

Fact-finding survey concerning
***Machine to Machine* (M2M) communication services**

Final report
(Annex A to decision no. 120/15/CONS)

Disclaimer

This document is an analysis for the identification of the possible scenarios, the risks, the impacts on the market, and the regulation that could follow the massive widespread of M2M services.

The analysis is based mainly on the contribution received from the parties concerned and the studies carried out by the offices.

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Executive Summary

The Italian Communications Authority (hereinafter Authority or Agcom), with decision no. 708/13/CONS, launched a fact-finding survey on *Machine to Machine* (M2M) communication services, with the aim of examining the factors that influence the development of M2M services (and the interaction between the market operators which cooperate in providing the services); to critically assess the development forecasts and the usage methods; to identify any regulatory barriers to the development of M2M services (especially in respect of numeration aspects and roaming); to identify any areas where it would be useful to develop coordination between the various national and European institutions involved in M2M.

The fact-finding survey is included within the scope of similar analysis initiatives undertaken by the main EU regulators, including, in particular: the European Commission's findings resulting from the public consultation on the *Internet Of Things* which took place in 2012; the assessments on the state of the roaming market expressed by BEREC and the European Commission's offices, in preparation for the revision of the Regulation in force and within the sphere of the new *Telecom Single Market/Digital Single Market* packet; the evolution of the legislative proposal relative to the *Connected Continent*, also in expectation of a future review of the electronic communications regulatory framework, relative to which certain activities at international level have been started up.

The fact-finding survey was carried out by means of questionnaires (on both quality and quantity) and meetings held from June to November 2014 with the parties concerned that had expressed their interest. In this report, the positions expressed by the participating subjects have been taken into account, also to identify the main relevant aspects from the regulatory viewpoint.

The analysis revealed that the M2M sector features the use of electronic communication technologies to connect "objects" to the network. M2M therefore involves a vast and very differentiated series of services, including: *connected cars*, i.e. cars which use the connection for safety devices and for *infotainment* services; *smart metering* and *smart grids* which, in the electrical sector, allow for eliminating electromechanical metres and for efficient and rational on-line management; *smart cities* thanks to which, with the application of ICT technologies to the infrastructures and to the city services, lead to greater efficiency and quality in the use of the services for the benefit of citizens and companies. M2M can also be used for domestic uses (*smart homes*), for the remote management of vehicles, in safe payment systems, and in various *smart devices* such as navigators, players, etc. which increasingly feature the so-called "*digital life*".

At the beginning of 2014 there were an estimated 225 million SIM based M2M connections in the world. Of these, 27% (61 million connections) was in Europe, showing a growth trend of over 20% a year. In Italy there were more than 6 million M2M connections mainly in the *smart car* sector (31%), the *smart home* and *building* sector (21%), and in the *utility, metering* and *asset management* sector (21%).

The M2M ecosystem includes many subjects: the producers of communication devices, the network operators, the platform managers the content producers and the service providers. With regard to the competitive dynamics, M2M services are changing relations between traditional telecommunications operators which, from the typical *Business-to-Consumer* (B2C) model, are evolving towards *Business-to-Business* (B2B) models or *Business-to-Business-to-Consumer* (B2B2C) models, losing the direct relationship with the final user, which becomes, instead, the prerogative of the “M2M services provider”. In this transition, international service platforms, the manufacturers of “*smart*” devices, and the developers of applications and services are becoming increasingly important.

The connectivity model at the base of M2M services is different from that of traditional applications for the transmission of data in the Internet world. The global nature of M2M in fact requires the preparation of connectivity offers that are not limited within national borders and, consequently, international alliances are being developed between the main mobile operators ⁽¹⁾. The alliances allow for answering the request for global connectivity, but they limit the possibility of changing the connectivity supplier, since they use proprietary techniques for the remote configuration of the SIMs (which are not inter-operable outside the alliance). The resulting connectivity market seems to be, at present, developed by a few large operators which, aggregating the various national infrastructures through roaming agreements, offer global connectivity services. This situation can cause risks of *market pre-emption* and *technology lock-in* and involve difficulties in entering the market for the weaker operators in the global competition ⁽²⁾.

The fact-finding survey identified the following main spheres of possible regulatory intervention: investment in the infrastructures and in the development of the services; regulation of connectivity; the final service; the vertical M2M markets. The type and urgency of regulatory intervention will depend on how widespread the M2M services are, which at present show appreciable usage values and significant development trends.

¹ About 60% of operators adhere to an alliance.

² This could be the case of many Italian national operators.

One of the most important aspects regards the public network infrastructures available at present, which are partially inadequate for the supply of M2M connectivity, in consideration of the specific technical needs required by the demand (reduced volumes exchanged, the need for ubiquity, always on, requests for low transmission latencies) and the relatively high costs for the supply of the connection itself ⁽³⁾. These critical aspects are pushing the M2M service suppliers to create *ad hoc* networks and architectures, alternative to the public networks, based on closed and non-interoperable proprietary networks, with a consequent risk of market concentration and dispersion of resources.

With reference to technologies, there is a considerable fragmentation of solutions adopted so far to offer M2M services to users. In the absence of specific standards for such purposes, solutions are being prepared which sometimes resort to non-conventional transmission methods ⁽⁴⁾. The results of the survey stimulate reflection on a possible role of regulation as an incentive for the development of standard solutions which can promote the massive adoption of M2M services in a competitive and open environment.

With reference to the change of connectivity provider (*contractual switch*), the regulatory framework may be insufficient since the present number portability procedures discipline only the domestic market, while the M2M connectivity service is often achieved with international SIMs.

With regard to international roaming, some uncertainties have emerged relative to the applicability of the EU Roaming Regulation, which was developed with the aim of reducing differences between national tariffs and roaming tariffs and, therefore, of favouring the creation of a European corporate space based on the mobility of persons and digital data flows. In this country at present, the number of devices with a mobile foreign number (*permanent roaming* devices) is not in line with the above-illustrated aims and this raises various doubts of a regulatory nature, such as: which Institution should be given juridical/regulatory competence; the congruity of the regulated prices with the underlying costs (for example, the maximum wholesale prices imposed by the Regulation were introduced to ensure the typical use of those who travel abroad, but do not consider the specific requirements of M2M). At the same time, it is necessary to recognise that permanent

³ From a technical viewpoint, the large scale spread of M2M technology on traditional networks could generate congestion of the network because of the maximum signal capacity supported (rather than in terms of maximum traffic limits supported). In the case of SIM based services, for example, the dimensioning of the 2G/3G networks was originally defined to ensure the support of a relatively low number of terminals per resident person. In the case of M2M, each person could have a few dozen units connected. In short, a traditional network (not developed for M2M applications, featuring very low but very widespread traffic volumes) cannot be expected to be adequate to supply connectivity to either today's users or the users of M2M technology services.

⁴ Such as the use of the signalling channel for the transmission of M2M data.

roaming is decisive to facilitate the configuration of the M2M devices and to take avail of the best coverage possible, since it allows for the use of the radio stations of all operators (see the case of gas metering in Italy, for which connectivity is requested by the contract awarding station with complete coverage of the territory and which is therefore achieved by Italian operators using foreign SIMs). It therefore seems necessary to identify solutions alternative to permanent roaming, which can operate nationally and reduce the incidence of opportunistic behaviour, at the same time creating a level playing field for the operators.

With regard to numbering, the National Regulatory Authority is required to monitor, within the sphere of its usual duties, the growth level of the market since the development of M2M could lead to the exhaustion of the available numbering resources (e.g. IPv4 addresses). It is also necessary to evaluate the regulatory developments in order to ensure harmonisation with the regulations in force in the other Member States, where it seems that flexible modes are being developed for the issue of the enumeration resources and to allow for use abroad. Lastly, some operators report that European regulation favours discriminatory treatment among operators and Internet service suppliers, which benefit from the possibility of freely exploiting, albeit in an indirect manner, the telephone numbers issued to the operators which requested authorisation.

With reference to spectrum management policies, it must be taken into account that, in the case of M2M and unlike what occurred with traditional mobile telephony, the transfer (*download*) speed from the network to the device is not always a priority, whereas the following are of great importance: i) the possibility of use in very particular indoor environments (such as gas metres in cellars or in basements); ii) the availability of a capillary coverage of the territory; iii) the transfer speed of the channel from the device to the network (*upload*). In addition, the radio spectrum assignment policies must ensure the economic sustainability of the business cases typical of M2M, which feature limited profitability values for each connected device. Lastly, the widespread of M2M applications with 2G modules (much used because of the low costs of the modules) can represent a problem for the future switch-off of the GSM network.

With reference to the *Service Level Agreements* (SLA), the analysis revealed the existence of applications which require "usage profiles" and/or quality levels that are not sold today at economic conditions that are sustainable for the user (see the case of connectivity for the *Smart Grid* market applications).

The question of privacy presents several critical aspects since M2M development intensifies the already existing problems due to the growing number of devices interconnected to the public

network, able to collect information linked to the personal sphere (⁵). In addition, the *smart metering* experiences lead to considerations on whether it is opportune for M2M service users to have avail of the flexibility necessary to define the specific parts for security and privacy controls.

With reference to security, M2M communications must guarantee a suitable level according to the diverse type of the services to which such communication can be dedicated or the routes that must be protected (in the case of M2M, the data transferred may be deemed sensitive and belonging to third parties). In this sphere, it appears opportune to avoid regulations which demand disproportionate levels of security which would require unsustainable costs.

With reference to the General Authorisation Regime provided by the EU Regulatory framework for electronic communications, the definition for Electronic Communication Services (ECS) is difficult to apply in the M2M sector because of the appearance of new subjects in the value chain. The transnational nature of M2M also stimulates reflection on the institutions which are in force to simplify the administrative procedures linked to the disclosure obligation in all States where the sale of the final service is expected.

An important reflection regards the most important fields of M2M application (so-called Vertical Segments or Vertical Markets).

Connected Cars and, in particular, the electronic communication devices for security installed in vehicles, are an important M2M development sector in Italy and in Europe. In addition to security, connected cars are also expected to have a considerable quantity of M2M applications for the management of the vehicle and for infotainment and activities carried out on board. The Connected Car case clearly shows the influence of regulation on the development of the entire market of connected applications. The subject of mobility, together with that of security, is a key element of the driving force for the increase of M2M services.

Smart metering is one of the important applications in the M2M field in Italy. Smart metering for gas is oriented towards proprietary network solutions for the entire network for the collection and concentration of the measuring signals (*Wireless MBUS* transmission technologies in the 169 MHz band). However, to guarantee returns on the investments in these infrastructures, the possibility of sharing them between diverse applications is being assessed. It is clear that in this way a network created as a private infrastructure, for that matter using unlicensed frequencies and on which it will be difficult to apply planning and service quality concepts, becomes "public" especially if shared

⁵ In the immediate future, for every traditional mobile phone there may be about 10 further M2M devices connected to the network.

by several utilities. The development of dedicated network infrastructures should be analysed, both for the implications on the spectrum and for market competitiveness.

The *smart grids*, i.e. intelligent electricity grids constructed in a manner which favours the distributed generation and energy efficiency, allows consumers to become interactive participants in a distribution network. The development of the smart grids requires a greater transmission capacity for communicating the information of the electricity networks. Electronic communications are one of the enabling elements for the development and, consequently, it is necessary to consider the possible need to define the technical connectivity requisites, assessing: the topology of the points to be connected, the re-use of pre-existing infrastructures, the quality requisites, the costs/benefits ratio, the availability of LTE networks in the vicinity of the generation plants.

Smart Cities are an opportunity for the telecommunications industry since the operators can offer high added value services and exploit their own technical skills, taking the role of project partners.

During the questioning of the survey, the need appeared to create an opportunity for constructive discussion between the subjects which operate in the development of the so-called vertical sectors and the operators specialised in traditional electronic communications, which are marginally involved in the development of the M2M chain of values. To this regard, the subjects active in the vertical segments have expressed the need to discuss collaboration with the subjects which own the infrastructures and the know how in order to favour an effective use of the resources through the coordination of the initiatives taken by both public bodies and private companies.

Agcom will establish a permanent M2M Committee in which the main actors (public and private) will be involved and, to ensure greater coordination of public intervention, it will also operate through bilateral agreements with the other regulatory bodies and private companies involved in the development of M2M services, according to the needs requested by the vertical sectors. This discussion table, focusing on problems with possible regulatory implications, can play an active role in reaching the following objectives: the promotion of the development of investments in electronic communication infrastructures and communications services for M2M; identification of the specific needs as regards the radio spectrum; definition of the appropriate forms for access to the network infrastructures; development of service profiles which meet the needs of the M2M applications; guidance on matters connected with IPv6 migration; coordination of matters relative to M2M with the initiatives promoted by the Italian Digital Agenda.

In the light of the critical aspects brought to light by the survey, Agcom, within the scope of its own institutional tasks, intends to continue supervision of the M2M sector, favouring the

development of the market and the growth of the operators which are at present the weaker in the global competition also in order to assure the availability of an adequate service quality level. Acknowledging that M2M has profiles that have not yet been completely determined because of the evolution of the business models, the technological choices and the effects due to regulation, it seems necessary to continue supervision and monitoring, identifying the *Key Performance Indicators* of this specific market and making quantitative estimates of how widespread M2M communication services are.

Lastly, to guarantee a high level of consumer protection in their relations with providers, it also appears to be useful to promote initiatives aimed at ensuring adequate protection, introducing M2M matters into the scope of the tasks already pursued by Agcom.

1. Introduction

Agcom, with decision no. 708/13/CONS, launched a fact-finding survey on *Machine to Machine* (M2M) communication services, with the aim of examining the factors that influence the development of M2M services (and the interaction between the market operators which cooperate in providing the services); to critically assess the development forecasts and the usage methods; to identify any regulatory barriers to the development of M2M services (especially in respect of numeration aspects and roaming); to identify any areas where it would be useful to develop coordination between the various national and European institutions involved in M2M ⁽⁶⁾.

The Italian fact-finding survey falls within the scope of similar analysis initiatives undertaken by the main European regulators of this matter, including, in particular:

- the results identified by the mediating European Commission downstream of the public consultation on the *Internet Of Things* carried out in 2012;
- the assessment of the state of the wholesale roaming market carried out by BEREC and by the offices of the European Commission, in preparation for the review of the maximum wholesale prices (*wholesale caps*) to be adopted pursuant to the *Roaming Regulation* in force or, possibly, within the sphere of the new *Telecom Single Market/Digital Single Market* packet;
- the preliminary analyses connected to the legislative proposal relative to the *Connected Continent* (which, in the last draft, included international roaming and network neutrality), also in view of a future revision of the regulatory framework in respect of which some activities have been launched at international level ⁽⁷⁾.

In 2015 BEREC will be engaged on all the above-mentioned points. In particular, the programming ⁽⁸⁾ contemplates specific activities concerning M2M, aimed at in-depth examination of what came to light in the two internal reports drawn up in 2013 and 2014, where BEREC, on

⁶ The activity of the survey is connected to possible interventions or positioning that the Authority may wish to adopt nationally and in Europe, and it is therefore useful to have as much detailed information as possible on the practices implemented today by the operators at national level.

⁷ For example, the BEREC programme includes an action on the *framework review*, with the examination of the role of the OTT, the questions on *joint dominance* and on the growing complexity of the relationship between retail products and wholesale products.

⁸ BEREC Work Programme 2015.

the basis of the information acquired from the regulatory authorities of the Member States and from some stakeholders, pointed out the existence of various regulatory aspects that will have to be considered if there is a considerable spread of M2M. More in detail, BEREC has identified certain questions worthy of attention relative to: spectrum, numeration, international roaming, the authorisation system ⁽⁹⁾. It has also pointed out the existence of certain application cases that are gaining growing importance: smart grids, smart meters and interconnected cars. The Italian fact-finding survey is connected to the BEREC works and those of other National Regulatory Authorities (NRAs) for the coinciding nature and context of the matters examined. However, compared to similar works carried out by the Member States, BEREC or other European institutions, the AGCOM survey stands out for the following specific aspects:

- the marked focus on the national Italian context;
- the particular level of attention paid to the questions regarding the connectivity market;
- examination of particular strictly regulated aspects and, in particular, the critical aspect of the Electronic Communications framework and of national laws, which can occur in the case of the considerable spread of M2M applications and terminals.

The fact-finding survey was carried out by means of questionnaires (on both quality and quantity) and meetings held from June to November with the parties concerned that had expressed their interest ⁽¹⁰⁾. The Authority's intervention for electricity, gas and the water system (AEEGSI) is also pointed out, which, in a pure spirit of institutional collaboration, has drawn up and published on its own Internet site an contribution to the AGCOM fact-finding survey, with particular reference to the developments linked to smart grids and smart metering⁽¹¹⁾.

The report illustrated the main results of the survey, proposing a possible interpretation of the many elements acquired on which regulations can be based ⁽¹²⁾.

To allow for faster identification of the problems linked to regulation and to favour a rational presentation, this work develops prioritarily and separately the aspects linked to

⁹ See the Conference Proceedings of the M2M Workshop (Brussels, 19 November 2013) organised by BEREC.

¹⁰ The following companies were heard: Milan Polytechnic, Telecom Italia, Vodafone, Wind, Fastweb, Poste Mobile, Huawei, Qualcomm, Gemalto, Ubiquity, Acotel, Enel distribuzione, Magneti Marelli. The companies AT&T and Verizon also sent their contributions.

¹¹ AEEGSI memorandum 457/2014/I/com of 25 September 2014, available at the AEEGSI website at <http://www.autorita.energia.it/it/docs/14/457-14.htm>

¹² It must be specified that the classification was highly complex because of the innovative and differentiated nature and the variability of the questions which M2M brings to the fore.

connectivity, then analysing later those linked to the final service. Consequently, the chapters of the report are structured according to the following logical scheme:

- identification of the economic scenario of reference;
- survey of the infrastructures and technologies that are being prepared for M2M;
- identification of the regulatory aspects and, in particular:
- considerations on the role of regulation and of public intervention;
- regulatory aspects linked to connectivity;
- service offered to the end user;
- specific features of the main vertical segments of M2M, i.e. those of major interest because of the expected development in the next few years.

With regard to the organisation of the document, chapter 2 analyses the M2M market, identifying the particular features and the main players involved, also in consideration of the affirmation of a new business model in the electronic communications sector. From the viewpoint of the stakeholders of this sector, it is pointed out that the M2M ecosystem includes many and variegated subjects, involved in the value chain, both in development and in the supply of services and technologies. In the second part of the chapter, there is a more detailed analysis of the business models which seem to be specifically designed for the M2M market, and light is cast on the variability of the business forms adopted in the present economic scenario.

Chapter 3 examines the aspects relative to the available infrastructures of the public network and those which, if compatible with the future developments of this sector, seem more suitable for offering connectivity for the specific transmission needs of M2M services and in terms of efficiency, both for their technical features and for economic reasons.

Chapter 4 analyses the regulatory aspects of this sector, with reference to the role of regulations, the issues relative to connectivity, the aspects linked to the supply of the service to the end user and, lastly, the link with the vertical markets and the relative regulations.

Chapter 5 illustrates the prospects of intervening to favour the development of the M2M networks and services.

Chapter 6 reports the conclusions, summing up all the main regulatory problems that arise with M2M development.

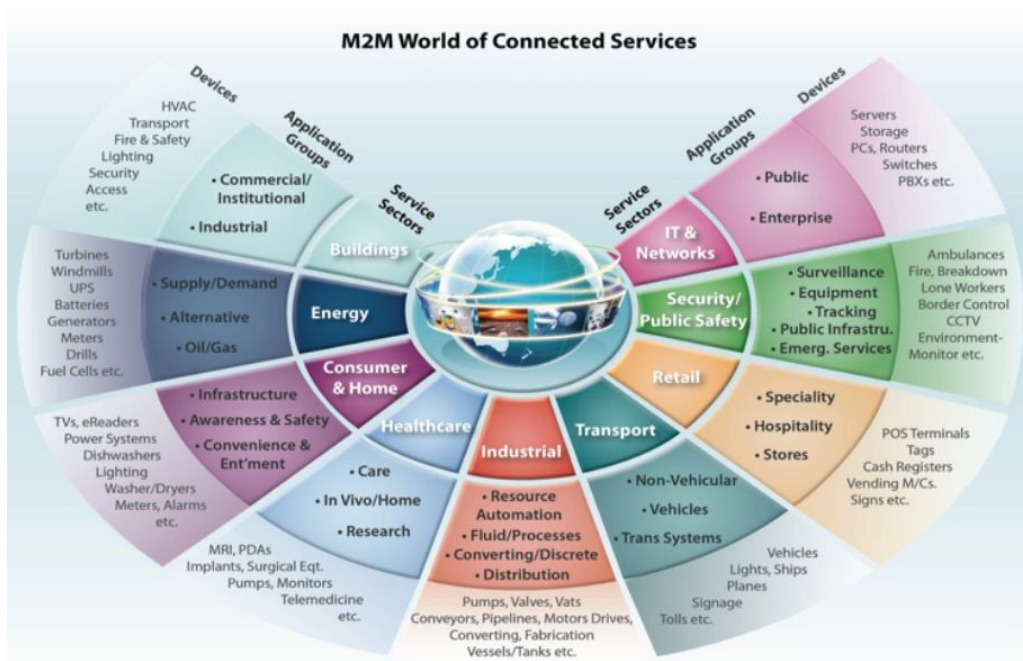
2. The economic and technological scenario of reference

2.1. The M2M market and the vertical segments

2.1.1. Scope of reference

The term *Machine to Machine* (M2M) generally refers to the process of the transfer of information on the part of devices which do not necessarily require human interaction ⁽¹³⁾. Since this process performance involves elements of both connectivity (access terminals and technologies) and of the supply of the service (contents and platforms), the term M2M covers many aspects and can regard many sectors of use (Figure 1 gives an indication of the sectors in which M2M is used).

