**Unit-II M2M to IoT \_Market Perspective**

**INTRODUCTION**:

The increasing interest in M2M and IoT solutions has been driven by the potential large market and growth opportunities. The global environmental sensor and monitoring market, for example, was valued at $11.1 billion in 2010, and is expected to reach $15.3 billion by 2016. The global market for products created with remotely sensed data is predicted to reach$12.4 billion by 2017.

The market development for IoT, however, is intricately linked to the technology implemented today, and how this will evolve to provide new economic benefits and value creation opportunities. This Chapter presents an overview of the market drivers that will see M2M evolve into a full-fledged IoT market. We discuss firstly the concepts behind the drive towards Information-Driven Value Chains (Mulligan2011), and then provide some real-world examples of how these are emerging today.

**3.1.1 INFORMATION MARKETPLACES:**

A key aspect to note between M2M and IoT is that the technology used for these solutions may be very similar they may even use the same base components but the manner in which the data is managed will be different.

In an M2M solution, data remains within strict boundaries, it is used solely for the purpose that it was originally developed for. With IoT, however, data may be used and reused for many different purposes, perhaps beyond the original intended design, thanks to web-based technologies.

M2M solutions will evolve to be able to share greater data with each other and across value chains or information marketplaces. Data can be shared between companies and value chains in internal information marketplaces. Alternatively, data could be publicly exchanged on a public information marketplace. These market places are based on the exchange of data in order to create information products.

While public information market places are generally the vision around IoT, in particular for Smart Cities. such marketplaces will become commonplace before trust, risk, security, and insurance for data exchanges are able to be fully managed appropriately.

  
Fig: M2M and IOT Market Places.

3.2 **Some definitions**

we provide some basic working definitions that will provide a working understanding of the market dynamics driving the move from M2Mtowards IoT,

**3.2.1 Global value chains**

A value chain describes the full range of activities that firms and workers perform to bring a product from its conception to end use and beyond, Including design, production, marketing, distribution, and support to the final consumer (Gereffi 2011). A simplified value chain is illustrated in Figure . it is comprised of five separate activities that work together tocreate a finalized product.



**GLOBAL VALUE CHAIN (GVC)**

These activities may be contained within a single firm or divided among different firms (Global Value Chains 2011). Analyzing an industry rom 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. GVC analysis therefore provides a holistic view of global industries - both from the top down and from the bottom up”

GVC analysis is particularly useful as such an analysis can help identify the boundaries between existing industrial structures such as M2M solutions and emerging industrial

structures, as seen within the IoT market.

**3.2.2 Ecosystems vs. value chains**

Business Ecosystems, defined by James Moore (Moore 1996), refer to “an economic community supported by a foundation of interacting organizations and individuals . . . The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set byone or more central companies.

Many people discuss the IoT market as an “ecosystem,” with multiple companies establishing loose relationships with one another that then may piggy back” on larger companies in the ecosystem to deliver products and services to end-users and customers.

A value chain is associated with the creation of value - it is the instantiation of exchange by a certain set of companies within an ecosystem, A value chain is a useful model to explain how markets create value and how they evolve overtime. While a market space composed of only competing value chains will eventually see the overall market value decrease (as they will compete only on price), in an ecosystem, the value chains will complement one another.

**3.2.3 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. This is one of the key differences between the M2M and IoT markets how the industrial structures will be formed around these solutions, despite very similar technology implementations.

**M2M value chains:**

M2M applications have - and will be in the near future - developed for some form of business process optimization**.** M2Mvary from project to project and company to company, but can include things such as cost reductions through streamlined business processes, product quality improvements, and increased health and safety protection for employees**.**

These solutions are generally all internal to a company’s business processes and do not included extensive interactions with other parties. Referring back to Figure 3.2, let’s take a look at the inputs and outputs of an M2M value chain.

**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**.**

**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.

**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 - something that is ready to be combined with other data setsto make it useful for corporate decision-making.

**Packaging:** Packaging refers to the process whereby a product can be branded 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, for example, to see whether the data received requires any action. This data would be recognizable to the end-users that need to use the information, either in the form of visualizations or an Excel spreadsheet.

**Distribution/Marketing**: This process refers to the channels to market or products. For example, a chocolate bar may be sold at a supermarket, a kiosk, 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

**3.4 IoT value chains:**

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.

