INSTITUT BELGE DES SERVICES POSTAUX ET DES TÉLÉCOMMUNICATIONS

CONSULTATION du 7 septembre 2010

concernant

LA DETERMINATION DE LA POLITIQUE DE NUMEROTATION EN MATIERE DE COMMUNICATION M2M

Mode de consultation:
Délai de réponse : Le 22 octobre 2010. Les réponses introduites plus tard ne seront pas retenues.

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La réponse doit indiquer clairement ce qui est confidentiel.

Table des matières

1. INTRODUCTION

Les applications Machine à machine (abrégé M2M) sont des applications où les appareils communiquent entre eux sans intervention humaine. Des exemples typiques sont la télémétrie, les systèmes d'alarme et la télécommande de processus. L'on observe une demande croissante sur le marché d'applications M2M qui fonctionnent indépendamment du lieu et utilisent des réseaux mobiles. Cette demande est encore intensifiée par la mise à disposition massive de l'électronique grand public, comme les lecteurs électroniques, les équipements de navigation et les afficheurs de photos qui sont également reliés sur des réseaux afin de réaliser l'interactivité.

Une partie des applications M2M est encouragée ou même imposée par l'intervention des pouvoirs publics, comme l'ecall, le smart metering et éventuellement des systèmes de taxation au kilomètre. Celles-ci peuvent entraîner un déploiement à grande échelle car chaque véhicule et chaque habitation doivent être équipés du M2M.

Autrement dit, il est probable qu'énormément d'appareils dépassant éventuellement le nombre d'utilisateurs humains, soient reliés aux réseaux et doivent utiliser des mécanismes d'identification. A long terme, tout le monde s'accorde pour dire que les adresses Ipv6, plutôt que les numéros E.164, sont le mieux appropriées à cet effet. Par contre, il faudra à court terme chercher d'autres solutions que les systèmes de numéros classiques en raison des limitations techniques des systèmes actuels.

Les grandes incertitudes relatives au succès du M2M, qui dépendra fortement des décisions des pouvoirs publics dans des domaines comme le transport et l'énergie, impliquent qu'il est très difficile de faire une estimation au niveau des besoins en numéros supplémentaires pour les applications M2M.

2. CONSULTATION EN MATIERE DE NUMEROTATION M2M

Le groupe de travail Numbering, Naming and Addressing (WG NNA) au sein de l'ECC (Electronic Communications Committee) de la Conférence Européenne des administrations des Postes et Télécommunications (CEPT) a préparé un projet de rapport (joint en annexe) sur la problématique de la numérotation dans un contexte M2M.

Ce rapport évalue l'éventuelle capacité de numéros requise uniquement pour la communication M2M d'ici 2020 en Belgique. Sur la base d'un scénario moyen, cette capacité devrait s'élever pour la Belgique à quelque 14 millions de numéros, rien que pour la communication M2M. Ce chiffre doit cependant être appliqué avec la prudence nécessaire: il s'agit plutôt d'une excentration de tous les scénarios possibles pour arriver à une moyenne, suggérant implicitement que nous avons ici une répartition gaussienne. Cette dernière est plus qu'incertaine et par conséquent, nous devons plutôt tenir compte de scénarios extrêmes. Soit il s'agira d'un besoin de plusieurs numéros par habitant, soit le M2M restera plutôt une application niche.

Pour les applications voix existantes (essentiellement des applications mobiles en Belgique), l'on observe une augmentation d'en moyenne 1,7 millions de numéros attribués par an durant les dix dernières années. Il faut s'attendre à ce que cette augmentation ralentisse à l'avenir, mais par extrapolation sur les dix prochaines années, on voit que, pour la période 2010-2020, 17 millions de numéros mobiles supplémentaires seront nécessaires. A l'heure actuelle, 34,5 millions de numéros mobiles sont encore disponibles. Nous en concluons donc que la réserve actuelle de numéros mobiles est suffisante pour les applications actuelles.

Question 1 : Pouvez-vous faire une estimation de la capacité de numérotation requise pour les applications M2M sur la période 2010-2020 ? Pour cette même période, quelle capacité de numérotation est requise pour (d'autres) applications mobiles et applications de données ? Selon vous, dans combien de temps les adresses Ipv6 remplaceront-elles les numéros de téléphones classiques ?

Le document de consultation ci-joint décrit 4 options pour la numérotation M2M. Ces options peuvent bien évidemment être combinées.

Dans l'option A, les séries de numéros sont déjà prévues dans le plan national de numérotation pour les applications de communication mobile, en particulier les séries 044X à 049X, également utilisées pour la communication M2M. Aucune distinction n'est faite entre les applications voix et d'autres applications. La réserve actuelle de numéros mobiles (34,5 millions) suffit tout juste pour répondre à la croissance anticipée (soit 31 millions = 17 millions + 14 millions) des applications M2M ainsi que des applications « traditionnelles ». Cependant, il existe bien un risque qu'à terme, la réserve de numéros mobiles s'épuise, surtout si l'on souhaite desservir le marché étranger au niveau de la communication M2M, depuis la Belgique et au moyen de numéros belges. De plus, une série d'applications M2M, comme le "small metering", ne correspond pas au concept de "numéro mobile", tel que repris dans l'arrêté royal relatif à la gestion de l'espace de numérotation national et à l'attribution et au retrait des droits d'utilisation de numéros. Pour les opérateurs, cette option est effectivement la plus facile à implémenter sur les plans technique et opérationnel, parce qu'aucune adaptation par rapport à la situation actuelle n'est nécessaire.

Dans l'option B, à savoir une nouvelle série de numéros, l'on pourrait prendre la série "40" suivie de 11 chiffres. Vu que les numéros sont formés par des machines, la convivialité n'est pas un critère de sorte qu'il vaut mieux directement créer la plus grande réserve possible en numéros. L'IBPT estime que s'il est opté pour cette solution, la série de numéros M2M doit effectivement être conforme à la recommandation E.164, de sorte que ces numéros puissent être formés et utilisés dans le monde entier. L'une des exigences du E.164 est qu'un numéro international ne puisse jamais dépasser les 15 chiffres. La séquence à composer pour les appels nationaux est donc 040 ABCDEFGHIJK et pour les appels internationaux +3240 ABCDEFGHIJK. Cette séquence crée 100 milliards de numéros : une réserve de numéros amplement suffisante. Il n'est pas exclu que l'adaptation des systèmes opérationnels et IT de certains opérateurs soit nécessaire. L'option B est la plus axée sur l'avenir. En effet, cette série de numéros particulière avec une réserve de numéros suffisamment élevée peut également être utilisée pour les applications M2M offertes par les opérateurs de réseaux fixes. La désignation par l'IBPT de séries de numéros propres aux communications M2M impliquerait une modification de l'arrêté royal relatif à la gestion de l'espace de numérotation national et à l'attribution et au retrait des droits d'utilisation de numéros. L'article 11, §3 de la loi du 13 juin 2005 relative aux communications électroniques prévoit en effet la possibilité que l'Institut fixe les règles provisoires, dans l'attente d'une solution par AR, après autorisation préalable du ministre.

L'option C ne fait plus appel à des numéros issus du plan national de numérotation, mais bien directement aux numéros d'un plan international de numérotation. Cette option est surtout attrayante pour des opérateurs actifs au niveau mondial. Cependant, les numéros étant attribués par l'UIT, cela signifie que les opérateurs doivent être entre autres membres de l'UIT, ce qui représente un obstacle de taille pour les plus petits opérateurs. De plus, cette approche nécessite que l'UIT attribue un code global international pour la communication M2M. Mais cette attribution nécessite à son tour un consensus au sein de l'UIT. Aussi existe-

il un risque élevé que ce type de numéros globaux engendre des problèmes au niveau de la possibilité de composer des numéros.

La quatrième option (Option D), à savoir celle où les numéros internes au réseau sont retenus, présente comme principal avantage une flexibilité accrue pour les opérateurs. Ce qui représente une solution attrayante, tant que les applications M2M ne dépassent pas les limites réseau du réseau propre. Ce choix a notamment pour conséquence que les opérateurs ne pourront plus utiliser ces numéros, par exemple dans un stade ultérieur, si l'interopérabilité entre limites de réseau est effectivement exigée. Cette éventualité exclut également la portabilité des numéros. Ceci représente une sévère restriction, surtout si l'on souhaite donner plus de flexibilité aux intégrateurs de systèmes M2M. Cette option n'exige aucune adaptation réglementaire, et constitue donc de ce point de vue la solution la plus facile à implémenter par l'IBPT. Toutefois, l'IBPT est convaincu que cette option ne permettra qu'à une petite partie des applications M2M (comme "smart metering") d'être utilisée de façon intéressante.

D'autres critères importants de décision pour retenir ou non certaines options sont les suivants: (1) dans quelle mesure est-il nécessaire de distinguer les services M2M des autres services mobiles et (2) comment faut-il, pour les applications M2M, interpréter un certain nombre d'obligations réglementaires, comme l'accès aux services d'urgence, l'inscription dans les annuaires, la rétention de données, la transparence tarifaire, …

Question 2 : Il est demandé aux répondants d'effectuer une analyse SWOT des options A, B, C et D de leur point de vue commercial.

