# Standardization Activities Related to Machine-to-Machine Communications

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**Abstract**

Machine-to-Machine (M2M) communications, which enables autonomous information exchange between machines via telecommunications networks, is currently receiving attention from diverse industries as a valid mechanism for supporting the future information society. M2M-related services are being launched by telecommunications operators in Japan and abroad, and relevant standardization activities are in progress at a number of standardization organizations and forums. This article mainly introduces M2M-related trends and M2M standardization activities.

## 1. Introduction

Various efforts using Machine-to-Machine (M2M) communications as a common infrastructure are being widely made towards information infrastructures for the next-generation society. Driven by EU directives and legislation in Europe and a number of economic policy initiatives set out by the Obama administration of the USA for reducing energy consumption, utilizing renewable energy sources, reducing environmental load, reducing traffic congestion, and eradicating traffic accidents, efforts to achieve an information infrastructure for the future information society through the use of smart grids and smart cities are taking place on a global scale. For instance, the introduction of the eCall system (emergency call system) and smart metering system in Europe and the USA, as well as the introduction of vehicle theft prevention measures in Brazil, have been driven by national policies.

With M2M, various *machines* that are currently not connected to networks will be connected, thereby enabling us to make use of the information collected from them for the provision of information that is useful to users. For this reason, M2M is becoming increasingly popular in various industry sectors.

For instance, the Intelligent Transportation Systems (ITS) developed by the automotive industry can contribute to the reduction of $CO_2$ emissions by providing realtime road traffic information, which should help to shorten traveling time and distance. Furthermore, information exchanged between vehicles and infrastructure elements or among vehicles can be used to recognize and avoid high-risk situations, which will result in fewer traffic accidents. For this purpose, standardization for Driving Safety Support Systems using the 700-MHz band is currently in progress in Japan. As a part of ITS, telematics offerings utilizing in-vehicle information technologies are also becoming successful. Another good example can be seen in the area of telemedicine/telehealthcare. Telemedicine enables swift and prompt responses to emergencies as well as lower labor costs. And with the aging of the world's population, future demands for telemedicine/telehealthcare services are expected to rise still further. M2M utilization aimed at speeding up and improving efficiency is also becoming increasingly active in various industry sectors, such as the logistics industry (for tracing baggage and commercial goods), the electrical power industry (for smart metering and smart grids), the insurance industry (for tracing and locating stolen vehicles), and the security industry (for remote monitoring and control).

M2M communizes networks and platforms against the background of social and industrial demands, and it will create attractive business opportunities for telecommunications operators. Furthermore, from the perspective of ensuring mobility and facilitating

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connectivity, wireless technology such as mobile communications and short-range wireless communications will play an important role in M2M.

As one activity communizing M2M, studies on international standards by major Standards Development Organizations (SDOs) such as ETSI (European Telecommunications Standards Institute) are becoming active, and M2M-related industrial trends and standardization activities are now receiving attention.

## 2. M2M issues for telecommunications operators

Taking into account the growing interests in various industry sectors for using M2M and new deployments of M2M equipment invoked by national legislation, the number of M2M devices is expected to increase sharply in the future. For instance, Cisco Systems, Inc. forecasts that by 2020, the number of devices connected to the Internet will reach 50 billion [1], of which the majority will be M2M-related devices. This figure indicates that, in comparison with the current number of global mobile subscriptions, which is around 5.4 billion [2], M2M devices of the next higher order of magnitude will be connected to the Internet by 2020. In addition to this, the range of network traffic needed by M2M devices varies widely from one M2M application to another: for instance, the volume of traffic generated by sensor equipment will be low, while that generated by security surveillance cameras will be relatively high. Supporting the enormous number of M2M devices to be connected and efficiently covering the wide range of traffic volume are challenging issues for telecommunication operators.

