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APPLICABILITY OF CELL-PHONE NETWORKS IN CIVIL ALARM AND INFORMATION SERVICE SYSTEMS

Abstract/Absztrakt

By now the Hungarian civil alarm and information service systems became anachronistic, and they can't do justice to resultant function efficiently. Since the mobile telephony systems and their construction and function, as well as their services wide incidence fit to reach the big proportion of the population in case of emergency fast, they should be expedient to case into alarming and informing functions.

A magyarországi lakossági riasztó és tájékoztató rendszer mára korszerűtlenné vált, és nem képes hatékonyan eleget tenni rendeltetéséből eredő feladatának. Mivel a mobiltelefon hálózatokat felépítésük, működésük, valamint szolgáltatásaik széleskörű elterjedtsége alkalmassá teszi a lakosság jelentős hányadának veszélyhelyzet esetén történő gyors elérésére, célszerű lenne riasztási és tájékoztatási feladatokba való bevonásuk.

Keywords/kulcsszavak: *cell-phone, civil alarm, information service system ~ mobil kommunikáció, információs rendszer, vészhelyzeti riasztási rendszer*

INTRODUCTION

In the event of natural disasters, industrial, chemical or nuclear catastrophes, mass traffic accidents or terrorist attacks the number of victims and the volume of property damage could significantly be affected by the speed and quality of civil alarm and information services targeting preventive actions against foreseeable events and handling of status quo.

Today mobile information technologies and services are continuing to gain space, so my paper concentrates primarily on the special alarm and information service systems – facilitating one-way communication between the authorities and the citizens – that could be implemented on the existing mobile networks, and on their anomalies.

LEGAL BACKGROUND

One of the determining fields of emergency broadcast is alarming and informing civilians in case of emergency situations to preserve human life and the safety of private property. Previous relevant legal regulations were based on outdated views, since their starting point was "unexpected aerial attack", and they did not provide for the establishment of a modern alarm and information service system meeting the needs of catastrophe prevention.

A positive step was taken on 26 July 2006, since Government Act 186/2007 (VII. 18.) on aerial alarm for the event of unexpected aerial attack entered into force, in which wording enabled the involvement of mobile telephony services in alarm and information services. Pursuant to §6 "Due to the emergency powers assigned by the Law on electronic broadcasting, the Minister of Economy and Transport appoints the broadcasting service providers and electronic broadcast providers to be involved in the national defense activity of aerial alarm, and establishes their roles." Having regard to the fact that the subject of the act did not change, the tasks of catastrophe prevention are mentioned, yet they are restricted solely to the event of aerial alarm.
The concept of catastrophe alarm is only contained in Government Act 60/1997 (IV. 18.) on air-raid shelter protection, supply of personal protective devices, alarming civilians, and general rules of evacuation and reception, which does not list electronic broadcast service providers as potential media. The harmonisation of this act with Gov. Act 186/2007 and Gov. Act 100/2007 on preparing electronic broadcast for the event of emergency and special period, the roles and conditions for operation of public administration, together with the construction of related Ministerial Decree(s) might establish the legal conditions for the extension of civil alarm and information service system with mobile telephony services.

PRESENT CONDITIONS

In her doctoral (PhD) thesis, Dóra Maros is investigating the present conditions of civil alarming and information services, its anomalies, and the possibility of involving wired and mobile telephony services, based on which the following statements can be made:

- In Hungary three platforms are at the authorities' disposal to ensure alarming and information of civilians: electronic or manual sirens, fix planted megaphones or ones mounted on automobiles and electronic media (radio, television).
- The majority of electronic sirens are out-of-date and manually triggered, and their operation relies on the energetic network; the citizens – due to lack of appropriate information – is not aware of the different signals and what to do when they sound; disregarding the system in Paks vicinity the maintenance and testing of sirens is defective; due to increased ambient noise level the audibility of the sirens decreased considerably.
- Due to intelligibility of speech (e.g. restricted bandwidth and sound level) information through megaphones does not meet the needs of civil information services either.
- A fundamental prerequisite of information through radio and television broadcast is that citizens should watch or listen to one of the appointed broadcasting services at the time of the announcement [4: p.90-93].

