A prospective towards M2M Communication

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ABSTRACT

M2M communication is the abbreviated form of Machine to Machine Communication. It is an innovation of technology in the field of Wireless Communication, where massive numbers of intelligent machines/devices are involved, sharing information and making collaborative and efficient decisions without human intervention. It is somewhat similar to the Internet of Things (IOT). Since M2M supports a large number of features and achieves better cost efficiency, it will be extremely beneficial for a wide variety of real-time monitoring applications, such as E-healthcare, Homes Automation System, Smart Warrior system-MA, Agriculture Application and Industrial Automation. This article explores the emerging M2M communication in terms of its definition, the requirements to deploy it practically and its architecture. In this paper we have discussed the potential research barriers, different Middleware topology and techniques at the different domain and suggested remedies and techniques which are helpful in propelling the development and deployment of M2M applications.

Keywords : Machine to Machine Communication, Internet of Things, MA-Military Application

1. Introduction

M2M communication is an acronym for Machine to Machine Communication, where a large number of devices can monitor, control and communicate with each other without human intervention. In the coming era M2M Communication is going to play a very important part in our day to day life, as it will make our lives easy and comfortable, allowing us to do things effortlessly. Not only will it help us in our day to day life, but it will also play an indispensible role in industries.

According to current research projections, it is estimated that within 5-10 years, 100 billion devices will be connected to the internet [1].So by observing this type of Estimation it would not be so natural that all these devices could be connected. The contemporary technology proposed by researchers is the Internet of Things or IOT. It is a system through which an object can communicate with other objects by means of the Internet.

M2M Communication is the communication between machines which can be done through different technologies like - Zigbee, PLC, Wi-Fi, Internet, Generation Network etc. Despite the tremendous benefits and technical advantages of M2M Communication, The research in M2M still in its infancy and is yet to flourish. The process of flourishing, step by step, year by year and day by day is called research and the problems faced in implementing the technology are called research issues. In this paper we have taken effort to give flashlight to different issue towards the convergence of M2M communication. If millions and trillions of machines start communicating with each other, it will be an extremely stringent task to build an interface for the communication of these machines.

Machine to Machine Communication is not a new technology. It has already been in existence for decades. As far as 30 years ago, there were companies that began utilizing manually controlled machines with sensors, communicating over fixed lines. This utilization of sensors happened before the full scale deployment of modern computer networks. In the early 1990's, supervisory control and data acquisition (SCADA) was introduced as a system of central server polling field equipment. SCADA sensors generally did not push data to servers and were mostly based on proprietary techniques. Therefore, they have not seen widespread deployment [1].

The National Aeronautics and Space Administration (NASA) was, of course, an early adapter of telemetry solutions to monitor satellites and space missions. Even today, they are one of the leading researchers of M2M solutions. They have, in the past, cooperated with M2Micorp, a leading supplier of M2M technology that develops automated M2M intelligence for space missions [2].

The telemetry and SCADA solutions of the manufacturing industry did not, however, live up to the notion of M2M Communications. They were not connected in the widest sense of the word. Being

different from the conventional technology of communication, M2M is a technique where millions of machines in the world will connect and communicate with each other, and potentially access any device from anywhere in the world. In the different prospect M2M can also be called as IoT (internet of Things),WOO (Web of Objects) and WOT(web of things).

2. VISION OF M2M COMMUNICATION

Manifold definitions of Machine to Machine Communication, which can be traced within the research community, prove that there is a strong interest in M2M issues that are hotly debated. If an interested reader wants to learn more about it and goes through some literature on it, he might not understand what M2M really means, which basic ideas stand behind this concept, and what social, economical and technical implications there will be due to the full deployment of M2M. In the following discussion, the definition of M2M communication will be elaborated upon. In this section we have discussed about definitions of M2M communication.

The definition of M2M is derived from Machine to Machine Communication: There have been many attempts to define M2M Communication. : Machine to Machine (M2M) refers to technologies that allow both wireless and wired systems to communicate with other devices with the same ability. [3]

In this paper, M2M stands for Machine-to-Machine, and hence Machine-to-Machine (M2M) Communication refers to the communication between computers, embedded processors, smart sensors, actuators and mobile devices without, or with only limited, human intervention [4]

M2M is a new business concept originating from telemetry technology, used for automation, transmission and measurement of data from remote sources by wire, radio or other means. [4]

It is difficult to comprehend the term “Machine to Machine Communication” because it is syntactically composed of two similar words - “Machine” and “Machine” which are integrated with the word “and”.

