M2M: Technological Basis for Internet of Things

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Abstract

This document explore the specification of a new platform for machine-to-machine communication (M2M) carried out by the European Telecommunication Standards Institute - ETSI, called Machine Type Communications (MTC). This document seeks to settle down which are their main features and how is its potential according to other technological proposals, in particular the Internet of the things.

Keywords: Machine Type Communications (MTC), machine-to-machine (M2M), Internet of Things (IOT), standardization and interoperability

1 Introduction

The technological industry have always generated new concepts that impel the adoption of novel technologies, one of the last concepts is the Internet of the Things (IoT). Frequently it is a term that appears and remits to a previous concept, the machine-to-machine communications (M2M), but the limits between both are diffuse,
this document seeks to clarify them and to present the technology M2M as the technological basis of the Internet of the things. The machine-to-machine communication arises like a necessity that diverse daily devices of different range and with different ends can communicate to each other to swap information related with its state. MTC (Machine Type Communications) is a platform that allows the communications M2M.

2 Standardization M2M

The characteristics and needs of communications between machines make it necessary standardization in different scopes [1]:

1. Data models. Determine the data structures used by applications and entities of the system M2M.
2. M2M Area Network. Reference is made to the communications between M2M devices connected to the same network. Corresponds to the physical and MAC layers of the OSI model. Communications can be affected by the limited resources and capabilities of the devices, these limitations include low processing capacity, low memory, dependent on battery and low rate of data transmission.
3. Optimization of the access network and the core of the network. It is required that the telephony operators to develop standards that will allow to optimize the systems that support to M2M Communications, through the redesign of the architecture and network elements to make it compatible with M2M.
4. Horizontal platforms. There is a tendency to change the systems approach vertical to horizontal systems. These platforms available to a set of APIs for the development and deployment of high-level applications in various sectors, allowing the integration of services offered in different vertical individual solutions.
5. Certification for M2M modules and terminals. Are the certificates issued by the agencies reviewers to devices that comply with certain characteristics.

The fragmentation of the market and the lack of global standards are common criticism of communication systems M2M. The harmonization of technologies on a global scale is treated in the standards development organizations (SDOS) and industrial associations or special interest groups (GIS).

There is a global initiative on the part of the principal agencies of SDO standardization (ARIB, ATIS, CCSA, ETSI, TIA, TTA and TTC), jointly with the WCO, in order to create a collaborative activity for the rules of M2M. Something similar to what happened to the shaping of the 3GPP, in this opportunity the project has been called "oneM2M Partnership Project" which was formally established in July of the year 2012.
The ETSI made the launch of the first version in 2012, which consists of 3 stages and focuses on development of an architecture end-to-end with emphasis in the intermediate layer for services (middleware), which involves addressing, localization, quality of service, management, interfaces and other aspects, so that the services are independent of existing technologies in access networks.

In addition, it specifies various capabilities of services that offer the functionality required by different M2M applications [2] [3] [4].

The list of publications ETSI M2M is shown in Figure 1.

![Fig. 1. List of publications ETSI M2M. Source: [5].](image)

The 3GPP, for its part, maintains and develops the specifications and technical reports for mobile communications systems; for this reason was asked to define the characteristics and requirements for, which defined as, communications type machine (MTC) in [6], in this technical specification defines 2 scenarios for MTC, MTC devices communicated with one or more servers MTC and MTC devices communicated with other devices MTC.

In the first case the MTC servers are connected to the network provider and is as well as communicate with devices MTC, and in the other form the devices can connect directly between them without the need for intermediate servers. However, because in the previous document, only were defined the requirements of the network to support communications MTC in mobile networks "3GPP Release 11" progress was made by performing a technical recommendation [3], to address and solve the problems encountered, which were basically related to the lack of congestion control and data for networks with large number of devices MTC and their respective IP addressing.

As solution is the management of M2M devices based on groups and the use of IPv6 addresses.

At the same time, the Institute of Electrical and Electronics Engineers (IEEE), standardizes the air interface and functions related to the wireless local loop (WLL), by means of the IEEE specification 802.16p [2], which defines a point of aggregation
for devices which are not compatible with 802.16 or other devices M2M which are. In spite of the fact that the ETSI is not the only source of standards in the area of M2M, is the most advanced comparing all the others. The collaboration between organizations of standards has enabled the creation of open interfaces, standard architectures and common platforms of hardware and software.

3 MTC Reference Points

The reference points are interfaces through which applications interact with the Service Capability Layers and service capabilities among themselves. In general, support the following procedures:

- Registration of a DSCL/GSCL with NSCLC and an application with their respective SCL.
- Read/write requests of information, limited to authorization, in the NSCLC, GSCL or dscl.
- Requests to perform management actions on the device.
- Subscription and Notification of specific events.
- Requests for creation or deletion of groups of devices and gateways.

The reference points or points of connection between the different entities M2M supported by the M2M platform are [4]:

- Mla: allows to NA network applications access the Service Capabilities SC in the domain of the network. Provides the registration function of network applications in the NSCLC.
- Dla: Allows residents applications in the Devices (DA) access to the SC in the same device or in a Gateway M2M, depending on if you reside in a device D or D'. It also allows the Gateway to access your own GSCL. Provides the function of the application log of Gateway or device (GA/DA) before the GSCL and the application log of device (DA) before the dscl.
- Mld: provides a mechanism for different SCL can interact between and among the procedures that supports are the record of a GSCL OR DSCL with NSCLC and communication between the SC on the device or Gateway M2M and the SC on the network domain to which uses functions of the network core.