A basic problem is that people staying away from populated areas and people with hearing problems cannot be reached with any of the above methods. Thus the risk of people with hearing defect is considerably higher in case of emergency than that of their "healthy" ones.

As a result the following conclusion can be drawn: the present alarm and information service is out of date, uneasy and does not ensure reliable reaching of the population concerned – thus it is only partially fit for its function.

APPLICABILITY OF MOBILE TELEPHONY SYSTEMS

Since the majority of the European population possesses mobile telephones, the most obvious solution would be the involvement of mobile networks in civil alarm and information service systems.

The basis of its implementation would be the at least the basic (cell-level) awareness of where the subscribers are staying; but if it cannot be ensured, due to the operational concept of the system the list of terminals staying in the service area of a given basic station is available in all cases. Since the call numbers of people staying in the endangered territory are available in the databases of the service providers, in case of emergency or catastrophe calls can be initiated or messages sent to reach them in connection with the critical event (prior to, at the time of, or after its happening). The present mobile networks in operation are technically capable of the implementation of the service. During the inevitable modifications (investments) the software of operating SMS and voicemail servers should be modified, or an integrated emergency messaging server (with appropriate backup) should be planted as a new system element. (Of course the system controller and network management software should also be modified.) The main idea of the solution is that pre-programmed text, voice and multimedia messages would be sent to every subscriber's device on the endangered territory depending on the alarm type, and extended with necessary (pl. position-dependant) information.

During the implementation of the system the following aspects shall be considered:

- The type of message sent to a given user is determined by the capabilities of his/her device, and on the potential handicap indicated in the subscriber's data on the subscription contract; this means that multimedia messages should only be sent by the system to MMS[1]-capable devices, and a visually handicapped people should receive voice messages, while people with hearing problems should receive text messages.
- In case of these special calls and messages higher priority (similar to emergency calls, but lower by one grade) should be ensured, which would mean in case of voicemail messages that the establishment of these calls (in case of messages the alarm and information SMSs[2] ands MMSs would be placed on top of the potential waiting list) should be ensured on all available transmission channels (in case of large number of subscribers by the use of half-speed channels), even at the price of breaking existing connections.
- To ensure the highest potential for success of the alarm and informational messages the base stations should indicate the importance of the information to be communicated to the user by a special, increasing volume ringtone (e.g. siren voice) sent on the signal channel.
- The above possibility should be ensured on silenced, yet switched on devices as well, through remote enabling of the disabled speaker.
- The controllability of the success of such messages and calls should also be ensured (4: p.93] (in case of calls after the detection of answer the duration of the call might propose whether the user listened to the message at full length, or the pressing of an acknowledge button (meaning the understanding and acceptance of the message content) might be requested from the user at the end of the call; in case of messages a reading confirmation should be requested from the device).
- In case of unsuccessful calls or messages the network keeps on trying by resending and recalling, or combining the two, within the validity period of the alarm; after the validity

[1] Multimedia Message Service
[2] Short Message Service

period of the alarm the system makes a report on the subscribers of the numbers not reached, and the service provider sends the it to the authorities (the report contains the possible location and potential handicap as well).

- The message kit should be constructed so that each of them would give the shortest possible, yet unambiguous information to the user on the nature and severity of the actual situation, the measures of the authorities and what to do (message frames quickly and dynamically configurable from the computer controlling the alarm).
- In the event of catastrophes voice message is one of the most efficient ways to give straightforward information to users staying on the endangered area in addition to the alarm; this solution can be used for all devices – offering the simplest services – for healthy and visually handicapped users as well; subscribers whose terminal for some reason are switched off and not operating receive the message in their own voicemail inbox (the network later re-tries with voice and text messages as well).
- MMS messages enable giving several additional information as well, such as escape routes illustrated on maps, and complementing text messages with voice messages for greater emphasis.
- The advantage of MMS and SMS solutions over voicemail-servers is that the information can be re-read, if necessary, the user can later document it (dates), in addition, it means less load on the network (at least on the transmission channels).