Sometimes, considerable differences arise in visualizing M2M, because the stake holders, business alliances, research and standardization bodies look at the issue from either a “Machine oriented” or a “Connection between two Machines” perspective, depending on their specific interests, finalities and backgrounds.

It should be kept in mind that the words “Machine” and “Machine” put together with “Communication”, give a sense of disruptive innovation in today’s ICT world, i.e. Machine to Machine Communication.

In a broader sense, M2M Communication is a matter of direct or indirect communication between two machines/ devices.

A UN report states that there will be a new era of ubiquity where humans may become the minority as generators or receivers of traffic. Also, the networking of everyday devices will gain more prominence than the changes brought about by the internet. [5]

A few examples of possible application scenarios in which the new paradigm will play a leading role in the near future are, domestics, assisted living, e-health, Home Automation and Smart Metering System . Similarly, from the point of view of business users, the most obvious effects will be visible in fields such as, Automation, Industrial manufacturing, and Fleet Management.

M2M uses a device to capture an event, which is relayed through a network (wireless, wired or hybrid), to an application, that translates the captured event into meaningful information (for example, items that need to be restocked) [7]. Such a communication was originally accomplished by having a remote network of machines that relayed information back to a central hub for analysis, which would then be rerouted into a system like a personal computer [8].

It is characterized by involving a large number of intelligent machines sharing information and making collaborative decisions without direct human intervention [9].

M2M is the birth of a fourth generation of computing. It combines communications and computer and power technologies to enable remote Human and Machine interaction with physical, chemical, and biological systems and processes [10].

It can be defined as a network communications system among specialized devices in homes, factories, offices and commercial venues that automatically connect to each other for the exchange of status and control information. In addition to automated device-to-device dialogs, M2M devices can be programmed to interact with Machines via the network, report events and request instructions, creating a

human aspect of the M2M world [11].

Machine to Machine Communication is a form of data communication that involves one or more entities that do not necessarily require human interaction or communication (MTC) in 3GPP. M2M can be carried over mobile networks (e.g. GSM-GPRS,CDMA-EVDO networks)[12].

In the most basic sense, M2M is a technology of the future, where a smart device will interact and communicate via a communications network. In order to function, each device must be outfitted with a communication module, and in many cases a sensor, for data collection .With numerous advances in wireless communication and in the base-band processor technologies, these devices can be easily placed in diverse locations, many miles away from one another, or form a central system through, IP, Satellite, GSM, GPRS and EDGE[13].

M2M is the automatic communication between devices without human intervention. It often refers to a system of remote sensors, middleware, software and applications that are continuously transmitting data to a central system [14].

When two electronic systems communicate autonomously, that is to say without human intervention, the process is described as Machine-to-Machine (M2M) Communications. The main goal of M2M Communications is to enable the sharing of information between electronic systems autonomously [15, 16].

Due to the emergence and rapid adoption of wireless technologies, the ubiquity of electronic control systems, and the increasing complexity of software systems, wireless M2M has been attracting a lot of attention from industry and academia [17, 18, 19, 20].

It is easy to monitor and control a small number of machines/devices, but it is really very difficult to connect and control millions and billions of machines without any human intervention. This concept, where billions or trillions of devices connect together, share information and make collaborative decisions, gives rise to a new nomenclature in the field of communications called Machine to Machine Communication. Many technical issues may crop up as billions of machines connect together. For M2M Communication technology to be accepted worldwide, a lot of technical issues have to be resolved on a large scale. Despite its real-time application and lots of benefits, research in M2M Communication is still in its infancy, and faces many technical challenges. These challenges include M2M Architecture, M2M Communication's Energy Efficiency issues, M2M cost effectiveness, M2M Reliability, M2M Privacy, Persistency and Security [17].

3. Architecture

High–level M2M Architecture Provides an overview of the components of a system as well as the relationship between the individual components. It provides the starting point for a stepwise approach to the description of the functional architecture. This second presentation of the architecture provides a more formal description of the interactions between functions within the system, where each function can be mapped into components of the high-level system architecture.

Although every particular deployment of M2M is unique, there are four basic stages that are common to most M2M based applications [9]: Collection of data, Transmission of data through a communication network, Assessment of data, Response to the available information.

