# Technology Digest

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## Machine to Machine Communication Standards

MACHINES are the new 'subscribers' of the cellular networks. According to some estimates, the world would have 50 billion connected machines by the year 2020. This would far exceed the connected humans even if the entire predicted world population of 7.5 billion by the year 2020 were to be connected. Therefore, the telecommunication networks, that currently cater predominantly to H2H (human to human) communications will need to be optimised for M2M (machine to machine) communication to cater to these new breed of 'subscribers' with different behavioural characteristics from current customers.

Source: ETSI

M2M communication, in which data is transferred among communicating machines with little or no human intervention, has been around for some time. However, the industry has come into greater prominence because of widespread availability of wireless networks. Personal health monitoring, tracking and tracing in supply chain management, fleet management and tracking, remote security sensing, smart electricity and gas meters, smart grids, intelligent traffic control, all involve M2M and are being strengthened by availability of mobile networks. M2M has lately received a boost as, on one hand, some countries are promoting Mobile health and smart grids as a government policy and, on the other hand, mobile operators are showing renewed interest in M2M to improve revenues and profit margins.

Just as in H2H networks, M2M networks need to be reliable, scalable, secure, and manageable. The possibility of the number of devices connected increasing exponentially requires optimizations to avoid network congestion and system overload. For instance, when power resumes after a failure, a large number of devices would try to connect simultaneously and may overwhelm a poorly designed network. Unlike H2H, M2M devices would frequently access the network, with small bursts of data, often in a low mobility situation. The network would need to support many types of M2M devices having different characteristics and requirement and running different applications. Limited human supervision requires advanced mechanisms for security. In addition, it would be necessary to ensure M2M services and devices at a low cost level for mass-market acceptance.

These challenges can be resolved by standardization. Many component-level standards already exist, addressing various radio interfaces, different meshed or routed networking choices, or offering a choice of identity schemes. Each is optimised for a particular application scenario and there is therefore a degree of fragmentation. Multitude of technical solutions and dispersed standardization activities result in the slow development of the global M2M market. Effort is required to bring all these pieces together and fill the standardization gaps that exist.

### M2M Architecture

The key elements are shown in the figure and described here:

M2M Device: Device capable of replying to request for data contained within those devices or capable of transmitting data autonomously.

M2M Area Network: Provides connectivity between M2M Devices and M2M Gateways, e.g. personal area network.

M2M Gateway: Uses M2M capabilities to ensure M2M Devices inter-working and interconnection to the communication network.

M2M Communication Networks: Communications between the M2M Gateway(s) and M2M application(s), e.g. xDSL, LTE, WiMAX, and WLAN.

M2M Applications: Contains the middleware layer where data goes through various application services and is used by the specific business-processing engines.

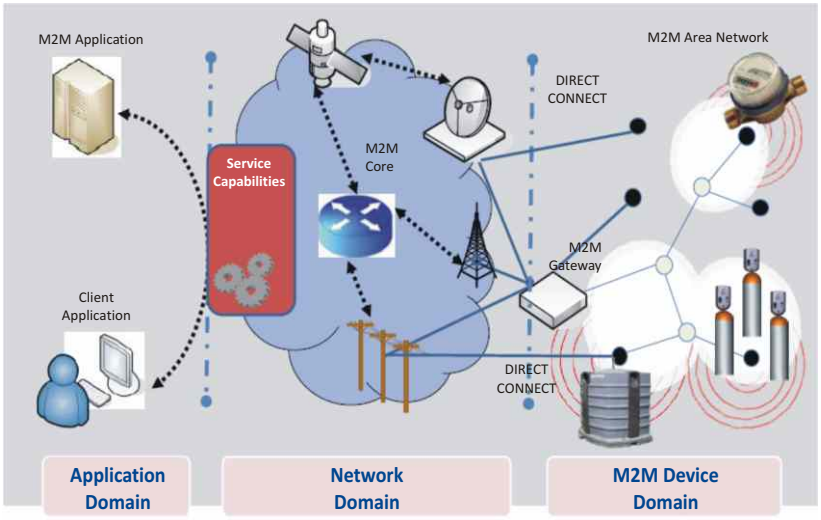



Fig: M2M Architecture Source: ETSI

## M2M Applications

The traffic flow in M2M applications consists primarily of data. There will be different service and processing requirements for this data, depending on the application served. Rich content based applications require high bandwidth and computational capabilities. At the other extreme monitor and sensor information has low bandwidth requirement and low computational demand. The consumer electronics, utilities, retail, telematics, transportation, medical devices, and remote home and industrial monitoring as well as the automation segments are already leveraging wireless as the primary or secondary backup connectivity option to expedite daily business operations. Additionally, new deployment models and use cases are continuously being evaluated, and many of them will ultimately lead to commercial deployment. The adjoining figure gives a snapshot of M2M applications.