Another additional advantage of the above solution is that alarm and information can be on several languages, thus increasing the safety of foreign citizens [4: p.93]. The language selection can technically be based on the mobile country code (MCC[3]) field of the IMSI[4] identifier if, in addition to the subscriber's data, the storage of mother tongue is also ensured in the registers (HRL[5], VRL[6]).

In consideration of feasibility and applicability the issue of reliability, speed and authenticity of mobile-telephony alarm and information systems are worth investigating, which, in our case, means inspecting the quality features of the networks of national service providers.

With respect to reliability the basic feature to be examined is the availability of service, which in this case means the availability of mobile services at a given period of time on a certain service area; namely, what is the possibility of the availability of the service in the given period of time [6]:

$$A = \frac{T_i - \sum_n T_{s_n}}{T_i} \cdot 100\%$$

where $T_{üz}$ is the time-period under investigation and ΣT_h is the service down-time within the examined period.

In Hungary the availability set forth for the service providers cannot be lower than 95%, yet in 2006 the parameter of all three service providers were above 99%. Pannon contributed to the national average of 99.61% by 99,83%, T-Mobile by 99.94%, and Vodafone by 99.06% [7: p.4]. This meant a daily average downtime of 2.45 min, 51.84 sec, and 13.64 min respectively, that means a total average of 5.62 min.

Within reliability we might consider the parameter considering network load as well, the rate of unsuccessful calls, which means connections initiated, but not built in the high-traffic

[3] International Mobile Subscriber Identity
[4] Mobile Country Code
[5] Home Location Register
[6] Visitor Location Register

period[7] as compared to the total number of calls. The set limit for this parameter is 1.4% within the network and 2.7% for other national and international calls. The rate of unsuccessful calls as compared to the total number of calls for the service providers in 2006 was 1.41%, 1%, 1,47% in the above order, totalling to an average of 1.29% [7: p.5].

With respect to speed the most important parameter is the connection time of the calls initiated, which cannot exceed 12 sec for national calls. The results of the national service providers were 5 sec, 4 sec, 4 sec, that is an average of 4.33 sec, which is considerably better than the set limit.

In case of mobile telephony networks the issue of authenticity means the identifiability of incoming calls and messages, which is whether the user is capable of clearly identifying the caller or sender, and whether he/she is able to check the uncorruptedness (integrity) of the information received. (It is important to avoid "false alarms"!)

Based on the above data it can be concluded that the system quality parameters of Hungarian mobile telephony service providers meet the fundamental requirements for civil alarm and information services with respect to both availability and speed. The question of authenticity can be solved by applying special signals for the identifiability of both the message sender and content that cannot be created in other ways by unauthorised (malicious) subscribers. (E.g. telephone numbers of civil alarm and information centres coded on the SIM-cards, message-formats extended by special characters and symbols, special ringtones sent on the signal channels, etc.)

Another important issue is the accessibility of the population, which can e characterised by the number of active subscriptions ready for receipt, and, on the other hand, by the network coverage. 10 226 389 active SIM-cards ready to receive were registered in Hungary in June 2007, out of which 9 464 896 were in use in the last three months; this means that on average there is at least one active subscription per citizen [8: p.1]. Naturally we cannot speak of 100% supply, since several users have more than one subscription, and also children and some of the old can not have access to mobile services. But in general we can say that a considerable proportion of the citizens can be reached with higher probability via mobile telephones than through the combined application of the present solutions. This is, of course, greatly supported by the nearly nation-wide (c. 97-99%) coverage.

However, there is one more aspect that needs careful investigation with respect to the efficiency of the system. The relationship between the traffic generated by the alarm and information calls and messages and the system throughput, and also the size of the VLR providing service on the area concerned significantly affects the delivery speed of the messages. In a catastrophe concerning only a few cells searching for whom to inform and the evaluation of the location data out of a database containing several hundred thousand or even a million users can take a long time, which in certain cases can hinder the success of alarms – thus the efficiency of the system, too.