3.1 3GPP Proposal

In 3GPP, the group of services and requirements "3GPP WG SA1", started in the 2008 to study the necessary improvements in the network for communications machine type, whose purpose was to define the requirements of the service for M2M. The 3GPP has adopted the name of communication machine type (MTC) to refer to M2M.
On the basis of the communication scenarios MTC identifies a series of common requirements for the proper functioning of the service MTC among which are in addition to the general requirements for activating devices, identification, IP addressing, pricing, security and remote MTC device management.

Because not all applications MTC have the same features, identified some specific requirements that are tailored to particular situations communications MTC, to which was called features ERM.

4 Evolution from m2m toward the Internet of Things

The Internet of Things (IoT) comes from the Internet industry, conceptually is to connect one device to another through a network of data. M2M, for his part, arrives from a universe more technical. In M2M there is no human intervention, that is its principle. The difference between IoT and M2M is that the M2M technology is what brings to the Internet of Things the connectivity you need and without which it would not be possible. M2M technologies can convert almost any thing in a component of the IoT that can be monitored at a distance and allowing interaction via an interface M2M.

4.1 Internet of Things
One of the most well known of the term referring to the Internet of things comes from the first report of the ITU in 2005 [7] where is described as:
"A promise of a interconnected devices world that provide relevant content to users".
That relevant content can be information of a product in a store, the contents of a medicine or the location of a particular device.

4.2 IoT architectures
Ideally the concept of Internet of Things must be able to offer, from the technical point of view a common framework on which define any solution required in a given application domain, taking into account the need to interoperate with other solutions.

The search for an architecture IoT of reference that support different environments and contexts of the world of things has been a challenge from the same appearance of the concept of IoT.
Below is a review architectures that have been proposed and defined in a specific context and that are a solution to a part of the world of the things. It is taken as reference for the work the architectural project for the Internet of Things (IoT-A) and describes the components and the scope of the reference architecture proposed by IoT-A.

The IoT-A Project made a series of works related to the IoT environments, among which is an assessment of platforms and solutions that have been developed in the world of IoT. These solutions are classified into: (1) solutions provided by public projects such as those of the FP7 of the European Commission and solutions arising
from existing commercial products and (3) attempts to normalization of the various standardization organisms [8].

Below are the features that are taken into account for the analysis of the IoT Architectures:

- **Description of the Architecture**: addressed as the vision of the architecture is provided in relation to the project/product/standard.
- **Style of architecture**: addresses on the style that governs the structure of the architecture.
- **Model and distribution of the information**: addresses the issue of how the information is processed by the project/product/standard and how it is distributed in the system and the way in which becomes accessible.
- **Horizontality**: refers to the ability of the system to the reuse of the same building blocks to provide different functionalities of the top layer. For example, the horizontality applies to a framework for the provision of virtual services for the construction of applications.
- **Knowledge of the context and semantic capacities**: Refers to the possibility of improving the information exchanged through systems with descriptors, which allow the data to be categorized and perform complex queries to be answered.
- **Technological Specification and Interoperability**: the projects / Products / standards depend on a particular technology and as focus on interoperability.
- **Adaptation and Self-Adaptation**: capabilities offered by the project / product / standard in terms of reactivity to environmental changes.
- **Programmability**: Defines API’s and specific standards for the development of an application.
- **Interface with the outside world**: There are several products or interfaces with which the user interacts.
- **Work Plan**: takes into consideration if a product (in this case commercial), includes within its planning one or several measures that are oriented toward the improvement of the compatibility and/ or development from the perspective of IoT.
- **Can the product interact with other articles?**: Refers to the capacity or flexibility that a particular product is at the time of establishing interactions with elements of the environment.
- **Obvious aspects of integration**: evaluates whether a particular commercial product has taken into consideration aspects that are basic or elementary for integration toward an architecture of IoT.

The Project IoT-A has conducted the evaluation on the basis of certain levels of score of inclusion as relevant characteristics within the systems of IoT:

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*The feature must be avoided in IoT systems.*  
- *The feature is recommended for systems IoT.*  
0 *A system that uses this feature can be part of the universe of the IoT, but in general*
terms is not recommended.
+ The feature you must have for systems of IoT and is proposed as a guide for a reference architecture.
++ The feature provides a good contribution to the universe IoT.
N/A: Is Not specifies the feature in the platform, solution or standard.

5 Conclusions

With time, the development and evolution of the various devices in the context M2M are increasingly better and they are looking to have a integration with other devices. However, the growth and development of technological products, sensors and devices have complicated their integration and communication, and although the definition by the ETSI serves as a useful frame of referenc e for the design of a system M2M, given the individual development of certain interfaces, communication protocols and other aspects that complicate the communication between devices, the growth in the market of M2M solutions this hampered by platforms and protocols that are incompatible with each other.

For this reason, M2M Technology, seeks to standardize and achieve a communication and horizontal platform that will optimize some specific attribute of M2M Communications (cost, coverage, mobility, and security).

The use of new technologies in the business processes is becoming increasingly common, communications machine to machine M2M allow you to perform automated treatments in these processes by reducing the time, costs and expand the services.

Internet of things is a technological revolution that represents the future of computing and communications, with a multidisciplinary development that involves important fields ranging from the networks of sensors to the nanotechnology.

References


[4] European Telecommunications Standards (ETSI). ETSI TS 102 921: "Machine-to-machine communications (M2M); mLa, dLa and mId interfaces".


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