Figure 1 – Sectors of M2M use



Source: Beecham Research

With regard to connectivity, although M2M was originally developed on wired network (typically for industrial automation), the scope of M2M has recently increased and it is considerably extended to wireless networks, both for the spread of low cost and low energy consuming "intelligent" terminals, and for the increased capacities of the radio networks. For that matter, the possibility of using the radio-mobile networks has allowed for the development of

¹³ During the hearings, it was specified that M2M services can include man-machine interaction, without, for this reason, losing their nature as M2M services.

certain applications such as logistics (e.g. goods monitoring) and the management of transport vehicles (e.g. fleet management).

This report concentrates on the M2M devices which require interconnection with the public network, since the other cases can be understood as private installations and therefore they are not of particular interest for the purposes of the regulatory analysis.

In M2M process, automatic interconnection of the devices takes place by connection to the Internet network. For this reason, M2M is often associated with the *Internet of Things* (IoT): in fact, M2M and IoT are partially overlapping concepts and, in much of the literary of the sector (especially that of Anglo-Saxon and United States origin), both terms are used as synonyms. On the other hand, on the technical level, a partial distinction between the two is possible: there are many applications (industrial automation, management of alarms, etc.) which are based on M2M communication services but which are extraneous to IoT.

Although the above considerations may not be shared (e.g. because they tend to confine M2M to intermediate services for the supply of connectivity and to separate it from the performance rendered to the end user), the relative arguments show that it is worth distinguishing between the two concepts of M2M and IoT. This breakdown, proposed herein, makes it easier to identify the more urgent regulatory matters and limits the risk of misunderstanding that could arise in debate on the regulation of IoT and, therefore, on the regulation of the Internet.

2.2. Subjects concerned by M2M

M2M, together with IoT, allow for the spread of new business models in the electronic communications sector. The main enabling factors are due to technological progress and to the improvement of manufacturing processes. It is worth mentioning, in particular: miniaturisation, reduced production costs obtained with globalisation, the availability of technologies and skills for system integration, IT technologies (*cloud, big data*), the possibility of providing *over-the-top* (OTT) application solutions, the existence of digital contents, the possibility of using services through the Internet network.

Using the scheme proposed in the SCREEN report ⁽¹⁴⁾, four typical elements can be recognised in the sphere of M2M communications, reported below.

I. Data collection

An M2M communication process starts from the acquisition of the data from a machine, to then analyse them and transfer them using a communications network. The purpose of an M2M system is to create a bridge between the intelligence of the machine and the processing system/use of the information. This means that the complexity of an M2M system depends strongly on the particular application considered.

II. Data transmission through a communication network

Possible solutions are the mobile phone networks, the telephone land lines, satellite communications and ad hoc networks. Also in this case, the choice of the most suitable infrastructure depends on the features of the application itself. For example, satellite networks are used for monitoring appliances in remote areas. In areas where the penetration coefficient of mobile phone networks is very high, it is obviously convenient to use radio-mobile type networks. In any case, it is evident that an increase in the availability of communication channels consequently decreases the cost of the service;

III. Information extraction

The techniques for extracting the information can be more or less complex according to the granularity of the monitoring system and the computing and analysis capacities of the receiving and processing system.

IV. Information use

Regardless of whether the application is of the stand-alone type or is part of an integrated system, the aim is to improve the efficiency of a process by automating the flow of data towards the possible users ⁽¹⁵⁾.

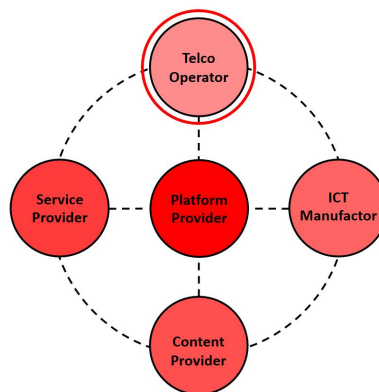
Therefore, the M2M ecosystem includes a variegated number of subjects involved in the development and supply of services and technologies: communication device manufacturers,

¹⁴ Research programme “Services and Contents for New Generation Networks” (SCREEN) promoted by the Authority. This follows on from the Authority's ISBUL research programme and aims to consolidate the research activities on issues relative to the economic, technical and social-legal aspects of the new generation networks, with particular regard for the problems inherent to the services, the content and the applications that can be used via the new networks.

¹⁵ The technology is enabling if it can transport the information at the right moment, to the right place and in the right way, according to the circumstances.

structured and virtual network operators, platform managers, content producers, service providers. Within this chain of values, every stakeholder attempts to exploit to the best its own assets and to integrate the various branches, thus proposing itself as a central operator of reference, the so-called platform provider. As coming to light in the confrontation with the subjects heard, this division of the stakeholders along the value chain is differentiated – within the M2M ecosystem – according to the vertical segment in question. However, one can try to describe the elements that are common to the various value chains, identifying the macro-categories that are common to all the segments (as in the example of Figure 2).

Figure 2 – Stakeholders of the M2M ecosystem value chain



Source: Agcom

2.2.1. Network operators

Network operators provide access to the M2Ms. Access is generally of the wireless type (about 80% according to the *Machina Research* estimates ⁽¹⁶⁾ and most wireless accesses take place through mobile networks (60%). In view of the type of consumption profiles (typically *burst* and with low *payloads*), the second mobile phone generation seems still satisfactory in terms of band (according to Cisco data, a generic M2M device requires a band 13 times lower than a tablet ⁽¹⁷⁾).

¹⁶ The Global M2M Market in 2013, Machina Research, 2013.

¹⁷ *Visual Networking Index*, Cisco, 2014. The comparison between the M2M band request and the tablet band request is reported to facilitate comprehension of the phenomenon; it must be noted that the use of the factor 13 requires caution to take into account the context in question. In any case, this parameter must be checked in real applications.

2.2.2. Content producers

Users of M2M services are also content producers since they generate “*personal data*”: in fact, if M2M devices produce by definition traffic not generated voluntarily by the user, it is also true that simple processing can allow for receiving “valuable” information (family members, expense capacity, etc.). The importance of the contents generated through M2M tools is also found in certain important commercial operations, such as the takeover, in January 2014, of the Nest Company (a start-up which produces smart meters) by *Google*. Similarly, the information produced by M2M devices in the industrial sphere also seem important: according to a study of the *World Economic Forum*, industries are already investing large sums to share (with other players of the supply chain or other consortium partners) and to process (*big data analytics*) data generated by M2M devices ⁽¹⁸⁾.

2.2.3. ICT manufacturers

As for other sectors of the digital ecosystem, the manufacturing works represents a particularly dynamic and innovative segment. In general, many manufacturing companies produce devices and develop software for M2M services. The macro-category of the manufacturers can, in turn, be further broken down into various subjects according to the vertical segment considered. It is interesting to note the recreation, in the manufacturing world, of the centralisation dynamics (*platformisation*), already noted at the higher level (*interior homothety*). Integration of the components therefore plays an important role, and tends to become nothing less than a real platform ⁽¹⁹⁾.

2.2.4. Service providers

Also in the sphere of services, there is considerable innovation, especially if one considers the “connected” part of the M2M segment, or the IoT: for example, *personal area networking* and *home automation* are two of the most promising sectors within the sphere of the Internet of Things: in the first case, one service could be *personalised shopping* (going up to a shelf, one receives information on the products), whereas in the second case the devices with home WiFi connection could interact and optimise consumptions ⁽²⁰⁾.

¹⁸ Winning with the Industrial Internet of Things, WEF, 2015.

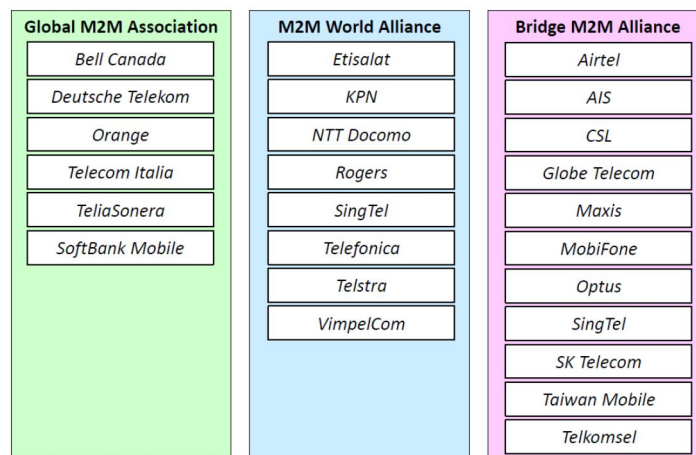
¹⁹ The value chain and the business models of the digital ecosystem, AGCOM, 2014.

²⁰ IoT, a great opportunity for industrial manufacturing and Internet of Things - Return to the Future (Near future), Key4biz, 2014.

2.2.5. Platform Operators

The aim of the various stakeholders is to create a device, equip it with connectivity, connect the data that the product can obtain, create vertical applications and therefore give added value to the said product. Thus, also in the M2M sector, competition between platforms is re-proposed. At present, about 60% of the operators on the market adhere to a global alliance, i.e. a platform which pushes towards standardisation and collaboration for the development of new products and services ⁽²¹⁾. At the moment, there are three main alliances, as shown in the following Figure 3.

Figure 3 – Main M2M alliances



Source: GSMA

It must be noted that the scheme proposed, precisely since it is general, may differ from the schemes proposed by certain subjects heard (typically linked to a specific vertical segment or concerned with a specific aspect of the value chain), however it is coherent with what is presented by the stakeholders and with what can be identified in other segments of the digital ecosystem and by other studies regarding the regulatory sphere ⁽²²⁾.

With reference to the cases examined in the Italian context, there are certain initiatives worth mentioning undertaken by virtual mobile operators (MVNO) which are developing interesting solutions for monitoring consumptions and for optimising the management of energy

²¹ On the market of communications between objects, even more than in human communications, scale dimensions are of great importance in order to face a highly complex and fragmented market.

²² Future Internet: scenarios of convergence, enabling factors and new services, AGCOM, 2014; The value chain and business models of the digital ecosystem, AGCOM, 2014; *Regulating Smart Metering in Europe: Technological, Economic and Legal Challenges*, CERRE, 2014; *Unlocking the Value of Personal Data: From Collection to Usage*, WEF, 2013.

inside buildings or other types of structures and plant. In the case examined within the scope of the fact-finding survey, connectivity is assured through the virtual operators' SIMs installed in the various devices, destined for the offer of assistance and system control services. The information is therefore collected, registered and transmitted to a web platform which, through an evolved and customisable interface, allows every user access to the data and the functions enabled according to his/her profile. In view of the central role of the SIM, the contract with the host mobile infrastructure also takes on a central role for the purposes of the preparation of the offer. Depending on the type of contract and the performances offered by the structured mobile operator (e.g. the possibility of sending signalling messages ⁽²³⁾), the virtual operator can configure itself or not as a facilitator ⁽²⁴⁾ of the M2M market.

2.3. M2M and change of paradigm

With reference to the network operators, the M2M could lead to a so-called paradigm shift, for at least two reasons.

First of all, there is progressive focus of its own activities from *Business-to-Consumer* (B2C), where the company has a direct economic agreement with the users, to *Business-to-Business* (B2B) and to *Business-to-Business-to-Consumer* (B2B2C), where there is no longer a direct agreement with the end user. Also if the operator continues to maintain an agreement with the end user, with M2M communication the service plan tends to disappear, and therefore the network operator^{4s} is mainly engaged on guaranteeing basic connectivity for the devices. The M2M connectivity service users are not the end users but they are the manufacturers of M2M devices or M2M service providers, even if the M2M services or M2M applications involved are destined for traditional users. At times the telecommunications operators do not interact with the service suppliers: in this case, the business is managed by the device makers and the service is rendered by the M2M service provider, which only optionally may be a telecommunications operator.

Furthermore, there is an additional push towards the globalisation of M2M services: in the case of global products (automotive products, e-readers, household appliances, etc.), M2M services are global by their very nature. In fact, a considerable proportion of M2M services are offered in a globalised manner. This feature is particularly evident when M2M is part of a product

²³ For example, the USSD (*Unstructured Supplementary Service Data*) messages usually used for sending instant messaging through the signalling network.

²⁴ M2M Service enablers.

which allows natively for the mobile connection (e.g. in the case of a new generation car, or an interconnected device like the Kindle). In some cases, the consumer buys an interconnected device, usually witted with a SIM, but does not sign a contract for the supply of a communication service. In these applications, roaming is almost always an enabling factor because it simplifies the predisposition and the distribution of such global products.

For mobile telecommunications operators, M2M services normally imply modest data traffic volumes, low profitability, long life devices and long life contracts. Only in the case of video signal transmissions are there consistent data volumes, but the land-line network is preferred for such connections. In general, mobile telecommunications operators have different strategies for the positioning in the M2M value chain. Since connectivity represents a relative modest part of the total sales of M2M services, the operators are increasingly exploring the opportunity of amplifying their services portfolios. In order to implement this strategy, the major operators have stipulated roaming agreements and they have developed specific protocols for M2M for the supply of connectivity services at global level. These agreements are stipulated within alliances, which also involve the sharing of specific technological solutions in order to provide the services with the evolved connectivity (e.g. support for the configuration of the SIM) necessary to answer the demand for global connectivity. In addition, the telecommunications operators, to develop added value services, are developing partnerships with system integrators and IT suppliers.

2.4. The M2M vertical segments

At global level, one of the key segments of the M2M industry is that of connected cars, i.e. cars which use the connection for the security systems (the eCall system mentioned in paragraph 4.4.1) and for infotainment services.

Another important sector is the smart metering sector. In this case, 71 million connections are contemplated in 2016. In particular, Italy stands out for the widespread use of electricity and gas metering with consistent numbers in terms of devices installed (the first country in the world to eliminate electro-mechanical meters, replacing them with intelligent meters).

The smart grids segment is also worthy of attention. A smart grid is an “intelligent” electricity distribution network which allows for the management of the electricity network efficiently and rationally, at the same time eliminating voltage overload and variations beyond the nominal value. To this regard, the Authority's intervention for electricity, gas and the water system (AEEGSI) is also pointed out, which, in a pure spirit of institutional collaboration, has drawn up

and published on its own Internet site an contribution to the AGCOM fact-finding survey, with particular reference to the developments linked to smart grids and smart metering ⁽²⁵⁾.

Lastly, the innovative sectors linked to the M2M and IoT world also include the smart cities segment, i.e. the application of ICT technologies to the city infrastructures and services, to obtain greater efficiency and quality of the same with benefits for inhabitants and companies.

There are also other interesting segments which, however, have not been further analysed in this report, such as smart homes & buildings (new solutions often addressed directly to the user-consumer, which vary from home management to the personal sphere), asset management (sensors connected to assets which are then registered and monitored in real time), fleet management (the vehicles can be managed and controlled while travelling along their routes), the security segment (connectivity used for the home and for the security alarms), payments (ATM/PoS terminals linked to a centralised secure environment).

The analysis of the factors which determine the spread of M2M is worth special consideration. In this context, it seems opportune to classify the applications assessing whether the development of the demand springs directly from a legal obligation (national or European), or if development is autonomous, determined by the market. This classification emphasises the role of legal provisions as driving factors for the development of M2M applications. On the basis of a preliminary investigation, three main groups have been identified, indicated below.

1. M2M applications which have developed subsequent to a legal obligation, e.g.
 - *connected cars* (for the provision on the eCall emergency call);
 - *smart metering* (for the Italian provision on meters);
 - *asset management* (limited to certain cases, such as lifts and gaming machines).
2. M2M applications whose development could be linked in the future to a legal obligation, e.g.
 - smart cities,
 - smart grids,
 - smart homes & buildings.
3. M2M applications whose development is not directly linked to a legal obligation, e.g.
 - fleet management,

²⁵ AEEGSI memorandum 457/2014/I/com of 25 September 2014, available at the AEEGSI website at <http://www.autorita.energia.it/it/docs/14/457-14.htm>

- payment,
- security.

2.5. M2M business models and financing sources

Despite the variegated nature of the IoT context, certain common lines can be identified in the development of the sector, as well as certain business models (so-called patterns) which appear to be specifically designed for the M2M market.

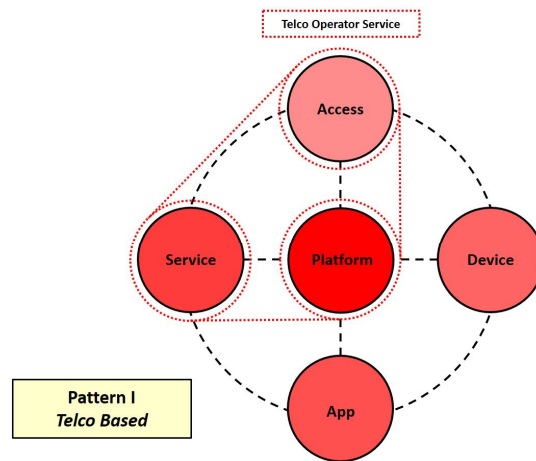
With regard to the development lines, there is a tendency, already highlighted previously, to "conquer the centre" of the value chain. The multiplication of the interactions between the different levels and the various players of the value chain gives a significant advantage for those who succeed in taking the role of intermediary between the various components. In fact, in all the main vertical segments considered (connected cars, smart meters, etc.), the role of the *integrator* stands out, i.e. the subject which, exploiting his/her own expertise and assets, presents him/herself as a unifying subject of the different requests. It is also to be noted that the role of *platform provider* can be carried out both by network operators and by device manufacturers (as in the case of smart meters), and by service and content providers (as in the case of connected cars).

Another element common to the various M2M applications is data valorisation. The phenomenon known as "*big data*" is also linked to M2M and IoT development. The analysis of the data automatically acquired from the various devices allows for greater efficiency of the processes and improved user profiling. Not by chance, there are many expert operators involved in the analysis of enormous quantities of data gathered from M2M devices. According to the CEO of Orange, "Information is the gold of the new digital era and entire sectors are getting organised to obtain maximum profit from it".

With regard to the specific development models (the so-called patterns), a possible classification is that based on the most involved actor involved in the role of platform operator (telcos, OTTs, utility, etc.).

Pattern I can be illustrated by Figure 4 below, which shows the Network Operator's role in the supply of M2M services.

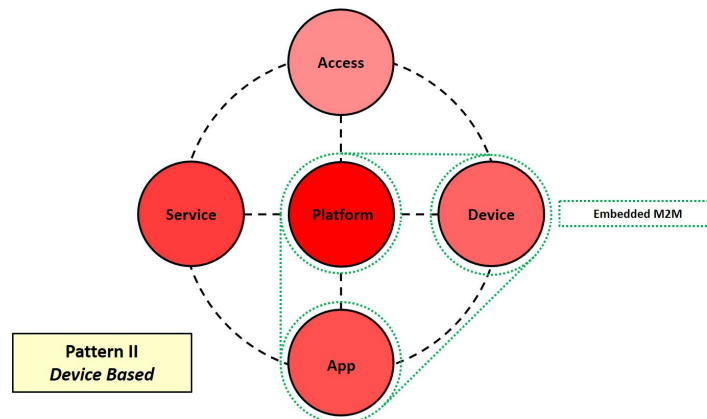
Figure 4 – Business model of an M2M service supplied by a network operator



Source: Agcom

Pattern II can be represented by the following Figure 5. For example, an M2M device which uses SMS transmission will extend the service to the operator with additional functions which feature the service layer used by the end application. Similarly, in the case of the use of the Internet network, the IP service layer will be provided by the Internet Service Provider.