Question 3 : Quelles conditions supplémentaires ou mesures d'encadrement doit-on encore imposer ou prendre par rapport à votre option préférée afin de garantir la stabilité du cadre réglementaire de la numérotation M2M ? A cet égard, on trouve les aspects suivants : importance des blocs de numéros, allocation directe aux exploitants d'applications M2M, critères de réservation, obligation de portabilité de numéros, …

L'IBPT a la conviction que l'option B offre les meilleures garanties à long terme pour soutenir un déploiement structurel du M2M. L'allocation directe peut également offrir des avantages aux prestataires de services M2M, en particulier pour les applications à grande échelle, parce que le passage à un autre opérateur est simplifié. Une autre solution à l'option B pourrait consister à retenir l'option A pour les applications M2M qui exigent interopérabilité et mobilité, en la combinant avec l'option D pour les applications que ne les exigent pas. Cette combinaison diminuerait le risque d'épuiser la réserve actuelle de numéros mobiles et de nous obliger à effectuer une nouvelle grande adaptation de numéros sur le long terme (après 2020).

Question 4 : Vers quelle option ou combinaison d'options va votre préférence définitive et pourquoi ? Dans quel délai faudra-t-il la mettre en œuvre ?

Il est à noter qu'il vaut mieux considérer le concept de communication de Machine à Machine avec une certaine marge d'interprétation. Le M2M pourrait être considéré comme une technologie de communication où les données sont transférées automatiquement entre les équipements et les applications sans ou avec peu d'interaction humaine.

Question 5 : Comment définiriez-vous la communication M2M ?

3. ETAPES ET PROCESSUS SUPPLÉMENTAIRES

Vous êtes prié de donner votre avis sur les considérations susmentionnées en combinaison avec le document de consultation joint ci-après.

Se fondant sur vos réactions, l'IBPT pourra transmettre pour le 22 octobre 2010 une synthèse des commentaires assortie de sa propre opinion pour soumission au GT NNA. Il est prévu que ce groupe de travail approuve le rapport final pour la fin novembre 2010.

Ensuite, l'IBPT définira une politique définitive en matière de numérotation M2M. Le mode précis d'implémentation réglementaire dépendra de l'option choisie (ou de la combinaison d'options) et sera, conformément à la Directive Autorisation, soumis à la consultation pendant au moins 4 semaines.

A. Desmedt
Membre du Conseil

C. Cuvelliez
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ANNEXE : Rapport ECC 153 : Numbering and addressing in Machine-to-Machine (M2M) communications

Cfr le site Internet http://www.ero.dk ; rubrique “ECC consultations”

Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

NUMBERING AND ADDRESSING IN MACHINE-TO-MACHINE (M2M) COMMUNICATIONS

Vilnius, June 2010

EXECUTIVE SUMMARY

In recent years a rapid development of a variety of services that make use of Machine-to-Machine (M2M) communication has taken place. M2M is a communication technology where data can be transferred in an automated way with little or no human interaction between devices and applications.
In this report, M2M communications is understood as a fully or largely automated communication (data transfer) between two or more information and communications (ICT) entities, that may be part of a predetermined group. A goal of this report is to help National Regulatory Authorities (NRA) in their considerations on efficient numbering and addressing solutions for Machine to Machine (M2M) applications and to avoid possible exhaustion of existing numbering ranges. Although a clear need for harmonization of numbers for use of these applications is not foreseen, the information in this report might be useful as policies on M2M numbering in most countries are still in an early stage of development and information on best practices does not yet exist.
It is expected that the development of M2M applications will have an impact on national numbering plans because machines need to be uniquely addressed in order to communicate with them, or rather to enable them to communicate with each other. The natural intention by operators and M2M service providers is to use E.164 numbers from the existing numbering plan for M2M services because of the relatively simple implementation in already existing network infrastructure.
The conclusion based on analysis from this report is as follows:

- The expected annual growth rate of required M2M numbers between years 2010 and 2020 is approximately 20%, but this is just a rough estimate and the actual figure may differ from this estimation significantly.
- In the long run IPv6 addressing will become very important as an alternative numbering resource for at least part of the M2M applications. However, there is much uncertainty what period is involved so that numbering policy for M2M should be flexible enough to be also a solution for the longer term.
- A significant number of CEPT countries do not have sufficient capacity in their existing numbering plan to accommodate numbering requirements for M2M applications.
- No harmonised approach on possible M2M numbering solutions is needed in Europe.

One of the main goals of numbering policy for M2M applications is that the provision of numbers for this kind of applications will not compromise specific end-user interests which are covered by the existing national numbering plans, such as user-friendliness and tariff transparency.
The report recommends[1] as follows:

1. Taken into account the potential extensive growth rates of M2M applications or other similar telecommunication services, the NRAs should, in cooperation with market players, establish a numbering policy for these kinds of services as part of the national numbering plan. The policy shall be flexible enough to accommodate also a longer term solution.
2. As a long term solution IPv6 addresses, or numbers/addresses other than E.164 numbers should preferably be used for device based communication applications. These numbering/addressing schemes or switching from E.164 numbering plan to a new plan should not prohibit market development or competition.
3. In a short and a medium term the 4 numbering options (A-D) can be envisaged; based on the current knowledge of the market none of these have a clear preference. In cases where there is a need to distinguish M2M services and the traditional mobile services option A has to be excluded. Options B and D are needed if the growth of M2M is larger than expected or if there is no adequate space in existing number ranges in use. Option C depends on ITU.
4. There are possible situations where a new number range (option B) should be opened. For example, the number range in question may require different regulatory treatment, e.g. relating access to emergency services, or the services to be provided have certain characteristics (e.g. M2M applications in fixed networks) where existing mobile number ranges may not be adequate.
5. For the services where number portability is an obligation or where subscribers can take advantage on number portability, option D should not be used.

Additional considerations regarding possible new number range(s) for M2M communications or other device based applications:

i. The new numbering range(s) accommodate future mass volume applications, such as M2M applications, and do not have prohibitive conditions for such applications.
ii. The NRA should ensure that the new numbering range(s) are not used as an alternative to existing numbering ranges to escape regulatory requirements.

[1] These recommendations are given for the purpose of this report only, and they should not be mixed with ECC Recommendations (capital 'R') as regulative tools.

iii. As some existing regulatory requirements may not be relevant or useful for certain applications such as M2M applications, exceptions regarding existing regulatory requirements could be applied to new numbering range(s) accommodating these applications. For example, for M2M numbering resources the issue of user friendliness (e.g. short numbers) is not relevant. Number portability requirements should be applied to network external numbers but not to network internal numbers, as this is not applicable in the latter case.

iv. The number length of network external numbers should be as long as possible (max 15 digits according to E.164). The length of network internal numbers should not be pre-determined.

Table of contents

Numbering and addressing in Machine-to-Machine (M2M) communications

1 INTRODUCTION

In recent years a rapid development of a variety of services that make use of Machine-to-Machine (M2M) communication has taken place. M2M is a communication technology where data can be transferred in an automated way with little or no human interaction between devices and applications. The advantages of M2M are great for both business and consumer purposes. For business use, M2M technology may lead to more effective and efficient operations (e.g. fleet control). For consumers, as an example, applications used for home security and smart metering can be facilitated by M2M.

It is expected that the development of M2M applications will have an impact on national numbering plans because machines need to be uniquely identified and addressed in order to communicate with them, or rather to enable them to communicate with each other. The natural intention by operators and M2M service providers is to use E.164 numbers from the existing numbering plan for M2M services because of the relatively simple implementation in already existing network infrastructure.

The potential amount of M2M devices could be large and some applications may need several numbers (e.g. E.164 numbers) or addresses (e.g. IPv6 addresses), and therefore there is a potential need for a large amount of identifiers. It is recognized that some national numbering plans may not be prepared for such big demand for numbers. Thus a numbering strategy is required for both short and long term to meet requirements for M2M services. The appropriate numbering or addressing solution to be chosen is related to the type of communications used to provide the service. These communications can either be fixed or mobile, they can require a continuous connection with the application server or they might be randomly reached by the server.

2 SCOPE

The purpose of this report is to help National Regulatory Authorities (NRA) in their considerations on efficient numbering and addressing solutions for Machine to Machine (M2M) applications and to avoid possible exhaustion of existing numbering ranges. Although a clear need for harmonization of numbers for use of these applications is not foreseen, the information in this report might be useful as policies on M2M numbering in most countries are still in an early stage of development and information on best practices does not exist, yet.

In this report, M2M communications is understood as a fully or largely automated communication (data transfer) between two or more information and communications (ICT) entities, that may be part of a predetermined group. The essence of the communications that is subject of this report is that there is no need for the numbering to provide any aspect of "human user friendliness" (e.g. that numbers are kept as short as possible) whereas in traditional approach to numbering "human user friendliness" is a major objective of the design of a numbering plan.

Machine related communications also includes Human to Machine (H2M) and Machine to Human (M2H) communications where the "Human" is a single person or a group of pre-determined people or any person who happens to be associated with the terminal that is identified by the number (e.g. anyone in a given car that has a built in terminal for data or speech communication[2]).

