usage.
- ✓ Another reason for an intermediary of this nature is to reduce transaction costs associated with the establishment of a market for many different companies to participate in.
- ✓ As an example, Jasper Wireless acts as an intermediary for the M2M , providing a connection point for several different parties in the M2M industry, it acts to expand the uptake of M2M technology.
- ✓ The different types of information products that are to be produced are only of interest to certain types of companies
- ✓ For example the marketing division of a company may be interested to understand customer sentiment about a particular product within a certain age group. Another company may want to understand what searches are being performed in their local area, while a local authority may wish to use sensor data to obtain real-time data about pollution from local factories.
- ✓ The quantity and nature of data being developed into information products also requires a completely new type of intermediary.
- ✓ To handle the scalability issues and the associated security and privacy questions raised by the use of this data to build products.

4. Resellers

- ✓ Resellers are those entities that combine inputs from several different intermediaries, combine it together, analyze, and sell it to either end-users or to corporate entities. These resellers are currently rather limited in terms
- ✓ One example is BlueKai, which tracks the online shopping behavior of Internet users and mines the data gathered for "purchasing intent" in order to allow advertisers to target buyers more accurately.
- ✓ BlueKai combines data from several sources, including Amazon, Ebay, and Alibaba.
- ✓ Through this data, it is able to identify regional trends, helping companies to identify not just which consumer group to target their goods to, but also which part of the country.

Advantages of IoT

- Efficient resource utilization:
- Minimize human effort:
- Save time:
- Enhance Data Collection:
- Improve security:
- Communication : IoT encourages the communication between devices, also famously known as Machine-to-Machine (M2M) communication.
- Automation and Control : Due to physical objects getting connected and controlled digitally and centrally with wireless infrastructure, there is a large amount of automation and control in the workings.
- Save Money : The biggest advantage of IoT is saving money. If the price of the tagging and monitoring equipment is less than the amount of money saved, then the Internet of Things will be very widely adopted.
- Automation of daily tasks leads to better monitoring of devices : The IoT allows you to automate and control the tasks that are done on a daily basis, avoiding human intervention.
- Efficient and Saves Time : The machine-to-machine interaction provides better efficiency, hence; accurate results can be obtained fast. This results in saving valuable time.

Disadvantages of IoT

- **Security:** As the IoT systems are interconnected and communicate over networks, so it can be lead the various kinds of network attacks.
- **Privacy:** Even without the active participation on the user, the IoT system provides substantial personal data in maximum detail.
- **Complexity:** The designing, developing, and maintaining and enabling the large technology to IoT system is quite complicated.
- **Compatibility:** Currently, there is no international standard of compatibility for the tagging and monitoring equipment.

Applications of IoT

Smart Cities

- The IoT can be used to monitor the vibrations of buildings, bridges, and monuments in case the building material is threatened or overloaded.

- Noise pollution can be controlled around hospitals and schools. It can be used to manage traffic especially during traffic jams, peak hours, accidents, and rains.
- It can be used to manage street lights—automatically switch them off in the presence of sunlight and switch them on at the onset of darkness.
- Another good application is alerting the officials to empty the trash bins when filled with waste.

Home Automation / Smart Home

- The IoT can be used to remotely control and program the appliances in your home.
- It can be useful in detecting and avoiding thefts.
- You can control and automate the lights, room heater, ventilation, air condition, and security system by yourself.
- Home appliances such as washer/dryers, ovens and refrigerators can be remotely monitored and automatically get operated.

Industrial Automation

- By using this technology, we can automate manufacturing processes remotely.
- It can also prove useful in optimizing the production processes.
- We can manage the inventory and the supply chain.
- We can also diagnose if the machines require repair and maintenance.
- We can monitor the emission of toxic gases to avoid damage to workers' health and the environment.

Health Monitoring

- We can use this technology to identify health problems.
- The patterns of heart rate, pulse, digestive system, and blood pressure can be monitored and diagnosed for anomalies.
- The information can be sent to the doctor for analysis.
- The hospital can also be contacted in times of emergencies. This system will be very useful to senior citizens and disabled people who live independently.

Smart Environment

- A very important application of IoT is detecting pollution and natural calamities.
- We can monitor the emissions from factories and vehicles to minimize air pollution.
- We can track the release of harmful chemicals and waste in rivers and the sea, thereby arresting water pollution.

- We can also keep tabs on the quality of water being supplied for drinking.
- We can send warnings of earthquakes and tsunamis by detecting tremors.
- We can keep the water level of rivers and dams under surveillance to be alert in case of floods.
- The detection of forest fire is also possible with this technology.

Wearables

- Watches along with time started giving people more data about their workouts, schedules, appointments and meetings, important days to remember Etc.
- Wearable devices are installed with sensors and softwares which collect data and information about the users.

- This data is later pre-processed to extract essential insights about user.

- These devices broadly cover fitness, health and entertainment requirements. The pre-requisite from internet of things technology for wearable applications is to be highly energy efficient or ultra-low power and small sized

Connected Cars

- A connected car is a vehicle which is able to optimize it's own operation, maintenance as well as comfort of passengers using onboard sensors and internet connectivity.

IoT in agriculture

- Smart farming is one of the fastest growing field in IoT.
- Farmers are using meaningful insights from the data to yield better return on investment. Sensing for soil moisture and nutrients, controlling water usage for plant growth and determining custom fertilizer are some simple uses of IoT.