Figure 5 – Business model of an M2M device supplier

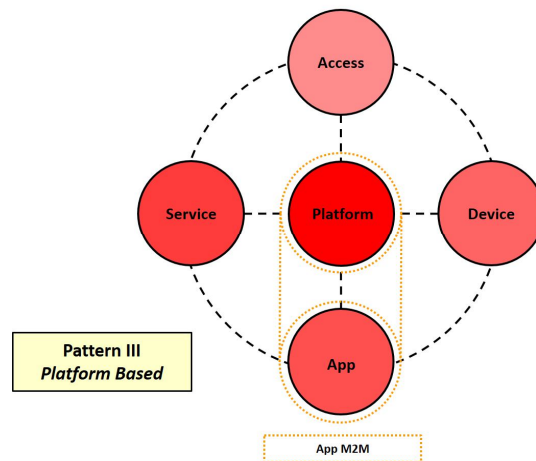


Source: Agcom

Pattern III, which refers to the development of platforms for third parties' applications, could be depicted by Figure 6 shown below: there can be an OTT which provides the service through the Internet (the IP transport service, on the M2M device side, is provided by the Internet Service Provider). An interesting variant of the above scheme is that of the recent cases of agnostic SIMs (the "network-agnostic" SIMs do not depend on the network of a specific mobile operator) and is very suitable also for international roaming, where the service is typically localised on the home network, while access is achieved on the visited network. In this case, the operator's

commitment (for example, the mobile network visited during the roaming session) consists of supplying exclusively access. In the case of agnostic SIMs, the activities identified under the item “M2M service” can be further broken down by isolating the authentication function from the remaining performance regarding the service. In this way, authentication could be linked, for example, to the M2M device and therefore directly installed in the device.

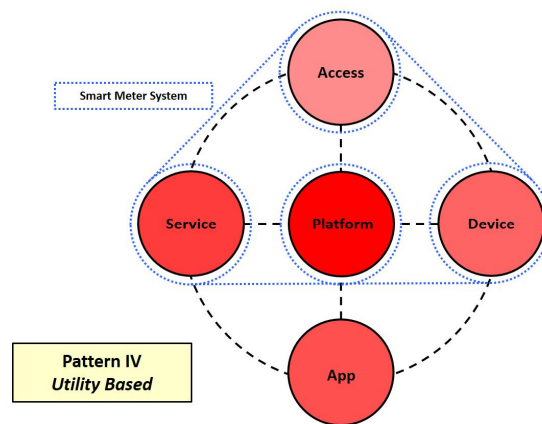
Figure 6 – Business model of an M2M services aggregator (platform)



Source: Agcom

Also the case of electricity meters (*Pattern IV*), presented in Figure 7, represents an interesting reference. In this case, the TLC service supplied by the operator consists only of the connection of the concentrators and therefore the access level is carried out directly by the entity which manages the M2M service (the electricity company). In this case the technology used is that of the waves transferred (*power line communication*) which uses the electricity supply network as a means of transmission. The case of the gas meter presents interesting points: the first reference would seem to be represented by the preceding organisational scheme relative to the electricity meter, but it is plausible for the implementation of the M2M service to be potentially carried out by an outsourcer, namely the operator which provides the access and transport service. Although this method is similar to Pattern I (at least from the operational viewpoint), from the formal viewpoint it is a particular implementation of the case shown for the electricity meter. In the case of gas, the access network is in fact normally that of wireless technology (e.g. W-MBUS on the 169 MHz band). The scheme proposed for gas metering shows one of the potential problems of separation which could be a feature of M2M. In fact, the use of the M2M service could require special interfaces with the operator's service and access platforms, which, however, might not be marketable at the wholesale level.

Figure 7 – Business model of utility companies which supply M2M service (for example, smart metering)



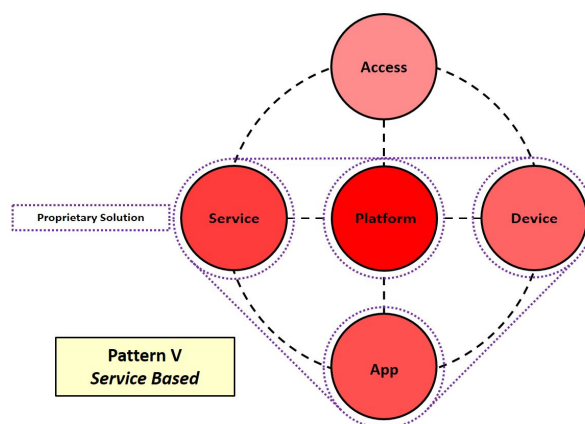
Source: Agcom

Lastly, there is the case of vertically integrated proprietary solutions (*Pattern V*), excluding access (see Figure 8). With reference to mobile technology, the main elements that could be required for the development of the M2M layer development are:

- configuration of the SIM;
- the technology for the *Over The Air* charging of the SIM;
- authentication of the terminal (*Authentication Centre - AuC*);
- management of the user profile (for example, APN configuration in the *Home Location Register - HLR*).

The unavailability of some of the said performances could limit the development of the M2M service platform on the part of alternative suppliers.

Figure 8 – Business model of an M2M services supplier



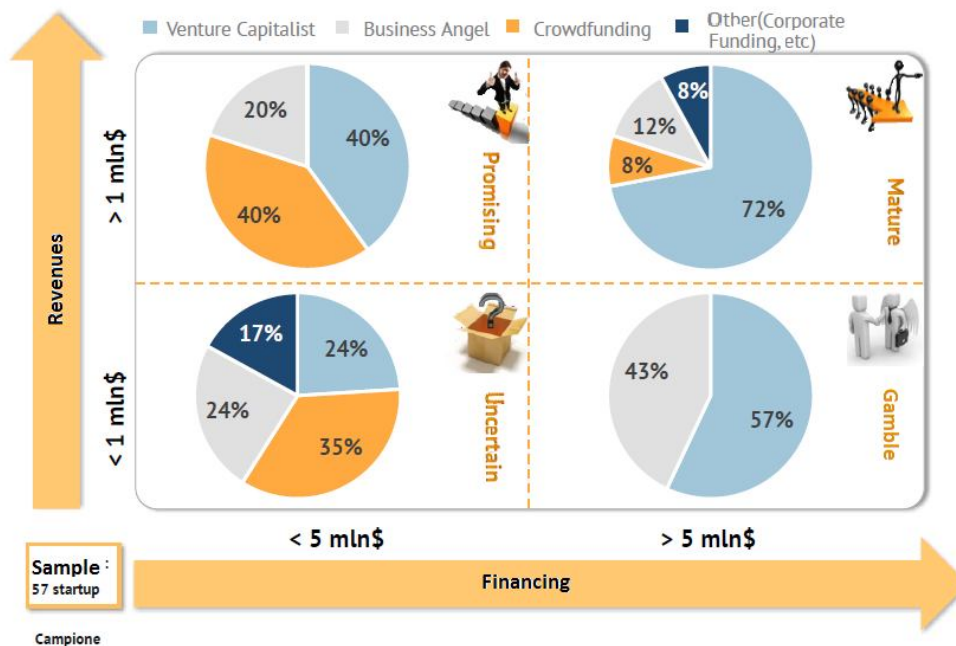
Source: Agcom

The variability of the business forms is also reflected in the extreme variability of the forms of financing. If, for example, one considers the *start-ups* operating on the M2M market (which, as pointed out previously, represent an important part of the ecosystem), one can observe various financing methods, such as *venture capitalists*, *business angels*, and *crowdfunding*. The first two figures represent those of the investors in non-listed companies (of the "formal" *venture capitalist* type, and of the "informal" *business angel* type), while *crowdfunding* is a micro-financing practice from the bottom.

Cross-checking the two dimensions (sales and financing), one can break down the companies which operate on the market into segments: companies with low sales and financing (*uncertain*), those with high sales and financing (*mature*), those with high sales but low financing (*promising*), and those with low sales and high financing (*gamblers*).

The M2M Observatory of the Milan Polytechnic has analysed 37 M2M market start-ups (see Figure 9), and has assessed the incidence of the various forms of financing of each of the 4 clusters (uncertain, mature, promising, gamble): when external financing is scarce (which often happens in the early live of a start-up), crowdfunding is one of the main forms of financing, while financing is from venture capitalists in over half of the mature and "gamble" start-ups.

Figure 9 – Sales, investors, and financing of M2M start-ups



Source: Milan Polytechnic

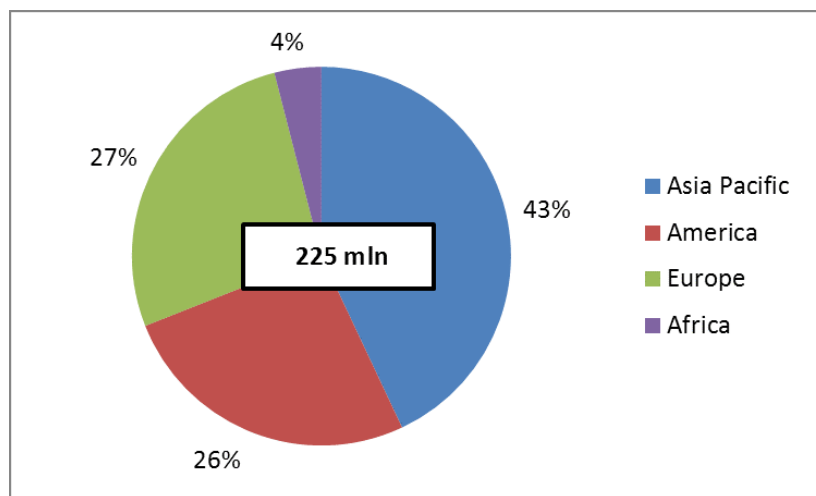
2.6. The Italian scenario

The fragmented nature of the IoT ecosystem imposes limits on the possibility of measuring the scope. First of all, an initial approximation, useful to give reliable estimates of the national scenario, is to consider only M2M devices connected to the mobile phone network: this decision is adopted also by other sources (the Internet of Things Observatory, the Quarterly Observatory on Electronic Communications) since it represents a reliable proxy of the phenomenon in question (according to *Machina Research*, most of the devices use mobile M2M connections), and it also allows for excluding the installations on private networks which are of less concern for the Authority.

The caveats on the estimated “dimension” of the M2M market are even more valid if one attempts to make a detailed estimate of the “value” of the M2M market: unlike the user base (which is affected by the accumulation effect), profits are mainly subject to the “variability” of the market (there can be swings due to the invoicing date and to the exchange rate, as shown also in the methodological notes of the above-mentioned observatories). The data given must therefore be interpreted as an evaluation of the size of the sector, and indicate a trend rather than a specific figure.

It is estimated that there are more than 200 million M2M lines in the world in 2014 (Figure 10). If the present growth trends are confirmed (over 20% a year), there will be half a billion devices in 2017. Asia, driven by the Chinese market, represents the greater part of the user base, while Europe and America are balanced in terms of numbers of lines.

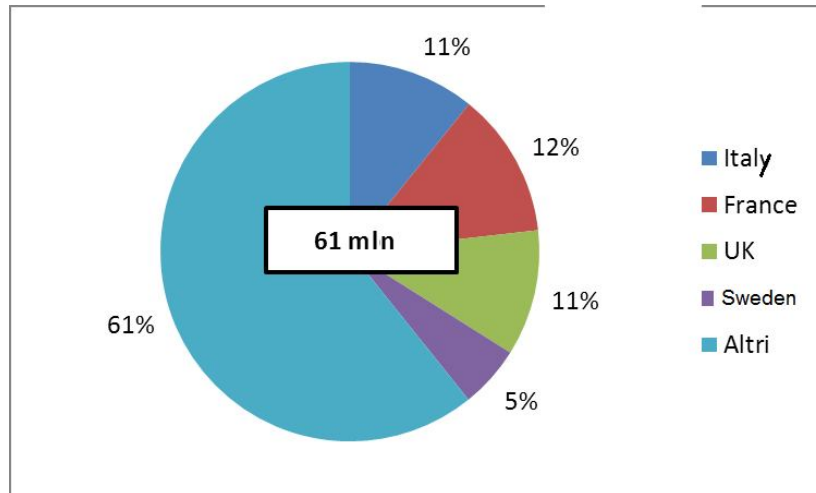
Figure 10 – M2M connections in the world in 2014



Source: processed by Agcom

On the European panorama (Figure 11) Italy, France and Great Britain have substantially similar quotas. However, it must be emphasised that if the number of M2M connections is normalised in respect of the total number of mobile connections, the Nordic countries prevail, such as Finland (12% of SIMs dedicated to M2M), Norway (15%), and Sweden (24%).

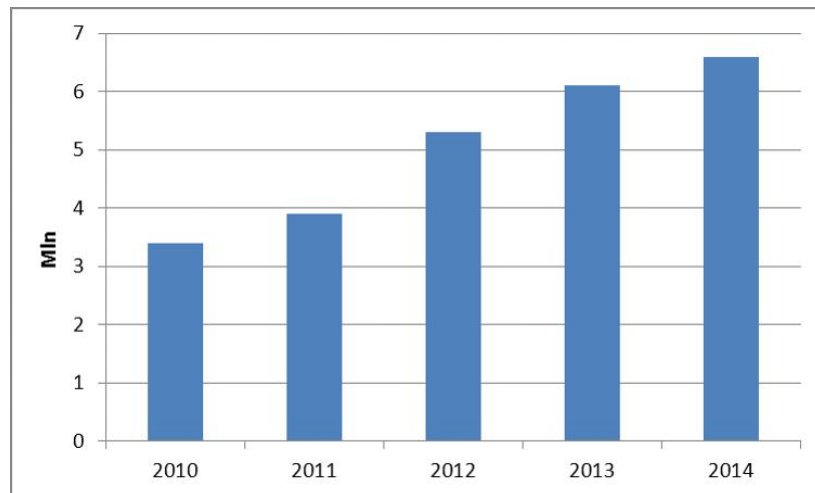
Figure 11 – M2M connections in Europe in 2014



Source: processed by Agcom

With regard to Italy (see Figure 12), a significant increase in M2M connections in the five years considered is confirmed (with an aggregate annual growth rate of 18%). The varied nature of the M2M market is also evident in the analysis of the growth trends of the vertical segments. Against segments like the automotive segment, in which connected cars are increasing by more than 30% a year, there are others, like the Smart City segment, in which the adoption of M2M devices is much lower. The incidence of connected cars has grown over the years (also due to the different cumulative effect mentioned above), increasing from about one third to almost half of the mobile M2M connections.

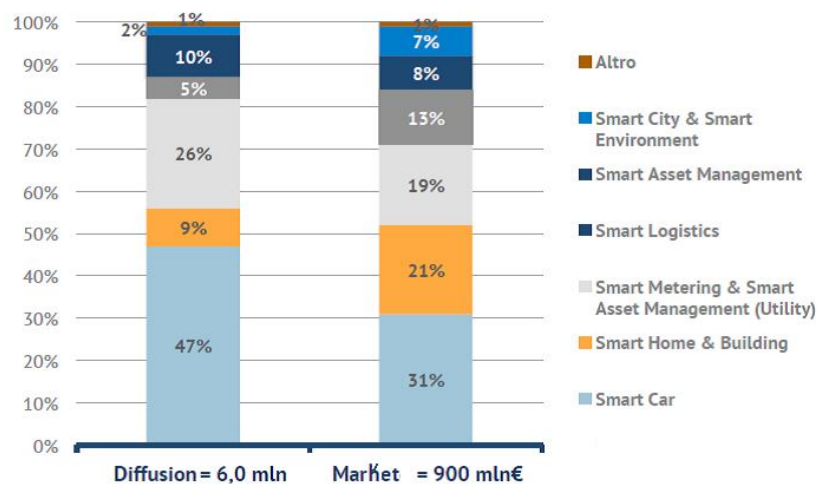
Figure 12 – M2M connections in Italy in 2010-2014



Source: processed by Agcom

However, as also pointed out by the M2M Observatory of the Milan Polytechnic (see Figure 13), the greater spread of connected cars does not immediately become a greater preponderance of revenues: in terms of value, the Smart City, Smart Logistics and Smart Homes give greater returns.

Figure 13 – Comparison between diffusion and market value: breakdown by application spheres in 2013

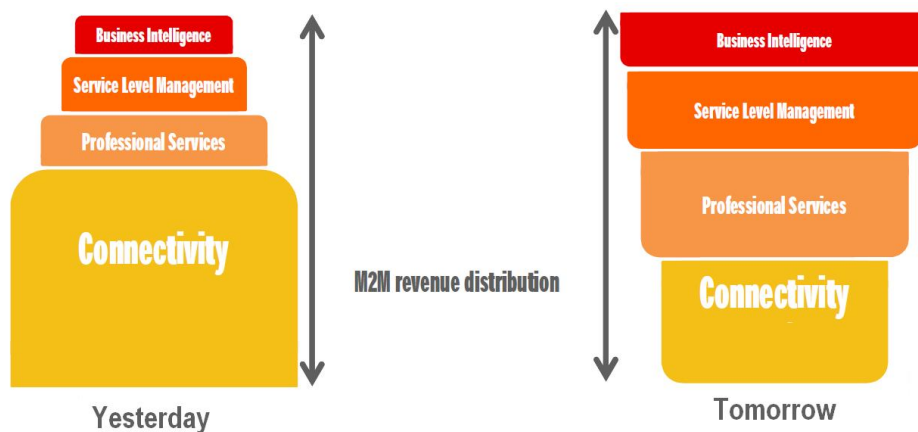


Source: Milan Polytechnic

With regard to revenues, the world M2M market has been estimated to be worth over 130 billion euro in 2014. Some analysts have attempted to quantify the value of only the connectivity components, estimating it at about 13 billion euro, i.e. 10% of the total. Although coming from different sources, the two values indicate a phenomenon pointed out by all subjects heard, i.e. the

progressively greater incidence of revenues for added M2M services compared to the access component (see Figure 14).

Figure 14 – Breakdown of M2M market revenues



Source: Informa

This migration is also apparent on the Italian market. Although with due caution in consideration of the varied nature of the sources and of the estimation methods, revenues from M2M connectivity in Italy in 2014 can be reasonably quantified in the order of tens of millions of euro, compared to total revenues estimated at hundreds of millions of euro (900 million euro according to the data of the Milan Polytechnic M2M Observatory).

3. Infrastructures and M2M technologies

The infrastructures of the public network available at present seem partially inadequate to offer connectivity for the specific transmission needs of M2M services, both for their technical features (M2M has very low, but very widespread, traffic flows) and for economic reasons (the diverse band occupation would require different economic models from those used by a massive use of the networks). These critical aspects are pushing the M2M service providers to create ad hoc networks and architecture which, in first analysis, seem to be classifiable in a regulatory key as private networks and therefore possibly excluded from the scope of the survey. It is clear that this solution is not efficient on the economic level and that it is reserved to the large providers (e.g. electricity operators which also receive economic incentives for the creation of such private networks). It is therefore necessary to begin careful reflection on the adequacy of the public networks and on the opportunity of their use to vehicle new services, thus allowing for benefiting from scale and scope economies that would otherwise be absent, to the detriment of the entire system and the development of the new services.

This chapter is dedicated to the analysis of the M2M infrastructures and technologies. The observation of the initiatives in progress, especially the technological developments, is, in fact, an essential point to understand the particular nature of the demand and of the offer of these new markets and, consequently, of the relative regulatory implications ⁽²⁶⁾.

3.1. Connectivity of M2M/IoT devices

M2M devices may have significantly different and varied connectivity requirements. For example, applications for the transmission of a video signal require sufficiently high transmission capacity; on the contrary, in the case of smart metering, the problem is the number of devices to be connected, their position (installation in shielded cavities, under the road surface, etc.) and the need to limit energy consumption since this would be provided by batteries, but transmission capacity is not a relevant parameter.

²⁶ In fact, it must be observed that at first sight it could appear inopportune to introduce specific new regulations for M2M since it could be assumed that, in virtue of the application of the principle of neutrality, the regulations in force are already adequate. This aspect has been widely sustained by all those already holding a general authorisation pursuant to art. 25 of the Electronic Communications Code, when requested by the Authority to consider the possibility of specific authorisation for M2M.

For greater contextualisation of the analysis, it was deemed useful to highlight the technical inadequacy of the infrastructure compared to the emerging needs and the consequent need to ensure coherence with the regulation. This "physical" aspect does not ratify the need to contemplate a separate authorisation for M2M, but it does give useful points for understanding and examining the problem.

A network capable of supporting M2M traffic must consider the many different needs, listed below:

- M2M requires efficient management of the signal load (i.e. the exchange of information functional to the network), in respect of the effective level of useful traffic exchanged;
- the transmission of very large files or continuous data flows (voice or video streaming) are not frequent;
- M2M traffic management is also different since it is mainly *uplink*, while conventional user traffic is usually *downlink* (or, at the most, balanced);
- the delay in M2M connection must be extremely short to guarantee fast access to the network when the device is activated;
- M2M applications could require very high priority to allow for the transmission of critical information;
- M2M requires the management of a very large number of terminal devices;
- it is necessary to manage thousands of terminals for every radio (and not to multiply the radio station) to allow for economic efficiency;
- the devices are often fixed and therefore it is not necessary to generate signalling traffic to support mobility;
- in the case of M2M, it may be necessary to ensure functioning for years or decades, due to the absence of evolutionary maintenance.