The report discusses the basic M2M characteristics, different access methods from M2M devices to networks and numbering and addressing alternatives for M2M applications. Finally, a set of recommendations for the NRAs regarding M2M communications is given.

[2] The definitions of H2M and M2H imply a margin of interpretation, for example machine initiated call set-up can be followed by voice communication.

3 GENERAL DESCRIPTION OF M2M COMMUNICATIONS

The M2M applications can be either for fixed or moving locations. However, there is a tendency that most M2M service providers deploy their business models on mobile infrastructure even for fixed locations. Some examples of mobile location applications are car pool monitoring, person monitoring, logistical supply chain control or automatic remote paying systems. Fixed location applications are for example remote surveillance and monitoring of buildings and homes, etc.

3.1 Parties of M2M Communications

M2M communications is a fully automated means of communication between two or more entities. Human interaction is not foreseen in this communication process. Parties in M2M communications are typically

- a M2M service provider (M2M SP);
- an operator; and
- an end-user (the subscriber to a M2M service) as a M2M SP's customer.

Although M2M applications vary very much from each other, today E.164 numbers for a M2M application are typically assigned to the M2M SP by the operator. Often the end-users do not see and even do not need to see these numbers. The end-user typically buys a certain M2M application (e.g. home supervision and alarm system) including the necessary equipment and telecommunication installations and connecting lines from a M2M SP. The M2M SP normally supervises the connections from the M2M equipment in customer's premises to his service centre, and thus the M2M application is not dependent on the end-user's choices on his private communications means.
Figure 1 illustrates M2M communications and communication parties with examples A and B. The example A could be automatic meter reading service, where an energy meter includes a communication terminal (①) able to receive a communication from the energy company (②) requesting a meter reading to be sent back. The example B could be a car theft alarm, where a GPS system installed in the vehicle (❻) transfers data to the vehicle's GSM connection (❽) to send the vehicle's identification and position to the vehicle monitoring service provider (❼). These examples are clarified in tables below figure 1.

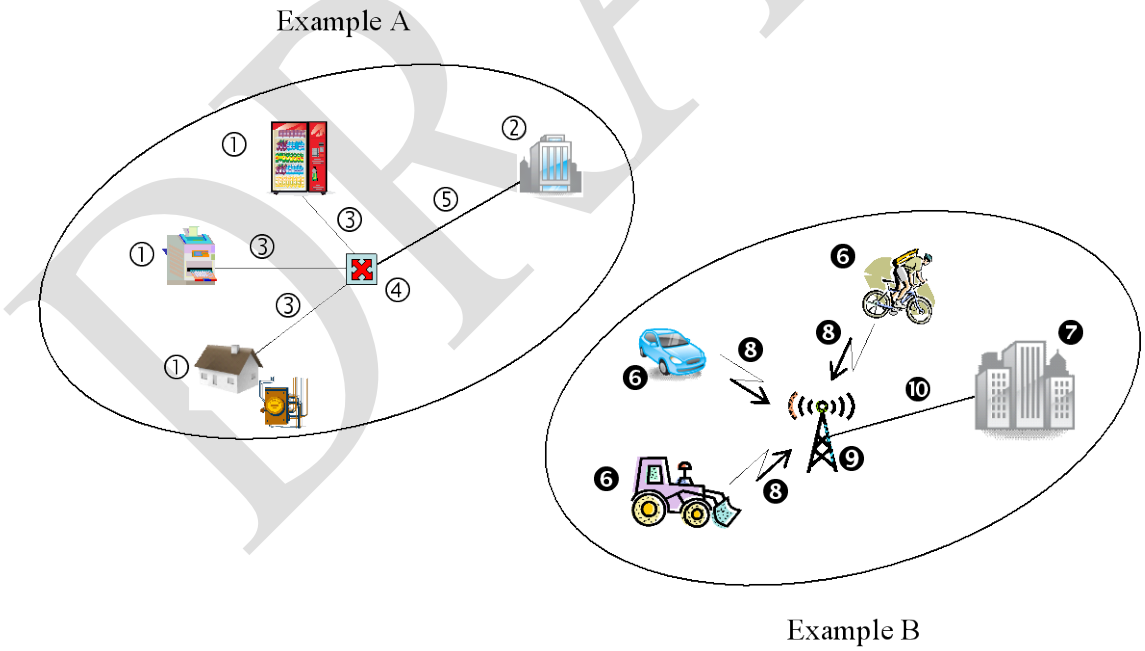

Figure 1: Examples of M2M communications

Item	Explanation
①	Subscriber (end-user) to a M2M service with a M2M service terminal, for example: ▪ supervision of vending machines ▪ collection of data from office/industry automation equipment ▪ smart metering solutions, e.g. electricity metering
②	M2M SP
③	Subscriber's M2M communication line, typically controlled by the M2M SP, provided by an operator. Subscriber's public communication line, e.g. a fixed telephone subscriber line is separate from the M2M communication line.
④	Operator's switch or concentrator.
⑤	M2M SP's communication line to the operator. This may also be used for the M2M SP's other communications means.

Example A (figure 1): M2M communications using fixed line connections

Item	Explanation
❻	Subscriber to a M2M service with a M2M service terminal, for example: ▪ collection of information from a bicycle messenger's service terminal ▪ vehicle alarm systems ▪ machine park rental supervision
❼	M2M SP
❽	Wireless communication from the subscriber's M2M service terminal typically controlled by the M2M SP, provided by an operator.
❾	Operator's base station.
❿	M2M SP's communication line to the operator. This may also be used for the M2M SP's other communications means.

Example B (figure 1): M2M communications using mobile connections

3.2 Access from the M2M Devices to Network

The choice of M2M communications depends much on the application itself, but also the access method from the end-user's device to network. The following approach applies:

	Fixed location	Mobile (moving) location
Access method	▪ Fixed access: PSTN / IP ▪ Mobile access: GSM / 3G (IP)	▪ Mobile access: GSM / 3G (IP)

Typically, the M2M SP wants to provide the full service package to the end-user, including the telecommunication connection, which in turn has been negotiated by the M2M SP with an operator. In this way the M2M SP is able to control his service portfolio in whole.

3.2.1 Fixed Access

Fixed access from the end-user to the M2M SP requires, quite naturally, a physical connection including "the last mile" of the subscriber line. Typically the existing subscriber line is used for the subscriber's other telecommunication purposes, such as PSTN line and/or broadband. This connection may be affected if the end-user resigns his fixed connections, and this may also affect the possible M2M communication connections. Thus the M2M SP would, in practice, be required to build his specialised M2M subscriber line in addition to the subscriber's private line. This is one of the reasons why M2M SPs prefer mobile access from their customers' devices.
A PSTN connection is reliable and cost-efficient. However, the PSTN connection to a M2M device limits, in most cases, the device to be wired to the PSTN, which may result to vulnerable implementations, as the wires may be easily cut. Although wireless implementations also exist, at least the PSTN is connected to the premises by wire.
IP connection is also reliable and cost-efficient. Here, too, we talk about wired solutions in most cases. Although wireless implementations also exist, at least the broadband is connected to the premises by wire.
Both of the fixed access methods would allow large volumes to be transferred with relatively low cost.

3.2.2 Mobile Access

Mobile access is provided by wireless connection from the device to the base station providing flexibility, security and increased safety in installation. The clear advantage for mobile access from the M2M SP's point of view is that it is available for both fixed and moving customers. This allows the M2M SP to implement only one platform (i.e. the mobile) to serve all customers.

3.2.3 Conclusion on Access

Mobile access gives flexibility, security and allows the M2M SP to implement only one service platform. Mobile technology is mature and more flexible than fixed networks. Typically the mobile access is implemented with a SIM card module in the subscriber's M2M device allowing an already secured connection between the terminal and a base station. Mobile technology is rather inexpensive and allows easy installations.
As a conclusion the mobile access from M2M devices is the most viable access method.

4 ASSESSMENT OF NUMBERING CAPACITY REQUIRED FOR M2M COMMUNICATIONS

4.1 Methodology

An assessment of E.164 numbering capacity required for M2M communications depends on various factors, such as type of services and potential customer base. A strong growth is expected for M2M communication in the future. There is only little reliable information on the existing market situation for M2M and its growth rates. Thus it is very difficult to make valid assumptions. Furthermore, those few sources that exist measure market in rather different ways.
As different M2M applications cannot be easily compared with each other in terms of assessing the future demand of numbering capacity, one alternative is to take a number of inhabitants as a starting point. In European countries the amount of inhabitants is rather stabile throughout recent (and forthcoming) years. In the following chapters different growth estimations and scenarios for M2M communications are given, based on this starting point. It must be understood that the estimates given do not necessarily take account of all future machine related applications. However, the growing use of SIM card technology implies that in the near future additional consumer products will be connected to mobile networks. So there is a substantial possibility that real market demand for numbers for mass applications could become far higher than the given estimates.
First, an assumption on the amount of M2M numbers today (year 2010) was assessed. In order to make figures comparable, this assumption was made as numbers per capita. Secondly, information from different sources was collected to estimate the amount of M2M numbers in year 2020, different growth rates were assessed. Finally, the information was used to estimate the annual average growth rate for M2M numbers from year 2010 to 2020.
Based on information collected from European (CEPT) countries the above mentioned information was used to assess how existing (mobile) number ranges would meet the requirements for M2M numbering capacity in year 2020.
It has to be underlined that the assumptions are not based on scientific facts, but rather estimates on markets by different players.

