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Modernizing National Numbering Plan on NGN Platform - Hungarian Case Study

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Modernizing National Numbering Plan on NGN Platform – Hungarian Case Study

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Abstract

The intensive technological development of the last years brought the overall acceptance of an IP based network and services vision based on the NGN. The realization of the NGN vision, the decision on the migration to NGN sets regulatory tasks, especially in the area of numbering and addressing. The utilization of the opportunities provided by the NGN platform requires the use of IP addresses and names in the core network, the role of the E.164 numbers is taken over by IP addresses. However in case of voice services the identification of end-user access points will remain by the use of E.164 numbers. Migration to NGN doesn't require directly the change of the subscribers' phone number; however the NGN enables among others the implementation of national number portability for fixed telephone service. The opportunities can be realized by using uniform domestic number length and dialling method, practically closed numbering. The introduction of a 9-digit uniform, closed domestic numbering provides a consistent solution for the deficiencies of the present Hungarian numbering plan, too. Recently it can be reached in single step so that the present 9-digit domestic numbers and the short codes remain unchanged, the 8-digit domestic numbers are completed to 9-digit by the insertion of an appropriate digit, as well as the present and new numbering schemes can be in operation simultaneously.

1. Introduction

From the end of the '90s the issue of the modernisation of the national numbering plan has arisen several times in Hungary. In the last years the appearance of the multitude of new technological solutions and services, the evolution of the convergence of telecommunication, IT and media, the emergence of the differentiated forms of mobility inevitably necessitated to rethink the strategy of the regulation of identifiers (numbers, addresses, names together). There exists also a legal obligation for the revision of regulation: the Electronic Communications Act sets it as the task of the government to revise the National Partitioning Plan of Identifiers at least in every three years.

During the research supported by the National Communications Authority (NHH) the challenges for the numbering and addressing plans were identified, originated from the development of technology and market, the vision of numbering and addressing was formulated, variants of solutions were developed to resolve the challenges, to realize the necessary modifications. At the comparison of the possible solutions of the *numbering reform and the selection of the strategy* to be applied the next guiding principles were followed:

- the regulation of identifiers by its specific instruments *should help the development of technology and market*, the appearance of new services, the strengthening of competition, the deployment of the IP based convergence of communication, information and media technologies and markets;
- *consumer protection* should be strengthened by formatting customer-friendly, well communicable regulation, by consequent customer-oriented evaluation of the solution variants;
- *modifications of competencies and procedure orders* should give an impetus to the more targeted, flexible and effective regulation and management.

The intensive technological development of the last years brought the overall acceptance of an *IP based network and services vision based on the NGN* everywhere in the world and in Hungary as well. The realization of the NGN vision, the decision on the migration to NGN sets tasks not only in network and service development, but also in regulation, especially in the area of numbering and addressing.

The paper overviews the European numbering plans and the challenges and opportunities provided by the NGN platform. These may require the reconsideration of the national numbering schemes. In Hungary some deficiencies of the present numbering plan also requires its modification. The paper shows solution versions and compares them. The best solution and the conditions for the realization are presented in detail. Finally general conclusions for international practice are drawn.

2. Numbering schemes in Europe

The present internationally used numbering plans follow the E-series recommendations of the ITU-T. Among these Recommendation E.164 [1] is outstanding in significance, being the international public telecommunication numbering plan.

Numbering Recommendation ITU-T E.164

An international telephone number unique for each subscriber and may consist of at most 14 digits, is split into two parts, the 1-2-3 digit country code (in general international code) and the domestic number. The country codes are assigned by the ITU-T, the formation of the domestic numbers based on the E.164 can be different country-by-country. The domestic number can be separated into two parts in such a way that the first part is the few digit national destination code (NDC) serving for the assignment of a given service, network or geographic district; the second part is the subscriber/user identity number (SIN), serving for the identification of the subscriber within the given service, network or district. The two major types of the NDCs are the district codes (DC) and service/network codes (SNC), the DCs nominate the geographic numbers, the SNCs the non-geographic numbers, among these the mobile and nomadic numbers. In particular it is necessary to mention the 2-5 digit special domestic numbers, the so-called short codes, which can be recognized by their first digit, in Europe they start with the digit ‘1’.

According to the Recommendation dialling the full international number is only necessary in case of international calls, in case of domestic calls it is enough to dial the domestic number, within district, service or network it can be enough to dial the subscriber number. To do so it is necessary to sign the format of the number to be dialled in advance, the distinction of three different formats (international, domestic, subscriber) requires two different prefixes (international and domestic), to distinguish two formats (international and domestic) needs only a single (international) prefix. If uniformly everywhere in the world in all cases the full international number would be dialled, there were no need for any prefix. The ITU-T recommendation for international prefix is: ‘00’, for domestic prefix: ‘0’.

In case of international calls the international prefix and the full international number is dialled. In case of domestic calls depending on the number of formats applied we speak of open or closed numbering.

In case of *open numbering scheme* the calls forwarded inside and outside the district/network in question are distinguished. If the called and calling parties have the same

national destination code (NDC), it is enough to dial the subscriber number. If the NDCs differ, the domestic prefix and the full domestic number (national destination code + subscriber number) must be dialled.

In case of *closed numbering scheme* only one sort of dialling method is allowed, namely at all domestic calls the full domestic number must be dialled. In this case domestic prefix is not needed. In practice the realization of a closed numbering scheme happens with unified domestic number length.

EU's requirements and recommendations

One of the basic principles of the regulation of the electronic communications market is to ensure equal conditions to all participants of the competition. One of the important means to create equal conditions is the appropriate regulation of numbering and number management. In the EU member states the formation of the numbering plan belongs basically to national competence, the numbering plans are elaborated by every national communication authorities, fulfilling the obligatory expectations formulated in EU directives, furthermore certain non-obligatory recommendations should also be taken into account.

The ECTRA reports [2, 3] based on ETO studies contain the principles of the formation of national numbering plans, and propose the harmonization of the first digit of the domestic number (Harmonized national numbering scheme). Its substance is to separate the geographic and various non-geographic numbers, the numbers of same type are grouped behind a determined digit. The reports emphasize that the significant restructuring of the numbering plan should be performed in a single step and in such a way that the new plan would be applied without modification for a long term.

