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

ACCESS TO EMERGENCY CALLS based on VOICE OVER IP

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EXECUTIVE SUMMARY

VoIP is a new technology for voice communication with far reaching impact on today's private and public telephony networks and services. Based on the fundamental changed service building options there are very different VoIP realisations already in place in the world out there ranging from pure internet based end to end applications without centralised control to centralised emulation of PSTN POTS service.

This TRIS report describes the main technical problems arising in the context of emergency access from VoIP terminals. Although it focuses on technical aspects it also examines how the new technology might affect regulations and points to regulatory areas where changes should be considered for the near to mid-term future.

There is a broad ongoing discussion all over the world on the regulatory treatment of VoIP, with one of the key questions being if at least certain VoIP scenarios fall within PATS regulation comprising (national specific) obligations for access to emergency services.

Disregarding the final outcome of this discussion and formal legal regulations there is widespread acceptance that from the customers point of view it would be most appropriate if voice enabled IP devices with national or global connectivity would also provide access to emergency services.

The main obstacle to reach this goal is the missing location information of the calling VoIP user. Whereas at present in telephone network solutions all necessary emergency routing elements are network based, in the IP based solution the terminal has a significantly more important role and may have to provide location information in the general case. This could be done either by local means (e.g. GPS receiver) or information obtained from the local access network. For the latter case it has to be emphasized that in the public internet access typically is completely decoupled from VoIP service provision and obligations on access networks (ISPs) that help global third party VoIP providers might be only achieved in a controversial process if there is no extra funding and ISP will have to bear these costs though they may not be able to benefit from the investments if they do not provide a VoIP service themselves.

Generally two stages might be differentiated:

- In the first stage there is no impact on infrastructure and basic processes at emergency centres, i.e. only changes outside the emergency centre responsibilities are considered.
- In the second stage there is an all IP infrastructure including IP connectivity of emergency response centers.

In absence of unavoidable national PSTN peculiarities the latter scenario is in the focus of international standardisation activities at IETF, nevertheless it is clear that in reality a long overlapping period of stage one in parallel with stage two will have to be considered at the national level. During this time period national Emergency Service Routing Proxies (ESRP) could help VoIP Service Providers without national gateways and access to the national emergency systems to provide access to emergency services.

One important medium to long term option is that emergency calls could end up as a stand alone services that no longer are integrated in general VoIP services and maybe registered by the users independently from other VoIP service registrations. IETF WG ECRIT is currently working on standards to provide direct access to Emergency Response Centres from the device without the need of a VoIP Service provider.

To summarize it turns out that, compared with current regulations, future regulations on emergency access might have to widen their scope compared with current emergency regulation on telephone networks and services and might include also the terminals and public IP / internet access networks and internet service providers.

It must be stressed that this report is dealing only with the communications access to emergency services. In practice the emergency services themselves will need to adapt to be more readily accessible and to receive and handle new forms of communication (eg SMS, MMS photos and video), and these changes are equally important.

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1 INTRODUCTION

VoIP is a new technology for voice communication with far reaching impact on today's private and public telephony networks and services. Based on the fundamental changed service building options there are very different VoIP realisations already in place in the world out there ranging from pure internet based end to end applications without centralised control to centralised emulation of PSTN POTS service.

There is a broad ongoing discussion all over the world on the regulatory treatment of VoIP, with one of the key questions being if at least certain VoIP scenarios fall within PATS regulation comprising (national specific) obligations for access to emergency services.

Disregarding the final outcome of this discussion and formal legal regulations there is widespread acceptance that from the customers point of view it would be most appropriate if voice enabled IP devices with national or global connectivity would also provide access to emergency services. Future access to emergency services will also allow other means of communication, which will be very important for some users with disabilities (eg the deaf). Text based is already a requirement in some countries. Video will be very helpful with new 3G/UMTS devices. IM and SMS/MMS can be supported. Automatic devices (eCall) will also require text messages. Emergency services and call centres will need to adapt to be able to receive these new forms of communication and will also need to develop new procedures for the best way to handle them.

This TRIS report describes the main technical problems arising in the context of emergency access from VoIP terminals. Although it focuses on technical aspects it also examines how the new technology might affect regulations and points to regulatory areas where changes should be considered for the near to mid-term future.

This report will:

- Investigate on the main impacts of VoIP services on access to emergency services
- Define the basic requirements for providing access to emergency calls from VoIP services, and identify the key short- to medium-term obstacles to providing access to emergency calls from VoIP services
- Summarise activities related to finding solutions to these problems, in the Internet Engineering Taskforce (IETF) and in other forums
- Identify the key stakeholders in implementing these solutions, and suggest where the responsibilities for implementing the solutions might lie
- Make some conclusions regarding the status of work to find solutions to accessing emergency calls from VoIP services and the next steps that are required, and propose some high-level principles that should be followed by regulators in addressing these issues.