4.2 Assumptions and Scenarios

4.2.1 Starting Points

The following starting points and assumptions deal with assessing the required M2M numbering capacity:

1. These assumptions deal with mobile number ranges as concluded in chapter 5.1
   - Operators and M2M SPs see mobile numbers as very important for addressing M2M applications in short and medium term.
2. Time window for M2M numbering assessment is from year 2010 to 2020
   - Various sources indicate that IPv6 may take over in addressing M2M applications. This would be likely to happen earliest in year 2020.
   - In emerging business the market players would like to see regulatory stability for the business for some time. 10 years have been mentioned.
3. M2M numbers in use per capita in year 2010 is 0,1-0,2; figure 0,2 is used as a starting point
   - The figure is based on information from a few operators. The figure is considered as rather optimistic but it was decided as a starting point by the PT FNI[3].
4. A hypothetical country of 10 million inhabitants is chosen as an example
   - Actually, the amount of inhabitants does not play a role here, it is used as a relative indicator to be able to compare countries in a reliable way.
5. Annual growth rate of M2M applications is 10% - 30%
   - It is very difficult to get estimations for M2M growth rate. Annual rates of more than 30% annually have been mentioned.
   - It may be possible that the growth is more intense in the beginning of the assessment window (2010-2020) and will slow down towards the end. This has been taken into account in figure 2.

4.2.2 Growth Assumptions Based on Population

The figure 2 illustrates the estimated growth of M2M numbers. The starting point is a hypothetical country with 10 million inhabitants where there are either 0,1 or 0,2 M2M numbers in use per capita in year 2010. Growth rates between 10% and 30% have been assessed with possibility of decreasing the growth with time (the growth rate colours are just for information purposes). The following assumptions are considered:

Alternatives (see figure 2)	**M2M numbers per capita 2010**	**M2M numbers 2010**	**Growth rate 2011 – 2015**	**Growth rate 2016 – 2018**	**Growth rate 2019 – 2020**
Alternative 1	0,1	1.000.000	10 %	10 %	10 %
Alternative 2	0,2	2.000.000	10 %	10 %	10 %
Alternative 3	0,1	1.000.000	30 %	20 %	10 %
Alternative 4	0,1	1.000.000	30 %	30 %	30 %
Alternative 5	0,2	2.000.000	30 %	20 %	10 %
Alternative 6	0,2	2.000.000	30 %	30 %	30 %

[3] PT FNI project team "Future Numbering Issues" (meeting in Brussels in February 2010) under the CEPT Working Group Numbering, Naming and Addressing.

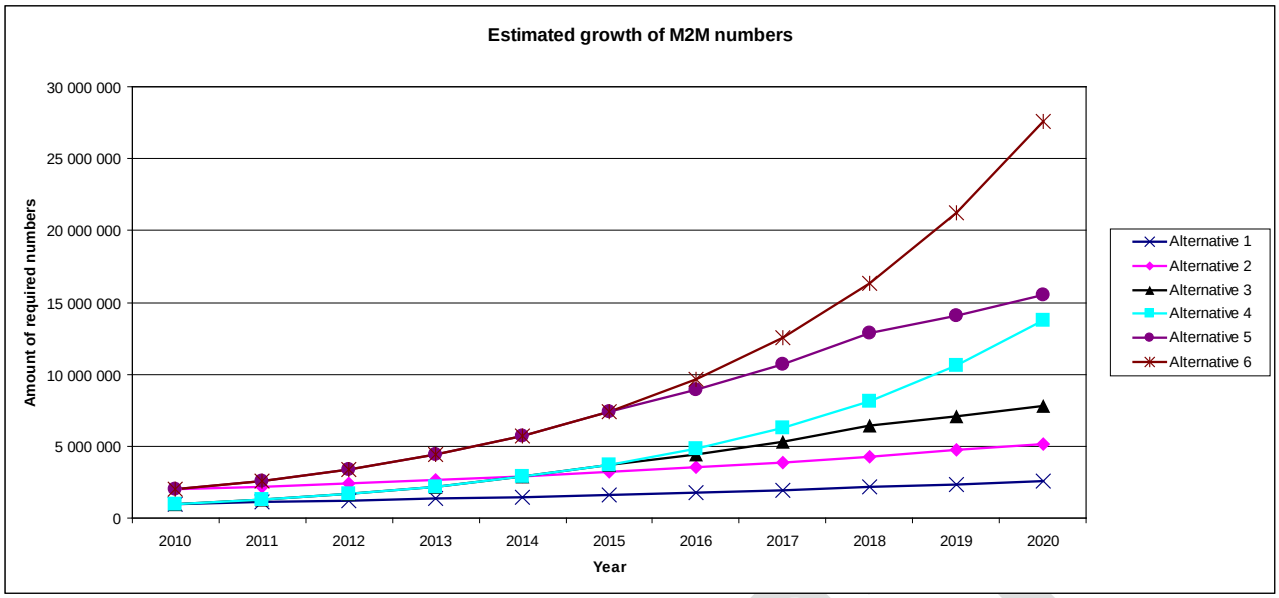

Figure 2: Estimated growth of M2M numbers

There are very little or no studies to support different scenarios. The table 1 below gives number information (estimation of M2M numbers needed) from years 2015 and 2020 from the graph in figure 2.

Table 1. M2M numbers needed (in millions) according to figure 2

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
2015	1,6	3,2	3,7	3,7	7,4	7,4
2020	2,6	5,1	7,8	13,8	15,5	27,6

As stated in 4.2 a starting point for numbers per capita in year 2010 is 0,2. The alternative 5 starts with 0,2 numbers in year 2010 per capita and the annual growth rate would be 30% in years 2011-2015, 20% in years 2016-2018 and 10% in years 2019-2020 giving a demand of 15,5 million (new) numbers for M2M applications only in year 2020.

4.2.3 Growth Assumptions Based on Households

This estimation is based on a hypothetical country of 10 million inhabitants in year 2020. Some studies indicate that the average number of persons per household in developed countries varies from 2,2 (Switzerland 2008[4]) and 2,4 (European Union 2007[5]) to 2,6 (USA 2007[6]). The following assumptions are made:

- 4 million households
- 75% of the households have 3 smart metering systems using M2M applications (electricity, water, heating)
- 25% of the households have a security system using M2M
- 1 car in a household; 50 % of cars include 2 M2M applications (eCall, theft alarm)

Numbering capacity required for the above mentioned example:

- Smart metering systems: $0,75 * 4 * 10^6 * 3 = 9$ million
- Security systems: $0,25 * 4 * 10^6 = 1$ million
- Car systems: $0,5 * 4 * 10^6 * 2 = 4$ million

- Grand total: 14 million

4 Federal Administration, Swiss Statistics – http://www.bfs.admin.ch/bfs/portal/en/index/themen/01/04/blank/key/haushaltsgroesse.html

5 Eurostat: Average number of persons per household – http://nui.epp.eurostat.ec.europa.eu/nui/show.do?dataset=lfst_hhantych&lang=en

6 U.S. Bureau of the Census, May 1996 – http://www.census.gov/population/projections/nation/hh-fam/table1n.txt

4.2.4 Other Growth Assumptions

Various M2M estimates are listed here mainly for background information:

- A telecom analyst firm[7] has estimated an increase of 32,9 % machine-connections to mobile networks in Europe every year – giving 52 million units in 2011. The firm estimates that much of this growth will come from the car industry.
- Conclusions from some M2M presentations suggest that within next 10 years, i.e. up to year 2020, 1-2 M2M related numbers are needed per inhabitant.
- A M2M service provider estimated in May 2009 that the Netherlands (16,5 million inhabitants) would require 25 million M2M numbers within 10 years.[8]
- A telecommunications operator has estimated in May 2009 that France (63 million inhabitants) would have 5 million M2M numbers in use in 2010 and would require 30 million numbers in 2015 and more than 70 million numbers in 2020.[9]

4.3 Conclusions on Required M2M Numbering Capacity

This chapter draws conclusions on required M2M numbering capacity based on estimates given above. Different approaches have been 'harmonized' by calculating a factor with which the number of inhabitants needs to be multiplied in order to get an estimate on required M2M numbering capacity in year 2020. It has to be noted that all the figures here are very rough estimates.

- A population based approach gives factors 0,3 – 2,8 depending on the alternative in question. As the alternative 5 was assessed as one of the most realistic ones the factor is likely to be 1,6.
- A household based approach gives a factor value 1,4.
- Other growth assumptions give factor values between 1,1 and 2,0.