National numbering systems of European countries

In Europe until the end of the '80s the open numbering scheme was exclusive, but in the past years several European countries changed over to the closed numbering [4, 5].

Major advantages of the closed numbering schemes compared to the open numbering:

- simple for the users, the numbers are unified in the whole country, they can be stored in a unified form;
- because of the uniform dialling there is no need to apply domestic prefix;
- in case of incoming international calls there is no problem whether a number contains the prefix or not;
- the rigid internal splitting of the domestic numbers is ceased, hereby number capacities excluded from use are freed.

Major disadvantages of the closed numbering schemes compared to the open numbering:

- because of the termination of the dialling form of subscriber numbers more digits should be dialled in case of the calls within the same geographic areas or networks. (The disadvantage is moderated by the fact that more and more CPEs have dialling number memory, thus dialling of longer numbers does not cause additional burden to the subscribers);
- closing the numbering is accompanied by costs and temporary inconvenience both for the subscribers and service providers.

Although the numbering plans are not uniform in Europe, however some important consequences can be deducted:

- From the mid '90s more than half of the examined countries closed their numbering plans, mostly around the millennium.
- Changeover to the closed numbering (with some exceptions) was accompanied by the introduction of unified number length,
- The unified number length was adopted in a lot of such countries where the numbering plan was not closed.

- At restructuring the numbering scheme in general the existing numbers were changed only in the necessary extent, the harmonized numbering scheme was mostly not introduced where it happened it was done with more compromises.
- Harmonization of the first national digit was primarily applied there and in such extent where it helped the formation of the unique domestic number length.

In Hungary the Act 100 of 2003 on electronic communications (Eht.) entered into force on 1st January 2004. In contains all the framework rules at an EU conform way necessary to the operation of identifier management in a liberalised market environment.

3. Trends and challenges for numbering and addressing

In general, technological and market trends on the electronic communications sector are essential for the development of the numbering and addressing systems.

3.1. Convergence and mobility

From the aspect of the identifiers of electronic communications two general trends appear: one is the trend of convergence of communication, information and more and more strongly connected media technologies, the other trend is that the demand for mobility is becoming general and differentiated.

One of the most dominant trends is *the convergence of communication, information and media technologies*, and the formation of substitutive role with each other, interlocking and combinations of services based on these technologies. All of these are accompanied by the interlocking and integration of separated markets, and the demand for the harmonization of regulatory approaches. At the same time it also involves the approach and harmonisation of numbering and addressing [6, 7, 8].

Traditionally the services operate separately, their networks are of different construction, the signals, signal levels differ, the use of each service requires service specific CPE, different regulations applies to them (Figure 1).

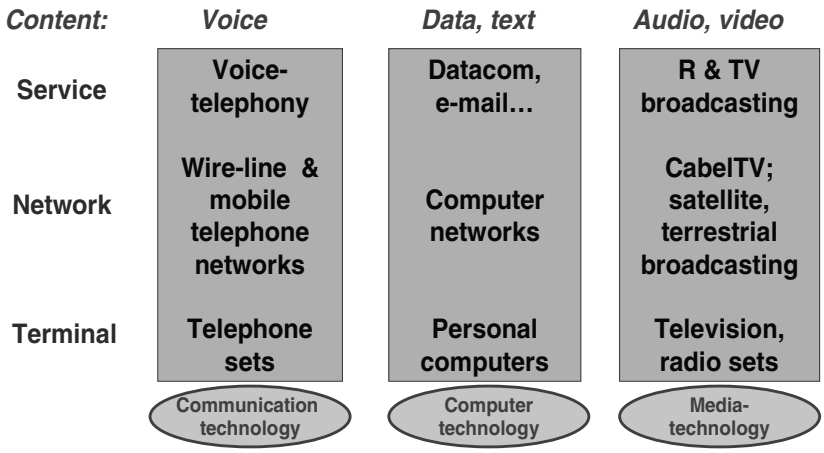

Figure 1: Traditional services

By today the convergence of communication, information and media technologies forecasted for a long while has not only been formulated, but also has a good progress at a lot of areas. Technically the opportunity of convergence was basically established by digitalisation. As a result of above all it is possible to use the Internet and transmit TV programmes (IPTV) over the fixed telephone network (PSTN), to phone over the Internet (VoIP), to listen to music, to watch video programmes, to download them, and to use the

Internet, to phone over the CATV network. The use of services becomes possible on a multitude of platforms and accesses in a complex way, joint provision of voice, Internet and content/media: 'Triple Play' and its extension 'Multi Play' are continuously spreading. The network of the future will ensure the provision of all kind of services at an integrated manner (Figure 2). From the viewpoint of numbering Fixed-Mobile Convergence (FMC) is outstanding in significance, where the subscriber gets mobile radiotelephone and some fixed telephone service (with wireline or wireless access) in the frame of a single subscription.

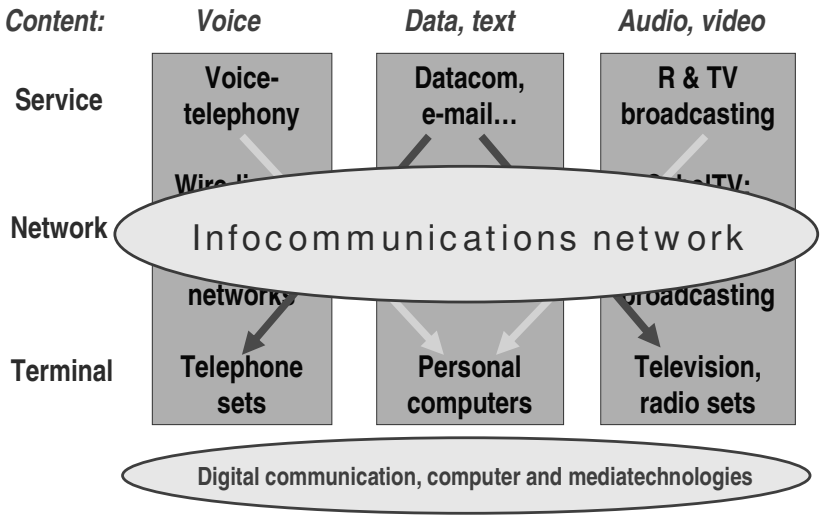

Figure 2: Convergent networks and services

Another important, general trend having more and more effect also on the identifiers is the mobility and its differentiation. With respect to the localization of the user, portability, nomadicity is located between fixed positioning and full mobility (mobile). These opportunities are mirrored in the definitions of the number types as well:

- *Geographic numbers* enable the identification and the reach of subscribers connected to the fixed telephone network.
- *Nomadic numbers (numbers of location independent electronic communications service for voice purpose)* enable the identification and the reach of subscribers connected to the electronic communications network in the area of the country (Hungary). The subscriber's access point may vary.
- *Mobile numbers* enable the identification and the reach of subscribers connected to the mobile radiotelephone network.