In the context of access to emergency services the report identifies some issues where there are differences or different levels of relevance depending on the national or international usage scenario. One example is the recognition of a dialled number as emergency number by the terminal and the involved VoIP providers. Another is international interconnection regarding emergency numbers because in many cases emergency numbers of foreign countries cannot be reached via international interconnection. Such issues are mentioned where relevant, nevertheless a more in depth evaluation might be considered for a follow up report.

1.1 Abbreviations

BCP	Best Current Practice
BT	British Telecom
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CEPT	Conférence Européenne des Postes et des Telecommunications (in English: European Conference of Posts and Telecommunications)
CLI	Calling Line Identification
DECT	Digital European Cordless Telecommunications
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
E.164	ITU-T Recommendation - "The international public telecommunication numbering plan"
ECC	Electronic Communications Committee (of the CEPT)
ECRIT	Emergency Context Resolution with Internet Technologies
EFTA	European Free Trade Association
EMTEL	Emergency Telecommunications
ERC	Emergency Response Centre (this term includes the PSAP)
ESRP	Emergency Service Routing Proxies
ETSI	European Telecommunications Standards Institute
GPRS	General Packet Radio Service
GPS	Global Positioning System
IETF	Internet Engineering Task Force
IM	Instant Message
IP	Internet Protocol
ISP	Internet Service Provider
ITU	International Telecommunication Union
LAN	Local Area Network
MMS	Multimedia Message System
MSN	Microsoft Network
NATO	North Atlantic Treaty Organisation
NDC	National Destination Code
NENA	National Emergency Number Association
NGN	Next Generation Network
NRA	National Regulatory Authority (or Agency)
PATS	Publicly Available Telephone Service
PBX	Private Branch Exchange
PoI	Point of Interconnection
POTS	Plain Old Telephone Service
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
RFC	Request For Comments
SIP	Session Initiation Protocol
SMS	Short Message System
TB	Technical Body
TDM	Time Division Multiplexing
UMTS	Universal Mobile Telecommunications System
URI	Uniform Resource Identifier
VoIP	Voice over IP
WiFi	Wireless Fidelity
WiMax	IEEE 802.16 standard

2 MAIN IMPACT OF VOIP SERVICES ON ACCESS TO EMERGENCY SERVICES

What are the reasons for access to emergency services currently being one of the biggest issues associated with VoIP in the regulatory area and *inter alia* in IETF VoIP standardization activities?
The main answer is a rather short one: the location of the calling user is not known in many of today's VoIP implementations and this is mainly due to complete separation of VOIP services and (IP-)access & transport. Depending on the scenario there may be additional drawbacks compared with the current emergency situation in the POTS case. Examples are missing call back opportunities and missing means to identify the calling user.

Why is the missing information on the location of the calling user (with different levels of accuracy required depending on application) so critical in the context of access to emergency calls?
The answer is twofold:
First, the location information of the calling user is used for routing such calls to the nearest Emergency Response Centre for the emergency service identified by the call emergency number. A solution for this problem is the main task of IETF WG ECRIT.

In the POTS case the location of the calling user is directly related (fixed) with the (geographic) number of the calling access. In the VoIP case no location information therefore means completely wrong routing in the worst case. The accuracy of the location information for routing purposes is not required to be very high, in mobile networks the cell information of the calling user is typically taken in mobile networks.

Second – and here the accuracy requirement are much higher – the information on the location of the calling user should enable emergency services to find a calling user in case of emergency in scenarios where this user for various reasons is not able to tell the Emergency Response Centre his current location / address personally. Based on the street address associated with a geographic number there is no basic problem in case of fixed POTS. Nevertheless, despite partly intense efforts to provide such information in mobile networks also, no major results are operationally available in most European countries. So with respect to the second usage of (accurate) location information the situation in VoIP is not that different from today's state of the art mobile services.

Are there fundamental reasons behind this situation?
Yes, in current telephone networks telephone service provision and the pure (switched) transport of voice data typically is vertically integrated in the same company.

In voice communications based on IP technology, especially in case of voice communication over the internet, there often is a complete technical and commercial separation between provision of the voice service ("VoIP provider") and the pure (packet) transport of the voice data provided by the ISP's. At least in VoIP scenarios using fixed internet access the location of the "calling" user is known by the access provider, but due to the technical and commercial separation there is – at least currently - no way of conveying this information between ISP's and "VoIP providers".

The above emphasis on location information should not lead to the impression that all other issues are minor ones.
Nevertheless that from a technical perspective it seems to be the most difficult to solve.