## 3. Background of M2M standardization

While traditional M2M systems are mainly vertically integrated systems specifically optimized for a particular industry sector or solution, horizontally integrated systems, which could be commonly used within and across any industry sector or solution, are becoming important. Therefore, M2M systems that support a variety of services are collections of technological elements that meet requirements from a very wide range of industry sectors (vertical players). The technical areas related to M2M standardization activities by major SDOs are shown in **Fig. 1**. They are broadly categorized into four domains: devices and gateways, access and core networks, platforms, and applications. Studies take a cross-category approach based on an end-to-end perspective.

### 3.1 Devices and gateways

There are two arrangements for supporting M2M device connectivity: either connection directly to telecommunications operator networks or connection via gateways located in home networks or elsewhere. Since sensors and actuators used for M2M applications are required to have low power consumption and long operating lives, various short-range wireless communications technologies such as Z-Wave, ANT+, ZigBee, and Bluetooth have been studied.

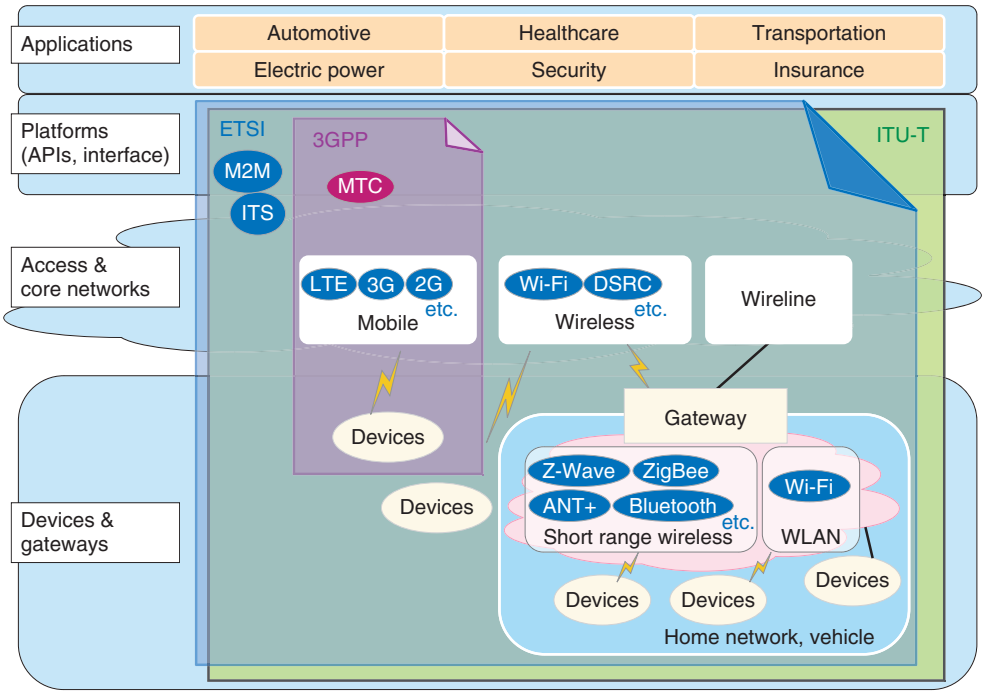
### 3.2 Access and core networks

It is assumed that existing technologies for access networks such as mobile, wireless, and fixed-line network technologies will be reused for M2M. In addition to mobile communications technologies, automotive wireless technologies such as DSRC (Dedicated Short-Range Communications) used by ITS hotspot services are also being studied for automotive use cases. The type of technology used will vary depending on the equipment's mobility and the criticality of emergency situations. For example, in the case of the eCall system for vehicles, mobile communications technology is promising as access technology because of its high level of mobility and high level of criticality for emergencies. Another case where mobile communications technology is also widely used is automatic vending machines because it facilitates their installation in various locations even though they remain immobile for most of the time. On the other hand, consumer electronics equipment, which requires only limited mobility and is installed in a limited range of locations, will be connected via short-range wireless to a home gateway supported by optical fiber access.

Core networks, on the other hand, require mechanisms for identifying a huge number of devices and performing efficient routing, as well as technology for efficiently handling a wide range of traffic volume.