Although this is not a statistical approach, the above mentioned assumptions give the factor a typical value of 1,4. This factor means that in year 2020 a country needs M2M numbers equal to the number of inhabitants multiplied by 1,4. For example, in a country of 10 million people 14 million M2M numbers are needed in year 2020. When the (starting) level in amount of M2M numbers in 2010 is 0,2 per capita this gives an average annual growth of 20% in 2010-2020.
It must be understood that the above mentioned figures do not incorporate all possible future machine related applications. However, the growing use of SIM card technology implies that in the near future additional consumer products will be connected to mobile networks. So there is a substantial possibility that real market demand for numbers for mass applications could become far higher than the given estimates.

5 M2M NUMBERING AND ADDRESSING

5.1 Introduction to M2M Numbering

Numbering and addressing alternatives for M2M applications deal quite much with the chosen access method. Fixed and mobile access for M2M applications has been discussed in chapter 3.2. Today fixed access can be divided into PSTN and IP-based networks.
For PSTN access the E.164 numbering resources are obvious. For IP-based fixed networks the IP-addresses are used either in IPv4 or IPv6 format. The former is close to exhaustion while the latter is not yet mature technology in all aspects.
Although IP-connection with IP-addresses would be possible with 3G/UMTS mobile networks in the future, today's mobile networks are not capable to support IP-based mobile access, i.e. it is not possible to set up communications using IP-addresses. Therefore, for mobile access E.164 numbers are the natural choice for the time being.
It can be concluded that the E.164 numbering resources (i.e. numbers in the national numbering plan) are the most viable solution for addressing M2M application at least in the short and medium run. It is expected that most M2M applications will be based on mobile networks, and therefore within E.164 numbers the present mobile number ranges[10] seem to be most suitable for M2M solutions as described earlier. It is possible that IP-based solutions with IPv6 addressing will become more important in the long run.

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7 Berg Insight: Fleet Management and Wireless M2M – 4th Edition (December 2008)
http://www.berginsight.com/ShowReport.aspx?m_m=3&id=79

8 Stratix, May 2009

9 France Telecom Group, May 2009

10 Term "mobile number ranges" includes all existing network external number ranges which are allowed to use in mobile networks.

5.2 Numbering Resources for M2M Applications

It was concluded above that E.164 mobile numbering resources would be the most viable methods for addressing M2M applications. The basic options are as follows:

- Option A: Existing mobile number ranges, including possible expansion of them[11] (E.164 numbers)
- Option B: A new number range for M2M or similar applications (E.164 numbers) (for example longer numbers than normally, however max 15 digits according to E.164)
- Option C: An international numbering solution (E.164 numbers)
- Option D: Network internal numbers

For the purpose of this report the following definitions shall apply:

- Network external numbers: E.164 numbers with maximum length of 15 digits or national-only numbers in the National Numbering Plan. E.164 numbers may pass the international network-network interface whereas national only numbers may only pass national network-network interfaces.

  National-only numbers do not belong to the international E.164 numbering plan nor do they conform to the structure of international E.164 numbers as defined in ITU-T Recommendation E.164[12].

- Network internal numbers: Intranetwork numbers that are meant to be used within one network only, i.e. they do not pass network-network interfaces. Network internal numbers are not part of the international E.164 numbering plan, or they do not need to be E.164 numbers[13] or national-only numbers. However, in order to avoid conflicts between the use of network internal and network external numbers, it may be necessary to reserve a specific number range within the national numbering plan to allow the use of network internal numbers. The number structure and length of these numbers may not be limited. A consequence of this is, however, that it will not be possible at a later stage to use these numbers between networks. From their nature these numbers are not portable, which might limit competition between operators, and potentially also between M2M service providers.

There are possible situations where a new number range could be opened if the number range in question may require different regulatory treatment, e.g. tariff transparency, access to emergency services, etc.

Another aspect is that the services to be provided have certain characteristics (e.g. M2M applications in fixed networks) where existing mobile number ranges may not be adequate, for example a home alarm system connected to the fixed network cannot use a mobile number in order to comply with the existing numbering plan.

The following basic possibilities exist:

- Communication remains within the same network (on-net)
- Communication may pass network-network-interface, either national or international (off-net)

In on-net communications the communication process remains within one operator's or service provider's network, i.e. the M2M end-user and SP are in the same network. In off-net communications the network-network interface between two or more networks may be passed.

Numbering resources used between two or more networks (network external numbers) can be used for both on-net and off-net applications. Although network internal numbers do not pass network-network interfaces, they may be used for off-net applications (thus facilitating traffic between networks) as the numbers do not have to be diallable by the broad public. Such use of network internal numbers is.based on bilateral agreement between operators of (mobile) networks and M2M service providers for the connection of M2M data networks to public (mobile) networks.

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11 The expansion is restricted to the spare capacity of the total reserved number ranges for mobile services.

12 ITU-T Rec. E.101 Definitions of terms used for identifiers (names, numbers, addresses and other identifiers) for public telecommunication services and networks in the E-series Recommendations (11-2009)

13 Also E.164 numbers or national-only numbers can be used within one network only, i.e. as network internal numbers.

Network external numbers – Option A-C	Network internal numbers – Option D
▪ Comply with ITU-T Rec. E.164 ▪ Telecommunications regulations apply ▪ Numbers are E.164 numbers with maximum length of 15 digits ▪ Number portability may be applicable ▪ Allows less new capacity than on-net solution ▪ Flexibility in choosing the operator by the M2M service provider, although the physical SIM card may remain another threshold ▪ International traffic is possible under normal circumstances (needs no special routing agreements) ▪ Interconnection is possible	▪ Not strictly regulated in many countries; decisions and management up to the operator ▪ Numbers are typically not E.164 numbers ▪ Allows long numbers with much capacity – even longer than 15 digits numbers are possible ▪ No need for determining number length; older networks may gradually change to longer numbers ▪ Allows use of hexadecimal digits ▪ Same numbers can be used in every network allowing multiplied capacity ▪ Number portability is – in practice – not possible ▪ M2M SP is – in practice – locked with one operator → possible competition issues ▪ Difficult or impossible to evolve to 'network external' mode if required for some reason ▪ International traffic only possible with special routing agreements ▪ Interconnection is not an issue

Table 2: Characteristics for network external and network internal numbers

Table 3 lists some characteristics between optional numbering ranges including on-net and off-net alternatives.

Option A Existing mobile number ranges	Option B New number range	Option C International number range	Option D Network internal numbers
▪ Number ranges may be quite full already ▪ Possible challenges in number analysis if different number length is used for M2M from traditional mobile users ▪ Little or no possibilities to treat M2M numbers differently from regulatory point of view ▪ May not allow separate back-office solutions for M2M applications	▪ Full capacity of numbers of the new range is available ▪ Large blocks available for each operator ▪ A fresh start for number analysis ▪ A fresh start for possibly different regulatory requirements ▪ May allow easier back-office solutions, such as charging and billing	▪ Number range needs to be assigned by the ITU and the applicant needs to be qualified ▪ International number, i.e. dialling starts with the international prefix even though the communication would stay in own country (not an issue for M2M) ▪ Challenges in number analysis and effective routing ▪ May need to be treated in the same way as other international traffic	▪ See the table 2 above (network internal numbers) ▪ In many countries this is not regulated, i.e. an operator may start to use network internal numbers without needing any permissions

Table 3: Characteristics of number ranges

The most challenging characteristics of existing mobile number ranges for M2M applications is that they may not have capacity enough to accommodate potentially very large amount of numbers required by all new M2M applications. An international number range may be viable, but has disadvantages such as it is not fully in national control and requires international dialling. Network internal numbers would give a huge capacity of resources for M2M applications, but have challenges as listed in table 2.
In case of number scarcity the practical alternatives that remain for M2M numbering in the short and medium term are to open up a new number range and/or to use network internal numbering.

5.3 Adequacy of National Mobile Number Ranges for M2M Services

As network operators have a strong preference for the use of mobile number ranges for M2M applications, it is necessary to understand how the mobile number ranges today are used. The CEPT Working Group Numbering, Naming and Addressing carried out in November 2009 – January 2010 a questionnaire on usage of national mobile number ranges amongst CEPT countries.

Responses from 29 countries were received. As countries have different ways to collect statistics on number usage not all information was available for all countries. Assessing the capacity for mobile numbers is also especially difficult in countries with variable number length. Annex 1 lists the detailed replies and analysis.
The available mobile number capacity in a country depends, quite naturally, on the population. Thus it does not make much sense to compare absolute figures of mobile number capacity in a country. The figures given here are averages amongst 29 countries. Mobile number capacity forms 18% out of the total availability in a numbering plan, and the mobile number capacity is 18 numbers per capita. Half of the mobile number capacity has been assigned to operators, thus giving another half to be free. 24% out of the mobile number assignment is in operation. National mobile number penetration is 143%.
Taken the basic assumptions into account as discussed earlier in this chapter, the 29 countries were assessed based on population, free mobile number capacity and annual growth rate of M2M numbers. The assessment revealed that 7 countries do not have adequate existing mobile number capacity to accommodate the estimated growth of M2M services and the amount of numbers they require. The number of countries where mobile number ranges will not be adequate may easily become higher because there is a substantial possibility that real market demand becomes far higher than the given estimates.