In general, M2M poses questions on the dimensioning of the existing mobile networks which could suffer from control channel congestion phenomena with consequent block of the entire service (for example, *Control Channel*, *Random Access Channel Congestions*).

In addition, the survey has brought to light the need to ensure the economic sustainability of the M2M business cases which feature limited profitability values for each connected device.

Lastly, some applications may require respect for predefined levels of network availability (see 4.4.3).

3.1.1. GPRS/EDGE mobile radio technologies

With reference to the 2G networks, the participants pointed out the high intensity of the adoption of this technology in M2M applications. This figure, on first reading, seems incompatible with the present prospects of GSM switch-off; however, a more detailed analysis will help to understand the reasons for this phenomenon. In fact, 2G technology transmission modules cost around 10 US dollars, while the corresponding 3G modules cost about \$20, and those in LTE

technology are in the 30 - 40 dollar bracket⁵. It is clear that the need to contain the costs of the transmission module is an essential condition in the light of the limited profitability possible for each connected line.

In addition to the unit cost of the module, one mobile radio operator pointed out, with reference to the GSM network, that standards are being defined to allow for the adaptation of mobile networks for the typical M2M uses. The technological innovation of reference is known as *Cellular IoT*, and regards the GPRS/EDGE network on bands licensed for mobile telephony and it should be available by 2016. The guidelines of this initiative are indicated below:

- use of the 900MHz spectrum, for the purpose of developing smart metering;
- introduction of simplifications of the network and of the terminal (taking note of the fact that smart meters do not require mobility support);
- use of transmission techniques which allow for an extension of coverage.

For more details, see the documentation published by the GERAN (GSM/EDGE Radio Access Network) group, which is responsible, in the 3GPP sphere (²⁷), for the specification of the GSM/EDGE Radio Access.

The solution must be evaluated also to understand whether it can be used only by 2G spectrum licensees and if diffusion involves restrictions in the spectrum *refarming* procedures.

3.1.2. LTE mobile radio technologies – Machine Type Communication

Machine-Type-Communication (MTC) is a new aspect to be considered in the study of the technological evolution of mobile networks. Mobile network operators, through the 3rd Generation Partnership Project (3GPP), are engaged on the preparation of LTE Machine Type Communication technology, or LTE-MTC, which will be issued in Release 13. LTE-MTC represents an optimisation of the LTE-Advanced standard for M2M support and it uses the following features:

- compatibility with the 4G evolution framework;
- considerable increase of battery duration;

²⁷ The *Third Generation Partnership Project* (3GPP) is a collaboration agreement between bodies which deal with the standardisation of telecommunication systems in various parts of the world. The original objective of the 3GPP was to produce specific techniques for a third generation mobile system based on the *GSM* Core Network and on the *Universal Terrestrial Radio Access* technology (UTRA). Later the 3GPP was asked to control and improve the technical specifications for GSM including more modern access technologies such as GPRS and EDGE.

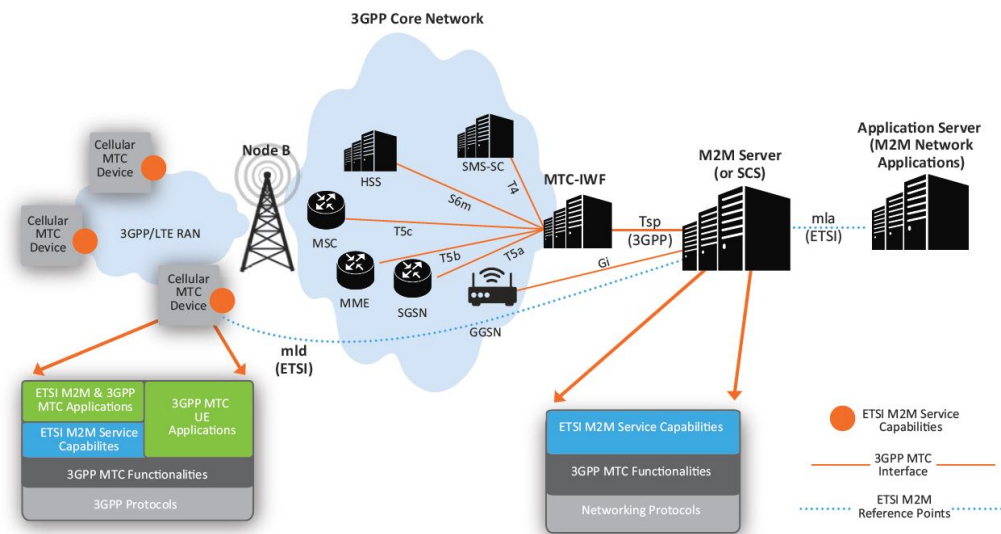
- reduced costs and complexity;
- compatibility with broadband mobile services;
- integration with IoT technologies.

LTE-MTC introduces the functioning mode called *Power Save Mode* (PSM) which allows for efficient switch-on and switch-off of the transmitter for devices which require programmed type transmissions. The LTE-MTC standard, compared to the LTE standard, therefore introduces:

- an updating of the architecture and, in particular, the introduction of the MTC server;
- an updating of the communication protocols;
- an updating of the radio technologies (RAN functions of *overload control*, *extended access barring*, etc.).

Figure 15 represents, in a simplified form, the main architectural elements introduced.

Figure 15 – LTE-MTC architecture



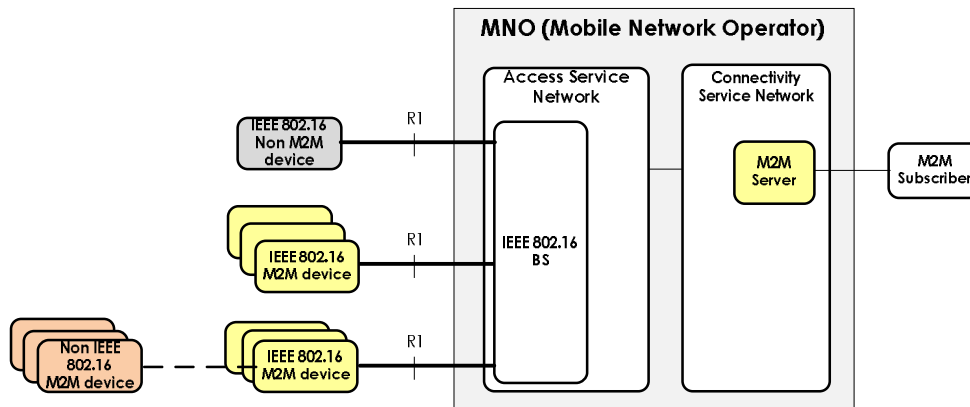
Source: 3GPP

3.1.3. WiMax mobile radio technologies

In the IEEE sphere, the standard 802.16p has been defined, which extends WiMax technology to M2M. The standard was issued by the IEEE in 2012.

Figure 16 represents, in a simplified form, the main architectural elements introduced.

Figure 16 – WiMax 802.16p architecture



Source: IEEE

3.1.4. W-MBUS radio technologies and solutions for gas metering

In 2008 the Electricity, Gas and Water System Authority (AEEGSI) resolved on the obligation – for gas distribution companies – to use a remote management system for the meters connected to its own networks and the time frames to be respected for installing and implementing this system. The Italian Gas Board (CIG) dealt with the activities for the regulation and distribution of this service.

The technical specifications define the architectural aspects studied to offer the flexibility necessary for operating in the more common usage scenarios. The architecture offers two basic communication modes by which every meter (regardless of its calibre) can link to the Management System (SAC): by a direct connection (point-to-point solution, for example with a GSM module on board the meter) or by wireless by means of a proximity network (point-multi-point network, with a low consumption wireless network).

Wireless MBUS (W-MBUS) is a standard European protocol developed for metering applications. It uses the frequency band between 169.400 and 169.475 MH⁽²⁸⁾. The driving reason

²⁸ W-MBUS uses a narrowband protocol in GFSK modulation with diverse data rates, exploiting 6 different channels. The channels range from 12.5 kHz and have a bit-rate of 4.8 kbps (channels 1a, 1b, 3a, 3b) or of 2.4 kbps (channels 2a, 2b). There is also an N2G mode which uses a 4GFSK modulation which covers the different channels to offer a greater data rate and which has been reserved to implement relaying mechanisms between different nodes. The standard also defined various service classes; the highest class contemplates a minimum level of sensitivity of the receiver of -115dBm with PER<10⁻² (Packet Error Rate). The protocol contemplates two types of communication mechanisms at application level, one in which the meter is activated at fixed times to communicate the meter reading to the concentrator (*Access Timing*) and one in which the meter, on activation,

for the choice of the W-MBUS protocol at 169 MHz was mainly the low work frequency, which should allow for reaching greater distances and suffer less from the attenuation caused by possible obstacles. ⁽²⁹⁾

At present, according to the Italian Frequency Allocation Plan, the 169.4-169.8125 MHz frequency band is used according to the European Commission's decision 2005/928/EC. It is divided into two parts, one for low power applications, and the other for high power applications, each of which contemplates preferential applications and possible other alternative applications, in compliance with art. 3 of decision 2005/928/EC. Low power applications are included within the sphere of the "free use" system contemplated by art. 105, section 1, of the Electronic Communications Code. High power applications, however, are subject to the "general authorisation" system and the relative "individual right of use" pursuant to art. 104, section 1, letter a), number 1), of the Electronic Communications Code. Thus, present legislation strongly limits the use of this frequency range for metering, to generic systems for the tracking of stolen or lost property, and lastly for assisted living/social alarm applications, excluding applications potentially of great interest (civil and commercial) such as public lighting, parking, waste collection, environmental monitoring, etc.

Furthermore, if there are many subjects using the band (in the case of multi-services, therefore, since in the case of gas metering there is a single subject which manages the gas network on a geographical basis), the mechanisms by which the various channels in the band are divided among the various operators are all still to be defined, since today this band is normally for "free use".

The analysis of the context stimulates the following reflections on the elements that could have relevance for the regulating body:

is notified of the presence of commands addressed to the same to establish a dialogue with the concentrator (*Synchronous Transmission*).

²⁹ The typical scenario of the remote gas meter reading network contemplates, in fact, devices installed in niches cut into walls, positioned on several levels. The question of the areas that can be reached by the installation of a concentrator or repeater is crucial in the business planning stage: the concentration factor and the number of devices that can be reached, whether they are meters, sensors, etc., allows for estimating the costs and the potential returns that can be obtained from the diffusion of the network. Radio coverage depends on various factors, some decisive and others uncertain. The elements that determine the level of the signal received include the type of place in which the devices are positioned at the moment of the data exchange. It is necessary to take into consideration the position of the meters: the niches for the gas meters significantly reduce the power of the signal, and those for water meters (man-holes or cellars) reduce it even more); furthermore the reduced size of the meters also cause a reduction in the size of the antennae which, therefore, can no longer be optimised for that frequency.

- the 169 MHz band has been little exploited over the years for widely distributed services, therefore the studies and analyses carried out to this regard are rare and rather superficial, and, in addition, there are no consolidated propagation models specifically designed for these frequencies;
- the CIG provisions presume that only one subject uses the remotely managed gas network and that this subject is the gas distributor;
- the user of the data acquired is the gas network manager; for that matter, if the intention is to favour the development of a multiservice model, it would be opportune to consider the role of a subject to which to entrust the collection of the data, a direct access to the network elements (e.g. concentrator), etc.;
- the limitations of the W-MBUS protocol in managing a high number of devices could cause a fall in quality. ⁽³⁰⁾

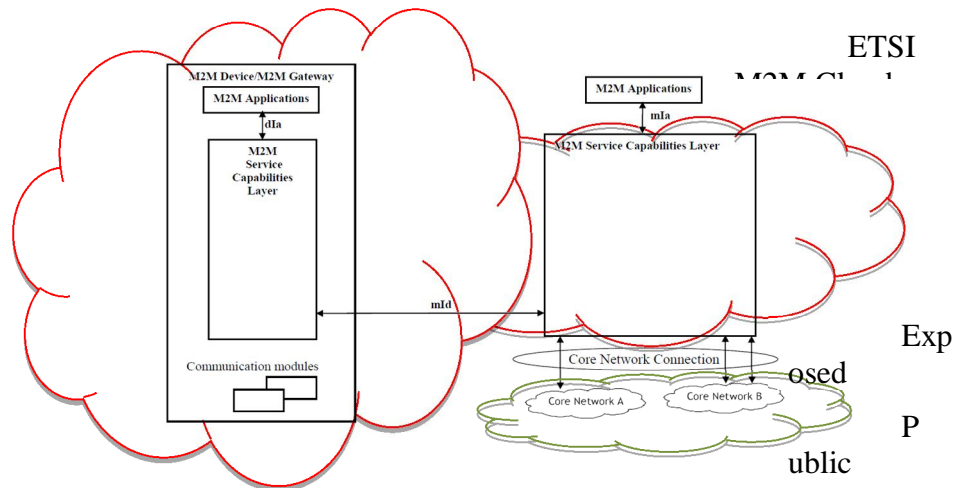
3.2. M2M services platform

3.2.1. ETSI proposal

ETSI proposes an *end-to-end* framework for M2M. The ETSI proposal suggests defining a functional level to support M2M development and applications (Figure 17).

³⁰ According to the technical news sheet of Telecom Italia, "If there are many subjects using the band (in the case of multi-services, therefore, since in the case of gas metering there is a single subject which manages the gas network on a geographical basis), the mechanisms by which the various channels in the band are divided among the various operators are all still to be defined, and a pronouncement on the part of the Authority could be opportune."

Figure 17 – Elements of ETSI architecture



Source: ETSI

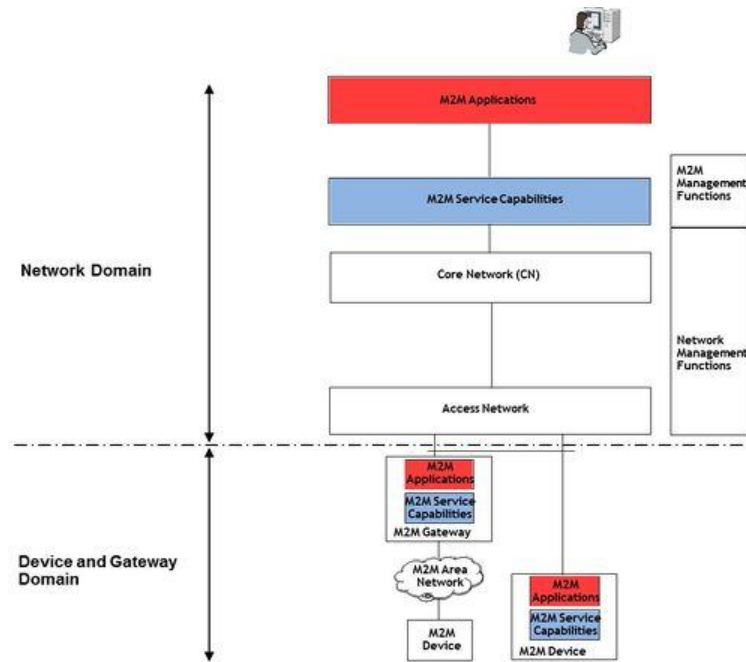
An intermediate level (*middleware*) is therefore also standardised for the identification, guidance, security and start-up of the system, for the management of the resources, the management of the connectivity, and the functional interaction with the network operator.

It is worth noting that the ETSI standard does not regard the access network (radio network) which is delegated to the operators, but the standard defines the mode of interfacing with the core network of the operators themselves.

Figure 18 shows a further representation of the ETSI architecture. The M2M *Service Capabilities* (SC) level is included in the operator's network, interfacing through the interfaces defined by 3GPP, 3GPP2, ETSI TISPAN, etc. The M2M-SC module can simultaneously interact with several networks.

In the case of the spread of M2M, the regulation will have to assess the role of these standards.

Figure 18 – ETSI architecture interfaces



Source: ETSI

3.2.2. Solutions of the IT world

The vendors of the IT world have prepared many solutions to support the IoT. The main players of the sector are: IBM, HP, CISCO, ORACLE, and many system integrators including Accenture and Atos Origin.

The systems to support the IoT (and therefore M2M) allow for:

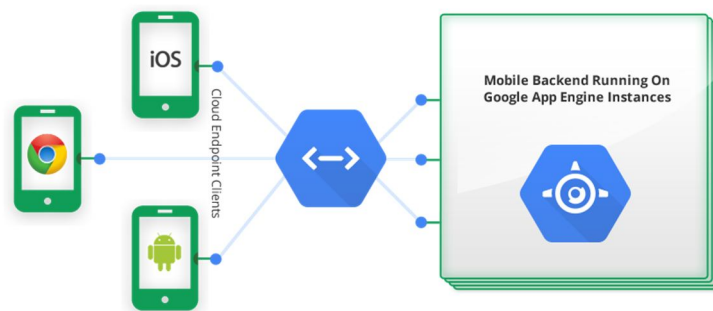
- connecting millions of objects and millions of events;
- supporting new systems of interaction with people, mobile devices, sensors, machines and applications;
- operating regardless of the physical location and without temporal limits and/or device limits.

It solutions also feature support for Big Data, i.e. for the collection/management/processing of data with extremely large volumes, very high speed and of extreme variety. In particular, Big Data technologies allow for the inter-exchange of data from different, non-structured sources, such as: images, e-mails, terminal position data, information acquired from *social networks*, etc.

3.2.3. The offer of the *Over The Tops*

The main OTTs (Google, Apple, Microsoft, etc.) are in a situation where they can play an important role in the development of M2M applications: in addition to the technical skills of the domain of provenance (the IT world), they offer technologies which can support the development of the applications (e.g. Google Cloud Platform and Google App Engine, illustrated in Figure 19).

Figure 19 – Google Cloud Platform



Source: Google

The OTTs, compared to other players, can often exploit specific levers, such as, in particular: control of the platform of the mobile and tablet terminals (Google for Android, Apple for iOS, and Microsoft for Windows Phone); the capacity to aggregate and analyse information; the capacity to vehicle contents.

4. Regulatory aspects

4.1. The role of regulation

The features of M2M services and applications, which are considerably different from those of communications between people which the European regulatory framework regards, are the subject of the debate on the applicability of the European and Italian electronic communication regulations to the M2M phenomenon. The concepts of the duration of the communication, the distance between the two parties, the quantity of data downloaded or uploaded on the network, have little significance for M2M applications, which (at least in the strict sense of the term, which involves only machines and possibly very limited human intervention) determine minimum data traffic, consisting mainly of “*bits*” or “*signals*” that are very frequent by of extremely reduced weight. Furthermore, the global dimension of the M2M market, in spite of the fact that most of the SIMs used for M2M communication are installed in mobile devices (such as cars or e-book readers) or, in any case, can potentially be sold abroad, means that the principles at the basis of the international roaming provisions must be declared and validated.

In recent months, the question of whether the development of M2M/IoT services requires a new regulatory frontier, specifically designed for communications that do not involve persons (unless to a very limited extent) has often come up on the agenda of the European and United States regulators, but so far no decision in this sense had been taken.

The above considerations require a preliminary assessment of the impact that the M2M trends linked to the telecommunications sector and to connected industries might have on the markets placed under the supervision of the regulatory Authorities (NRAs). The impact of M2M can be assessed both in terms of new objectives, and in regard of the possible extension of the activities in certain "pioneer" sectors compared to the present scope of the NRAs themselves (e.g. terminals, Internet ecosystem, security, the Apps market, privacy, intellectual property rights, etc.).

In general, the theories of economic regulation consider as a premise for possible regulatory intervention the assessment of the conditions which, on the basis of the observation of the present trends, would indicate the plausibility of a risk of achieving unsatisfactory results in the sector industries. In this case, the Regulators would be legitimated to intervene in the face of concern that, in the absence of any additional public intervention, market forces would not be able to spontaneously generate the desired results for society.

The progressive adoption of M2M products and services brings up questions on many issues of interest for the NRAs, for example:

- the risk of an excessive consumption of scarce public resources (such as the radio spectrum, telephone numbers or IP addresses);
- the risk of long-term problems linked to so-called “*path dependence*”, i.e. the fact that present choices could negative condition future prospects (this mainly regards the adoption of technical solutions);
- the risk that there may be obstacles to the development of competition in the M2M value chain;
- the risk for the security of M2M communications;
- protection of privacy and of personal data.

The efficient regulation of the M2M context

The general question, relative to the capacity of the market to produce optimal results, is classically analysed by the economic notion of efficiency, which gives a useful basis for assessing the adequacy of public intervention.

The legitimate purpose of public intervention on the economy is to change society so that there is an improvement on a situation which would have occurred without such intervention. In a market economy, the State is not proposed as the usual producer of services, so that public intervention is justified only when the markets cannot produce optimal results for society. Regulatory intervention in a sector like that of electronic communications represents a typical example: the NRAs are first of all charged with identifying and correcting market failures and, as the case may be, the failures of the various markets of the sector, in order to pursue the efficiency of the system.