A new ETSI Technical Committee [23] is developing standards for M2M Communications. The aim of this group is to provide an end-to-end view of M2M standardization cooperating with ETSI's activities on Next Generation Networks and 3GPP standards initiative for mobile communication technologies.

ETSI TC M2M has adopted the following Architecture which allows for a common understanding of the system that is under standardization. This high level architecture fully endorses the need for M2M service capabilities that are exposed towards applications, be it in the network, the device or in the gateway. One important aspect of this high-level system view is that it provides an end-to-end representation of an M2M system. However not all elements of this architecture are targeted as standardization work in ETSI TC M2M. According to definition, the architecture of Machine to Machine Communication System is composed of three domains i.e. M2M Node domain, M2M Network domain and Application domain. M2M Node domain is used to sense the activity under area of interest and collect the data for further processing [9]

Therefore, the entire system of M2M Communication is composed of three domains: namely,

(i) M2M device domain (ii) Network domain (iii) Application domain

In this section we will discuss about the detailed architecture of M2M Communication. As shown in Fig.1, the architecture of M2M consists of sensor nodes, network domain, and application domains. Sensor Node domain is the same as M2M Node domain in M2M communication [2].

(i) **M2M Node Domain:** In the M2M Node domain, an area network is potentially formed by a large number of M2M nodes {N0, N1 …} and an M2M Gateway (GW). Each M2M node, Ni, is a very flexible and smart device equipped with some specific sensing technology for real-time monitoring. Once monitoring data are sensed, M2M nodes make intelligent decisions and transmit the sensory data packets to the GW in single-hop or multihop patterns.

(ii) **The Network domain** provides cost-effective and reliable channels for transmitting sensory data packets from the Sensor domain to the Application domain. Again, Network domain can be divided into two parts

(a) M2M Area Network (b) M2M Access Network

(a) M2M Area Network: It is a generic term referring to any network topology that provides physical and MAC layer connectivity between different M2M devices connected to the same M2M area network, or allows an M2M device to gain access to a public network via a router or a gateway. The term M2M Area Network was first used by ETSI TS102690 Technical specification [24]. M2M Area Network is the first communicating tool, after sensing tools, which provides physical and MAC layer connectivity between different M2M devices in the same area network or allows the conveyance of data to a public network via a router or a gateway.

In general, M2M represents a future in communication where billions or trillions of everyday devices will be connected and managed [25].

(b) M2M Access Network: M2M Access Network is a kind of network that allows the M2M device to communicate with a core network. Examples of access networks include xDSL, HFC, satellite, GERAN, UTRAN, e-UTRAN, W-LAN, WiMAX and Internet Protocol. In the following discussion we are going to elaborate on the different technologies and protocols which play a vital role in M2M Access Network.

Fig: 1.Architecture of M2M Communication.

M2M applications like automotive or utility metering , can have a 10 year deployment lifetime. 2G M2M modules are still being deployed in 2012, because 2G has a lower module cost, it is more reliable and it has low power and coverage. 2G is superior in lower band-cellular 800 and 900 MHz GSM band while 3G is superior in the higher bands-1800MHz DCS and 1900PCS

Application Domain : is the last part of the architecture. In the application domain, BS (base end server) is the key component for the entire M2M communication paradigm. This BS forms the data

integration point for storing all sensory data from the M2M Communication domain. It also provides these real-time data to a variety of M2M applications for remote monitoring management.

4. Enabling Technology

The practilization of M2M Communication into the real word is possible only due to the integration of several sensing and communication technologies (for the M2M area Network and M2M access network) [24]. As mentioned above, the entire enabling technology of M2M Communication is a combination of sensing network and communication system. According to the architecture of M2M, we can divide the implementation of sensing technology into two network level mainframes:

(i) Sensing technology at M2M area network domain
(ii) Sensing technology at M2M access network domain

To develop a concept of an Efficient and Reliable M2M environment we will have to go through many enabling technologies at every node level.

Technology at the M2M node or at the sensor node is for identification, sensing and collection of data at sink node. According to the above discussion, the entire M2M system is composed of three domains, namely, M2M node domain, Network domain & Application domain. We can say that sensing technology is required to sense the activity of a device at the node level and communication technology is required to collect and transfer this activity to the application layer to maintain connectivity inside and outside the system.