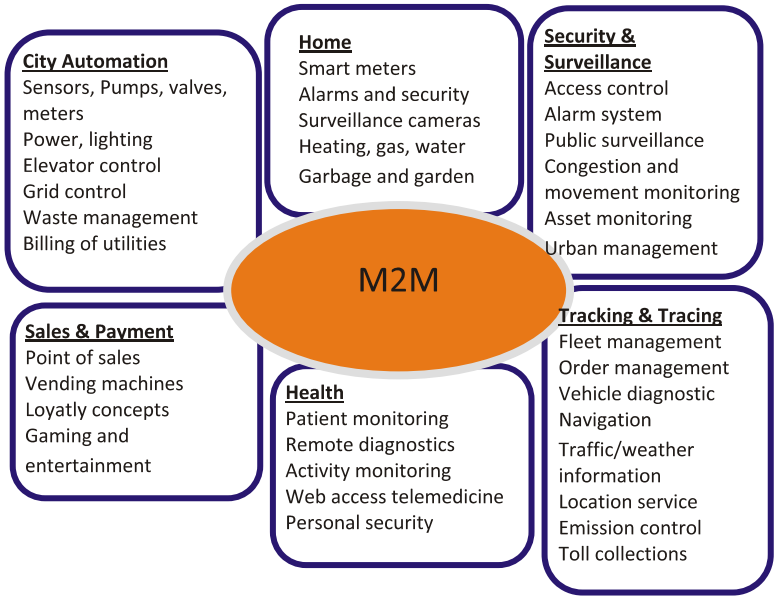



Figure: M2M Applications

## M2M Standards

Various standards bodies are currently in the process of defining specifications for M2M communications.

### European Telecommunications Standards Institute (ETSI)

The ETSI Technical Committee (TC) M2M was created in January 2009 to provide an end-to-end view of M2M standardization and co-operate closely with ETSI's ongoing activities on Next Generation Networks, Radio communications, Fibre optics and Powerline as well as close collaboration with 3GPP standards group. The TC M2M standardization work mainly focuses on the service middleware layer. M2M services will be implemented over M2M service platform, M2M gateway and M2M terminals. To support a wide range of M2M applications, the TC M2M is defining a set of standardized service capabilities that provide functions that are shared by these different M2M applications. These service capabilities can use core network functionalities through a set of exposed interfaces and can

interface to one or more core networks. ETSI TC M2M has started 10 work items, of which M2M service requirements (TS 102 689) and smart metering use cases (TR 102 691) have been published and M2M functional architecture (TS 102 690) and M2M definitions (DTR/M2M-00004 are targeted to be published in 2011. In terms of protocol definitions work on three main interfaces between service capabilities, devices and applications (mld, dla and mla) is targetted to be completed by end of 2011.

**3GPP**

The initial M2M standardization effort in 3GPP was started by the Service and System Aspect Working Group 1 (SA1 WG), which defines the service requirement for machine type communications (MTC), the 3GPP term for M2M. The technical report TR22.868 was completed in March 2008. Based on the study reported in TR22.868, several work and study items were created for M2M in various 3GPP working groups. The SA3 Security WG completed a new study item on "Security Aspects of Remote Provisioning and Change of Subscription for M2M" in December 2009 by releasing TR33.812. The SA1 WG work item for "Network Improvements for Machine-Type Communications" (NIMTC) in March 2010 is still active and deals with LTE networks. The Radio Access Network Working Group 2 (RAN2 WG) WG is developing the technical report TR37.868 for the study item "RAN Improvements for MTC in Release 10." A new SA1 WG study item on service requirements for further improvement for MTC (SIMTC) was approved in May 2010. This item deals with Advanced LTE and the corresponding technical report is TR22.888. However, because of slow progress, SA2 WG later decided to focus only on generic capabilities such as overload and congestion control for low mobility and latency-tolerant MTC features for Release 10. They're postponing support for other MTC features and functions.

**3GPP2**

3GPP2 is a partnership project developing global specifications based upon the ANSI/TIA/EIA-41 network. Three major activities in 3GPP2 are related to the M2M work: developing an M2M study report, investigating the impact of existing numbering schemes used as device and subscription identities for M2M devices over a code division multiple access (CDMA) network, and working on network enhancements to accommodate future M2M devices. The first two study items are expected to be completed with the publication of two study reports in 2011. Aspects Technical Specification Group (TSG-S) completed the draft of the study report on "Machine-to-Machine (M2M) Communications for 3GPP2 Networks." The scope of S.R0141 is to evaluate the aspects of M2M communications required to ensure that the 3GPP2 infrastructure is a viable communication network alternative for M2M business segments. The 3GPP2 Steering Committee is also investigating M2M numbering issues and coordinating with industrial M2M committees. The findings will be published in a study report, titled "3GPP2 M2M Numbering Recommendations" (SC.R4005- 0) in 2011.