### 3.3 Platforms

Studies of platforms are currently in progress to examine the functions required for the provision of application services from a variety of industry sectors, as well as studies of the basic Application Programming Interfaces (APIs) commonly used regardless of the industry sector. As for the arrangement of platform provision, noteworthy studies include the horizontally integrated cloud platform approach




2G: second generation
3G: third generation
LTE: Long Term Evolution
WLAN: wireless local area network

Fig. 1. M2M technical areas and major SDOs.

making use of cloud-computing technology to be commonly used within any industrial sector and across any industry sectors.

### 3.4 Applications

Similar use cases are currently being examined by among various SDOs. Applications considered suitable for each industry sector are shown in Fig. 1.

## 4. Current status of major M2M standardization activities

Standardization activities covering M2M-related technical issues are currently under development by various SDOs and forums. This section provides a brief summary of the activities undertaken by the major organizations shown in Fig. 1. A study of this area under the title "Internet of Things" (IoT) has been started by ITU-T (International Telecommunication Union, Telecommunication Standardization Sector). The term IoT is also used in the EU Framework Programme 7 project.

### 4.1 3GPP

3GPP (3rd Generation Partnership Project) started standardization activities on mobile network-based M2M in September 2008 under the title "Machine Type Communications" (MTC). This study is regarded as one of the most advanced studies of M2M.

3GPP Release 10 specifications approved in March 2011 cover use cases, service requirements, and a functional architecture for MTC intended for application to mobile networks. In this release, 3GPP standardized overload and congestion controls for networks and secure telecommunication functions for MTC devices in roaming environments in order to cope with new traffic characteristics caused by collecting small amounts of information at the same time from a huge number of MTC devices, which has not previously been done in existing human-oriented telecommunication. Technical documents covering the service requirements and architectural model have also been issued as TS 22.368 and TR 23.888, respectively.

At present, issues such as group-based MTC device

management capabilities and communications between MTC devices are being studied under a new work item entitled System Improvements to Machine-Type Communications (SIMTC).

### 4.2 ETSI

#### 4.2.1 TC M2M

In accordance with EU Mandates M/441 (on smart metering) and M/490 (on smart grids) issued by the European Commission, ETSI established ETSI TC M2M (Technical Committee M2M) in January 2009 to develop European standards covering M2M. TC M2M is currently studying use cases, service requirements, architecture, and interfaces at the M2M service layers considering the independence of end-to-end services from access technology. Study work on M2M use cases covers five M2M application areas: smart metering, eHealth, connected consumers, automotive, and city automation. One Technical Report (use cases for smart metering) has already been published as TR 102 691.

TC M2M initiated work on detailed technical issues in 2011, and Release 1 specifications were approved by February 2012. Technical Specifications covering M2M service requirements, architecture, and interfaces have already been published as TS 102 689, TS 102 690, and TS 102.921, respectively.

#### 4.2.2 TC ITS

In October 2007, ETSI established TC ITS (Technical Committee ITS) to standardize ITS/telematics covering the study outputs from the EU Framework Programme project. While the dominant members of TC M2M are telecommunications operators, dominant members of TC ITS are vehicle manufacturers.

In June 2009, TC ITS published TR 102 638, which defines the Basic Set of Applications (BSA) for ITS across Europe. This was followed in September 2010 by the publication of TS 102 637-1, which specifies the functional requirements driven by applications and their use cases defined in the BSA. These technical specifications identify a total of 32 use cases categorized into 7 applications in 4 application classes.

### 4.3 IETF

In IETF (Internet Engineering Task Force), an informal Bar BOF (birds of a feather) on IoT research issues was held at IETF 77 March 2010. Research is merely at the preliminary stage of calling for the need to study IoT, on the basis of individual drafts, and trying to identify issues that may arise in the case of connecting various things, such as radio-frequency identification tags to the Internet.