3.2. Technology trends: NGN platform

The technological trends partially motivate the general trends and partially realize them.

The convergence of information and communication technologies (ICT) and its extension to other technologies will be realized on an IP basis. The spread of IP technologies has got a significant impetus almost at each area (VoIP, IPTV, etc.), with its cost effectiveness they displace not only the traditional 'circuit switched' but also the traditional 'packet switched' telecommunications solutions (X.25, ATM, etc.) and also the IP based ancestors. Today IP can also appear as a real competitor with respect to QoS management, scalability, reliability, security, etc.

A new broadband network and service platform has emerged: the Next Generation Network (NGN), in which the services are separated from the networks, therefore they can

be created independently of the networks. On the network plane the core networks are integrated in order to the joint transmission of the common services. By the help of the IP Multimedia Subsystem (IMS) practically any service will be available on any type of access. On the world wide broadband network created by the interconnection of various NGNs built in different countries the subscribers will be able to use the enhanced traditional and the future new services.

The explosion like evolution of wireless access technologies is manifested in the appearance of the various fixed, nomadic and mobile communications solutions and a variety of their intelligent integrations. Beside the mobile radiotelephone as primary wireless access the application of cordless phone sets is more and more usual to access a wireline network. Its integrated example is the UMA (Unlicensed Mobile Access) general network access standard developed by 3GPP (3rd Generation Partnership Program) providing two types of accesses, on one hand to mobile radiotelephone, on the other hand a 'cordless' access to a fixed base station. In the range of the gradually spreading Wi-Fi hot spots and WiMAX hot-zones both the data and the voice communication can be IP based, it will be possible to phone with VoIP over the wireless (cordless) access. In parallel to this development process the evolution of the fourth generation mobile radiotelephone systems is in progress (LTE – Long Term Evolution, etc.), after a few years the two evolution processes will 'meet' under the aegis of IP based convergence (Figure 3).

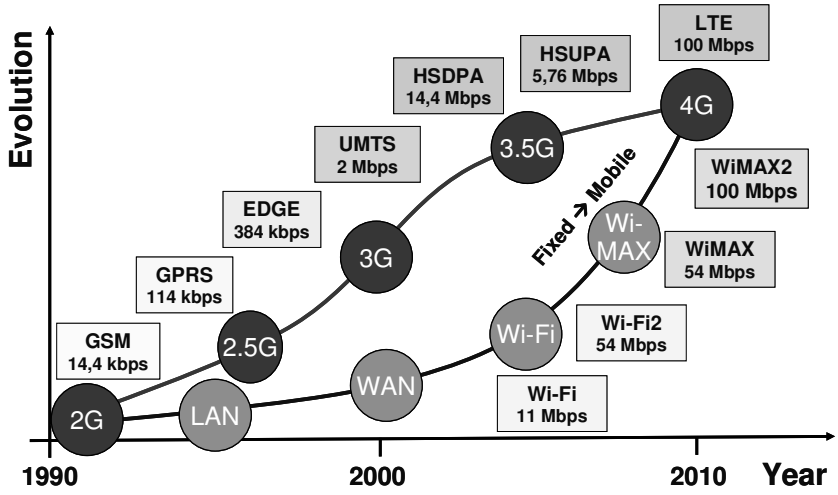

Figure 3: IP-based convergence of mobile and wireless broadband services

3.3. Implications for Numbering and Addressing

National numbering schemes and numbers, used by the communication services are defined by national decrees based on international recommendations and agreements.

Convergence of the numbering and addressing systems

Convergence of networks and services involves the approach and harmonization of numbering and addressing by necessity, it comes forward in the formation of gateways between different numbering and addressing systems. Under harmonisation we mean the process enabling the subscribers to use jointly the services presently used and the complex ones provided on the new platforms appearing in the future at a more and more simple manner [9, 10]. In viewpoint of the different voice services it appears as follows (Table 1):

- In case of fixed telephone and mobile radiotelephone services E.164 numbers are used, the subscribers and their accesses (e.g. the phone lines) are identified by phone numbers and mobile numbers. At the fixed telephone services the numbering and the network structure, the routing plan are in strong relationship. The switches make the decision based on the analysis of the called number, in which direction to forward the calls.

- VoIP identifies the end points by IP address, but it is possible to assign also E.164 numbers to the end points, e.g. in case of Publicly Available Telephone Service (PATS) or nomadic voice service. The interworking capability of IP based voice services with public telephone networks is based on the fact that beside the usual IP addresses in IP networks also phone numbers are assigned to the VoIP users. It makes possible that the subscribers of the two services can mutually call each other.
- In case of fixed-mobile convergent services on the one hand E.164 mobile number is used, on the other hand the fixed or nomadic accesses can use E.164 number or IP address. At fixed-mobile convergent services in that case when mobile and fixed telephone services are the two components, it is enough to use E.164 numbers.
- In an NGN the end points are identified by E.164 numbers and IP addresses, the call control is based on IP identifiers, more precisely IP addresses. Because the NGN is a fully IP based network, the E.164 numbers are only used for the public identification of the customers. The internal points of the network also have IP addresses. In the NGN the correspondence, the mapping between E.164 numbers and IP addresses is satisfied by the ENUM (*E*lectronic or *E*.164 *NUM*ber mapping) server.