First we will discuss about the different types of sensing technologies and then move towards the communication technology of different mainframes of a single M2M paradigm. The M2M vision consists, in most pictured scenarios, of several sensor networks connected to the wider internet. M2M nodes are nothing but a sensor that can monitor activity, behavior, conditions and communicate with the outside world. This communication is through wireless, as this is most convenient. A typical sensor network is composed of the sensors and their local interconnections, the gateway (optional) to the external world, a transport network and a service platform that handles the data and supports applications and users [26]. This is visualized in figure 2.1 Our focus will lie on the interfaces between the devices, such as the access network and the service platform itself. An important point to note in this figure is that the authors of [26] indicate the possibility of leaving the service platform out of the public network. This could potentially be interesting for a closed system with critical demands, such as remote management of off-shore installations. Then there would be no need to include an external telecommunications provider, and hence have complete control of the networks utilized by the M2M service. To sum up, a typical sensor network, and especially one utilized in an M2M context, usually consists of the following parts:

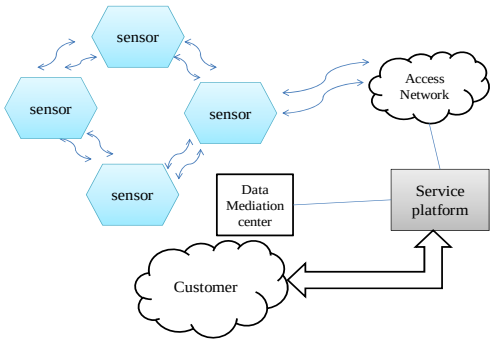

Fig :2 Connected Sensor networks

• Sensors • Local wired or wireless communication • Access network • Transport network • Service platform

In this context, the key component of M2M communication at M2M node domain is RFID technology, Sensor network, and RAN (RFID area network).
Sensor area networks play a crucial role for the deployment of M2M Communication. The usage of sensor network has been proposed in several M2M application scenarios, such as-E-healthcare, M2M Home Automation system, Fleet management, M2M field warrior as in Military Application and many more.

An M2M Sensing network consists of a large number of M2M nodes communicating in a single hop or multi-hop manner. A large amount of literature has been produced on sensor networks in the recent past, addressing several problems at all layers of the protocol state [27]. The major issues, with the wireless sensor node, are to maintain the energy efficiency, scalability, reliability, privacy and security at the node level. In the next section we will attempt to describe these issues.
Today, the most common commercial M2M sensor network solution is based on the IEEE 802.15.4 standards. These standards define the physical and MAC layers for low power and low bit rate communication, in wireless personal area network (WPAN) [28]. The next tool of M2M communication at the M2M node sensing level is the RFID system [29]. which is composed of RFID readers with RFID tags. Tags are unique identifiers attached with M2M nodes near the area of interest. A signal is generated, that causes the readers to trigger the tag transmission. This technique can be used to sense any device or machine in real time without human intervention. Due to these types of specifications, the application of this technique is widely used, from fleet management to E- health care and security application.

The WISP project is being carried out at the Intel lab to develop wireless identification sensor place or WISP [30]. The WISP is only to sense the device and is powered and read by the RFID reader. The RFID sensor system gives rise to the need for the building of RFID sensor network RAN [31].

5. Middleware /Software

There has been a significant activity in the open source community relating to the development of platforms and operating environments upon which M2M applications can be built. This section provides an overview of the most important open-source platforms used to realize M2M communication.

OSGi: The OSGi(Open source gateway initiative) technology [32] is a set of specifications for the Java platform and it defines a Dynamic module. The specification of OSGi enables a development model where the M2M application is composed of small M2M nodes. The OSGi technology is based on a service-oriented architecture and is able to enable M2M nodes as a component of OSGi to dynamically discover and collaborate with each other.
A service within the context of OSGi , is specified as a Java interface implemented by one or more bundles. A bundle is practically a java .jar file that realizes the deliverable application and registers the services the application offers. When a bundle is not working, the services registered by the bundles are removed along with references to other services. Bundles can be notified when a service they depend on is unregistered and class path dependencies are managed. The OSGi architecture is depicted in Figure 3. The Bundles are the OSGi components (in M2M system M2M node) made by the developers. The OSGi Architecture is made with seven components enlisted as – Service layer, Life cycle, Modules, execution Environments, java virtual machine, and native operating system.