### 4.4 ITU-T

ITU-T's Telecommunication Standardization Advisory Group (TSAG) agreed to establish a Global Standards Initiative on the Internet of Things (IoT-GSI) at the February 2011 meeting. IoT-GSI comprises relevant Questions from Study Groups, and at its first meeting held in May 2011, IoT-GSI began a study mainly targeting IoT definitions, IoT overviews, and an IoT work plan for deploying IoT. The third IoT-GSI meeting held in November 2011 almost completed the draft ITU-T Recommendation "IoT Overview", which covers the definition of terms including IoT definition, general overview, requirements, and the architecture. Activities of the EU Framework Programme 7 project are also recognized, and coordination has started. Three draft ITU-T Recommendations—Overview of Internet of Things, Requirements for support of machine oriented communication applications in the NGN environment, and Framework of object-to-object communication for ubiquitous networking in NGN—began the approval procedure as Y.2060, Y.2061, and Y.2062, respectively, at the SG13 meeting held in February 2012 (NGN: Next Generation Network).

## 5. Coordination among standardization activities

Up to now, standardization efforts including those for M2M applications have been undertaken separately by regional standardization organizations in Europe, the USA, Asia, etc. These activities are leading to fears of a tightness of work resources from industries and of market fragmentation. From this standpoint, a movement to internationally integrate M2M-application-related standardization activities has been seen.

### 5.1 M2M consolidation

ETSI agreed to the establishment of M2M-PP (M2M Partnership Project) at the General Assembly held in April 2011 in order to avoid overlapping efforts for common M2M service-layer standardization activities among various SDOs; this was later followed by the setting up of the Board M2M-PP in ETSI. Like 3GPP, M2M-PP is intended to be a *partnership project* of several SDOs. In response to an appeal by ETSI, SDOs from different countries held preparatory meeting officially three times in 2011 (July 2011 in Seoul, Korea; August 2011 in Washington D.C., USA; and December 2011 in Berlin, Germany) targeting the establishment of M2M consolidation. SDOs are currently exchanging views

towards the consolidation of various M2M standardization activities, including the scope of activity and organization structure. Participating SDOs are: ETSI from the EU, ATIS (Alliance for Telecommunications Industry Solutions) and TIA (Telecommunications Industry Association) from the USA, CCSA (China Communications Standards Association) from China, TTA (Telecommunications Technology Association) from Korea, and TTC (The Telecommunication Technology Committee) and ARIB (Association of Radio Industries and Businesses) from Japan.

ETSI initially planned the first meeting of the new consolidated organization to be launched by early December 2011; however, the establishment of this new organization has been delayed owing to a counter proposal for an M2M Global Initiative from SDOs in the USA concerned about avoiding EU-centric management. Finally, in January 2012, the above-mentioned seven SDOs officially announced agreement to establish a new organization called oneM2M [3]. The fourth preparatory meeting was held in Tokyo in March 2012, where agreements including management and funding arrangements were planned for July and an initial technical meeting was planned for September.

Since it is recognized that engaging and partnering the vertical market players is important, a key factor for success will be how many vertical market players from various industry sectors become involved in the oneM2M activities. This deserves close attention.

## 6. Major issues related to future M2M standardization

There is a growing need to establish a flexible way to identify the vast number of M2M devices and routing methods for them. Another major issue to be addressed is ensuring security by the networks to prevent devices from being stolen and information leaking through attacks on networks.

The volume of traffic exchanged during a single M2M communication session is considered, in general, to be small; therefore, if session-based communications like SIP (session initiation protocol) were to be used each time, it would result in a large overhead that could lead to network congestion. Therefore, simplified methods of communication control and congestion control are also considered to be issues that need to be solved.

Another important issue is how to design APIs for services from various industry sectors and how to profile various standard technologies.

## 7. Conclusion

M2M standardization has just started towards services from various industry sectors integrated horizontally. From a practical viewpoint, however, the creation of a common place for discussion involving various industry sectors that have traditionally had different backgrounds will be a key factor not only for the success of this effort, but also for the provision of commonly used functionalities and for cooperation with applications by telecommunications operators beyond the provision of basic connectivity. This article is based on information obtained through the support business for the NTT R&D laboratories.

## References

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