Calling of all the users concerned, which in case of a busy cell means a huge time delay for the subscribers at the end of the information chain, would create an even greater loss. Naturally the time required to notify all subscribers depends greatly on the length of the information messages as well. For example, in case of a cell containing 200 subscribers, with messages of 20 sec, connection time of 4 sec and an additional delay (answering and

[7] On workdays, Monday to Friday, from 9 a.m. to 5 p.m.

disconnection time of the call, etc.) of 6 sec, with a base station of one transceiver (1 frequency, 8 timeslots), notification optimally takes 12.5 min. (Of course, this assumes the priority of alarm and notification messages over calls initiated by the users.) This seems a bit contradictory to the next statement that: "The information announced can be repeated in an unlimited number either automatically, or at the request of the alarmed" [4: p.93]. In my opinion reality is that in certain cases there is a possibility to repeat the messages, but only on condition that the users at the end of the notification list are not risked by the additional delays.

However, there are solutions by which the total notification time could be decreased. The use of half-speed transmission channels (TCH/H[8]) enables the doubling of the number of connections made simultaneously on one carrier, and thus the number of subscribers supplied on the same territory, meaning that the notification time would be halved (in case of the previous example it would mean 6.25 min). Efficiency can be further improved by the so-called "cell-rotation", which means that the base station concerned is helped by the increased transmission performance of its neighbours in supplying users on the borders. With the combined application of these methods notification time can be decreased to a fraction, thus efficiency can significantly be improved.

In case of SMSs the above observation is modified inasmuch as they are delivered on signal channels instead of transmission channels; as a result sending simultaneously in great numbers might cause jams in administrative and controlling traffic. Sending text messages could optimally mean a quicker and more effective solution. Service providers use their GPRS[9], EDGE[10], or UMTS[11] HSDPA[12] infrastructures for sending MMSs, which at present are mainly available in the vicinity of densely populated towns and high-traffic areas. The packet-switched data transmission process applied enables more optimal use of the available spectrum, thus further increasing the efficiency of notification.

With the simultaneous application of the three solutions and an optimal division of available (2G, 2.5G, 3G, 3.5G) resources the reaction time of reaching users on the endangered area can significantly be reduced.

However, there is a significantly quicker, but less flexible solution to transmit information simultaneously to a wide spectrum of users. From among the Hungarian service providers only one uses this method for displaying the location of the user on the terminals. Usually information specific to a given base station are transmitted on the so-called BBCH broadcast channel, which is used by the devices within the operational area to identify the cell and measure its level of performance. This information could be supplemented by the alarm and information messages that could, after broadcasting, be displayed simultaneously on the displays of all terminals within the area concerned. Special voice signals can also be attached to these types of messages to raise attention. The inflexibility of the system derives from the quantity and quality restrictions on the information to be delivered, and the unverifiable nature of the receipt of such messages. A great advantage, though, is that it does not mean any extra load to the network, minimizes the evaluation period, thus its application can often be effective.

[8] Traffic Channel/Half rate
[9] General Packet Radio Service (2,5G)
[10] Enhanced Data Rates for GSM Evolution (2,5G)
[11] Universal Mobile Telecommunications Systems (3G)
[12] High Speed Downlink Packet Access (3,5G)

SUMMARY

As a summary we can state that with respect to its structure, technical and quality parameters domestic mobile telephony networks are suitable both technically and with respect to the services offered for the implementation of such national civil alarm and information service systems that aim not at replacing, rather at complementing the traditional solutions in need of modernisation. Such a system is capable of ensuing round-the clock fast and reliable information of both the healthy population and people with visual or hearing problems, both on densely populated areas and far from urban areas, in the event of local or large area catastrophes as well. The most effective and fastest solution can be the combined application of voice, text and multimedia messages and broadcasting channels, with optimised resource-division. The activation of the system can be done upon direction from the authorities by the round-the-clock support centres operated by the service providers. The state would pay, in addition to a standby-fee, a service charge in proportion to the network usage.

For the introduction of the service first the relevant legal regulations would need to be altered, then, after conducting feasibility studies and negotiation with the service providers, the actual technical plans and documentations should be prepared. Operation can start only after implementation and test operation, with the appropriate training and information of the citizens (information booklets, leaflets, practices, etc.).

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