IoT value chain, including an Information Marketplace, illustrated in Figure below.



Inputs: The first thing that is apparent for an IoT value chain is that there are significantly more inputs than for an M2M solution. In Figure four are illustrated:

**• Devices/Sensors**: these are very similar to the M2M solution devices and sensors, and may in fact be built on the same technology. As we will see later, however, the manner in which the data from these devices and sensors is used provides a different and much broader marketplace.

**Open Data**: Open data is an increasingly important input to Information Value Chains. A broad definition of open data defines it as: “A piece of data is open if anyone is free to use, reuse, and redistribute it,. open data as those provided by government and city organizations. Open data requires a license stating that it is open data.

**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 - for example, where phone usage data is already owned

by the company in question.

**Corporate Databases**: Companies of a certain size generally have multiple corporate databases covering various functions, including supply chain management, payroll, accounting, etc. . .Over the last decades, many of these databases within corporations have been increasingly interconnected using Internet Protocol (IP) technologies. As the use of devices and sensors increases, these databases will be connected to this data to create new information sources and new knowledge.

**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. Irrespective of input type described above, this process will need to include tagging and linking of relevant data items in order to provide provenance and traceability across the information value chain. Some examples,

as illustrated in Figure, are 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. Essentially, this relates to whatever the sensor/device has been developed to monitor.

• **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.

**Processing**: During the processing stage, data from various sources is mixed together. At this point, the data from the various inputs from the production and manufacture stage are combined together to create information. This process involves the extensive use of data analytics for M2M and IoT solutions

**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. In addition, however, they could be fed into knowledge management frameworks in order to create not just visualizations of existing information, but to create new knowledge for the enterprise in question.

**Distribution/Marketing**: The final stage of the Information Value Chain is the creation of an Information Product. A broad variety of such products may exist, but they fall into 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. For example, through an IoT solution, a company may have market information about a certain area of town that another entity might pay for (e.g. a real-estate company).

**3.5 An emerging industrial structure for IoT:**

The technologies of the industrial revolution integrated physical components together much more rapidly, M2M and IoT are about rapidly integrating data and workflows that form the basis of the global economy at increasing speed and precision**.**

In contrast to fixed broadband technologies, which are limited to implementation in households mainly in the developed world, mobile places consumer electronic goods into the hands of over 4 billion end-users across the globe, and connects billions of new devices into the mobile broadband platform. Concepts such as cloud computing, meanwhile, have the ability to provide low cost access to computational capacity for these billions of end-users via these mobile devices. Combined, these two technologies

Create a platform that will rapidly redefine the global economy.

A new form of value chain is actually emerging as a result - one driven by the creation of information, rather than physical products. The adoption of the mobile broadband platform is therefore different from previous incarnations of Information and Communication Technology (ICT) industrial platforms as it reshapes not just how economic actors within a value chain interact with one another, but also with employees and the wider economic environment in a similar manner to the technology of the industrial revolution.

For IoT, however,

**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. Services will require multiple devices, sensors, and actuators from suppliers to be integrated and

Exposed to developers. Only those companies with sufficient scale to understand the huge number of technologies well enough to integrate them fully on behalf of a customer can handle this technical complexity.

**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.

There is in fact 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.

Firstly, information about individuals is now captured, stored, processed, and reused across many different systems that sit on top of the mobile broadband platform. This data has always existed, but with the increasingly low cost of computing capacity in the form of cloud computing platforms, it is now cheap enough to store this data for an extremely long length of time. It is now possible, therefore, for information about individuals and digital systems to be packaged, bundled, and exchanged between economic entities with an ease that has previously been impossible.

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.

Difference in value can be identified in knowing my location when I step off a train in a new city and am looking for a decent cup of coffee.

I may choose to activate my smartphone and perform a localized search using my phone’s GPS and browser features. Alternatively,

I may be happy enough to just walk around until I find a place that I think looks OK.

in this case, the value that I as an individual place on my phone knowing my location and assisting me to find a local coffee store is relatively low -personally, I might not value this very highly.