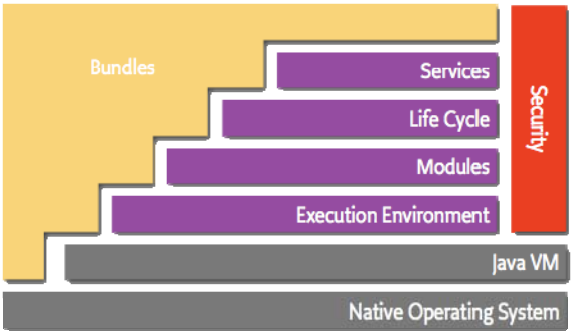

Fig:3 Architecture of OSGi [33]

There are currently a number of open-source OSGi framework implementations, which have been adopted by the community of OSGi developers. Widely-used OSGi frameworks include the Apache Felix [34], Makewave Knopflerfish [35], and the Eclipse Equinox [36].

Mango: Mango [37] is web-based, AJAX-enabled M2M software that enables users to access and control electronic sensors, devices and machines over multiple protocols, simultaneously. The data that is collected is stored in its database. Graphs, diagnostic data and management information can also be obtained from its Human-Machine Interface. According to Mango philosophy, end devices are treated as data "sources", which are polled in user-defined time intervals for data collection. Depending on conditions configured by the Mango user, the data values may lead to the triggering of events, which are acted upon by the corresponding handler -i.e. sending an e-mail or setting the value of a device.

Manual monitoring, control, and data logging is possible through the Mango M2M application development environment, but the automation power of Mango lies in the event subsystem. Events are split into two parts: the first part is the sensing/collection of data and the second part is the monitoring of data. These parts can be chained and also swiftly paired in a one-to-many fashion. An event detector could be a high limit (for analog data) or a binary/multi-state state.

Very Simple Control Protocol & Friends: The Very Simple Control Protocol [38] is a protocol developed for use on microcontrollers. The VSCP and friends are used to remotely measure, control and provide application for home automation. In order to provide a complete solution, VSCP is combined with a package referred to as VSCP & Friends. The package includes the VSCP protocol specification and software, web-related tools for realizing home automation on top of VSCP. VSCP supports global unique identifiers for nodes. By this means it is useful for M2M Communication, thus making an M2M node identifiable no matter where it is installed in the world. Furthermore, it includes a register model in order to provide a flexible common interface for node configuration and a model for controlling the functionality of each node. VSCP does not make any assumptions regarding the lower level system used to realize physical interconnection with the node. Therefore, it works with different transport mechanisms such as Ethernet, TCP/IP, Wireless, Zigbee, Bluetooth, CAN, GPRS, RS-232 and USB. VSCP is event-based. Every time an event occurs, it is broadcast to all other nodes on the network. From there on, each node decides on its own if the event received needs to be processed or not. The final decision depends on the node's decision matrix. The decision matrix is made up of a number of if <condition> then <action> lines, where the <condition> is evaluated based on fields present in the VSCP datagram broadcasted to the network.

AllJoyn: AllJoyn [39] is different from the Mango protocol and is a peer-to-peer framework, which enables ad-hoc, proximity based, and device-to-device communication. Practically, compared to mango, it provides device-to-device communication protocol which enables mobile devices to support peer-to-peer applications. It is designed as a backwards-compatible extension of DBus, a standard protocol for inter-application communication in the Linux desktop environment. Its API provides support for both C++ and Java. AllJoyn addresses the issues of discovery and network complexity management in peer-to-peer networks, in order to enable nearby devices communicate directly with one another over Wi-Fi or Bluetooth without the need to connect to cellular networks. Towards this end, it provides application developers with a simple API for enabling ad-hoc networks from within their applications.

Practically it provides an M2M Communication protocol which enables mobile devices to support peer to peer applications. It addresses the issues of discovery and network complexity management in peer to peer networks. To make it possible for nearby devices to communicate directly with one another over a WiFi or Bluetooth, without the need to connect to cellular networks, it provides application developers with a simple API for enabling ad-hoc networks from within their applications. This protocol is able to solve problems about communication barriers related to peer-to-peer communication, such as transparently managing a device and service discovery, managing network and message routing and providing a secure framework for message authentication and encryption, designed to have minimal requirements on the host operating system, being hardware and radio technology agnostic.