Voice communication	**Fix**	**Mobile**	**Nomadic**	**Numbering**
Fixed telephony	X			E.164
Mobile telephony		X		E.164
Voice over IP (VoIP)	X	X	X	IP and E.164
Fixed-mobile convergence (FMC)	X	X	X	E.164 (and IP)
NGN	X	X	X	E.164 and IP

Table 1: Numbering of the voice services

Figure 4 shows the *present* use of numbering and addressing systems at the customers, in the backbone and access networks and in service provisioning. In general the identifier systems are *service specific*, e.g. the numbering of the fixed and mobile telephone services are separated. In case of voice services E.164 numbers play a dominant role in the whole process from the calling to the called party, the use of the E.164 system is realized at a technology neutral manner.

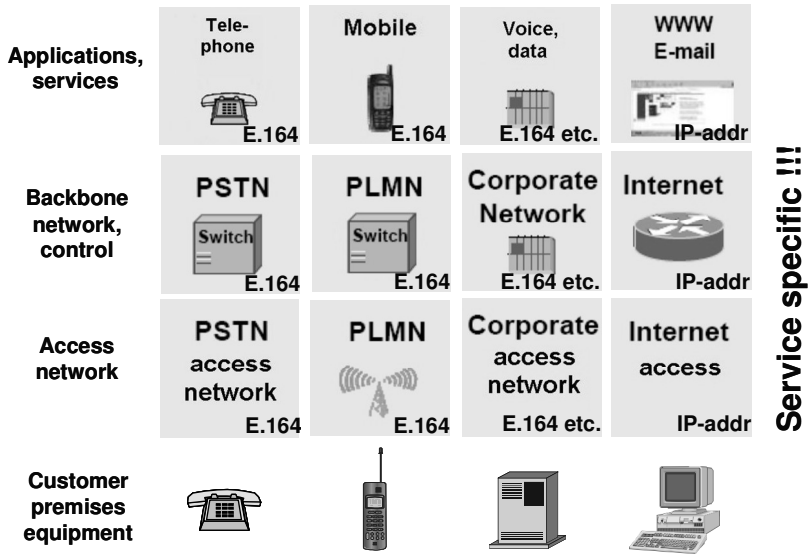

Figure 4: Recent numbering and addressing systems

The convergence of fixed, nomadic and mobile voice services necessarily motivates to make their numbering systems uniform, then later to integrate the number ranges. In the IP like services and in the IP networks IP addresses are of primary importance. The evolution of the IP addressing system, the version change can be independent of the E.164 numbering system.

Numbering – addressing vision

The electronic communications services – where numbering and addressing play role – continuously migrate to IP basis. It means that inside the network, in the unified core network and in the provisioning of applications and services IP addresses and names are used. The roles of E.164 numbers in traffic control are taken over by IP addresses. At voice services the identification of the subscribers' end points will happen by the use of E.164 number also in future. The model shown in Figure 5 can be considered as the vision of numbering and addressing, it will be realized – besides saving the uniqueness of the access – as the development of the IP based core network will takes place. In the figure the applied numbers and addresses are signed.

Two advantages of the application of IP can be recognized:

- on the one hand over IP any service can be provided,
- on the other hand IP as a higher level protocol works over any network hiding all the lower levels (the transport) from the subscribers and the services.

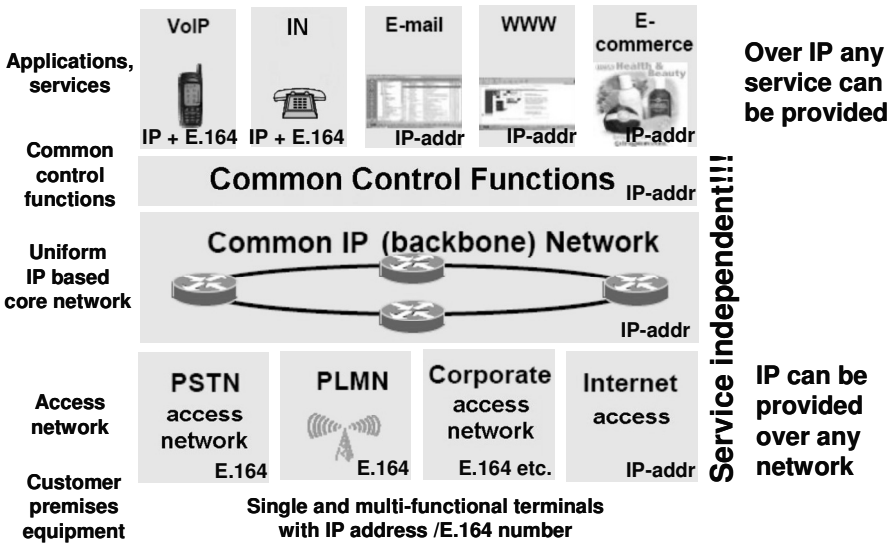

Figure 5: Vision of numbering - addressing for IP-based networks

The reality of this vision is based on the fulfilment of the *network vision built on the NGN concept* (Figure 6). In the NGN reference architecture some building blocks having importance with respect to numbering-addressing are signed. On the control plane the call control is performed by the SIP (Session Initiation Protocol) server. On the application plane the application servers, the Intelligent Network (IN) servers and the ENUM server providing gateway between the E.164 numbers and IP addresses can be found [11].

The effect of the NGN concept based on numbering and addressing manifests in the followings: district numbers continuously lose their meaning, national number portability in the fixed telephone network can be realized, unified national tariff can be introduced, integration of fixed, nomadic and mobile services can take place. ETSI has developed the standard of Universal Communications Identifier (UCI), its main objective is a single communications identifier belonging to an individual, to be used in a proper way in any life situation. The spread of UCI can also occur in connection to the NGN.