5.4 Strategy for M2M Numbering and Addressing

From chapter 4 of this report it can be concluded that the annual growth rate in M2M applications between years 2010 and 2020 is about 20%. This chapter revealed that 8 European countries do not have adequate mobile number capacity available to accommodate estimated growth in M2M applications.
With the fast development of M2M applications, countries are challenged to accommodate the demand for numbers by using numbers from the national numbering plans. It is likely that in the long run IP-based solutions, such as IPv6, may become viable as alternative numbering resource for at least part of the M2M applications. It is, however, uncertain how long a period a numbering policy for M2M applications should cover, before IP-based solutions take over.
One of the main goals of numbering policy for M2M applications is that the provision of numbers for these applications will not compromise specific end-user interests which are covered by the existing national numbering plans, such as user-friendliness and tariff transparency. A new number range for M2M communications or other device based applications with possibly different regulatory requirements would give large numbering capacity and would lower the risk that end-user interests are negatively affected.
The NRAs should introduce a numbering policy for M2M communications. Such policy could include reserving a separate numbering range for M2M communications or similar device based applications in the national numbering plan if the existing number ranges do not have sufficient unallocated capacity to support the potential demand for M2M applications. In addition, there are possible situations where a new number range could be opened if the number range in question may require different regulatory treatment, e.g. tariff transparency, access to emergency services, etc. A new number range would also allow flexibility to accommodate possible future applications similar to M2M communications into this new number range.
When considering which form of numbering range to use, countries should take into consideration which sort of range (existing or new, on-net or off-net) would be most applicable and what possible consequences this might have on competition in the whole M2M business chain.

6 IMPLEMENTATION ASPECTS OF A NEW NUMBER RANGE

In this chapter some aspects of the creation a new numbering range are elaborated.

6.1 Network External and Network Internal Numbers

As set out in chapter 5, two types of numbers, network external numbers and network internal numbers, are candidates for M2M numbering resources. The appropriate type of numbers depends on the type of application and market conditions for the application concerned. From the viewpoint of an efficient use of numbers, network internal numbers should be preferred but this should not compromise the market position of the users of the M2M applications. Therefore the use of separate number ranges for network external numbers and network internal numbers is a valid option.
As there is no need to pre-determine the number structure and length of network internal numbers, an option is to create a numbering range for these numbers without conditions related to a number length. This may assist networks that have some difficulties with routing long numbers, in taking a gradual path, starting with using shorter numbers but stepping over to longer numbers when this is technically feasible for these networks.
As number portability can not be applied to network internal numbers, the users of these numbers should be aware that it may be more difficult to change their services from one operator to another.

6.2 Installed Base of M2M Applications

Many countries, which already have assigned numbers from existing number ranges for M2M applications, are considering opening a new number range to accommodate future numbering requirements in M2M business. Typically these existing M2M applications have mobile numbers because of commercial reasons. It will be a national matter whether existing M2M numbers should be moved to a new number range or not. However, the following factors are important:

- the level to which numbers used for current M2M applications forms an additional risk that in a later stage number scarcity in the number range concerned is to be expected;
- applying an adequate period for phasing out of such number use may reduce to a large extent the negative effects for operators and M2M service providers;
- the time the market needs for commercially setting up the new numbering range, so that this number range has no disadvantages in comparison to the (mobile) numbers currently used;
- possible renumbering of existing devices may have commercial barriers.

6.3 Assignment Mechanism

There are no strong reasons to apply specific assignment principles to the new numbering range which are different from those most countries apply to geographic numbers and mobile numbers (secondary number assignment via operators would still apply). The interests of users of M2M applications such as large companies regarding the numbers used for these applications are not stronger than in the case of geographic or mobile numbers. Given the availability of number portability where this is appropriate (for network external numbers), assignment of numbers from a new number range to operator would be the most appropriate option as this may be easier for operator to implement (block routing).

6.4 Use of Long Numbers

The number length of network external numbers should be as long as possible, however maximum of 15 digits according to ITU-T Rec. E.164. The length of network internal numbers should not be pre-determined.
The use of long numbers in networks with older technologies may imply that the impact on such networks may be larger than on more modern (mobile) networks, especially for network external routing. This may affect the way in which long numbers are introduced in the new numbering range.

7 REGULATORY REQUIREMENTS

As a starting point, existing regulatory requirements should be in force for M2M communications. There are impacts to regulatory requirements based on the choice between the use of network external or network internal numbers.
It is possible that the use of network internal numbers will require a regulatory decision, as in principle it will violate or even not make it possible to apply certain existing regulatory requirements. On the other hand, the use of such numbers may be regarded as operator internal business, as it does not influence or affect any other operator. The latter is however not a strong argument because network internal numbers can also be used to route traffic from or to other networks based on bilateral agreements between operators, and some regulatory issues are also relevant for on-net traffic.
Table 4 lists the impact of the choice between network external and network internal numbers to regulatory requirements.

Regulatory measure	Network external numbers	Network internal numbers
Interconnection / Interoperability	Valid	May not be applicable
Termination rates	Valid	N/A
Tariff transparency	N/A	N/A
Number portability	Valid	N/A
Emergency calls	Not an issue with most applications, relevant with e-Call	Not an issue with most applications, might be relevant with certain applications
Legal interception	May be valid	May be valid
Directory aspects	N/A	N/A
Data retention	May be valid	May be valid
CLI	Valid	N/A

Table 4: Impact of the choice between network external and network internal numbers to regulatory requirements

There are regulatory issues which may not be relevant with M2M applications, although it may be challenging to allow exceptions for certain applications. These issues include:

- Interoperability and termination rates. If interoperability issues are valid, then termination rate issues are valid, too, as is the way to charge interconnection.
- Tariff transparency. End-users may use M2M and similar applications where network connections are started without or with only limited human interaction. Therefore, if tariffs are call or time dependent, there would be a clear need for tariff transparency. However, it is expected that for most M2M applications the tariff structure for end-users will be flat fee. This also holds for wholesale tariffs. In this case no additional measures need to be taken to ensure adequate tariff transparency for a new numbering range. This policy may change when there are signs that also other tariff structures will be applied.
- Number portability. Number portability in M2M environment is less relevant than in traditional voice telephony world as it is easier to change numbers.
- Directory aspects. There is no need for the wide public to know M2M numbers.
- Emergency calls. Although the situation is not totally clear, it is not likely that numbers for M2M applications should be subject to conditions for emergency calls.
- Data retention. might be applicable according to Directive 2006/24/EC
- CLI. Calling Line Identification may be used to identify the M2M application.

8 CONCLUSIONS AND RECOMMENDATIONS

With the fast development of M2M applications, countries are challenged to accommodate the demand for numbers by using numbers from the national numbering plans.
The conclusion based on analysis from this report is as follows:

- The expected annual growth rate of required M2M numbers between years 2010 and 2020 is approximately 20%, but this is just a rough estimate and the actual figure may differ from this estimation significantly.
- In the long run IPv6 addressing will become very important as alternative numbering resource for at least the major part of the M2M applications. However, there is much uncertainty what period is involved so that numbering policy for M2M should be flexible enough to be also a solution for the longer term.
- A significant number of CEPT countries do not have sufficient capacity in their existing numbering plan to accommodate numbering requirements for M2M applications.
- No harmonised approach on possible M2M numbering solutions is needed in Europe.

One of the main goals of numbering policy for M2M applications is that the provision of numbers for this kind of applications will not compromise specific end-user interests which are covered by the existing national numbering plans, such as user-friendliness and tariff transparency.
The report recommends[14] as follows:

1. Taken into account the potential extensive growth rates of M2M applications or other similar telecommunication services, the NRAs should, in cooperation with market players, establish a numbering policy for these kinds of services as part of the national numbering plan. The policy shall be flexible enough to accommodate also a longer term solution.
2. As a long term solution IPv6 addresses, or numbers/addresses other than E.164 numbers should preferably be used for device based communication applications. These numbering/addressing schemes or switching from E.164 numbering plan to a new plan should not prohibit market development or competition.

[14] These recommendations are given for the purpose of this report only, and they should not be mixed with ECC Recommendations (capital 'R') as regulative tools.

3. In a short and a medium term the 4 numbering options (A-D) can be envisaged; based on the current knowledge of the market none of these have a clear preference. In cases where there is a need to distinguish M2M communications and the traditional mobile services option A has to be excluded. Options B and D are needed if the growth of M2M is larger than expected or if there is no adequate space in existing number ranges in use. Option C depends on ITU.
4. There are possible situations where a new number range (option B) should be opened. For example, the number range in question may require different regulatory treatment, e.g. relating access to emergency services, or the services to be provided have certain characteristics (e.g. M2M applications in fixed networks) where existing mobile number ranges may not be adequate.
5. For the services where number portability is an obligation or where subscribers can take advantage on number portability, option D should not be used.