In comparison, however, there is a great deal of value for a coffee company to know that a few hundred women have stepped off a train in search of an espresso. A coffee shop chain would know that it is potentially quite profitable to open a new store there. In addition, understanding the age group of those women, their level of education, and their general tastes would allow the chain to tailor the coffee store to their target market with much greater precision.

**IOT based i- GVC FOR CLOTH RETAIL SHOP:**

Similarly, 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. Information about what path I take through the store during my search for the clothes could be fed back into an information system that

would allow the store to reorganize their floor layouts more effectively, track the clothes that I was interested in, and those which I actually select to try on and purchase. This information can be used to streamline the supply chains of corporations even further than is possible today, and represents the next phase of the impact of communication technologies on the boundaries of the firm within the global economy: companies that share this type of information would be more deeply embedded in one another’s workflows, leading to highly concatenated supply chains and a further blurring of the boundaries of the firm within the digital economy. This is illustrated in Figure below



**3.5.1 The information-driven global value chain:**

There are five fundamental roles within the I-GVC that companies and other actors are forming around, illustrated in Figure below.

1 Inputs:

Sensors, RFID, and other devices.

End-Users.

2 Data Factories.

3 Service Providers/Data Wholesalers.

4 Intermediaries.

5 Resellers



1. **Inputs:**

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

**Sensors and radio frequency identification:**

Sensors and RFID are already found in a multitude of different applications worldwide 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 have also been developed that 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 data exchanged between the actuator and a mobile terminal may not be readily understood or even useful for the device in question.

**End-users:**

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

of the computing and mobile broadband platforms, 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. Each individual’s data can be treated as unique within this value chain; in fact, it is the ability to capture the uniqueness of every person that is a key aspect of the I-GVC in comparison to the other commodity chains that are at work within the global economy. 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.

1. **Data factories:**

Data factories are those entities that produce data in digital forms for use in other parts of the I-GVC. Many of these companies existed in the pre digital era; for example, Ordnance Survey (OS) in the UK has always collected map information from the field, and collated and produced maps for purchase. Previously, such data factories would create paper-based products and sell them to end-users via retailers. 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.

Essentially, its business model has not changed significantly it still produces maps but its means of delivery of products has changed. Moreover, its 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.

1. **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. Many examples exist; several well-known ones 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, meanwhile ,through collating streams of “Tweets” from people worldwide, 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.

A new set of data wholesalers is starting to emerge, however: those 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.

1. **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. As mentioned above, there are many privacy and regional issue associated with the collection of personal information.

The development of databases such as the ones created by Google, Facebook, and Twitter may therefore require the creation of entities that are able to “annoymise” 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.

The quantity and nature of data being developed into information products also requires a completely new type of intermediary, one that is able to handle the scalability issues and the associated security and privacy question raised by the use of this data to build products. This is perhaps the most obvious role for operators and network vendors with global services operations to take, as they have many decades of experiences in developing, operating, and maintaining secure systems that scale to millions of users.

1. **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 of the data that they are able to easily access via the converged communications platform, but they are indicative of the types of corporate entities that are forming within this space.

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. Throught his 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. As an example, BlueKai is able to identify all those

end-users in West Virginia currently searching for a washing machine in acertain price bracket.

**The international-driven global value chain and global information monopolies**:

Currently within the industrial structure of the converged communications industry, there is a large regional disparity between those companies that produce the infrastructure for the I-GVC and those that make a significant profit from it. Through positioning themselves within the correct part of the GVC, these companies are able to take the lion’s share of the profit. Through the breakdown of regional boundaries for collection of data by the development and implementation of a global converged communications

infrastructure, these companies are able to enlist every person using a mobile device worldwide as a contributor to the development of their information products in effect, every person worldwide is working for these corporations so that they are able to sell aggregated data for a huge profit.

In effect, the I-GVC, rather than breaking down the digital divide as many have predicted, is in fact leading to a new form of digital discrimination and a new sort of dependency relationship between large multinationals and those participants, or “workers,” within the I-GVC. While there may appear to be huge differences between the industrial revolution and the birth of the digital planet in the nature of how workers are treated,in particular with so much being advertised as “free” for end-users, there

are in fact many similar parallels in the aggregation of human endeavor in the processes of the accumulation of capital. A multitude of workers contribute to the information products developed, but only a few large corporations capture the surplus value.