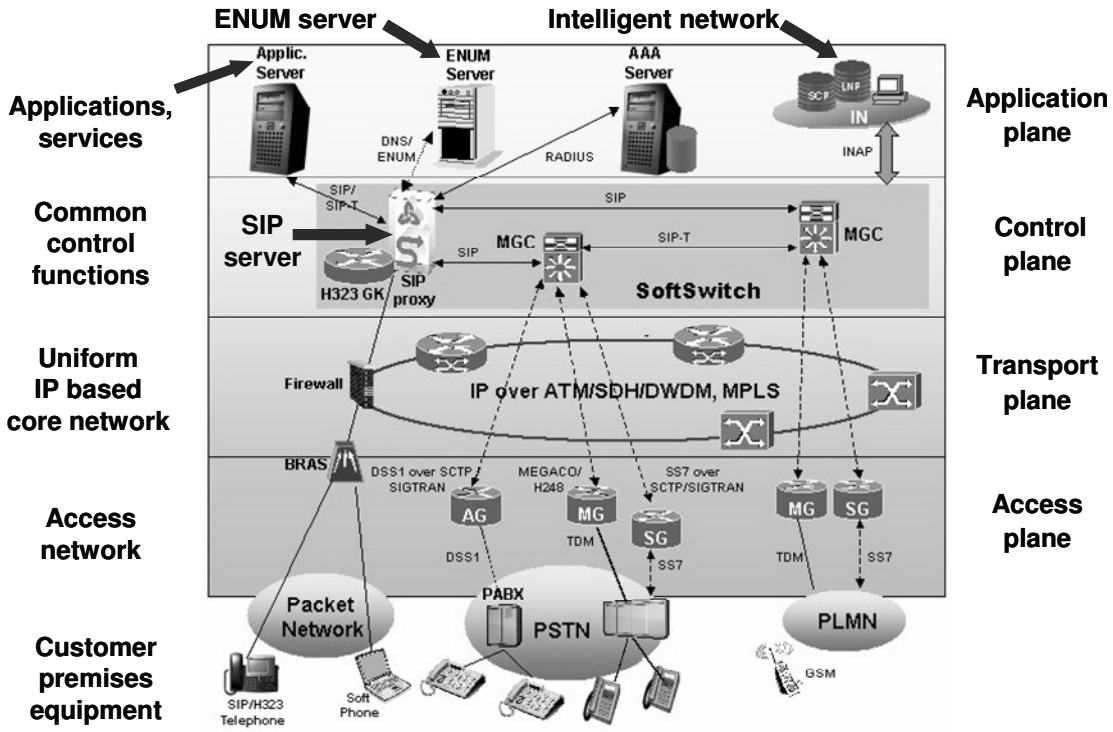

Figure 6: NGN reference architecture and addressing solutions

4. Modernizing the Numbering Plan in Hungary

The result of the revision of the national numbering and addressing shows that in the forthcoming years modernization of the national numbering system became an absolute necessity, on one hand and in particular for the future exploitability of the opportunities arising from the emergence of the NGN; on the other hand because the presently existing opportunity for the advantageous restructuring becomes impossible due to the patching of the present system and/or application of emergency solutions [12, 13, 14].

4.1. Goals of the modernization

In accordance with the technological development, the spread of convergent services and the customer demands it is necessary to answer the following challenges:

- Maximal utilization of the opportunities inherent in NGN (e.g. national number portability, preparation for fixed-mobile number portability);
- Facilitating the flexible launch of new services inspired also by NGN, in general helping the service convergence;
- Standardisation of mobile and non-mobile dialling;
- Facilitating the interworking of numbering and addressing systems (e.g. preparing the introduction of UCI);
- Increasing short code capacity;
- Increasing the number of free service/network codes (SNC);
- Increasing subscriber number capacity;
- Elimination of the '06' domestic prefix;
- Differentiated handling of premium services;
- The numbering reform should burden the users as less as possible by chance, it should not change numbers unnecessarily, as a result of the changeover a stable, future proof numbering system should come into existence, it should be performed in the least steps at a minimum cost.

With respect to the numbering systems the obligatory EU regulations refer to the '00' international prefix and certain short codes ('112' and '116'). For the domestic prefix there is no obligatory regulation, in the EU countries the domestic prefix – if any – is everywhere '0' with the exception of Hungary where it is '06'.

4.2. Modernization options

During the modernization of the numbering system generally some combination of the following three methods can be used:

- formation of unified domestic number length – in case of all number types the full domestic number length should be the same (NDC + SN),
- harmonization of the first digit of the domestic number - the numbers of same type are grouped behind a determined digit, in such a way the geographic and various non-geographic numbers are separated,
- closing the numbering - only one sort of dialling method is allowed because of the termination of the dialling form of subscriber numbers, i.e. at all domestic calls the full domestic number must be dialled, (therefore domestic prefix is not needed).

In the present Hungarian numbering system (S – Start version) the number of digits of NDC + SN is 8 or 9, 9 digits will be enough in the future as well. Taking into account the international experiences by the systematic combinations of the solution methods and their application in different extent several transition plans have been formulated and evaluated, among them the followings are the most important:

- Plan T: present system without considerable change;
- Plan A: 06 – 0 transition and utilisation of free district codes (DC);
- Plan C: 06 – 0 transition and formation of unified domestic number length by completing to 9 digits;
- Plan D: 06 – 0 transition and introduction of 9 digit fully harmonized numbering plan;
- Plan E: closing the numbering, formation of unified domestic number length by completing to 9 digits;
- Plan F: closing the numbering, introduction of 9 digit fully harmonized numbering plan.

Figure 7 demonstrates all of these plan versions ('butterfly' plan versions) and the practically relevant transition opportunities between the plans.