OpenSCADA: OpenSCADA(open source Supervisory Control And Data Acquisition System) [40] is OSGi based framework. It is a protocol of tools. It has ability to combined to create SCADA applications.

Therefore, it gives the path towards development libraries, interface applications, mass configuration tools, as well as front-end and back-end applications. It support various functionality subsets that are provided by different subprojects within OpenSCADA , with the main ones being ATLANTIS and UTGART. The former is the main SCADA component; it contains the implementation of the OpenSCADA interfaces in Java, and provides modules for interfacing with external systems like S7 PLC, OPC, SNMP, relational databases, etc. Data acquired by these interface modules can be processed, monitored and archived by the components of ATLANTIS. Furthermore, OpenSCADA provides components for building custom client and server applications. UTGART on the other hand is a vendor-independent Java OPC Client API that can be also used independently from other OpenSCADA projects. The scope of UTGART is to provide functions that enable connection to an OPC server. UT-GART is used in conjunction with ATLANTIS to enable connection and communication with third party systems via OPC. As OpenSCADA is implemented entirely in Java it is platform-independent.

Proview: Proview [41] is a Process Control System, that provides functions required for control sequentially , acquisition of data, communication etc. In theory, it is based on a soft-PLC solution, which runs on standard computers that have the Linux operating system. As Proview is a distributed system, there may be several M2M devices connected through a network, with the preference being Ethernet, in the overall process control system. A typical Proview system consists of one process control system and one or more operator stations. It is possible to program Proview with a graphical PLC editor and also with high-level programming languages such as C, C++, or Java. The common I/O system used in Proview is Profibus, which is a robust and well-tested field bus. However, other I/O systems such as Modbus TCP, also have support. The capability to implement other I/O systems with available drivers or develop new ones using high-level languages is also prevalent.
Finally, Proview supports communications with other process control equipment over the OPC XML/DA protocol.

Pvbrowser: Pvbrowser [42] is a SCADA application framework based on web browser and provides a specialized browser for the client computer, and an integrated development environment for creating servers that implement the visualization presented on the client. It has the capability to provide data acquisition programs for a variety of protocols that the server uses to communicate with the M2M application. The data acquisition programs are realized in the form of daemons, where a separate daemon is used for each interface. The daemon reads the interface and writes the result in a shared memory. The visualization server may read the shared memory and display its content, thus revealing the interface information to the end user. In the reverse direction, the interface daemon has a mailbox, which is written by the virtualization server to output signals to the interface. The overall Pvbrowser architecture is summarized in Figure

6. M2M Applications

Smart homes: If there are sensors and actuators all over our houses and offices, it can make our life more comfortable in several ways: From room heating to alarm system- room heating that can be changed accordingly to the time of the day. Domestic incidents can alter in accordance with the time of the day. It is possible to avoid domestic monitoring if there is an appropriate monitoring and alarm system. When an electrical equipment is not needed, energy can be saved by automatically switching it off. For example, to reduce load peaks, the overall energy consumption could be altered by energy providers that use dynamically changing energy prices.

An automation logic may optimize power consumption cost throughout the day by observing when the prices, which are provided by an external web service and are set according to current energy production and consumption, are cheap and by considering the specific requirements of each appliance at home [43].

Usually, small and inexpensive Machines/Devices in M2M Communication, have limitations like energy consumption, storage and bandwidth. Because of these constraints, it becomes challenging to design Home M2M networks to accomplish a highly connected, efficient and reliable home. These are interference, channel dynamic, resource constraints, device heterogeneity, self organization, quality of service and security [44]

E-health care: When dealing with serious diseases, like an acute heart disease or a stroke, time is of utmost importance. According to the WHO, 16.7 million people around the globe will die of cardiovascular disease each year [45]. 75 percent of the 300 million adult diabetics in 2005 lived in developing countries [46]. It is projected that the number of people with diabetes in developed countries will rise 42 percent from 51 million in 1995 to 72 million in 2025 [47]. These analyses give the actual scenarios for the requirement of an E- healthcare system. If immediate medical treatment and care is made available, many patients' lives can be saved if they are transferred quickly to a hospital.

Techniques like angioplasty and installing lifesaving defibrillators in proper areas, are some of the approaches that have been developed to reduce fatalities in acute diseases.

Now, Body Area Networks (BANs) are emerging that can efficiently monitor a patient's health and disease progression. These are seen to be a promising approach to improving health care. [48]. In BAN, sensors are deployed within the body to monitor the physiological condition of the health care provider in a remote area by internet or any other wireless technology without seeing them physically in person [49, 50].