A market failure occurs when the functioning of the market does not produce desirable results from the viewpoint of society. In a sector such as electronic communications, the desirable results are pursued by the opportune use of the resources, i.e. seeking to maximise the value of the services provided to the end users, considering the price that they are prepared to pay to acquire the services. A corollary of this approach is the use of the minimum quantity of resources - money, radio spectrum, numbers, etc. - necessary for the production of the service; in fact, without this optimisation, the relevant resources could be used more efficiently in other spheres.

The correction of market failures therefore aims to improve the efficiency, or at least to limit inefficiencies, in the functioning of the markets concerned.

According to the traditional approach, the notion of efficiency combines several aspects, which are not always compatible with each other:

- production efficiency: this consists of achieving a better input-output conversion ratio; it is achieved by choosing the best production process applicable to the specific context;
- allocation efficiency: this is the allocation of the available resources in order to maximise the production of the highest value for society;
- dynamic efficiency: this consists of the allocation of the resources in a manner which allows for obtaining the highest value possible for a long period of time, rather than in the short-term.

The difficulty of evaluating economic efficiency often arises from the search for a compromise between the various forms of efficiency. For example, what is efficient from the production viewpoint, is not necessarily efficient from the allocation viewpoint. On the other hand, the most efficient solution in the short-term, from the allocation and/or production viewpoint, might not lead to efficient long term results. Lastly, the different perception of the temporal dimension may be particularly challenging in terms of the assessment of the efficiency of a future result, especially when the future is highly uncertain. However, to a certain extent, it may be possible to identify market shortcomings (present, future or possible) that can lead to inefficient results.

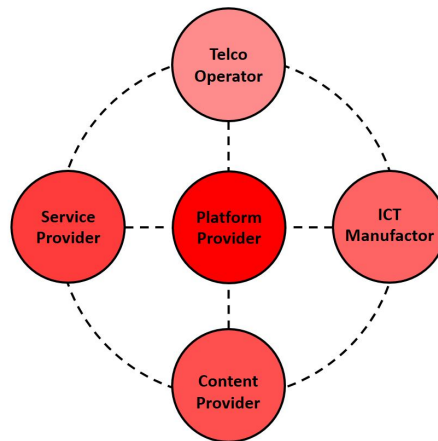
To assess the desirable results for the M2M communications ecosystem can present specific challenges. In any case, the notions of market efficiency and failure offer a useful analytical framework, facilitating the delimitation of the key questions, regardless of the technologies used.

From the Regulator's viewpoint, the impact of the spread of M2M services for the telecommunications sector can be analysed in terms of the sharing of the risks and profits among the various categories of stakeholders at different moments in time. M2M introduces new functions for existing activities and new needs in respect of traditional resources.

4.2. Regulatory aspects linked to connectivity

Connectivity to the public networks has a fundamental role in the M2M sphere. Figure 20 discussed in chapter 2 recalls the collocation of connectivity within the M2M organisational and business models.

Figure 20 – Connectivity within the value chain of the M2M ecosystem



Source: Agcom

As it is known, connectivity to M2M can be achieved through land-line technologies (copper, fibre) or radio technologies. Radio technologies are particularly widespread for M2M applications, especially for 2G/3G/4G mobile networks. In addition, LPWA (*Low Power Wide Area*) technologies (proprietary solutions based on unlicensed bands, normally below one gigahertz), W-MBUS technologies, Wi-Fi technologies and ZigBees also have a certain importance.

In this sphere, it is important to note that the industry has expressed the need to update cell standards, for the specific needs of M2M. The technological and infrastructural developments are required to solve new problems that arise with the massive widespread of M2M terminal, in particular:

- the high number of devices that a radio cell must manage;
- appliances with limited traffic in respect of usual uses;
- high delay intervals between transmissions;
- limited dimension of the message transmitted;
- limited transmission frequency;
- imbalance of upload activities compared to download activities;
- possibility of programming the traffic;
- efficient use of the spectrum;
- efficient use of the battery;

- co-existence with other communication systems, possibly with different cell technologies;
- reduction of impact on traditional cell communications.

4.2.1. Use of the radio spectrum

M2M uses a relevant variety of wireless technologies, according to the nature of the application, the type of coverage requested and the choice of the user.

The technologies prevalently adopted for M2M are:

- *Bluetooth, Wi-Fi, ZigBee* and the generic short range device (SRD) techniques for local connections. It is also worth mentioning the standards for specific applications (such as alarms, medical devices, RFID, et.);
- 2G cell (GPRS), 3G (UMTS / HSPA) and 4G (LTE) technologies for “Wide Area” connections;
- *W-MBUS (Wireless M-BUS (W-MBUS))* ⁽³¹⁾ for Smart Meters, in conformity with the operating solutions hoped for by the AEEGSI;

The radio spectrum has a central role for M2M development, although at present the scope and nature of future spectrum needs are not yet clear. In this sense, it is wise to take into account, in any case, that in many cases the data volumes generated by M2M applications are relatively small compared to the entity of traffic generally supported by the cell networks;

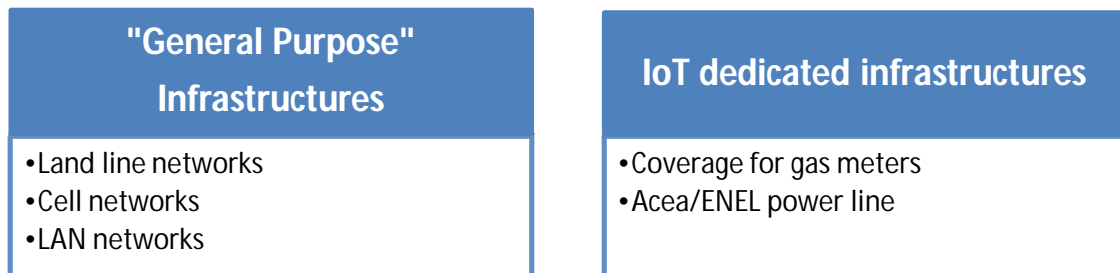
- the number of future connections seems destined to exceed the number of the other mobile devices used for data transmission.

More in general, the implications linked to a massive diffusion of M2M could be observed as a forecast of the future situation, both by the analysis of the market of reference, and on the basis of transmission features (i.e. transmission distance, band width, service quality). The need to answer a growing band demand poses the problem of identifying the most adequate infrastructural solution in consideration of the specific features of this market. There are many technological

³¹ W-MBUS is a standard European protocol developed for metering applications on the frequencies from 169.400 to 169.475 MHz. Wireless MBus uses a narrowband protocol with various data rates exploiting 6 different channels. The driving reason for the choice of the m-bus wireless protocol at 169 MHz was mainly the low work frequency, which should allow for reaching greater distances and suffer less from the attenuation caused by possible obstacles. The typical scenario of the remote gas meter reading network contemplates, in fact, devices installed in niches cut into walls, positioned on several levels. The question of the areas that can be reached by the installation of a concentrator or repeater is crucial in the business planning stage: the concentration factor and the number of devices that can be reached, whether they are meters, sensors, etc., allows for estimating the costs and the potential returns that can be obtained from the diffusion of the network.

options that are compatible with the development of the M2M market. Figure 21 classifies the infrastructural alternatives of two categories, depending on whether the development is of the traditional networks or of systems created exclusively for permitting M2M/IoT connectivity. The representation shows the above: the expression ‘*General Purpose*’ refers to the traditional technologies to allow for connectivity to the Internet, whereas the second category includes the dedicated networks, i.e. those created specifically for M2M/IoT connectivity.

Figure 21 – Infrastructural alternatives for the future development of M2M/IoT.



Source: AGCOM

According to the mobile operators' viewpoint, the problems in terms of capacity regard not only the M2M environment, but more in general the spectrum licensed for the cell network.

However, it must be pointed out that in some European applications ⁽³²⁾ a relevant portion of M2M devices are not served by the cell network, but use an unlicensed section of the spectrum at 868 MHz and that, in Italy, 169 MHz has been chosen for the meters of the gas network. These findings are of absolute importance for understanding the diffusion of the wireless connections, also because cell network developments have gone in the direction of broadband. The case of the Italian smart meters shows this limitation very well, demonstrating the need to find alternative solutions such as W-MBUS.

It is therefore necessary to consider evolved strategies for narrow band transmission and the possible impact on the spectrum.

Lastly, with reference to smart gas metering, it must be pointed out that:

- the 169 MHz band has been little exploited over the years for widely distributed services, therefore the studies and analyses carried out to this regard are rare and rather superficial, and, in addition, there are no consolidated propagation models specifically designed for these frequencies;

³² Weightless and Sigfox networks that have been optimised for the transport of low data rates.

- with the increase in the number of devices present in the network, the absence within the W-MBUS protocol of advanced access management systems to complement the physical means could create problems (transmission collision/overlapping) and cause deterioration of the performance of the network itself. For all the more reason, if there are many subjects using that band (in the case of multi-services, therefore, since in the case of gas metering there is a single subject which manages the gas network on a geographical basis), the mechanisms by which the various channels in the band are divided among the various operators are still to be defined.

Refarming of the 2G spectrum

The switch-off of 2G could represent a problem for the existing M2M applications. The size of the problem must be analysed in consideration of the data for the switch-off and of the expected diffusion of M2M.

GSM technology is much used today in the M2M field due to the low cost of the modules (a 2G module costs less than \$10, a 3G module about \$20, and a 4G about \$20). At present, in spite of the fact that the present licences of the mobile operators have an expiry date, M2M devices based on 2G modules continue to be sold widely.

Regulation of spectrum usage rights

In the case of the use of radio technologies, M2M is based on the use of both the licensed and the unlicensed spectrum.

The licensed spectrum is linked above all to mobile connectivity; vice versa, the unlicensed spectrum is, in any case, important since M2M economics often impose shared connectivity through concentrators which interface with the public network, grouping transmissions from several M2M devices.

It must be considered that the regulation of the exclusive usage rights ensures control of interference. In fact, in the absence of an individual report, it would not be possible to ensure service quality and to allow for efficient use of the scarce resources. At the same time, the use of the unlicensed spectrum has significant importance for limiting connectivity costs.

The hearings carried out during the survey brought to light the existence of alternative models such as, in particular, licence sharing (*LSA - licence shared access*). The findings indicated that the LSA models, although applicable to any portion of the radio spectrum, are considered for

the frequencies 2.3-2.4 GHz and 3.4 GHz. These frequencies are useful to sustain the development of capacity and, therefore, there are many fields of M2M application that could benefit: Smart Homes, e-Health, video surveillance, remote monitoring, smart cities. In addition, if LSA is not used in the spectrum regions below GHz, the smart metering applications would be excluded due to the limited propagation of the 2.3 and 3.4 GHz frequencies. The LSA mode could be considered in the case of Cell IoT. Figure 22 illustrates the policies for the allocation of spectrum usage rights, showing the alternative technologies (available or programmed) that can be considered valid to a certain extent to allow connectivity for M2M devices. The in-field options are classified according to whether they are subject to spectrum usage rights.

Figure 22 – Feasible policies for regulating spectrum use

		Spectrum usage rights		
		Individual licence	Shared licence	Unlicensed
“General Purpose” networks that can be used for IoT	Mobile networks (800 – 900 MHz)	To be assessed	WLAN - WiFi (2.4 – 5 GHz)	
	Mobile network evolutions LTE-MTC, 3GPP-IoT (800 -900 MHz, 2.6 GHz)	The technological innovations regarding “cognitive radio” and “white spaces” allow for maximising the use of the spectrum also in cases in which the band is partially allocated (and cannot be liberated) and therefore individual licences cannot be issued without limitations	WLAN -WiFi (2.4 – 5 GHz) W-MBUS (169 MHz)	
IoT dedicated infrastructures				

Source: AGCOM

In conclusion, new spectrum organisation schemes, in addition to the classic schemes, could make it necessary to allow for more flexible shared use of the spectrum, also to optimise the use of this scarce resource. In particular, the evolution policies must take into consideration the need to ensure, on one side, costs that are compatible with M2M needs and, on the other, the effectiveness and coherence of the traditional framework.

Coverage development plans

The major technical problems encountered in the implementation of Smart Grid services and connected to M2M applications regard the opportunity to be able to have avail, on a large scale at all the electricity distribution nodes, especially the peripheral nodes (HV/MV and MV/LV transformation sub-stations, of producers' and customers' plants, in particular hooked up to the MV network), broadband communication channels and, especially, with low latency, since only the combined effect of these two features can guarantee the transfer of information between remote plants at very high speed, such as to satisfy the needs of certain smart grid functions (automation based on selectivity logics and automatic remote disconnection of the producers to avoid the formation of undesired "islands" on the distribution network).

Considering the large number of systems that must potentially be covered (e.g. the company Enel Distribuzione has about 400,000 MV/LV substations spread over Italy), the difficulty arises of being able to sustain the costs necessary for the construction and maintenance of a proprietary telecommunications infrastructure.

It therefore seems to be necessary to address the connectivity services market, preferring wireless connectivity which allows for easier penetration capacity over the country, with costs that are certainly lower than those of wired connectivity.

To this specific regard, in the Smart Grid sector, the utilities operators have pointed out that the choice of 4G, as a type of wireless connectivity is substantially an obligatory choice, while waiting for technical reasons ⁽³³⁾. However, 4G systems have not been specifically designed or regulated for the needs of the M2M applications. Consequently, an operator in the electrical sector, choosing to use public 4G access infrastructures made available to the carriers, must deal with:

- the digital divide problems (although rapidly increasing, 4G coverage is often absent in rural areas where there is the highest concentration of the production of renewable sources);
- the absence of SLA and, more in general, of "consumption profiles" suitable from the technical and economic viewpoint for the needs of M2M applications for smart grids; the availability of the infrastructure and of the relative services is particularly important, also in the case of electrical disservices extended to very large areas of the territory (autonomy of the base stations in the case of black-out).

4.2.2. Matters connected with roaming

Roaming has been the subject of wide debate in respect of M2M and, in particular, regarding the question of the applicability of the European Regulation EU no. 531/2012, known as the "Roaming III" regulation.

It is useful, first of all, to recall the reasons which lead to the fact that such an important role has been entrusted to international roaming.

➤ The transnational dimension of the M2M market

The parties concerned point out the global nature of M2M services. Although certain services are marketed at national level, a relevant number of devices are offered on the global market. Roaming represents a practical solution for the "one-stop-shop" model and allows the company to sell products throughout the world ("*Build it once, sell it everywhere*").

³³ Because of the latency requirements that are not supported by 3G or lower technologies.

➤ **Technical complexity**

Some M2M models require services to be issued in a consistent manner at world level, including the possibility of rendering the production resources centrally operative (orders management, provisioning, customer care, information security, invoicing and reporting). A fragmented distribution model based on SIMs distributed in the various countries would need the use of many management interfaces with the different operators, with relevant technical complexity for the service provider.

➤ **Efficiency**

The reduced ARPU requires the adoption of scale economies. Due to this, the manufacturers of terminal devices, in an attempt to distribute M2M products and services on a global scale, cannot allow themselves to develop contracts for the supply of connectivity with each country where the product will be sold, since this would lead to transaction costs for the negotiation of dozens, or hundreds, of individual agreements.

Furthermore, the manufacturer would have to manage the SIMs with a specific IMSI code for the country in which the M2M device would be used. This would imply the management of specific stocks for each country in every production site, with consequent increase of management costs. If the M2M devices use the E.164 numbers, the manufacturer would have to have specific E.164 numbers for each country in which it wishes to distribute its products, further increasing the costs.

➤ ***Time to market***

The GSMA has developed a series of guidelines for roaming agreements between operators which are used by over 800 operators which subscribe to the GSMA. The guidelines contain common terms accepted by the sector and the conditions for accelerating negotiations for roaming agreements. The use of existing agreements allows for reducing the time-to-market of the M2M devices.

➤ **Regulatory framework**

M2M benefits the Regulation (EU) no. 531/2012 and, in particular, the provisions on access to regulated wholesale.

Almost all the subjects concerned have pointed out that the application of the EU Roaming Regulation⁽³⁴⁾ is an important element for M2M.

It may be noted, first of all, that on the formal level there are uncertainties regarding the application of the Regulation since the purposes and definitions adopted clearly refer to the people who move them in the European space. In fact, the Regulation intends to protect people who move in Europe and it is potentially inadequate for M2M services, are permanently in

³⁴ The present regulatory framework includes the following sources:

- Regulation (EU) No. 531/2012 of the European Parliament and Council of 13 June 2012 on roaming on public mobile communication networks within the Union;
- Execution Regulation (EU) No. 1203/2012 of the Commission of 14 December 2012 on the separate regulated retail sale of roaming services within the Union;
- BEREC Guidelines on Roaming Regulation (EC) No. 531/2012 (Excluding articles 3, 4 and 5 on wholesale access and separate sale of services);
- BEREC Guidelines on the application of Article 3 of the Roaming Regulation – Wholesale Roaming Access;
- BEREC Guidelines on the application of Article 4 and Article 5 - Separate sale of services.

In addition, the following documents define the technical aspects of wholesale performance both as regards the technical mode known as “*Single IMSI*” and for the “*Local Break Out*” (LBO):

- ETSI, “EU Roaming regulation III, Structural Solutions, High Level Technical specifications”;
- ETSI, “EU Roaming regulation III, Structural Solutions, Process”;
- ETSI, “EU Roaming regulation III, Interface & Protocol, Detailed Technical specifications”.

For brevity, the entire regulatory framework is often referred to as “*Roaming III*”.

The most discussed problems relative to M2M regard: the bundle of regulated roaming services; the wholesale roaming access obligation, regulated prices, the decoupling obligation, and permanent roaming, summed up below

Art. 3 of Regulation (EU) No. 531/2012 disciplines wholesale roaming access. With regard to the possible restrictions of art. 3, the BEREC, during the consultation procedure carried out in 2012, had analysed the M2M case by means of a specific question. The BEREC had then concluded that M2M is not a special case for exclusion from the obligations and that permanent roaming is admissible under the regulatory framework. Given this, the debate on permanent roaming seems to have been resumed recently relative to the *eCall* implementation obligations. In fact, although the *eCall* services does not necessarily require roaming, the implementation of premium services (connection to Internet to give information on traffic congestion, petrol stations, etc.), can imply that most cars will be connected in permanent roaming.

The prospective of the regulation draft on the Telecom Single Market do not show conflicts between the provisions in force and the framework under discussion. In fact, the presumption is that the decoupling obligation will be used by all the operators and it will apply to all the operators (reference is made to art. 5 of Regulation (EU) No. 531/2012). Given this, one of the spheres of complex interpretation regards the so-called *reasonable use criteria*, contemplated to avoid market distortions. It seems evident that permanent roaming, typical in some M2M contexts, cannot be included in the conditions of *reasonable use*, so that infrastructural competition of the regulation would seem to be destined to M2M, while traditional services could benefit from the mechanism known as *roam-like-at-home*.

Articles 7, 9 and 12 of Regulation (EU) No. 531/2012, instead, discipline the single maximum price thresholds applied on wholesale, while arts. 8, 10 and 13 give the retail prices.

Since the Regulation establishes the maximum voice, SMS and data tariffs (the *price CAPs*), it seems that M2M features significantly lower average consumption profiles – at least for some applications – than traffic normally generated by the remaining terminals (“*persons*”) and therefore it might not be estimated consistently in the cost models taken as reference to fix the regulated price CAPs.

roaming mode, use business market connectivity offers, and have traffic profiles that are considerably different from those produced by conventional terminals. Moreover, since this is a global market, although the Regulation imposes limits to wholesale roaming access prices within the EU, in practice the regulated CAPs also influence pan-European business agreements, since the non-EU countries can access regulated prices, whereas the symmetrical condition does not occur. In other words, from a global viewpoint, Regulation is, *de facto*, an obstacle to the global competitiveness of the operators, limiting the contractual capacity of the EU operators towards their non-EU counterparts.

In spite of the above definitions and considerations, at European level there seems to be a converging choice to apply the Regulation also in the case of M2M. Consequently, articles nos. 7, 9 and 12 of Regulation (EU) no. 531/2012, which regulate the maximum wholesale tariffs, and articles nos. 8, 10 and 13 which regulate retail prices, establishing the maximum thresholds (CAPs), are applied to M2M SIMs, as well as art. 3 which obliges national mobile infrastructures to sign roaming agreements.