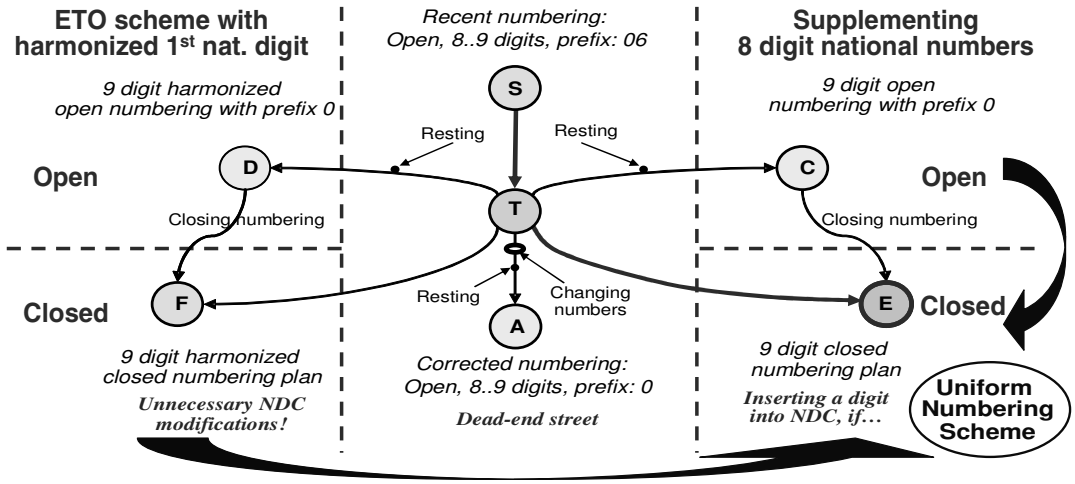

Figure 7: Butterfly scheme of the modernization versions

In the frame of Plan T there are no overall changes in the numbering plan, the emerging demands are fulfilled in the present frame. It is possible to remain in the frame of Plan T as long as the emerging demands do not force such change which would make impossible later the structural changes, or rather it is worth to remain until the conditions of the structural changes are created.

From Plan T it is possible to switch to an open or closed system. In case of changeover to an *open system* (Plans A, C and D) because of the 06-0 change before the transition the SNCs 60 and 61 should not be opened, they must have a 'rest'. At Plan A beside 60 and 61 all the DCs starting with 6 must be changed and rested. Plan A is obviously a dead-end: major part of the objectives cannot be reached, the later structural changes become impossible, the plan in itself can be realized only in a very inconvenient manner. In case of changeover to a *closed system* (Plans E and F) there is no constraint for the SNCs and DCs in the numbering plane '6'. If necessary SNC 60 can be opened at once for the mobile service providers if it is followed by closing the numbering.

Implementation of the ETO scheme with fully harmonized first national digit (Plans D and F) is not supported, it became out of date. It would require unnecessary change of more than 10 million mobile numbers.

Plan E meaning closed numbering has several advantages – beyond its easier realization – with respect to plan C remaining open henceforward:

- Plan E – with formation of unified domestic dialling and number length – enables the utilization of the opportunities offered by NGN.
- Because the numbers have only a single form, therefore from the customers' viewpoint the use of numbers becomes definite (entry to the phone directory, call from abroad to Hungary, etc.).
- Because of closing the numbering the capacity of number planes increases by 25% (subscriber numbers starting with '0' and '1' are allowed), the length and range of short codes can be extended (e.g. 5 or 6 digit codes starting with 55, 66, etc.).

The counter argument sounded against the closed numbering system is that because the opportunity to dial only the subscriber number is ceased the users are forced to dial more digits. However the dialling form of subscriber numbers must be terminated for various reasons: already now dialling form of subscriber numbers is not possible in case of all non-geographic numbers, it has been finished also for mobile numbers because of the uncertainty caused by the number portability, in addition in fixed networks its termination becomes justified in order to utilize completely the opportunities of the NGN. Therefore the only advantage of the open numbering has been lost, and in reality closing the numbering makes possible – without the domestic prefix – to dial less numbers.

Based on the above Plan E can be undoubtedly proposed for the modernization of the Hungarian numbering system, for its name Uniform Domestic Numbering Plan (UDNP) is recommended.

4.3. The Uniform Domestic Numbering Plan

The most important characteristics of the UDNP compared to the present numbering plan are as follows:

- by closing the numbering the domestic prefix (presently '06') will terminate, all the numbers should be dialled as 9 digit domestic numbers;
- the presently 9 digit domestic numbers (mobile service, nomadic service, business network numbers) will *not* change;
- the NDCs of the presently 8 digit domestic numbers will be completed by one digit in the interest of the uniform domestic number length, the subscriber numbers remain unchanged. Its solution is to insert one digit properly into the concerned SNCs and DCs according to the followings (Figure 8):

  - in case of geographic numbers a digit 4 will be put before the present district code, thus the district code of Budapest will change from 1 to 41, while e.g. that of Eger will change from 36 to 436;
  - in case of Internet dial-up access a 0 is put after the present SNC 51 thus it changes to 510;
  - the SNC 80 of green numbers changes to 800, while the SNC 40 of blue (shared) numbers change to 840, in such a way all the services of preferential tariff are placed uniformly in the number plane 8;
  - the SNCs 90 and 91 of premium services alter to 900 and 910 respectively;
- because of the 9 digit uniform number length short codes can be longer – up to 6-7 – than presently;
- the use of international number format is generally allowed, i.e. also in case of domestic calls initiated from fixed networks similarly to the opportunity in mobile networks.

The UDNP fulfils all the requirements determined from our present-day knowledge:

- Utilization of the opportunities of the NGN, promoting the service convergence;
- Standardisation of mobile and non-mobile dialling;
- Unified opportunity for dialling domestic numbers with international format;
- Elimination of the '06' domestic prefix;
- Increasing the number of free SNCs;
- Differentiated handling of premium services;
- Radical increase of short code and subscriber number capacities;
- Facilitating the introduction of Universal Communications Identifier (UCI).

For the users the changeover to the uniform domestic numbering will ensure the exemption from changes for several decades, univocal definition and dialling of numbers, transparency and ease to memorize the numbering structure, dialling mobile numbers with less digits, support of location based (geographic) number portability at national level, and the future introduction of number portability among geographic and mobile numbers. UDNP does not affect the numbers stored with the most frequently used international number format in mobile phones.

For the service providers the changeover to the uniform domestic numbering results in such a robust numbering structure, which enables the use of opportunities provided by the NGN, the smooth launch of new services, provision of additional revenues, access to numbering resources with even chances, transparency of the numbering structure, univocal dialling of numbers. Closing the numbering system increases the number capacities to be assigned behind the NDCs by 25%, broadens the possible range of short codes, simplifies the operation of the switches because of the uniform number format and the absence of the domestic prefix.