## All-optical computer

Light can be used to transmit, record and process information. Optical information processing is based on the idea of using all the properties of speed and parallelism of photons in order to process the information at high data rates. The information is in the form of an optical signal. The inherent parallel processing is often cited as one of the key advantages of optical processing, compared to electronic processing using computers that are mostly serial. Therefore, optical technology has an important potential for processing a large amount of data in real time.

The main building block of computers is the electronic transistor. In order to build an optical computer, the equivalent optical transistor is required. The biggest challenge in optical computing is that, over short distances, the energy consumed by photons in information processing and transmission is greater than using electrons. Although the building blocks of the processor (such as all-optical logic gates, optical switches, optical memory and optical interconnections) have been produced in research laboratories, there is no optical transistor equivalent.

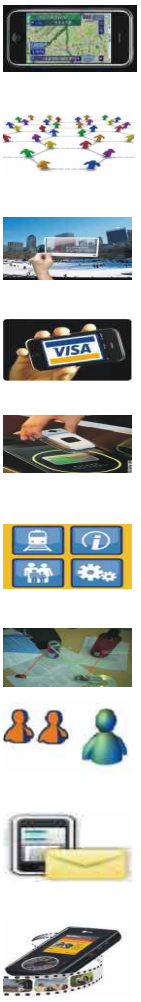
The research on developing the all-optical computer is a multidisciplinary arena and involves new topics such as biophotonics, nanophotonics, femtosecond nonlinear optical technology, materials science and nanotechnologies. A new paradigm is needed for packaging alloptical components that is different from what is being done currently. Until this process is standardized so that the optical transistor equivalent can be packaged and mass produced, then the optical computer will continue to remain a dream.

**WiMAX forum**

The WiMAX Forum (WMF) has also been conducting discussions on M2M. The task for defining M2M requirements has been handled by the WMF Service Provider Working Group (SPWG), and the requirement specification was completed and approved in December 2010. The **Service Requirements** are mainly concerned with the communication between devices and the server. These requirements also define service access control and use of features for a given M2M application. Different priority levels are supported for M2M traffic. Besides the general requirements, there are naming, identification and addressing requirements that allow devices on the WiMAX network to be identified based on MAC address of the

device. Communication with a M2M Device that has either private non-routable IPv4 address or public IPv4 or IPv6 address shall be supported. The **System Requirements** include capability to allow subscribers to subscribe to multiple M2M features, activate/de-activate and provision/de-provision M2M Service on a particular M2M Device, mechanism to reduce network congestion through Air Interface access control, Core Network 1 access control, M2M Server access control and Universal Service Interface access control. There is also a requirement to support capability to support reduction of mobility management traffic, frequency of location updates and mobility configurations. The network may also restrict service access to only certain defined times. According to Monitoring Requriements, the Wimax M2M Device shall report the event that may indicate possible theft or damage. It shall be able to define which monitoring events to detect so that M2M subscriber may select one or more of the available follow-up actions to be performed by the system when an event is detected. The system shall also support low data bursts and mechanisms to save power consumption on M2M devices. According to the **Roaming Requirements** the M2M subscriber should have similar user experience of subscribed M2M feature when roaming while utilizing WiMAX Service. The **Accounting and Management Requirements** require that the system should be able to generate bearer accounting information per M2M device group based on the criteria in the M2M feature subscription. The **Operation and Management Requirements** are that the network shall support over the air activation/de-activation and provisioning/de-provisioning of M2M Device. The M2M device should also be able to activate and deactivate M2M Features e.g. over the air or web-based. The **Security Requirements** require support for M2M Device only authentication, integrity protection and privacy of M2M application traffic which requires secure connection. The **Regulatory Requirements** requires that WiMAX M2M Service implementation shall comply with the Lawful Intercept requirements and the network shall be able to perform lawful intercepts based on identification of specific M2M devices, M2M groups defined in the WiMAX network, or the subscriber of a WiMAX M2M Service.

**Technology Trends for 2012**




Source: Gartner

**IEEE**

In IEEE 802.16, whose family of standards forms the basis of the WiMAX standards, the M2M-related standard activities are mainly in task group 802.16p. The 802.16p was formally approved as an 802.16 task group in November 2010 and is expected to complete its standard by July 2012. Its aim is to standardize enhancements to 802.16 networks for enabling a range of M2M applications in which the device communications require wide-area wireless coverage in licensed bands and are automated, rather than human-initiated or human-controlled, for purposes such as observation and control. The unique requirements that 802.16p is intended to address include low power consumption, a large number of devices, short-burst transmissions, and device tampering, detection, and reporting. The IEEE 802.16p-10/0005 “Machine-to-Machine (M2M) Communications Technical Report” has been completed.


*References: There are many to be individually acknowledged, the primary ones are cited here*

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