According to some mobile operators, M2M can appreciably engage the network (generating signalling traffic), but without generating traffic that can be invoiced (voice, SMS and data traffic). In the future, a massive use of M2M could produce significant quantities of signalling traffic with consequent needs for re-dimensioning the dedicated resources (*Control Channel*, *Random Access Channel Congestions*, etc.). The Regulation, in its concrete implementation, should take into account the emerging nature and the specific features of M2M services and, in particular, the fact that a relevant quantity of M2M services based on SIMs develops traffic volumes close to zero, with the consequent impossibility of invoicing, and therefore the corresponding wholesale revenues are insufficient to guarantee coverage of the costs. To this regard, tariff regulation at European level should contemplate an additional profit margin to allow for covering the costs connected to signal traffic.

Permanent Roaming (or PR) is one of the subjects frequently brought up by the participating subjects. On one hand, it has been observed that:

- PR is a *key enabler* in the case of global products (cars, *Kindle* and *TomTom* type devices, etc.) since it allows for manufacturing efficiency, as well as reduced *time-to-market*;
- PR is widely used in metering since it ensures quality parameters (coverage) that otherwise cannot be reached by a single national network;
- PR allows for access to regulated prices.

On the other hand, the operators report the potentially distorting effects due to Permanent Roaming and, more in general, the impossibility of producing, by national methods, an offer that can compete with the roaming solution. It is therefore advisable to launch a reflection on the regulation and, in particular, on the trend of the criterion based on the CAPs, with a formulation of obligations that are more appropriate for M2M. A future evolution of the Regulation could consider the following alternatives:

- to ban permanent roaming;
- to regulate M2M prices, for example by the institution of specific CAPs;
- to leave negotiating to the market, possibly maintaining some of the obligations existing at present with some amendments (negotiation obligation, fair and reasonable prices, arbitrage before the NRAs).

The first two hypotheses seem more complex, while the third is simpler to put into practice. In general, the basic principles of the roaming regulation (wholesale access obligation) could be maintained, but the M2M traffic and permanent roaming should rather be left to commercial negotiation, possibly with the inclusion of protective measures to protect the small operators and, in particular, the virtual operators (such as, for example, the use of fair and reasonable prices). If the Commission's proposal is adopted, certain clarifications will be necessary for application to M2M services. The criteria which go under the name of “*Fair Use Limits*” seem insufficient to solve the problems opened by M2M.

It has been reported that the wholesale roaming access obligation, favouring access to the infrastructures of the network visited by the roaming service provider, on one hand facilitates the implementation of net neutrality⁽³⁵⁾, but on the other hand it can preclude the effectiveness of the traffic management policies⁽³⁶⁾ at present considered in the debate on the Telecom Single Market. In fact, the wholesale obligation of art. 3 of the Regulation⁽³⁷⁾, as clarified by the BEREC⁽³⁸⁾, contemplates only the application of the principle of non-discrimination and of internal external equal treatment⁽³⁹⁾.

³⁵ Equal treatment for all traffic.

³⁶ Functions for security (e.g. the *parental control* function of the security dedicated performances), or functions to allow for the development of specialised services at faster speeds by traffic prioritisation.

³⁷ In particular, sections 3 and 5.

³⁸ BEREC BOR (13)15 “Guidelines on the application of Article 3 of the Roaming Regulation – Wholesale Roaming Access”, Guideline 21 and following.

³⁹ BEREC BOR (13)15, Guideline 23: “The specified minimum service levels should be at least as good as those normally achieved by the MNO in respect of services provided to itself and should, in addition, be consistent with best industry practice”.

Lastly, an element for evaluation should regard the adoption of national roaming as a technical solution to allow for coverage parameters and the availability of complex networks, which would not be possible without resorting to international roaming, but which are becoming more and more necessary for the M2M demand.

4.2.3. Numbering resources

M2M in the various technologies can use E.164 (mobile phone numbers) and E.212 (SIM identification number) numbering resources, and IPv4 and IPv6 addresses. The widespread use of M2M devices could lead to the exhaustion of the E.164, E.212 and IPV4 resources.

It is first and foremost necessary to state that Agcom has already analysed the question of the availability of the telephone numbering resources, by a specific procedure ⁽⁴⁰⁾ and it is also addressed by the CEPT ⁽⁴¹⁾.

At present, the presumed scarcity of E.164 numbers does not seem to represent an obstacle or problem to be resolved for M2M development. On the contrary, in the short and medium term the E.164 and E.212 numbers seem to be the most commonly adopted solution for M2M uses. In a long-term perspective, the use of IPv6 could become the best solution. However, these observations are not unanimously shared by all those concerned, especially those who consider the use of telephone numbers improbable for IoT services ⁽⁴²⁾. In general, it seems useful to put into practice initiatives which favour the use of IPv6.

As anticipated in the introduction, however, a swift and significant penetration of M2M services could lead to the exhaustion of the E.164 numbering resources used today for mobile telephony. For this reason, the operators of some Member States have requested the introduction of a new series of numbers destined specifically for M2M services. With reference to the case of Italy, the problem of the possible scarcity of E.164 numbering resources is analysed by the Authority in implementation of the recommendations issued by the CEPT (recommendation (11)03).

⁴⁰ Decision no. 8/15/CIR modifies and adds to the electronic communications sector numbering plan of decision no. 52/12/CIR and S.M.I.

⁴¹ The European Conference of Post and Telecommunications administrations.

⁴² This latter interpretation is also confirmed in similar works carried out in Europe (e.g. OFCOM, “*Promoting investment and innovation in the Internet of Things*”, par. 1.4.3.).

The present national legislation of some countries does not allow M2M service providers to be assigned MNCs ⁽⁴³⁾, representing a potential obstacle to competition. On this topic, the CEPT has proposed loosening up the restrictions which must be satisfied by the operators/companies requesting the assignment. However, in this case the E.212 numbers could also become scarce (at least in the future). The problem has already been considered by the CEPT, which recommends a shift towards 3-figures including the multinational and global MNCs. Always for the purpose of stimulating the development of competition, the CEPT has given a contribution for the revision of the E.212 recommendation issued by the ITU-T ⁽⁴⁴⁾.

With reference to the assignment of the MNC numbers proposed by the CEPT, it must be noted that the car makers and the utility companies have not shown interest in buying such numeration resources to support M2M traffic.

The use of extra-territorial telephone numbers merits special attention. At international level, some subjects have requested permission for the extra-territorial use (outside national confines) of E.164 and E.212 numbers in the case of M2M applications. In this sphere, it can be observed that the significant use of international roaming for national applications (*permanent roaming*), involves the use of foreign enumeration resources, both telephone numbers and IP addresses.

The contributions received from subjects concerned in this fact-finding survey show significant interest on the part of the Northern European countries and the USA in the extra-territorial use of numbering resources. At present, the mobile operator is obliged to grant access to its own infrastructure on the part of terminals with foreign numbers (international roaming) pursuant to the obligations contemplated by the EU Regulation. For this reason, there could be a considerable presence of foreign numbers (EU and non-EU) in Italy. Quantitative evidence on this issue is not available. However, the participating subjects were less argumentative regarding the inverse phenomenon, i.e. the use of Italian numbering resources abroad: Quantitative evidence on

⁴³ The MNC – Mobile Network Code, is a content of the IMSI (*International Mobile Subscriber Identity*) number. The IMSI is an identification number memorised in the user's SIM which, however, does not correspond to the telephone number known to the user. The IMSI number conforms to the ITU E.212 numbering standards, and is consequently composed of 15 figures. Some of these, known as MNCs, are used to identify the network.

⁴⁴ ITU-T is the acronym of *International Telecommunication Union – Telecommunication Standardization Bureau*, i.e. the sector of the International Telecommunications Union (ITU) which deals with regulating telephone and telegraph telecommunications.

this issue is not available. Regulating initiatives will be launched if it is necessary to harmonise the extra-territorial use of national numbers.

Within the context of the fact-finding survey, the operators reported the use on the part of the *Over The Tops* of users' telephone numbers for the purpose of identifying the terminal ⁽⁴⁵⁾. In particular, according to the subjects concerned, this practice does not completely conform to the regulations ⁽⁴⁶⁾.

Some participating subjects pointed out that the issue and use of M2M SIM cards should not be subject to the regulatory obligations on emergency calls, on legal performance, on number portability and on the transfer of remaining credit, and in general also to the restrictions imposed by the national enumeration plan (such performances should be optional) ⁽⁴⁷⁾.

With reference to the IP context, the structure of IPv4 addressing gives a sufficient number of addresses for public use. For that matter, the migration to IPv6 would allow for access to the M2M devices from the public network, and the direct unequivocal nature of the same.

To understand the importance of the diffusion of IPv6, it is useful to observe that in the case of metering, the connection is achieved through the concentrators, thus the numbers are not assigned to the terminal devices (except in the case of the point-to-point gas model). In this way, the numeration resources are used more efficiently, but the M2M devices cannot be directly

⁴⁵ The case of APPs in which messages are sent via the Internet (therefore not through the telephone service) and the users are identified by the individual telephone number which is communicated by the user to the Platform Manager during the application installation phase.

⁴⁶ In particular, during the hearings, it was reported that the present application practice of the definition of the electronic communication service makes possible an anomalous situation from the competitive viewpoint: in Italy, in fact, there are services offered by the OTTs which take the place of regulated services without the need of the authorisation contemplated by art. 25, and without any interoperability with the regulated services, since they are not included in the aforesaid definition. The non-interoperability of these services, which also ensure fully equivalent messaging and communication performances, seems to breach the legislation on electronic communications since an Italian number is used, in any case, to identify the recipient and the sender. If such providers began to also issue M2M services, without a similar competitive possibility for the national providers, the development of entirely Italian M2M services would not be possible. Some operators therefore request a clear standard regulatory choice (or simplification/deregulation), applicable to all types of services which ensure the same kind of communication. On this point, there is an important need to ensure M2M service providers equal exercise of the right of access to the network, also through the Authority's support in the case of possible disputes generated by denied access on the part of the structured operators which use the low volumes of M2M services as a pretext to deny access and interconnection. To this regard, the comparison of M2M volumes per SIM and those presented by the SIM M2M of the operator requested to grant access, could be a useful criterion of analysis.

⁴⁷ However, the Smart metering, Building Automation and similar services are distinct, in respect of which, in the opinion of one operator, the law should contemplate a distinction, i.e. it should apply the provisions on personal data processing to the specific type of data involved. The distinction of the services (rather than generic M2M services), would lead to an important consideration on the need to identify the user of the Machine to Machine service: the subject which should possibly be identified for the purpose of issuing the service is not the end customer, but the subject which creates the service itself for resale to the end customer.

addressed from the network, limiting the possibility of developing the services. In other words, in the case of the use of concentrators/routers, these applications, the telephone number or the IP address are not used to unequivocally identify the M2M terminal device.

4.2.4. Global connectivity and change of connectivity provider

The connectivity model at the base of M2M services is very often different from that of traditional applications for the transmission of data in the Internet world. M2M services express different needs according to two particular features: a connection available always and everywhere.

With regard to the mobile networks, there is frequent use of foreign SIMs in roaming in order to benefit, on one hand, from the agreements with all the operators and, on the other hand, from European regulation on the maximum prices applicable. The coverage needs, in fact, do not coincide with the requests from traditional services at national and European levels. As a consequence of the transnational dimension of the relevant M2M market, some international alliances are being developed between the main mobile operators. Each alliance is developing specific technologies for remote reconfiguration of the SIMs.

The resulting connectivity market seems to be, at present, developed by a few large operators which, aggregating the various national infrastructures through roaming agreements (sometimes specialised for M2M), offer global connectivity services. Therefore, market pre-emption and technology lock-in risks arise, as well as competition restrictions through the application of exclusive discounts and/or the sale of specialised products/services between the operators adhering to the alliance. This circumstance presents several market entry difficulties for the national operators (which are smaller in global competition). It therefore seems central to assess the possibility of facilitating, also with regulatory measures, access to mobile infrastructures and connectivity provider exchange on the part of the user.

These measures must be evaluated also in the new of the new regulation on the *Telecom Single Market* (TSM) and/or the *Digital Single Market* which, favouring the single market, will have probable effects also on M2M/IoT development. At present, there are no clear strategies that could be put into practice to change provider and which could contemplate: a) the use of coordinated national solutions, e.g. through enumeration; b) the adoption of a standard model within the sphere of the EU Regulation; c) no intervention.

The possibility of changing connectivity provider is a potential goal since, as it is known, the change of the operator enables competition of offers and of prices.

M2M can benefit from regulation of mobile number portability or, theoretically, from the infrastructural competition introduced by the roaming regulation. For this second case, there are no Alternative Roaming Providers available in Italy at present. Both in the case of the use of number portability, and with the Alternative Roaming Provider solution, the alternative operators must be positioned in the country where the number is assigned. This limitation could be particularly burdensome, especially in the case of imported goods, since it might be impossible for the national operators (owners of the infrastructure) to compete on the global market.

The use of e-SIMs seems a natural goal, but there is, as yet, no consolidated standard and there are distinct positions within the industry. It is not even certain that the standardisation initiatives in progress will reach commonly accepted solutions, because, for example, of the interests of the operators, on one side, and of the device makers on the other.

In the case of M2M players with relevant commercial capacity (e.g. car builders), the e-SIM or multi-profile SIM solutions are already in use. In other words, these large players do not complain of difficulty regarding connectivity provider change.

It can be understood, however, that this problem may be decisive in the case of the medium and small players. To this regard, it would be opportune to take into consideration the differentiation in terms of the contractual power of the players which find themselves signing an agreement with a connectivity provider within the sphere of the M2M market.

Several subjects underlined the fact that the physical replacement of the SIM card determines a prohibitive cost and thus turns out to be an obstacle to competition. Several operators pointed out that regulation should favour the adoption of SIMs that can be configured in remote mode by means of the OTA (*Over The Air*) technology. In this way, the physical replacement of the SIM can easily be avoided, facilitating a change of operator. Examples of such SIMs are the so-called embedded SIMs (E-SIMs) and the Soft-SIMs:

- the E-SIM is defined by the GSMA in the document “*The Embedded SIM Architecture*” as a “SIM card” which is physically included within the device, the profile of which (including the IMSI number) can be modified in remote mode;
- the Soft-SIM consists of the virtual creation of the SIM by means of the M2M module System software. In this case, a physical module (or a chip) is not contemplated and the functions are achieved by means of other elements of the electronic M2M device (e.g. the central processor).

Both solutions would allow for solving the lock-in problem, since in both cases the user profile and the IMSI number can be configured with OTA technology without the need to replace

the SIM. However, the operators' favourite solution seems to be the E-SIM since the Soft-SIM could lead to security problems. It must be noted, in fact, that the SIM is a key element for authenticating the user and it is central for the invoicing process of any mobile telephony operator. In addition, the "integrated SIM" (welded into the M2M module) also involves a minor risk of piracy.

The e-SIM supports various business models: it can be used with the global SIM (i.e. an IMSI which functions everywhere in the world on the basis of roaming) or a "local" IMSI (programmed according to the country of origin of the device, but which also requires single local agreements for each roaming country). It is important to note that a single business model probably will not be able to satisfy the needs of all the stakeholders (device distributors, system integrators, or other market operators). Thus, while the e-SIM can enable new business models, these should not be conditioned by the SIM. In this sense, it is worth point out that the e-SIM does not allow adequate flexibility for the device manufacturer which intends to directly develop roaming agreements with at least one MNO in every country in which it intends to offer the service. On the contrary, the global SIM model (i.e. with the capacity to use a single IMSI in several countries) seems to offer a more effective solution (for this problem), since it allows for multi-country distribution of M2M devices.

4.2.5. Specific M2M service profiles

The absence of SLA and, more in general, of "consumption profiles" suitable from a technical and economic viewpoint for the needs of M2M applications for smart grids, is a possible problem.

In this sphere, it is necessary, according to some participants, to make the infrastructure and the relative services available also in the case of an electricity failure occurring over vast areas of territory.

Some applications depend on the functioning autonomy of the base radio stations (in the absence of an electricity supply).

4.2.6. Security

The protection of M2M communications should be of a suitable level according to the various types of services for which the communication is dedicated, or the stretches it is protecting (in the case of M2M, data deemed sensitive in as much as they are the property of third parties can be transferred).

Regulations which demand security levels that are technologically inapplicable or, if applicable, at absolutely unsustainable costs, must be avoided.

Important suggestions have emerged from the analysis of the energy sector. Smart metering experiences lead, in any case, to considerations on the opportunity of M2M service users having to have the flexibility necessary to define the parts specific to security and privacy controls, with more effective adaptation of the scope and level of effort requested for targeted security, on the basis of the knowledge of the vulnerability, the threats and the experience gained, without penalising the efficiency of the communication system, such as, for example, with the occurrence of unintentional DoS (*Denial of Service*).

4.2.7. On the creation of new infrastructures and the re-use of existing infrastructures

One of the arguments which came up on the occasion of the analysis regarded the identification of the M2M fields of application in respect of which the telecommunications network could represent an essential facility. In this sense, in the debate in progress, the fact that electronic communications are an enabling factor for the development of the smart grids is apparent.

Speaking of a purely technical assessment, the progressive spread of devices for distributed generation (such as solar panels, wind systems, etc.) increases the risk of the overloading of the electricity grid, generating possible black out phenomena on the grid itself. Although European and national institutions have pointed out the economic importance of investments for the development of smart grids, it is also true that the future development of an energy system in this direction is an obstacle to the pursuit of the public interests. In this sense, considering the value of the supply of electricity throughout the entire country and continuously to citizens, this service should undoubtedly be defined a service of general economic interest (SIEG). On the other hand, a system for the general control of the electricity network to minimise cases of disservice of the grid itself could be resolved by interconnecting the management nodes by means of electronic communications. This consideration leads to the value of electronic communication devices to guarantee the SIEG supply.

In the light of the technical findings, one of the questions posed in the fact-finding survey was if, and to what extent, it may be opportune to integrate the regulatory obligations in force on

access to the network infrastructure/element for the electronic communications sector, with those in force on SIEG and applied to the service of the supply of electricity. ⁽⁴⁸⁾

However, the question, aimed at understanding whether it is legitimate to impose telecommunication network access obligations in exceptional cases and for the purpose of protecting the collective interests, is extraneous to the purposes of the fact-finding survey. (It is mentioned here for the sake of completeness since this aspect was considered during the hearings).

4.2.8. The allocation of responsibilities among the subjects involved in the supply of M2M services

The allocation of responsibilities among the telecommunications operators in the case of a disservice towards the end user is a question which, at present, leads to debate. The issue involves the M2M sphere in which, considering the type of the material examined and the speed at which this market is evolving, there is growing interest in this matter.

Entering into detail, with regard to the applications of the security systems where connection to the public network is required, the question was put of who is responsible for failing to announce an alarm (or, in general, who is responsible for the disservice), when the anomaly is caused by the unavailability of the network. The growing spread of M2M communications in the security segment (e.g. alarms for evacuating stadiums, the communication of infrastructure sensor readings, anti-theft devices, lift alarm systems, sensors for medical use, etc.) make this an extremely current question and such as to justify further analysis of the survey.

4.3. Service offered to the end user

4.3.1. Authorisation system

As already stated regarding the role of regulation, the legal and regulatory challenges presented by M2M and IoT communications have strongly attracted the attention of the regulators who, in recent months, have discussed whether to open a new regulatory frontier, specifically designed for communication between machines or between machines and people, when the intervention of the latter is very limited.

⁴⁸ According to economic theory, an essential facility is a legal institution which imposes an obligation on the owner of a resource pursuant to which the said owner will be called upon to grant the use to third parties in the case of certain conditions: 1. the resource must be essential for the practice on the part of the applicant subject; 2. the resource must be irreplaceable and in practice accessible to the applicant; 3. there must be no objective reasons justifying a refusal on the part of the owner of the resource.

However, while an answer to this question is being sought, the conviction that at least some of the problems determined by this new type of communication can also be solved on the basis of the regulatory framework in force is becoming affirmed among the bodies appointed to guarantee the regulation of the electronic communications sector. This consideration is certainly true for the problem concerning the applicability, or non-applicability, of the provisions of the European directive (and its transposition into this country) on general authorisation in the M2M context.

Firstly, with specific reference to M2M connectivity, in all cases in which the operator concerned uses enumeration resources or licensed spectrum, authorisation is certainly necessary. But on closer examination, also in cases in which enumeration or licensed spectrum resources are not used, it is easy to assess the need for authorisation. It can suffice, in fact, to refer to the definition of art. 2, letter c), of the Framework Directive 2002/21/EC of 7 March 2002, as amended by Directive 2009/140/EC and by Regulation 544/2009, which define “electronic communication services” as “*the services provided, usually for payment, consisting exclusively or prevalently of the transmission of signals on electronic communications networks*”. Well, starting from article 2 of the Framework Directive, it can be concluded that all M2M services whose prevalent feature is the transmission of signals on electronic communications networks, can be included among electronic communication services.