For the regulator of identifiers the introduction of the uniform domestic numbering creates a flexibly manageable, significantly increased numbering resource. It stably makes achievable the more effective numbering management, the flexible utilization of number fields, the realization of the principle of equality of service providers in the use of numbering resources, it ensures the transparency of the numbering structure, the smooth launch of new services, the univocal dialling of numbers. Furthermore it supports the location based (geographic) number portability at national level, and the future introduction of number portability among geographic and mobile numbers, and last but not least it satisfies the European harmonisation efforts and rationally accommodates to the present European practice and trends.

Present Domestic Numbering Plan

A\B	0	1	2	3	4	5	6	7	8	9
1	---	---	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp
2	Mobile	Nomadic	DC	DC	DC	DC	DC	DC	DC	DC
3	Mobile		DC	DC	DC	DC	DC	DC		
4	Shared		DC		DC	DC	DC	DC	DC	DC
5	Mobile	Internet	DC	DC	DC		DC	DC		DC
6	Mobile		DC	DC			DC		DC	DC
7	Mobile	Business	DC	DC	DC	DC	DC	DC	DC	DC
8	Green		DC	DC	DC	DC		DC	DC	DC
9	Premium	Premium	DC	DC	DC	DC	DC			DC

Uniform Domestic Numbering Plan

A\B	0	1	2	3	4	5	6	7	8	9
1	Short codes									
2	Mobile	Nomadic								
3	Mobile									
4	---	Bp	DC	DC	DC	DC	DC	DC	DC	DC
5	Mobile	Internet								
6	Mobile									
7	Mobile	Business								
8	Green				Shared					
9	Premium	Premium								

Figure 8: Mapping of the Numbering Plans based on the first two digits

5. Migration to the Unified Domestic Numbering Plan

The changeover to UDNP (Plan E) can be theoretically performed in different manners. These opportunities are evaluated in the followings (Figure 7):

- Plan T means to perform the most urgent changes, regulatory amendments related to numbering. It is possible to remain in the frame of Plan T as long as the emerging

demands do not make impossible the changeover to the targeted Plan E, or rather until the conditions of the changeover to there are created.

- The proposed Plan E can be realized also in more steps. The changeover to UDNP in one, two or even in three steps will be accompanied by more and more increasing costs on the whole. The costs of the single steps are almost the same in order of magnitude. The changeover can be performed in one step, because the former and new numbers can be definitely distinguished, it is not necessary to 'rest' any numbers. As a consequence the one step changeover is obviously cheaper than stretching the changes in time. At the same time the transition with less and less changes and the numbering system stabilized as fast as possible are basic customer demands. Based on the above the one step changeover is explicitly supported.

5.1. Tasks of the changeover to UDNP

Figure 9 shows the phases of the changeover to UDNP. The process starts at that moment when the positive decision is born it is called to D-day and it is finished on the S-day when the switch to UDNP really happens. The S-day can be preceded by a so called transition period, during this period the former and new numbers – which can be clearly distinguished in case of UDNP – can be equally used. It is practical to time S-day for summer (1st January is explicitly counter-advised). The switch is advised during the night from Saturday to Sunday (e.g. at 2 a.m.) generally the traffic is the lowest at that time.

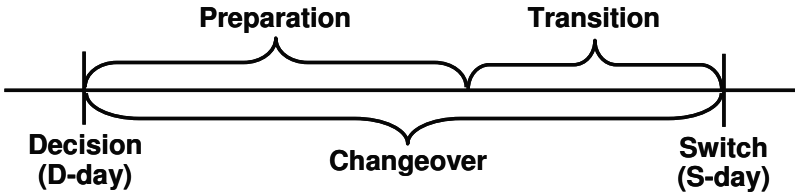

Figure 9: Phases and critical day of the changeover

For the sake of the success several tasks should be solved during the changeover period:

- The changeover strategy is accepted (D-day) by the National Communications Authority (NHH) and released at a press conference.
- NHH consults with the market players about the way of execution of the 'butterfly' strategy, conciliates and agrees about the compensation method in the interest of the successful realization of the strategy.
- NHH prepares the government decree referring to UDNP.
- NHH informs the ITU and the partner authorities of all countries about the change-over.
- NHH develops the communication strategy, prepares and executes the campaign.
- In the first part of the changeover the service providers prepare, perform and test the reconfiguration of the switches.
- Switching to UDNP happens on S-day, from that time the switches accept only the numbers of new type.

The tasks of the switchover require about one year. With respect to the successful realization, cost minimization and avoidance of the effects disturbing the customers timing is very important, therefore a project plan should be prepared in detail. The government decree announcing the change should be put into force in such a way that the service providers could have enough time to prepare and the costs of the changes can be calculated in their annual plan. The launch will be trouble free if the changeover is introduced by a well organized, suitable communication campaign, the transition can be properly prepared by the

service providers, and for the customers there are opportunities to make the changeover easier. An example for the latest is the storage of mobile numbers in international format (starting with +36) in the mobile phones, which are not affected by the changeover.

5.2. Separation of the calls of former and new numbering schemes

In case of the change of numbering schemes one of the most important issues is if an old number can be interpreted as a new one. The changeover to the new numbering scheme is the most favourable, if during the transition the calls according to the old and new schemes can be clearly distinguished. This aspect is automatically and entirely fulfilled by the changeover to UDNP.

In case of calls initiated in Hungary:

- if the dialled number starts with 00 or in mobile networks with the '+' sign, also after this it means international number format, depending on the country code it should be handled as an international or a domestic call;
- if the dialled number starts with 06 then it is a call belonging to the old scheme;
- if the number starts with a non-zero digit, the calls belonging to the old scheme (local or in-network calls) can be distinguished from the new numbers by their number length, thus the old subscriber numbers are of 6 or 7 digits, the new numbers are of 9 digits.

In case of calls coming from abroad:

- the international number of mobile subscribers does not change,
- in case of geographic numbers after the country code '36' the old number length is 8, the new number length is 9.