Additional considerations regarding possible new number range(s) for M2M applications or other device based communication applications:

i. The new numbering range(s) accommodate future mass volume applications, such as M2M applications, and do not have prohibitive conditions for such applications.
ii. The NRA should ensure that the new numbering range(s) are not used as an alternative to existing numbering ranges to escape regulatory requirements.
iii. As some existing regulatory requirements may not be relevant or useful for certain applications such as M2M applications, exceptions regarding existing regulatory requirements could be applied to new numbering range(s) accommodating these applications. For example, for M2M numbering resources the issue of user friendliness (e.g. short numbers) is not relevant. Number portability requirements should be applied to network external numbers but not to network internal numbers, as this is not applicable in the latter case.
iv. The number length of network external numbers should be as long as possible (max 15 digits according to ITU-T Rec. E.164). The length of network internal numbers should not be pre-determined.

ANNEX 1: MOBILE NUMBER USAGE IN EUROPE

Country	Q1		Q2		Q3		Analysis						
	Population July 2007	Mobile number capacity	% out of total numbering plan	Allocated to operators	% out of mobile number capacity	Mobile numbers in operation	% out of allocation to operators	Numbers in operation per capacity	National penetration	Mobile number capacity per capita	Free mobile number capacity (capacity - allocation)	% out of total capacity	Requirement of M2M numbers in 2020 (1)	OK with current capacity?
Austria	8 199 783	460 000 000	5,7%	59 300 000	12,9%	27 500 000	46,4%	6,0%	335,4%	56	400 700 000	87,1%	10 154 179	OK
Belgium	10 392 226	60 000 000	5,4%	25 500 000	42,5%	11 840 000	46,4%	19,7%	113,9%	6	34 500 000	57,5%	12 869 185	OK
Croatia	4 493 312					6 106 820			135,9%				5 564 281	
Cyprus	788 457	9 000 000		3 000 000	33,3%	2 280 000	76,0%	25,3%	289,2%	11	6 000 000	66,7%	976 384	OK
Czech Republic	10 228 744	161 000 000	27,0%	34 800 000	21,6%	14 257 000	41,0%	8,9%	139,4%	16	126 200 000	78,4%	12 666 737	OK
Denmark	5 468 120	20 650 000	20,7%	19 692 000	95,4%					4	958 000	4,6%	6 771 432	NOK
Estonia	1 315 912	11 640 000	74,0%	3 786 500	32,5%					9	7 853 500	67,5%	1 629 556	OK
Finland	5 238 460		N/A		N/A	7 800 000	N/A		148,9%				6 487 033	OK
France	60 876 136	150 000 000	17,0%	90 200 000	60,1%	57 311 200	63,5%	38,2%	94,1%	2	59 800 000	39,9%	75 385 798	NOK
Germany	82 400 996	1 130 000 000	2,3%	250 000 000	22,1%	108 215 000	43,3%	9,6%	131,3%	14	880 000 000	77,9%	102 041 050	OK
Hungary	9 956 108	60 000 000	45,0%	18 340 000	30,6%	11 792 475	64,3%	19,7%	118,4%	6	41 660 000	69,4%	12 329 119	OK
Ireland	4 109 086	70 000 000	7,0%		45,7%	5 200 000		7,4%	126,5%	17			5 088 475	
Italy	58 147 733	700 000 000	7,0%	340 000 000	48,6%	87 661 000	25,8%	12,5%	150,8%	12	360 000 000	51,4%	72 007 087	OK
Lithuania	3 575 439	10 000 000	14,3%	7 088 174	70,9%	4 960 000	70,0%	49,6%	138,7%	3	2 911 826	29,1%	4 427 635	NOK
Luxembourg	480 222	100 000 000		6 000 000	6,0%					208	94 000 000	94,0%	594 682	OK
FYROM	2 055 915	8 000 000		4 324 000	54,1%	1 956 894	45,3%	24,5%	95,2%	4	3 676 000	46,0%	2 545 937	OK
Malta	401 880	10 000 000	20,0%	3 070 000	30,7%	467 000	15,2%	4,7%	116,2%	25	6 930 000	69,3%	497 667	OK
Netherlands	16 570 613	60 000 000		46 000 000	76,7%					4	14 000 000	23,3%	20 520 174	NOK
Norway	4 627 926	16 000 000	20,0%	10 348 000	64,7%	7 019 134	67,8%	43,9%	151,7%	3	5 652 000	35,3%	5 730 980	OK
Poland	38 518 241	110 000 000	18,0%	90 200 000	82,0%	45 000 000	49,9%	40,9%	116,8%	3	19 800 000	18,0%	47 698 959	NOK
Portugal	10 642 836	80 000 000	10,0%	35 300 000	44,1%	15 536 000	44,0%	19,4%	146,0%	8	44 700 000	55,9%	13 179 527	OK
Romania	22 276 056	100 000 000	12,5%	53 000 000	53,0%	28 800 000	54,3%	28,8%	129,3%	4	47 000 000	47,0%	27 585 493	OK
Serbia	10 150 265		11,1%		30,0%	8 795 981			86,7%				12 569 553	
Slovak Republic	5 447 502	39 000 000	4,9%	22 100 000	56,7%	5 300 000	24,0%	13,6%	97,3%	7	16 900 000	43,3%	6 745 899	OK
Slovenia	2 009 245	16 000 000	16,0%	7 500 000	46,9%	2 100 000	28,0%	13,1%	104,5%	8	8 500 000	53,1%	2 488 143	OK
Spain	40 448 191	100 000 000	39,2%	77 600 000	77,6%	55 609 000	71,7%	55,6%	137,5%	2	22 400 000	22,4%	50 088 907	NOK
Sweden	9 031 088	40 000 000	11,3%	31 500 000	78,8%	11 250 000	35,7%	28,1%	124,6%	4	8 500 000	21,3%	11 183 623	NOK
Switzerland	7 554 661	50 000 000	7,5%	20 500 000	41,0%	14 200 000	69,3%	28,4%	188,0%	7	29 500 000	59,0%	9 355 294	OK
United Kingdom	60 776 238	800 000 000	19,2%	393 700 000	49,2%					13	406 300 000	50,8%	75 262 089	OK
Average	17 109 703	168 126 538	18,0%	66 113 947	48,4%	22 539 896	49,1%	23,7%	142,3%	18	105 937 653	50,7%	21 187 754	OK
Minimum	401 880	8 000 000	2,3%	3 000 000	6,0%	467 000	15,2%	4,7%	86,7%	2	958 000	4,6%	497 667	19
Maximum	82 400 996	1 130 000 000	74,0%	393 700 000	95,4%	108 215 000	76,0%	55,6%	335,4%	208	880 000 000	94,0%	102 041 050	NOK
Amount	29	26	23	25	27	24	20	21	24	26	25	25	29	7

The Annex 1 lists the results of the questionnaire on mobile number usage in Europe carried out by the Working Group Numbering, Naming and Addressing in November 2009 – January 2010.

The population amount is taken from the World Factbook as status of July 2007 in order to have the figures comparable with each other. The questions asked were

1. Mobile number capacity out of the whole numbering plan
2. Amount of mobile numbers assigned to the operators
3. Amount of mobile numbers in operation

In Analysis columns the following has been calculated:

- Mobile numbers in operation per capacity (%)
- National mobile number penetration: numbers in operation divided by population (%)
- Mobile number capacity per capita: capacity divided by population
- Free mobile number capacity: capacity minus allocation
- Free mobile number capacity as percentage out of capacity (%)

Requirement of M2M numbers in year 2020 has been calculated based on the following assumptions:

- The starting point is 0,2 M2M numbers per capita in year 2010
- The annual growth rate of required M2M numbers is 20%

The assessed amount of M2M numbers in year 2020 has been compared with the free mobile number capacity (in year 2010).

Countries that would have problems in this assessment to accommodate M2M applications within their existing mobile number ranges are:

- Denmark
- France
- Lithuania
- The Netherlands
- Poland
- Spain
- Sweden[15]

Norway has opened a new number range for M2M applications and thus they do not have problems with numbering space.
Luxembourg and Romania should pay close attention to their M2M growth as the estimated required amount of M2M numbers exceed 50% of the free capacity.

[15] Since 2005 there are two separate NDCs (one for fixed networks and one for mobile networks) for Telematic services (M2M communications) in the Swedish National Numbering Plan

ANNEX 2: DESCRIPTION OF M2M APPLICATIONS

This annex describes M2M applications based on various factors given in table 5 (the list of applications is not exhaustive). The purpose of this annex is to give additional information to the reader on different M2M applications and their usage.

Name of the Application	Point of origin?	User interaction?	National/international?
	<fixed / nomadic / moving>	*<e.g. H2M aspects>*	*<is cross border traffic valid>*
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	<point-to-point / point-to-multipoint / broadcasting>	*<is the service open to all, or e.g. subscription based>*	
Description of the Application	Networks involved?	Type of traffic?	
	<network internal / cross network>	*<volume, bursting / continuous>*	
	Network types involved?	Terminal control?	
	<fixed / mobile / IP based>	*<who controls the M2M terminals, e.g. M2M service provider>*	

Table 5: A model for assessing M2M applications

1 Monitoring and Smart Metering

1. Automatic Meter Reading (AMR) can be used to monitor electricity, water, windmills and gas meters. Utility providers within the electricity sector have rolled out SIM-based AMR-systems to consumers in Sweden and a major rollout is scheduled to take place in Norway within few years. The system offers a major improvement of efficiency and accuracy.
2. No user interaction – usually metering applications are sealed to prohibit "fixing".
3. Open application or a pre-determined group of users
4. Terminals are controlled by one party.
5. Two way communication – the provider sends a request and the application replies with the metering value.
6. Fixed.
7. On-net, i.e. mainly network internal.
8. Mainly mobile.
9. Typically within a country.