As far as concerning authorisation profiles, art. 3 of the "authorisations" Directive 2002/20/EC of 7 March 2002 rules that “the supply of electronic communication networks or electronic communication services, without prejudice to the specific obligations of article 6, paragraph 2 or the usage rights laid down under article 5, can be subjected only to a general authorisation”. As it is known, 26 EU Member States out of 28 adopt the general authorisation procedure for electronic communication service suppliers, requiring these latter to notify the start-up of their relevant activity. The only exceptions are Great Britain and Denmark. Consequently, in States where the authorisation procedure is implemented the subject which provides an M2M service identified as an electronic communication service pursuant to art. 2 of the Framework Directive can be required to notify the start-up of its activity.

This consideration, inevitable on principle, becomes more complex, however, when one leaves the sphere of connectivity or if one asks who must bear the notification obligation. For example, in the case of connected cars, in which the passenger benefits from a tele-metering service or a pay-as-you-go insurance service, it would seem legitimate to wonder whether or not it is the cars themselves which provide an electronic communication service. To further clarify the

concept, the electronic communication service inside a Connected Car certainly exists and is offered by the supplier of the M2M application which, for example, registered tele-metering data or evaluates the use of the car for the purpose of paying the pay-as-you-go policy". However, whether it is admissible to extend this consideration to the builder of the car in which the communication module, which guarantees the said services, is pre-installed, is a question which must be asked. In other words, the moot point is whether supplying a user with an M2M service, clearly identifiable as an electronic communication service provided by a third subject, makes the car builder, in turn, a supplier of electronic communication services. If, on one hand, in fact, the car builder can decide to pre-install the M2M module or not, and possibly even change the service supplier, on the other hand the said car builder supplies a product to the passenger, whose main function has nothing to do with the supply of M2M services and even less with the supply of electronic communication services. This latter consideration seems decisive and leads to excluding the applicability of the authorisation system to car builders. However, as repeated several times in this document, M2M services and applications differ greatly from each other, and it is impossible to establish in advance whether the provisions of the Authorisation Directive are generally applicable to the entire M2M phenomenon or not.

With regard to the Authorisation Directive, it is worth noting that the European Commission, opening the *Telecom Single Market* revision process, wished to overcome the regulatory obstacles that still hinder the full exploitation of the economic potential deriving from the creation of a European digital market which includes the large operators that have the capacity to compete on the global scene. In particular, the Commission maintains that at the basis of Europe's delay compared to other market contexts (such as, for example, the United States and South East Asia), above all in terms of investments in fixed and mobile third generation infrastructures, there is insufficient coordination between the regulatory approaches adopted by the NRAs of the various Member States. This would lead to legal uncertainties and obstacles to the entry to the various national markets on the part of the operators interests in operating on a continental scale and, consequently, to a reduction of business opportunities, with negative repercussions on the investments.

In the Regulation proposal, the following objectives are outlined: to ensure that citizens and companies have access to electronic communication services wherever these are provided within the Union, without limits between borders or unjustified additional costs; to ensure the providers of Internet access and services can operate wherever they and their users are located within the Union. The Commission indicates three tools for the pursuit of the above objectives:

the removal of unnecessary obstacles in the authorising system and in the rules on the supply of the service, the assurance of greater harmonisation of the relative laws and regulations within the Union, and lastly harmonisation of consumer protection levels. Only thus, in the Commission's opinion, can the operators work with standardised rules over the entire territory and not only in their country of origin.

In this analysis, it seems useful to coordinate the reasons declared by the European Commission with some elements that emerged during the consultation. To this regard, the players of the energy sector have pointed out that the different systems should depend on the use made of the service, regardless of the technologies used. It was pointed out in particular that the M2M services used in the management of critical infrastructures should be treated separately, as, in general, all services that the legislator could identify as essential for the safe and efficient management of those systems the absence of which could seriously harm the national system.

It is therefore reasonable to conclude that, until a general reform of the European (and consequently national) legal and regulatory framework has been introduced with provisions that are more suitable to communications between machines, M2M services which "consist exclusively or prevalently of the transmission of signals on electronic communication networks" should also be theoretically subjected to the provisions which govern the electronic communications sector at present. The practical application of such provisions will be delegated to the prudent assessment of the NRA, also on the basis of generally relevant criteria such as the importance of the connectivity of the service offered, the impact that the service could have on people's safety and its public usefulness.

Nevertheless, as often happens when a generic definition leads to many different interpretations, the decision on the applicability of that generic definition to the concrete case falls within the competence of the subject holding the power to impose the application of the rules. In Italy in the electronic communications sector, this power is held by the regulating body, without prejudice to the possibility of resorting, in the last instance, to the administrative court.

4.3.2. Interoperability, interconnection and change of service provider

In analogy with the preceding paragraph, there is a problem of the interoperability and the interconnection between systems. The Electronic Communications Code places great importance on interoperability and interconnection between the networks.

The pursuit of interoperability and interconnection requires the adoption of common technical standards. The fact-finding survey revealed the existence of many solutions and

considerable fragmentation. This situation is probably linked to the fragmentation of the public ICT system and the fact that the public administration data centres often are not interoperable.

It must first be noted that fragmentation does not necessarily represent a condition for market failure (it could even indicate good competition); however, public action aimed at the development of common standards and actions to reduce fragmentation can be pursued if it is maintained that at the basis of the European delay, compared to other market contexts (such as, for example, those of the United States and South East Asia), above all in terms of investments in third generation fixed and mobile infrastructures, there is insufficient coordination between the technological and regulatory approaches adopted by the Member States.

The question of changing connectivity provider is discussed in paragraph 4.2.4. This section considers what elements should discipline service provider change.

At present, M2M/IoT services to which the concept of the change of operators is applicable have not been identified, nor have elements supporting the introduction of new obligations been identified. Nevertheless, it is hoped that in the future services of public importance will be widespread (for example, in the fields of eHealth, eLearning, etc.) and that, as in the case of telephony, it will be possible to benefit from the possibility of changing the service provider.

The development of these scenarios would be facilitated if adequate coordination of the European Digital Agenda and of the relative national initiatives were guaranteed. The possibility of changing operator can be proposed if a market of end services becomes affirmed and if common standards are adopted, as in the case of voice telephony, both fixed and mobile.

4.3.3. Security and Privacy

The analyses carried out show the potential of M2M and the benefits for society as a whole deriving from the use of a system based on M2M applications. In addition, observation of the particular economics of this market shows that the users of M2M applications are also content producers (they generate “personal data”): although the device users are often not aware of the entity of the data traffic deriving from the use of M2M applications, the information based on human behaviour is “valuable” (it is sufficient to remember that industries have started to invest large sums to share, process and interpret data generated by M2M devices). Consequently, the analysis of the impact of the new technologies on collective well-being cannot disregard the quantification of the risks linked to the availability of a huge quantity of information (such as the

components of families, spending capacity, kilometres covered, etc.) on the part of experts whose job will be precisely to interpret and re-sell the results of their surveys.

During the hearings, the following questions were brought up, regarding the spread of M2M communications.

First of all, the question of who owns the information was raised: the end user or the M2M device "manager"? ⁽⁴⁹⁾

Consequently, the question of privacy was recognised, and the need to guarantee correct personal data processing. In fact, it is necessary to observe, firstly, that the service providers have access to the data and they can save them in their own databases, to then use them to supply the service, but also with economic purposes that are not necessarily linked to what is strictly necessary for the performance provided for the user. According to what has been learnt from the discussions at EU Community level, the question should be dealt with on several levels, since it is first necessary to know whether it is possible to access the information on the user's consumptions, habits or geographical location also without the consumer being aware of the fact (or, in any case, without his/her explicit consent). The problem is particularly important in the case of M2M, since the user could underestimate the scope of the contractual conditions and the real effects of consenting to the processing of his/her personal data, in as much as unaware of the quantity of information obtained. On the other hand, during the hearings, some subjects claimed ownership of the information obtained from the use of the devices bought by the users (specifying that they had borne the expense of the design and production of the devices, and therefore they were authorised to exploit information of a general nature on the functions and measurements of the performances that could be achieved). The question also regards precisely where, geographically, the data and information of each individual will be memorised and the security protocols put in place to maintain confidentiality. In other words, the availability of information which is actually confidential falls within the sphere of the problem of disclosure and of the cataloguing of the data in territorial areas in which it could certainly be used incorrectly.

All the above mentioned problems are particularly important if considered in reference to M2M since, although a consumer may not express particular perplexity in releasing information by means of one or a few devices, the forecast development of the market suggest that in the near

⁴⁹ The case of the SIM installed by car builders to control vehicle performance and maintenance is of particular importance. Are the data generated, e.g. by the vehicle engine, owned by the car builder, the car owner or the end user (who might not be the car owner)?

Similarly, are the measurements taken by a smart meter owned by the end user or by the utility company which provides the service?

future, there will be a multiplication of devices from which it will be possible to acquire information on the end user. In other words, M2M intensifies the effects deriving from an already uncertain operating framework, and the development of this market will increase the number of devices from which to obtain information without the consumer being correctly informed on the quantity of information regarding his/her personal life which will be released through M2M applications.

With regard to the above mentioned issues, for some time now there has been discussion at Community level on proposals which could give effective answers which, on the other hand, will not prejudice the innovative nature of the system or the development of a sector which, as already stated several time, takes on particular importance and can have a deeply beneficial impact on society as a whole. The subjects under examination include, firstly, the proposed adoption, at Community level, of a body of provisions on data protection: in this way, the inefficiencies linked to the individual actions on the part of each company would be reduced.

In addition, the possibility of introducing solutions which facilitate access to one's own personal data, allowing for greater flexibility in the transfer of the data by one services supplier to another (data portability right) to thus improve competition between services, are being discussed. Lastly, the right to oblivion must be recognised, i.e. the possibility for anyone to cancel is/her own data (unless there are legitimate reasons for their conservation).

The questions regarding the security of communication for M2M are often made to concern the application sphere, therefore with the formulation of solutions suitable for communication devices (the implications of which almost always fall within the scope of the user). This need arises from the fact that the communication services offered by the network operators (like SMS) are structurally deficient from the security viewpoint and therefore cannot be directly used in industrial applications for which the reliability, integrity and confidentiality of the information transferred is required. In spite of this, it seems necessary to consider whether connectivity services that can ensure adequate security and privacy levels should be developed in order to foster the development of applications of national interest ⁽⁵⁰⁾.

⁵⁰ The network used by the ABI has an embedded protection mechanism. Certified e-mail is more protected than traditional mail. The GRX network interpreter uses protection mechanisms, etc.

4.4. The vertical segments

The following paragraphs are dedicated to the more important M2M applications from the economic and regulatory viewpoint.

4.4.1. Connected cars

Connected Cars and, in more detail, the electronic communication devices for security installed in vehicles, are an important part of M2M development. With regard to these applications, some estimates suggest that in 2017 there will be 140 million interconnected devices in the world⁽⁵¹⁾. In Europe, one of the main development drivers is consequent to EU Regulation no. 305/2013 on eCall, which imposes the installation of automatic devices for the immediate generation of the emergency call in the case of a road collision. The said Regulation requires the installation of the safety device on all new cars and also the updating of the networks (to allow for locating the vehicle). To this regard, it seems evident that the availability of a mobile terminal device in every car is a stimulus to the spread of added value services which could be activated by the user, perhaps on signing a contract with the service provider. In fact, in addition to eCall, there are other specific M2M applications for the automotive segment. Above all, reference is made to the possibility of using M2M devices for all activities regarding the management of the vehicle (such as, for example, applications prepared by the car builder for maintenance and those prepared by the insurer to limit fraud). In this sense, a significant case is that of the “black box” (also known as a *Check Box*) which is prepared and installed by almost all insurance companies. With regard to incentives to the demand, the black box allows for a discount on third party vehicle insurance, for knowing the real dynamics in the case of an accident, and for tracing the vehicle if it is stolen. Together with the cases examined, the application of M2M devices in the development of Connected Cars must also be analysed in respect of *Automotive Infotainment Systems*, i.e. applications destined for entertainment and for assistance to the activities carried out on board (such as satellite navigation systems). In short, the Connected Cars case clearly shows the role of M2M regulation in the creation of conditions for the development of the applications to be used by M2M devices. The subject of mobility, together with that of security, is a key element of the driving force for the increase of M2M services.

⁵¹ <http://www.strategyanalytics.com/>

4.4.2. Smart metering

Smart metering ⁽⁵²⁾ is one of the important applications in the M2M field. It must be observed, first of all, that the Italian Smart Metering system for electricity (pursuant to the Authority's decision no. 292/06 for electricity, gas and the water supply system) is one of the few European applications with about 33 million devices installed which interconnect to the cell network through about 400,000 concentrators equipped with SIMs and installed near the low voltage electricity transformers.

Smart gas metering, which has developed at a sustained rate over recent years (although, at present, there is no clear regulatory reference for its implementation), tends towards proprietary network solutions for the entire segment of the measuring signal connection and concentration network, seeking to develop systems that ensure limited costs: in particular, mono-service point-multi-point W-MBUS transmission technologies in the 169 MHz band have been chosen. Although a point-point technology is used at present for the smart gas metering system, a great development is expected with the multi-point W-MBUS solution. For more information on W-MBUS technology, see paragraph 3.1.4.

With regard to gas metering, one mobile operator stated that it wished to start up experimentation on the use of the modified cell network (the standard of which is being prepared ⁽⁵³⁾) to be proposed as an alternative to the W-MBUS solution. It is useful to specify, in this sense, that if an alternative solution to W-MBUS is adopted, the large scale use of smart metering will be a challenge to the existing technologies and tariffs. In respect of this, it is maintained that, to ensure the economic sustainability of the investments, a lower ARPU will have to be accepted.

The electricity, gas and water board, with decision 393/2013/R/gas, has started the experimentation of *multi-service smart metering* to verify in the field the degree of efficiency resulting from sharing the communications infrastructure, otherwise dedicated to smart gas metering, with other public utility services, even if not regulated by the Authority but included in a smart city logic.

In Europe the Smart Metering service is presenting problems relative to the assignment of mobile radio and/or geographic numbering resources, i.e. with specific enumeration, and the methods of applying the rules in force for the concrete execution of number portability (for example, problems linked to the physical or virtual replacement of the SIMs built into the M2M

⁵² See, for example, <http://www.etsi.org/technologies-clusters/technologies/m2m>.

⁵³ See par. 3.1.1.

devices, since control of the SIM cards could be an important element for the development of competition in the M2M field, and for the entry of the smaller operators into the market).

4.4.3. Smart grids

Smart Grids, or intelligent electricity networks, allow consumers to become interactive participants of a distribution network. Thanks to government incentive programmes and the growing demand for renewable energy sources, and the installation of photovoltaic panels and small wind turbines on the roofs of houses and buildings, Smart Grids fall within the scope of common interest to Europe: with the aid of intelligent electricity networks, consumers could use their internal generation capacity and become active participants in the energy supply chain.

For this to take place, consumers must be able to monitor the electricity consumption in real time. The network managers must be able, on the basis of the demand, to adapt the electricity offer, both from centralised power stations and from an increasing number of distributed sources of reduced dimensions.

The management of the electricity network, to support the Smart Grids, needs a greater capacity to transmit information since optimised and capillary management of the resources is required, by means of control systems in real time. Electronic communications are one of the enabling elements for the development of Smart Grids; it therefore seems important to identify how the communication services must be designed, according to the technical requisites which include: the topological features of the points to be connected, the presence of any existing infrastructures, the quality requisites of the Smart Grid applications, the costs (compared with the benefits) ⁽⁵⁴⁾.

One of the aspects under examination regards the choice of developing dedicated or shared networks, in order to take advantage of the lower costs that could result. For this purpose, therefore, possible "interactions between the Electricity and the Telecom worlds" must be examined, considering that:

- some of the mobile operators' costs are due to the base network management services and in some cases mixed shared/dedicated solutions can be of interest;
- some Electronic Communications operators may be interested in providing application development platforms for Smart services;

⁵⁴ Prof. Antonio Capone's presentation, at the seminary organised by the AEEG "Smart Grid Project promoted by the Authority - The monitoring of the activities in progress and assessment of the intermediate results".

- on the new installation of low voltage/medium voltage network stretches, the marginal cost of fibre is low and it can be useful to share access resources with Telecom operators (if the area reached is of interest or if there are Digital Divide incentives).

4.4.4. Smart cities

The M2M applications which can potentially be subject to regulatory obligations include, in particular, the case of the Smart Cities. A city can be classified as a Smart City if it manages the economic activities, the mobility the environmental resources, relations between people, residential policies and the administration method in an intelligent (“*smart*”) way. In other words, a city can be defined as smart when the investments in human and social capital and in the traditional infrastructures (transport) and the modern infrastructures (ICT) support sustainable economic development and a high quality of life, with wise management of natural resources, through a participatory method of government.

Smart cities therefore represent, in a single urban model, environmental protection, energy efficiency and economic sustainability, with the aim of improving the quality of life of the people who live there and of creating new services for citizens and for the Public Administrations.

The rationalisation of energy consumption, the production of energy from renewable sources, the creation of new products and services, and the activation of new scientific-technological know-how at local level, are components for the creation of an efficient and integrated urban environment.

The subject is of great interest, if one considers that Europe has planned investments of about 11 billion euro over the next ten years for the Community project which incentivises smart cities. Starting from this consideration, smart cities are an opportunity for the telcos. In fact, the possibility of offering services with high added value and of exploiting one's own technical skills taking the position of project partner, rather than limiting one's offer to pure connectivity, would allow operators to increase their revenues (since pure connectivity margins are continually falling).

Also in this case, however, there are aspects of regulatory importance. In particular, the issues to be dealt with include interoperability and security, as well as fragmentation, which become matters of extreme importance in view of the need to seek a common standard (⁵⁵).

⁵⁵ One can consider, for example, the activities connected to the standardisation of the Smart Apps <http://ec.europa.eu/digital-agenda/en/news/smart-apps-toolkit-connected-cities>.

5. Intended action on the part of Agcom

On the basis of the critical aspects brought to light by the survey, certain activities have been identified that Agcom intends to start during 2015, to favour the development of M2M investments and solutions.

➤ M2M services and market monitoring

Since there are aspects of M2M that are not yet determined because of the evolution of the business models, of the technological choices and of the effects due to regulation, Agcom will continue its monitoring within the sphere of the ordinary supervisory activities.

M2M services and market monitoring
Monitoring <i>M2M services and market</i> , with the purpose of: <ul style="list-style-type: none">– developing the <i>Key Performance Indicators</i>, for monitoring this specific market;– analysing, through quantitative surveys, the spread of M2M communication services.

➤ Permanent M2M Committee

With regard to issues of national importance, it emerged from the interviews held during the fact-finding survey that there is a need to create an opportunity for constructive dialogue between the subjects which operate in the development of the vertical sectors and the operators specialised in traditional electronic communications. Many of the latter are now marginally involved in the development of the M2M value chain and still use B2B type business models. The subjects active in the vertical segments, however, have expressed the need for dialogue with the owners of the infrastructures and of the know-how, in pursuit of collaboration and development rather than a supplier-customer relationship. It therefore seems useful for Agcom to act as coordinator to favour the development of the synergetic development of the initiatives launched by public and private subjects, with special focus on actions which reflect on regulation.

Agcom will therefore establish a permanent M2M Committee in which the main actors (public and private) will be involved and, to ensure greater coordination of public intervention, it will also operate through bilateral agreements with the other Sector Authorities and the other bodies

involved in the development of M2M services, according to the needs requested by the vertical sectors.

Permanent M2M Committee
<p>The <i>Permanent M2M Committee</i> will represent the place where the coordination of the public and private initiatives will be favoured, with special focus on actions which reflect on the regulation and the competitiveness of the sector. The <i>Committee</i> will play an active role in order to reach the following objectives:</p> <ul style="list-style-type: none">– promotion of the development of investments in electronic communications infrastructures and in communications services for M2M;– identification of the specific needs in respect of the radio spectrum, particularly regarding the taxonomy of utilisations and the sustainability of the economic models;– definition of appropriate forms for access to the network infrastructures (e.g. national wholesale roaming access) and the promotion of soft regulation initiatives;– development of connectivity services suitable for the needs of M2M applications and, consequently, identification of the usage profiles and of the service quality levels (QoS) which must be met by the national wholesale and retail offers;– guidelines for questions connected with IPv6 migration;– coordination of issues relative to M2M with the more general initiatives promoted by the Italian Digital Agenda;– support for the Authority's activities at Community and international levels.

➤ M2M market supervision

Surveys on the competitiveness levels of the market seem important, in order to avoid future risks of market pre-emption and of technology lock-in, and to ensure that economic regulation is imposed in advance and adequately in time. Agcom, in consideration of its own institutional duties, intends to continue its supervision, fostering market development and the growth of

those operators which have a weaker position on the world market, by the promotion of an adequate level of competitiveness and of service quality.

➤ Initiatives to protect the end user

To guarantee a high level of consumer protection in their relations with providers, it also appears to be useful to promote initiatives aimed at ensuring adequate protection, introducing M2M matters into the scope of the tasks already pursued by Agcom. If the Permanent M2M Committee detects problems relative to user protection, institutional action will be taken under the Authority's management board.