Fleet Management: Sensors, actuators and processing power are now being associated with smart cars, trains, bicycles along with roads. Roads and transported goods are equipped with sensors and send important information to the driver or service providers as traffic information and weather forecast. Given below, are the main applications in transportation, fleet management, vehicle maintenance infotainment, theft prevention, emergency call support, navigation, toll and asset tracking.

Car dealers can send reminders and special deals to vehicle owners for routine maintenance or promotional offers. These could be, electric vehicle charging related applications that give the location of charging stations, manage the charging process and parameters in the car if any, and generate relevant records for billing purposes. Because of the essential mobility requirement of vehicular communications, almost all transportation applications use commercial cellular networks. Typically, a vehicle that uses mobile communications, in order to connect to the application server in the network, has a modem embedded in it.

Smart grid (SG): Smart Grid is a new concept of technology in the context of M2M Communication. Smart grid is based on the idea of the connectivity model of millions of smart meters. It is a technology where smart meters would not require human intervention in characterizing power requirements and energy distribution.

Power providers, distributors and consumers can maintain near-real –time awareness of one another's operating requirements and capabilities with the help of an electric grid that has smart capability. The Smart Grid can produce, distribute and consume power in the most efficient and intelligent way through this awareness.

Three task forces have been created for IEEE P2030 SG standards. These are dedicated to the standardization of power engineering, information and technologies, respectively [51].After various analyses, it is predicted that the M2M market will have more than 85 million connections globally by 2012[2].

The smart metering system allows the collection of various data, in real time, from meters that provide temperature, energy consumption or pollution level. The M2M device is configured so that it can be scheduled to periodically report the meter data. For example, a smart meter will report the metering information to an M2M server, every 3 hours.Two possible solutions for periodic reporting have been adopted in current deployments:

- Sms Solution- sms is used to report the meter data.
- GPRS solution – a GPRS bearer is established and then used to report the meter data over TCP/IP.

One example of a smart telemeter is a gas tank monitoring system that is used in an energy company. The use of MNO networks allows for increased worker security, as well as a high degree of operational efficiency. Real time monitoring of gas tank level communication module that is installed in the gas tank level meter can be done.

M2M Smart Warrior System: A study published by IDATE earlier this year assures that an important part of the recent market growth in M2M satellite communications was caused, among other things, by the increase of its use in military applications.

Acknowledging the potential of GPS-based M2M and wireless sensor networks to coordinate military operations, the militaries of many countries are using them in many critical operations. The U.S. Army currently employs a system called Blue Force Tracker (BFT), which provides a commander with real-time feed of the soldier's location and allows tracking of individual units.

Providing information, in real time, of the location of something or somebody is important when you are running a business, but when your life or the life of your comrade is hanging by a thread, it is vital to be able to rely on a superior tracking solution.

Projects such as the Future Force Warrior aim to integrate not only tracking technology, but also monitoring of biometric readings of the soldiers to know their status at every moment. Among the data provided would be that of body and skin temperature, heart rate, and hydration levels.

From securing intel to taking care of soldiers: On September 2012, the site AOL Defense published an article describing a series of information and intelligence management problems that NATO forces were experiencing in the campaign of Libya. In the article, interviewee US Air Force Lt. Gen. Frank Gorenc, suggested that the solution to avoid similar future problems might be to "develop systems that allow for the machine-to-machine transfer of data". Providing secure data channels are one of the challenges of using M2M military applications. There are companies specialized in military-grade secure M2M communications. However, there are many more potential uses on the theater of operations.

Military transportation is a sector in which M2M could make great improvements. Fleet management and connected vehicle solutions similar to the civilian counterparts, may enable vehicle diagnostics. M2M border warrior is the concept where the system can control the whole area without humans – that may be the real-time innovation in the field of M2M Communication. In the end, military applications are not very different of the civilian ones. Their purpose may be saving lives instead of making profits, but the key still lies in improving efficiency.

7. Issues with M2M communication

Despite the tremendous benefits of M2M Communication, it is still in its infancy and faces many technical issues – energy efficiency, Govt. reorganization, reliability of protocol, software development issues, security and privacy .For the deployment of M2M Communication these challenges must be resolved. These challenges include: energy related issues connected to keeping our surroundings green, cost related issues, technology for everyone, security, and privacy and reliability issues. For some types of real time applications these issues are very precious, especially in the E-healthcare system. In the following section we have taken care to cover almost all these issues.