Monitoring and Smart Metering	Point of origin?	User interaction?	National/international?
	Fixed	No user interaction – usually metering applications are sealed to prohibit "fixing".	Typically within one country
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Two way communication – the provider sends a request and the application replies with the metering value	A pre-determined group of users	
Automatic Meter Reading (AMR) can be used to monitor electricity, water, windmills and gas meters. Utility providers within the electricity sector have rolled out SIM-based AMR-systems to consumers in Sweden and a major rollout is scheduled to take place in Norway within few years. The system offers a major improvement of efficiency and accuracy.	Networks involved?	Type of traffic?	
	On-net, i.e. mainly network internal	Small volumes a few times in a year	
	Network types involved?	Terminal control?	
	Mainly mobile	Terminals are controlled by the utility provider	

2 Automatic Toll Systems and eCall

1. Both GSM and GPRS/UMTS will probably be the preferred communication technology from an economic point of view
2. application providers prefer network external numbers as this may facilitate competition between mobile telecom operators
3. application falls within scope of mobile networks, mobile networks might be able to easily implement long numbers, so a range with long numbers may be the preferred solution here

<table>
<tr><td rowspan="2">Automatic Toll Systems</td><td>Point of origin?</td><td>User interaction?</td><td>National/international?</td></tr>
<tr><td>A moving vehicle through a toll gate</td><td>No</td><td>National</td></tr>
<tr><td rowspan="2">An application to collect road tolls in an automated way. The system is based on a vehicle installed tag/short range identifier (e.g RFID) which communicates with the toll gate to identify the vehicle and register various parameters for the interaction.</td><td>Direction of communications?</td><td>Open application or a pre-determined group of users?</td><td>Other remarks?</td></tr>
<tr><td>Point-to-point</td><td>A pre-determined group of users</td><td rowspan="3">This application collects vehicle information by sending a radio frequency signal to vehicles driving through a toll gate. The vehicle’s tag responds to this signal with relevant vehicle information, e.g. by using RFID. This application does not require public numbering/addressing schemes.</td></tr>
<tr><td>Networks involved?</td><td>Type of traffic?</td></tr>
<tr><td>Network internal</td><td>Burst</td></tr>
<tr><td></td><td>Network types involved?</td><td>Terminal control?</td><td></td></tr>
<tr><td></td><td>Not relevant</td><td>By the toll system provider</td><td></td></tr>
</table>

<table>
<tr><td rowspan="2">eCall</td><td>Point of origin?</td><td>User interaction?</td><td>National/international?</td></tr>
<tr><td>Moving</td><td>Automatic, no human interaction</td><td>National</td></tr>
<tr><td rowspan="2">eCall is a project of the European Commission intended to bring rapid assistance to motorists involved in a collision anywhere in the European Union. The projects aims to employ a hardware black box installed in vehicles that will wirelessly send airbag deployment and impact sensor information, as well as GPS coordinates to local emergency agencies to the general emergency number 112.</td><td>Direction of communications?</td><td>Open application or a pre-determined group of users?</td><td>Other remarks?</td></tr>
<tr><td>Point-to-Point</td><td>Open application, i.e. everybody with a relevant equipment may use eCall</td><td rowspan="3"></td></tr>
<tr><td>Networks involved?</td><td>Type of traffic?</td></tr>
<tr><td>Cross network</td><td>Burst</td></tr>
<tr><td></td><td>Network types involved?</td><td>Terminal control?</td><td></td></tr>
<tr><td></td><td>Mobile</td><td>?</td><td></td></tr>
</table>

3 Positioning and Tracking

1. M2M communication can be used in facilitating better control over moving objects such as cars, trailers, ships, containers, expensive medical equipment etc. GPS bracelets can be put on animals and humans.
2. In the transport sector trucks are monitored by GPS and GSM-communication in the German system "Toll Collect". Positioning would make it easier to trace valuable items, like boats and cars, if stolen. Insurance companies might offer discounts for insurance policies for cars if such positioning systems are installed.

Positioning and Tracking	Point of origin?	User interaction?	National/international?
	Moving	No	Both national and international traffic is likely
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Point-to-Point	A pre-determined group of users	
Collection of location information of moving targets. Tracking of the path of moving targets.	Networks involved?	Type of traffic?	
	Cross network	Burst	
	Network types involved?	Terminal control?	
	Mobile	By the service provider	

4 Road Navigation

Road Navigation	Point of origin?	User interaction?	National/international?
	A moving target is receiving GPS satellite information.	Not valid	Not valid
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Broadcasting (signal from satellites to vehicle = one way)	Open	Public telecommunications networks are normally not involved in this application, therefore no public numbering resources are needed. Public broadcasting networks with RDS information may be involved to provide additional traffic information to users.
The actual road navigation system is nowadays typically based on Global Positioning System providing the user with map information and directions to a destination.	Networks involved?	Type of traffic?	
	Not valid	Continuous reception of satellite information	
	Network types involved?	Terminal control?	
	Satellite	Not valid	

5 Machine Park Control

1. Seem to have less implications for numbering as only fixed networks are used and network internal or service provider-specific numbering solutions exist

Machine Park Control	Point of origin?	User interaction?	National/international?
	Fixed	No	Both
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Point-to-Point	A pre-determined group of users	
Automated status control of various machines of different kinds.	Networks involved?	Type of traffic?	
	Cross network	Burst	
	Network types involved?	Terminal control?	
	All	Status control service provider	

6 ICT-entities in Vehicles

1. Advanced ICT-entities and telematics in cars (“fleet managing”) represent an upcoming area of M2M communication. It implies communication of different types of information about car and traffic status. Car manufacturers are offering integrated solutions such as post-crash systems, eCall services, navigation services, traffic-information services and diagnostics about brake status, weight etc.

ICT-entities in Vehicles	Point of origin?	User interaction?	National/international?
	Moving	Could be possible, but usually not	International
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Point-to-Point	A pre-determined group of users	
Advanced ICT-entities and telematics in cars ("fleet managing") represent an upcoming area of M2M communication. It implies communication of different types of information about car and traffic status. Car manufacturers are offering integrated solutions such as post-crash systems, eCall services, navigation services, traffic-information services and diagnostics about brake status, weight etc.	Networks involved?	Type of traffic?	
	Cross network	Bursting	
	Network types involved?	Terminal control?	
	Mobile or IP based	Fleet management service provider	

7 Security and Surveillance

1. M2M communication is relevant for alarm systems, access controllers, mobility controllers, property surveillance systems, weather/climate surveillance systems, vermin traps etc. For example M2M communication over UMTS can be used to facilitate sending of live video from cameras in taxi cabs, busses and other mobile entities.
2. The security features can be based on pure machine to machine communication, but there could also be elements of human interaction, e. g. a person sends an SMS to an SIM-equipped camera which returns MMS pictures or live video. Communication can also originate from an ICT-entity when an alarm is tripped, sending footage to an ordinary handheld terminal.

Security Systems	Point of origin?	User interaction?	National/international?
	Fixed	Possibility for a manual alarm	Typically national
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Point-to-point	A pre-determined group of users	
Typical application would be a burglary alarm system in a building including door and window sensors as well as movement detectors. An alarm would be passed to the security center via public or private telecommunications networks.	Networks involved?	Type of traffic?	
	Cross network	Burst	
	Network types involved?	Terminal control?	
	Typically mobile, but other networks are also possible	By security system service provider	

Surveillance Systems	Point of origin?	User interaction?	National/international?
	Fixed	Possibility for a manual alarm	Typically national
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Point-to-point	A pre-determined group of users	
This application may be connected together with the Security Systems (see above), but it may also have its own supervision system. Examples include heating control or over flood control.	Networks involved?	Type of traffic?	
	Cross network	Burst	
	Network types involved?	Terminal control?	
	Typically mobile but other networks are also possible	By surveillance system service provider	

8 Point of sales

1. M2M can be used to communicate with different payment terminals such as vending machines, credit card terminals, parking meters, gambling/lottery machines etc.

Point of Sales	Point of origin?	User interaction?	National/international?
	Fixed	Not directly	Typically national, ATMs may require international communication
	Direction of communications?	Open application or a pre-determined group of users?	Other remarks?
	Point-to-Point	A pre-determined group of users	
M2M can be used to communicate with different payment terminals such as vending machines, credit card terminals, parking meters, gambling/lottery machines etc.	Networks involved?	Type of traffic?	
	Cross network	Burst	
	Network types involved?	Terminal control?	
	Fixed or IP based	By point of sales provider	

9 Other applications

1. M2M communication can be used in communication with ICT-entities integrated in heaters and coolers, door locking systems, street lighting systems.
2. New applications occur continuously.