Because the calls according to the old and new schemes can be automatically separated, the two systems can temporarily operate simultaneously. Prior to the official date (S-day) of the switch optionally, according to their own decision the service providers can apply a 1-3 month testing period, which can provide a suitable preparation both for the service providers and the customers:

- The service providers can implement the modified programmes in their switches, they can test their systems. The switches should be programmed in such a way to be able to recognize the old and new numbering and dialling systems, after the S-day only the new numbers are accepted, in case of the old ones a warning voice message can be heard for a given time.
- In the transition period before the S-day the service providers can publicly announce the pilot (test operation) and to allow for their customers to use the numbers of new type before the official date of the changeover. The pilot can help discover the incidental failures as well.
- It means that in the mobile sets and in the programmable telephone sets having memory the numbers can be rewritten with respect to the new format, in the PABXs of companies, institutions the programmes can be modified in advance.
- It is important to motivate the users with appropriate communication to perform the number changes continuously.

In such a way the systems can be tested in advance, the users can be "accommodated" customer friendly to the use of the numbers of new type, after the S-day there will be less calls with wrong number.

5.3. The costs of the changeover

The cost of the changeover to UDNP basically occurs at three places: at the users, at the service providers and at the state budget, these are summarized below.

Costs at the users

The important components of the emerging costs at the users are as follows:

- direct cost of informing the acquaintances and most important business partners of the number change;
- loss of revenue in case of enterprises because probably the notification of the change will not get to all business partners;
- change of business papers, cards, envelopes, etc.;
- loss of advantages incidentally connected to a given “well known” number, costs of the “introduction” of a new number;
- cost of the modification of programmable equipment (facsimile, PABX, PC, etc.);
- cost of wrong calls after the switchover.

The whole costs emerging at the users will be probably comparable with the costs emerging at service providers, and in addition these costs are mostly independent of the nature of the change (e.g. the cost of the change of a stamp or a lorry canvas does not depend on the measure of the number change). Therefore the changeover in more steps would multiply the costs of the users.

Costs at the service providers

The costs emerging at the service providers have three major components:

- Elimination of the domestic prefix, alteration of number analysis;
- Modification of the routing tables in the switches;
- Application of voice messages in the time period after the switchover.

The elimination of the domestic prefix causes alterations in the programming of the switches, at the same time the operation of the switches will be simplified. Probably there is no need for software version upgrade.

Modification of the routing tables in the switches is such a technical task which should be performed individually in each switch. The advantage of the proposed solution is that there is no need to change the routing system, only the NDC values should be rewritten in the routing tables to a certain extent. During the transition to the new numbering system it is necessary to modify also the database of the ported numbers at the service providers and also in the central reference database.

Further costs can emerge after the switchover because of the wrong calls and the voice messages. Because the mobile numbers do not change and the calls from mobile to mobile network are initiated by the use of numbers stored in the mobile phones, in the mobile networks the loss because of wrong numbers will be little, at the same time in the fixed telephone networks – mostly at local calls within numbering districts – a lot of users will use routinely the subscriber number instead of the full closed number, furthermore the altered district code can cause wrong numbers.

Costs at the state budget

The costs of the changeover to UDNP can affect the state budget in two major areas:

- Compensation (partially) of the costs of service providers;
- Costs of the communication campaign of the changeover.

From fairness the service providers could get support from the state budget to the changeover. Our proposal is that in the calendar year of the switchover the service providers should get a reduction proportional to the usage fee of the normal subscriber numbers assigned to the service providers. According to the real costs the reduction ratio can be differentiated. Of course other compensation methods can be applied as well.

The implementation of the communication campaign before the switchover is a role of the state, its cost requires resource from the state budget, even if in parallel probably the service providers will also inform their customers.

6. Conclusions

The utilization of the opportunities provided by the NGN requires the use of IP addresses and names inside the network, in the unified core network. The role of the E.164 numbers in routing and traffic control is taken over by IP addresses. However in case of voice services the identification of end-user access points will remain hereafter by the use of E.164 numbers. Migration to NGN doesn't require directly the change of the subscribers' phone number, however the NGN enables among others:

- implementation of national number portability for fixed telephone service;
- integration of the number ranges of fixed, nomadic and mobile services, enabling their portability;
- deployment of an effective universal communications identification plan;
- flexible introduction of new services and applications.

Their realization requires uniform domestic number length and dialling method, practically closed numbering. The introduction of uniform, closed domestic numbering provides a consistent solution for the deficiencies of the present Hungarian numbering plan, too. In Hungary if all domestic calls are uniformly dialled by 9-digit domestic numbers:

- there is no need for domestic prefix, it is possible to avoid the change of '06' domestic prefix used in Hungary to the internationally recommended '0';
- the average number of digits to be dialled decreases (always 9);
- numbering is simpler and more transparent: the dialling of local and long distance, mobile and non-mobile numbers is unified, domestic and international calls are clearly separated;
- the range of freedom is growing by an order of magnitude in case of national destination codes (NDC) and short codes, the subscriber number capacity of each number plane increases by 25% (because of closing the numbering);
- fixed-mobile convergent services, fixed-mobile number portability can be introduced.

The *Uniform Domestic Numbering Plan* (UDNP) can be developed in such a way that the present 9-digit domestic numbers and the short codes remain unchanged, the 8-digit domestic numbers are completed to 9-digit without number change, by the insertion of an appropriate digit. The transition doesn't touch any subscriber numbers or short codes, only the area codes and certain service code assignments will be completed by one digit. E.g. in case of geographical numbers a digit '4' will be inserted before the present area code, but the mobile numbers representing the largest mass will not change at all. The deployment of the Uniform Domestic Numbering Plan doesn't influence mobile calls of international format at all, involving calls from abroad to mobile phones. Due to the dialled numbers in the present and new numbering schemes may unambiguously be separated; the two schemes can be in operation simultaneously, e.g. in the testing period.

UDNP is a robust numbering plan for long term; it provides a frame to utilize the opportunities of NGN. Detailed technical, financial and impact analyses of the different development versions of the present numbering plan have shown that UDNP can solve the issues of the numbering plan at the most advantageous and future proof way, it is suitable to perform the transition in single step, and it is not reasonable to introduce the harmonised national number plane conventions, recommended by ECTRA/ETO in 1997 due to significantly higher transition problems. Even if some corrections of the numbering can be performed within the frame of the present numbering regime, Hungary can directly migrate to UDNP in the next years. In case of delay of changeover, the satisfaction of momentary demands by obligate, mending solutions - besides losing possible advantages and additional revenues - the status quo cannot be kept up any longer, the opportunity of advantageous reform becomes impossible.

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