8. Efficiency and Reliability in M2M Communication

At present, there are many rapidly growing M2M communication systems that have unique features. However, most M2M communication systems are generally organized in the architecture similar to that shown in fig (1). They have the following common characteristics: there are a large number of M2M nodes set up in an M2M domain. These collect useful information that have been sensed, and transmit the same to the application domain via the network domain. These common characteristics can benefit users of the fast growing M2M communication system. They, however, require fulfilling the criteria for energy efficiency, security, privacy, cost-effectiveness and reliability. For the successful deployment of M2M Communication, these requirements must be satisfied. In this paper we have discussed the requirements of energy efficiency, reliability, and cost effectiveness on node level and network level, and efforts have been made to propose a methodology for an efficient and reliable M2M Communication.

A. Energy Efficiency:

We need an energy efficient system in order to help our environment cope with global warming and facilitate sustainable development. However, telecommunication data volume increases approximately by an order of 10 for every five years. This results in an increase of the associated energy consumption by approximately 16-20 percent per annum [52]. For instance, in Japan the N/W power consumption in 2025 is predicted to be 15 times that of the 2006 level. Due to the anticipated increase in traffic volume with broadcast services and machine to machine communication, there will be a burst of traffic

originating from cloud computing [53]. Information and Communication Technology usages have grown at a staggering rate worldwide with an estimated 6 billion users in 2007[54]. Every year, 120,000 new base stations are deployed servicing 400 million new mobile subscribers around the world [55]. The impact is compounded by the incredible growth of M2M Communication in the developing world that turns to wireless as a medium to leapfrog from past traditional communication. Remote sites prevent the developing regions which often rely on insufficient diesel generators for power, expanding the communication's carbon footprint at an even higher rate. A low power urban cell site requires 3KW of power (70-80 KWH of energy for a 24-hour operation) and generates an estimated 11 tons of carbon dioxide [56].

Currently 3 percent of the worldwide energy is consumed by the ICT infrastructure. This causes about 2 percent of world wide CO_2 emission by an airplane i.e. through the aviation industry or ¼ of the world-wide CO_2 emission by cars.

[57] The last report by ABI research estimates an M2M projected compound annual growth rate (CAGR) of over 25 percent per year with 232.5 million cellular M2M connections by 2014[58]. Since there are currently 50 billion machines in the world that would benefit from M2M activity, market growth is expected to accelerate. While we would like to say that zero carbon foot print is a major contributor to growth, the reality is the significant environmental benefits of M2M that are often fortunate side effects in smart technology. Recently, the term "Green M2M Communication" has been marketed and sloganized as a solution to addressing the growing cost and environmental impact of M2M Communication system.

B. Reliability:

To achieve Energy Efficient and Reliable M2M Communication individually is not a difficult job. However, when the requirements of Energy Efficiency and Reliability are viewed as a whole, the issues become complicated. Reliability is a critical issue for Green M2M Communication, because unreliable transmission of data causes false monitoring data reports, long delays, and even data loss, which would reduce people's interest in M2M Communication. Therefore High Reliable M2M Communication is the demand for the next generation communication. Till now researchers have investigated and invented many efficient methods to develop an energy efficient environment for Node Domain . They use different types of sleeping algorithms. A certain research paper has investigated the power consumption of a wireless sensor node with regard to the size of the cell area. Reducing the cell size reduces the cell ECR (Energy consumption ratio) as desired while increasing the capacity density, but the overall RAN energy consumption remains unchanged. In order to trade the increase in capacity density with the sensor node area without degrading the cell capacity provision, a cluster sleep mode is proposed [58].

9. Conclusion

It is possible to enable communication among smart devices by the means of M2M, and this adds a new dimension to the whole process. Thus the vision of "connectivity of a large number of devices/machines without human intervention", becomes a reality. To this end, we put forth that M2M Communication should be considered as a part of the overall communication of the future. This will certainly be dramatically different from the present day's communication pattern.

In this paper we have surveyed the most important aspects of M2M with emphasis on what is being done and what are the issues that require further research. Indeed, current technologies make the M2M concept feasible but do not fit well with the scalability and efficiency requirements that they will face.

10. References

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