Smart Retail

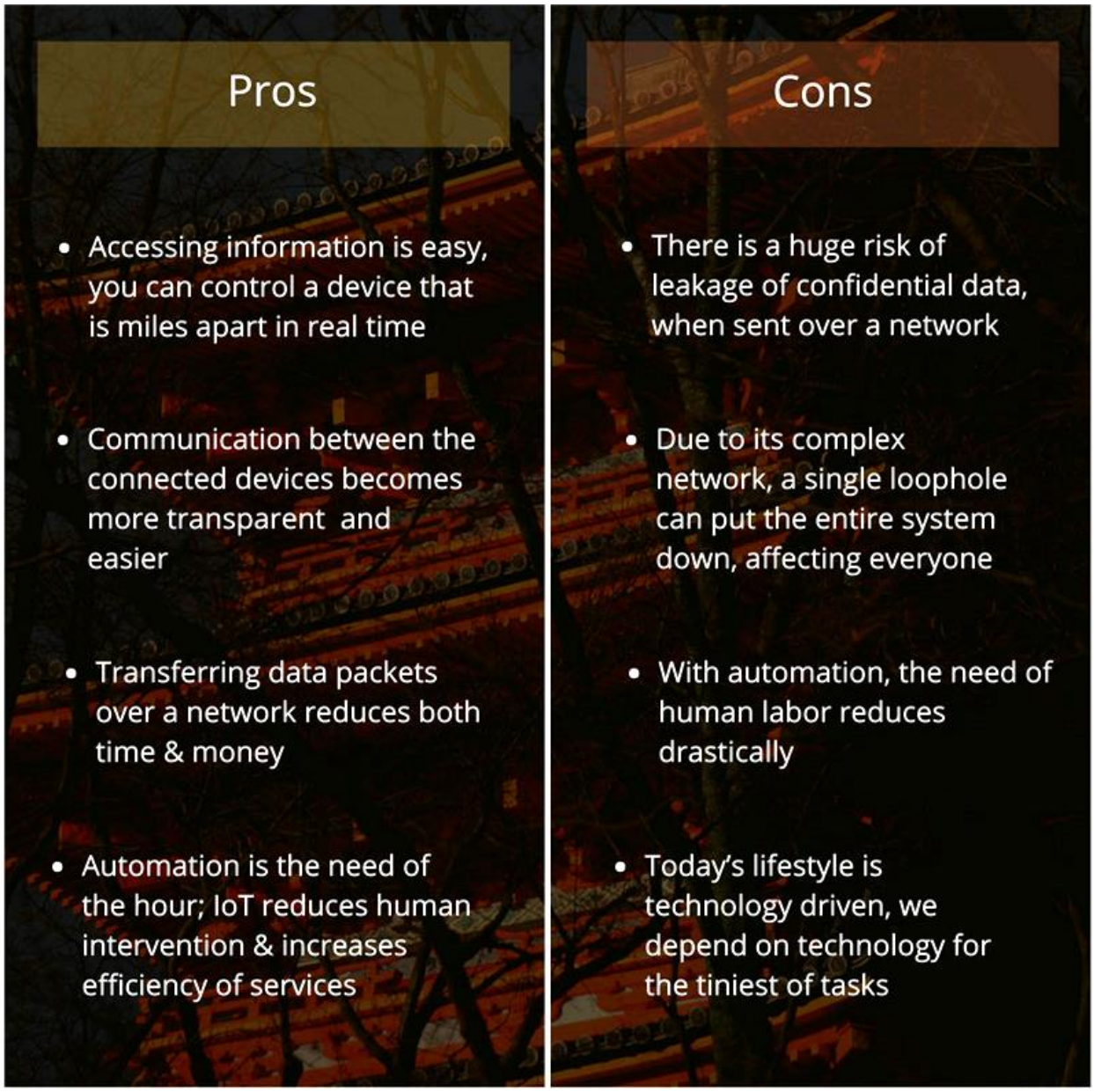
- The potential of IoT in the retail sector is enormous. IoT provides an opportunity to retailers to connect with the customers to enhance the in-store experience.
- Smartphones will be the way for retailers to remain connected with their consumers even out of store.

Energy Engagement

- Power grids of the future will not only be smart enough but also highly reliable. Smart grid concept is becoming very popular all over world.
- The basic idea behind the smart grids is to collect data in an automated fashion and analyze the behavior or electricity consumers and suppliers for improving efficiency as well as economics of electricity use.
- Smart Grids will also be able to detect sources of power outages more quickly and at individual household levels like near by solar panel, making possible distributed energy system.

IOT in Healthcare

- Connected healthcare yet remains the sleeping giant of the Internet of Things applications. The concept of connected healthcare system and smart medical devices bears enormous potential not just for companies, but also for the well-being of people in general.
- Research shows IoT in healthcare will be massive in coming years. IoT in healthcare is aimed at empowering people to live healthier life by wearing connected devices.
- The collected data will help in personalized analysis of an individual's health and provide tailor made strategies to combat illness.


Pros
Accessing information is easy, you can control a device that is miles apart in real time
Communication between the connected devices becomes more transparent and easier
Transferring data packets over a network reduces both time & money
Automation is the need of the hour; IoT reduces human intervention & increases efficiency of services
Cons
There is a huge risk of leakage of confidential data, when sent over a network
Due to its complex network, a single loophole can put the entire system down, affecting everyone
With automation, the need of human labor reduces drastically
Today's lifestyle is technology driven, we depend on technology for the tiniest of tasks