6. Conclusions

The analysis has brought to light many important aspects for regulatory revision, which can be grouped into the following macro categories (developed further below in this chapter):

- the state of the development of the infrastructures and services;
- connectivity regulation;
- the final service;
- vertical M2M markets.

The activity for revising the regulations must be modulated according to how widespread the M2M services are, which at present show appreciable usage values and significant development trends. To this regard, therefore, some initiatives have been identified which the Authority intends to carry out, in order to favour the development of M2M services.

The state of the development of the infrastructures and services

➤ Infrastructure operators

The infrastructures of the public network available at present seem partially inadequate to offer connectivity for the specific transmission needs of M2M services, both for their technical features and for economic reasons (the diverse band occupation - typical of M2M services - would require different economic models from those used by a massive use of the networks). From a technical viewpoint, in fact, the large scale spread of M2M technology on traditional networks could generate congestion of the network because of the maximum signal capacity supported (rather than in terms of maximum traffic limits supported). In the case of SIM based services, for example, the dimensioning of the 2G/3G networks was originally defined to ensure the support of a relatively low number of terminals per resident person ⁽⁵⁶⁾ which, instead, in the case of M2M can reach a few dozen connected units per person. In short, a traditional network (i.e. not developed for M2M, which features very low but very widespread traffic volumes) cannot be expected to be adequate to supply connectivity to either today's users or those of M2M/IoT technology.

These critical aspects are pushing the M2M service providers to create ad hoc acquisition networks and architecture which, in first analysis, seem to be classifiable as private networks and therefore possibly excluded from the scope of the survey. It is clear that this solution is

⁵⁶ There are about 90 million active SIMs in Italy.

not efficient on the economic level and that it is reserved to the large providers (e.g. electricity operators which also receive economic incentives for the creation of such private networks), thus creating a model which cannot be used on a large scale, especially for the more commercial applications. It is therefore necessary to question the adequacy of the public networks and whether they are suitable to vehicle new services, thus allowing for benefiting from scale and scope economies that would otherwise be absent (to the detriment of the entire system and the development of the new services). And it is therefore necessary to assess whether action should be taken to offer new forms of symmetrical access to the suitable (or adapted) infrastructures for the new services, unless the market spontaneously provides for such access, or to assess whether the alternative tools of soft regulation can be equally effective.

Lastly, with regard to the cell network, coordination of the LTE coverage plans is required, with the investments sustained for the smart grids, in order to allow for the interconnection of the electricity generation plants located in rural areas, where intervention on the part of the mobile operators is not normally contemplated (although there are incentives for investments in smart grids).

➤ Technologies

With reference to technologies, there is a considerable fragmentation of solutions adopted so far to offer the end service to the user. In the absence of standards suitable for these purposes, solutions are being developed often based on proprietary technologies and using unconventional transmission means (such as, for example, the use of signalling channels for the transmission of M2M data) ⁽⁵⁷⁾. Some standards, to allow for the adaptation of the cell networks for the typical M2M uses, are being defined ⁽⁵⁸⁾ and will probably influence the development of M2M solutions as early as 2016.

⁵⁷ This is the case of the information services offered by Acotel.

⁵⁸ Some operators – including Vodafone and Telecom Italia - are pushing, for example, for the release of the “*Cellular IoT*” standard in 2016, to be able to use the bands licensed for mobile telephony for the services typical of M2M.

➤ Services

The provision of M2M services normally contemplates, in addition to connectivity, the creation of a "services platform" which can acquire the data from the connected devices and distribute them to the subject which provides the service. These M2M platforms have not yet been developed except in proprietary form ⁽⁵⁹⁾. Standardisation initiatives at ETSI level are in progress ⁽⁶⁰⁾ to develop interoperable solutions. To this regard, it is necessary to reflect on the possible involvement of regulation for the purposes of developing such platforms, as far as they are essential for the development of M2M services. The European Directives in force do not deal with these aspects (unknown when the directives were pronounced) and the Digital Agenda itself, although mentioning M2M services, gives no indications in this respect.

It is therefore necessary to consider whether public intervention is necessary/opportune to allow for the development of new platforms in an open, competitive environment. The clarity of the applicable regulatory framework, which gives investors guarantees and stability (avoiding the inefficient use of the available resources), is an essential condition for the development of M2M services.

Connectivity regulation

➤ M2M and change of economic paradigm for the operators

One of the relevant aspects emerging from the survey is the role covered by the telecommunications (TLC) operators. M2M is causing a paradigm shift, leading from relations which are traditionally of the *Business-to-Consumer* (B2C) type towards *Business-to-Business* (B2B) models or, more commonly, *Business-to-Business-to-Consumer* (B2B2C) models. In these cases, TLC operators can lose the direct relationship with the end user, which instead

⁵⁹ Vodafone has declared that it has created a platform for M2M services which is managed by *Vodafone Global Enterprise*, i.e. from its own division dedicated to multi-national companies and which guaranteed the direct presence of its sales teams in 32 countries spread over the 5 continents.

Telecom Italia, in a similar way, through a company belonging to the group (*Telecom Italia Digital Solutions*), develops *M2M*, *Internet of Things* and *Cloud Computing* solutions in both national and international spheres.

In both the said cases (representing the general context), there are evident efforts spent by the operators to extend the offer beyond pure connectivity which, at present, offers increasingly lower margins.

<http://www.vodafone.it/portal/Aziende/Grandi-Aziende/Perche-Vodafone/operatore-globale-business>

<http://www.tidigitalsolutions.it/>

⁶⁰ The *European Telecommunications Standards Institute*, or ETSI, is an international, independent non-profit body officially responsible for defining and issuing standards in the field of telecommunications in Europe.

becomes a prerogative of the “M2M service provider” (⁶¹). The role of the TLC operator is therefore limited to offering base connectivity for the devices (mainly through mobile network SIMs), which different subjects provide the service (⁶²). M2M connectivity service customers are, therefore, the suppliers of M2M services (if not directly the M2M device manufacturers (⁶³)), but they are not the end customers. To this regard, it may be observed that a considerable part of M2M services developed are today offered by global suppliers, above all when the M2M service is part of an object which has a native connectivity (such as, for example, a new generation car connected directly via a service SIM to the assistance centre). In these cases, the connectivity service user is often unaware of the network supplier chosen by the subject which offers the M2M service.

The electronic communications code (and the EU directives of 2002 (⁶⁴)) has been developed on the traditional network-service-user model and does not clarify the problems deriving from the development of new business models, in which the contractual models are more complicated and new subjects appear, such as: intelligent terminal manufacturers, M2M service providers, app suppliers, etc.

➤ The connectivity market

The connectivity model at the base of M2M services is very often different from that of traditional applications for the transmission of data in the Internet world. M2M services express different needs according to two particular features: a connection available always and everywhere. This means that for SIM based services, there is frequent use of foreign SIMs in permanent roaming in order to benefit, on one hand, from the agreements with all the operators, obtaining the maximum coverage possible over the territory, and, on the other hand, from European regulation on the maximum prices applicable. The coverage needs, in fact, do not coincide with those required by traditional services at national and European level, for which the maximum extension of the service is obtained with interoperability. As a consequence of the transnational dimension of the relevant M2M markets, some international alliances are

⁶¹ During the hearings, it was brought to light that the services for which consumers are directly involved in the purchase of M2M SIMs are few and circumstanced (e.g. SIM cards for home and/or lift alarms - a use, for that matter, often forbidden by the terms and conditions of the main telephony operators), and, therefore, the Authority should consider the prevalence of B2B, in carrying out every evaluation.

⁶² For example, *Octo Telematics* traffic monitoring services.

⁶³ For example, the *Kindle* reader produced by *Amazon* is sold with an embedded SIM for downloading e-books, for which the user does not directly pay the connectivity costs (which are covered by *Amazon*).

⁶⁴ One must also consider the amendments of December 2009 (the so-called “*Telecom Package*”).

being developed between the main mobile operators. Each alliance uses specific technologies for remote reconfiguration of the SIMs.

The resulting connectivity market seems to be, at present, developed by a few large operators which, aggregating the various national infrastructures through roaming agreements (sometimes specialised for M2M), offer global connectivity services. This situation can lead to market pre-emption and technology lock-in risks, and to restricted competition by the application of exclusive discounts and/or the sale of specialised products/services between the operators of the alliance, and it can also make it more difficult for the national operators which are weaker in global competition to find it difficult to enter the market. It therefore seems central to assess the possibility of facilitating access to mobile infrastructures and connectivity provider exchange on the part of the user.

These measures must be evaluated also in the new of the new regulation on the *Telecom Single Market* (TSM) and/or the *Digital Single Market* which, favouring the single market, will have probable effects also on M2M/IoT development. At present, there are no clear strategies that could be put into practice to change provider and which could contemplate: a) the use of coordinated national solutions, e.g. through enumeration; b) the adoption of a standard model within the sphere of the EU regulation; c) no regulatory intervention.

➤ The spectrum

During the survey, it was found that M2M services have particular features compared to the classic data applications of cell technology, requiring narrow band transmissions (without any particular need for speed transmissions) and with adequate levels of indoor propagation (as in the case of the smart gas meters). Consequently, adequate radio spectrum assignment policies must be ensured to guarantee the economic sustainability of the M2M business cases, which feature limited profit for each connected device. It is therefore necessary to assess the need for identifying specific frequency bands for these solutions (such as 169 MHZ proposed for the gas metering service or the white space) or to consider the methods by which they can be issued on the frequencies at present assigned for mobile telephony services.

Another aspect which stands out regards the present spread of M2M applications with 2G modules (diffusion due to their low cost) which can represent a problem for the switch-off of the GSM network.

➤ International roaming

As already mentioned, a relevant part of the debate on M2M (and also TSM) now regards international roaming and, according to some studies ⁽⁶⁵⁾, this is the regulatory sphere where the more urgent questions arise. Above all, there is uncertainty on the applicability to M2M services of the EU Regulation in force at present, since the present definitions of roaming do not seem compatible with the services issued, especially in the case of the "fixed" devices, for which the application of the said regulation has become common practice in Europe.

The question of the applicability of the present regulation on roaming via SIMs located permanently outside the country of origin (permanent roaming) is a topic of much debate at European level, which also directly involves some Italian operators ⁽⁶⁶⁾.

The regulations applicable to permanent roaming should define a series of questions such as, for example, the identification of the Institution which should hold legislative/regulatory competence and, above all, the application of the national regulatory system (also to protect users) which might be only partially applied. To this regard, since permanent roaming is often used solely to allow for easier configuration of M2M devices and to assure a better service level, it seems possible to analyse alternative solutions such as the opening of national roaming ⁽⁶⁷⁾.

On the other hand, the application of wholesale CAPs also to M2M traffic is an additional problem, since the regulation criterion does not guarantee, under all circumstances and in consideration of the typical features of M2M traffic already described, coverage of the costs effectively sustained by the host infrastructure. If the obligations on wholesale roaming access, of the present Roaming Regulation ⁽⁶⁸⁾ are applied, the criterion of the CAPs should be carefully analysed to avoid market distortion phenomena due to the present regulatory framework (subsidised M2M traffic). Although there are differing opinions, hypotheses

⁶⁵ Machina Research, The Impact of Regulation on M2M and IoT – October 2014.

http://www.m2m-summit.com/files/matt_hatton_machina_research_m2m_iiot_regulation.pdf

⁶⁶ 74% of the sample considered by *Machina Research* maintains that permanent roaming, from the regulatory viewpoint, is “Unclear/no regulation (probably permitted)”, while 13% believe it is permitted. About 10% of the sample, however, maintains that permanent roaming is clearly banned or “probably forbidden”.

⁶⁷ On this point, there is an important question of ensuring M2M service providers the possibility of exercising the right of access to the network, also through the Authority's support in the case of possible disputes generated by denied access on the part of the structured operators which use the low volumes of M2M services as a pretext to deny access and interconnection.

⁶⁸ Art. 3 of the Regulation.

alternative to CAP have been proposed and which seem more appropriate for regulating the price for M2M traffic and which should therefore be opportunely studied (introduction of the obligation to contract and, possibly, the adoption of fair and reasonable prices).

Lastly, it has been reported that the wholesale roaming access obligation, favouring access to the infrastructures of the network visited by the roaming service provider, on one hand facilitates the implementation of net neutrality ⁽⁶⁹⁾, but on the other hand it can preclude the effectiveness of the traffic management policies ⁽⁷⁰⁾ at present considered in the debate on the Telecom Single Market.

➤ Numbering

It is a shared opinion that M2M development can lead to the exhaustion of the numbering resources. These problems have already been addressed both through international coordination (CEPT), and through specific national procedures on enumeration.

Within the sphere of the fact-finding survey, the participating operators pointed out the use of telephone numbers in the transmission of Internet messages, for identification of the terminal ⁽⁷¹⁾. In particular, according to the subjects concerned, this practice does not completely conform to the regulations ⁽⁷²⁾.

It seems opportune to point out that the activities in progress must be coordinated with the initiative of the Telecom Single Market: in particular, national regulations must ensure "competitiveness" in respect of the other Member States which, in some cases, seem to offer less complex/less expensive methods for access to numbering resources ⁽⁷³⁾.

➤ Specific service profiles

The absence of Service Level Agreements (SLA) and, more in general, of specific "user profiles" from the technical and economic viewpoint, relative to the needs of M2M applications, may be a problem for the development of certain services (e.g. the Smart Grids for which, according to some participants, it is necessary to guarantee the availability of the

⁶⁹ Equal treatment for all traffic.

⁷⁰ Functions for security (e.g. the parental control function of the security dedicated performances), or functions to allow for the development of specialised services at faster speeds by traffic prioritisation.

⁷¹ The case of APPs in which messages are sent via the Internet (therefore not through the telephone service) and the users are identified by the individual telephone number which is communicated by the user to the Platform Manager during the application installation phase.

⁷² In particular, if the provision and the definition of Electronic Communication Service (see the Authorisation System) are taken literally.

⁷³ See the case of the national smart gas meters which use foreign numbers and not Italian numbers

infrastructures and of the relative services also in the case of extensive black-out). More in general, in addition to the above-mentioned energy sector applications, it is clear that some applications of public importance can be conditions by the autonomy and functioning of the radio station bases in the absence of electricity.

➤ **Security**

With reference to security, M2M communications must guarantee a suitable level according to the diverse type of the services to which such communication can be dedicated or the routes that must be protected (in the case of M2M, the data transferred may be deemed sensitive and belonging to third parties). In this sphere, the players of the energy sector ask for avoiding regulations which demand disproportionate security systems and which would therefore call for unsustainable costs (in some Member States, these discussions are slowing down the adoption of smart metering). In addition, the smart metering experiences lead to considerations on whether it is opportune for M2M service users to have avail of the flexibility necessary to define the specific parts for security and privacy controls.

The final service

➤ **Authorisation system**

The definition of Electronic Communications Service, as reported at present in the Electronic Communications Code ⁽⁷⁴⁾, is difficult to apply in the M2M sector and, more in general, in the Internet of Things. This aspect leads to potential complexity on the applicability of the authorisation system. In particular, the transnational nature of this service stimulates thought on the need for a review of the definition now in force, also to avoid indicating an obligation of notification in all the States where the sale of the service is contemplated. There is discussion in progress at BEREC on whether to introduce a European authorisation system for services of a transnational nature.

⁷⁴ With regard to the authorisation deed, it must be remembered that the Code defines Electronic Communication Services (ECS) as services normally supplied for payment, consisting of the transmission of signals on an electronic communications network, including telecommunication services (art.1, section 1, letter gg) of the Code).

➤ Interoperability, Interconnection

At present, apart from personal communications services, there has been no identification of "strategic" services for which the obligations of interoperability, interconnection and change of service provider must be applied. The Code has dealt with such problems for past reasons only in the case of traditional services, but there are no references to the innovative M2M/IoT services. This fact requires careful consideration ⁽⁷⁵⁾ in order to assess the future benefits for users and for the development of M2M/IoT services in a competitive context.

The vertical markets

➤ Connected Cars/Mobility

Connected Cars and, in particular, the electronic communication devices for security installed in vehicles, are an important M2M development sector in Italy and in Europe. In this case, the main driver of development is the Regulation (EU) no. 305/2013 on e-Calls, which aims to bring swift assistance to car drivers and passengers involved in a collision ⁽⁷⁶⁾. In addition to safety, it is contemplated that interconnected cars will be equipped with a considerable number of M2M applications for the management of the vehicle (e.g. applications designed by the car builder for maintenance and applications designed by the insurer to limit fraud), as well as those for entertainment and in support of activities carried out on board.

The Connected Car case clearly shows the influence of regulation on the development of the entire market of connected applications. The subject of mobility, together with that of security, is a key element of the driving force for the increase of M2M services.

➤ Smart Metering

Smart metering is one of the important applications in the M2M field. In this sphere, it must first be observed that the Italian smart metering system for electricity is one of the most developed European applications (with about 33 million devices installed).

Smart metering for gas is oriented towards proprietary network solutions for the entire network for the collection and concentration of the measuring signals (*Wireless MBUS* transmission technologies in the 169 MHz band). It is clear that in this way a network created as a private

⁷⁵ Obviously, the detailed analysis of this aspect does not fall within the scope of the fact-finding survey.

⁷⁶ It has been reported that the European project is at risk of late implementation in respect of the similar initiatives of Russia and China, which, however, were launched later and which use the most modern and efficient solutions: unlike the case of Europe, the use of 3G is required (while the e-Call also contemplates 2G) and the emergency must be communicated by SMS.

infrastructure, for that matter using unlicensed frequencies and on which it will therefore be difficult to apply planning and service quality concepts, becomes "public" especially if shared by several utilities.

At the same time, various experiments are in progress, based on the cell network (also regarding the standards being drawn up) to be proposed as alternatives to the Wireless MBUS solution. The development of dedicated network infrastructures must be carefully analysed from the regulatory viewpoint, both for the implications on the spectrum and for market competitiveness. It must first be observed that to guarantee returns on the investments in these infrastructures, the possibility of the use of the same for several measuring applications and, in the last instance, also for Smart City applications, is being assessed.

In the European sphere, smart metering is presenting problems regarding the assignment of the enumeration resources and how to apply the rules in force on number portability in the case of SIM-based solutions (the physical or virtual replacement of the SIM card embedded in the M2M devices). Control over the SIMs is a relevant element for the development of competitiveness and to avoid discrimination against the smaller operators.

➤ Smart Grids

The *smart grids*, i.e. intelligent electricity grids constructed in a manner which favours the distributed generation and energy efficiency, allows consumers to become interactive participants in a distribution network. The development of smart grids requires a greater capacity for the transmission of information on the electrical networks since an optimised and capillary management is necessary by means of control systems which operate in real time. Electronic communications are one of the enabling elements for the development of smart grids and, consequently, it is necessary to consider the possible need to define the technical connectivity requisites, assessing: the topology of the points to be connected, the use of pre-existing infrastructures, the quality requisites of smart grids, the costs/benefits ratio, the coverage of LTE networks in some specific rural areas.

➤ Smart Cities

Of the M2M applications that are potentially compatible with the regulatory obligations, the case of smart cities is important. Smart cities represent, in a single urban model, environmental protection, energy efficiency and economic sustainability, with the aim of improving the quality of life of the people who live there and of creating new services for citizens and for the Public Administrations.

The development of smart cities requires the coordination of various services operating at urban level and the adoption of standards and rules which can foster the development, define intervention priorities and identify the relative technologies.

Smart Cities are an opportunity for the telecommunications industry since the operators can offer high added value services and exploit their own technical skills, taking the role of project partners, rather than limiting their offer to pure connectivity which today offers increasingly lower revenues.

Intended action on the part of the Authority

Since there are aspects of M2M that are not yet determined because of the evolution of the business models, of the technological choices and of the effects due to regulation, the Authority will continue its monitoring within the sphere of the ordinary supervisory activities.

The tools for in-depth examination and for identifying any regulatory actions which can favour the development of M2M services includes a special Committee which the Authority will set up, open to the participation of all subjects, institutional and private, involved in the development of M2M services. In fact, the need has come to light to arrange for the subjects holding the know-how in the telco sector to meet with the subjects engaged in the implementation of the end services (e.g. utilities, smart cities, etc.).

The M2M Committee will be able to play an active role in the identification of the specific connectivity needs of M2M and in the analysis of appropriate forms of access to the network infrastructures.

Annex 1

List of fact-finding survey participants

- The Electricity, Gas and Water System Authority
- Milan Polytechnic
- Telecom Italia
- Vodafone
- Wind
- Fastweb
- Poste Mobile
- Huawei
- Qualcomm
- Gemalto
- Ubiquity
- Acotel
- Enel distribuzione
- Magneti Marelli

Written contributions

- AT&T
- Verizon
- Telecommunications Industry Association