3 EMERGENCY CALL SCENARIOS

From a consumer point of view it would be desirable that it is possible to make an emergency call from all IP devices. Therefore also for non PATS classified VoIP services some form of regulatory requirement for emergency calls might be introduced in the future as the likelihood of a VoIP service being used for an emergency call increases. In applying regulatory requirements relating to access to emergency calls based on VoIP one may differentiate two scenarios where VoIP is involved in an emergency call. VoIP being:

- the only option for making an emergency call
- a natural choice for making an emergency call.

3.1 VoIP service is only option for making emergency call

In the short- to medium-term, a VoIP service may be the only option for making an emergency call if a VoIP service is implemented as a primary line residential service or operates across a corporate network.

A VoIP service would not be regarded as the only choice for making an emergency call if it is used in a home or office environment in which a PSTN-connected phone or a mobile phone is readily available. However, VoIP services have started to be marketed in some European countries as a primary line service; that is, as a replacement for a PSTN-connected phone; for example, A VoIP provider in the UK, markets its VoIP service with the message, "Get rid of your BT line and enjoy free broadband calls with multiple lines and advanced calling features." In these circumstances, users may rely only on a VoIP service running over a broadband connection and dispense entirely with their PSTN connection.

Additionally, some industry observers are predicting that VoIP services running over WiFi or Wimax may become a replacement for mobile services. Although the functionality available via WiFi or Wimax networks may be quite different to that available via a mobile network – for example, WiFi and Wimax networks do not offer cell handover functionality – it is plausible that some users will find the functionality available via a WiFi or Wimax network is an adequate replacement for their mobile service. The first generation of voice over WiFi handsets are already available, and as their functionality improves, it is feasible that large numbers of users will use these handsets instead of mobile services.[1]

It should be noted that currently most people already consider mobile phones as the natural choice of making emergency calls. More than 50% of emergency calls are already placed from mobile phones.

3.2 VoIP service is natural choice for making emergency call

A VoIP service will, in the short- to medium-term, be a natural choice for making an emergency call if it appears to be identical to a PSTN (or mobile) service, or is used in a similar way to a PSTN (or mobile) service.

This would appear to rule out the likelihood of devices such as gaming consoles or applications such as MSN Messenger being used to make emergency calls; the addition of call functionality to such devices and applications would mostly be perceived as non-core features. . On the other hand, a normal PSTN phone connected to an analogue terminal adaptor, or an IP phone, could be a natural choice for making any call, including an emergency call. It is possible that even a softphone may be a natural choice if it is used via a handset attached to a computer that is similar in style to a PSTN phone.

It needs to be recognised, however, that a user making an emergency call is often under severe stress, and it is possible that such a user may attempt to make an emergency call via whichever method appears to be most accessible, even if this would not normally be a natural choice.

[1] Dual-mode voice over WiFi/mobile handsets may allow users to take advantage of both voice over WiFi and mobile services. Such handsets are predicted to become available in 2005. However, it might be possible that a dual-mode voice over WiFi/mobile handset automatically switches to a mobile connection if an emergency call is made.

4 REQUIREMENTS FOR PROVIDING ACCESS TO EMERGENCY CALLS

The basic requirements for providing access to emergency calls are the following:

1. An emergency call must be identified as such by the device and/or the originating service provider
2. Given that a VoIP service may be used nomadically or may be provided across multiple countries, the country in which the emergency call is made must be determined and the call routed to an Emergency Response Centre or at least a Gateway in that country
3. The particular emergency call centre which is responsible for handling emergency calls for the area in which a call is made must be determined and the call routed to this Emergency Response Centre. It should explicitly be stressed that for this purpose the caller location has to be known in a far less accurate manner as for dispatching the emergency response service vehicles (see next point) – in the ongoing discussion there seems to be a lot of confusion on this point. As routing is done without real time interaction with emergency response centres this kind of caller location and the according routing information from a mapping database has only to be known at the originating device or service provider to enable call establishment to the responsible Emergency Response Centre or at least a gateway to the national emergency system. .
4. The specific location of the user making the emergency call must be available to the emergency call centre, so that an emergency service response vehicle can be dispatched to that location; in practical terms this address is usually provided by the calling user himself but there should be alternatives for special cases where this is not possible (remark: the same problem as in nomadic VoIP cases occurs in current mobile networks, where typically at best the current cell information of the calling user is known). The location information available at the device may be transmitted directly to the Emergency Response Centre, if appropriate signalling exists), or it may be stored temporarily in a database to be retrieved by a certain key (e.g. the CLI).
5. A correct and meaningful number corresponding to the user making the emergency call must be available to the emergency call centre so that, if necessary, it can call back (e.g. given address cannot be found by emergency personal due to local particularities). This means that VoIP gateways that handle emergency calls from users who do not have an E.164 number for incoming calls will have to allocate a number temporarily when the user makes an emergency call.
6. Calls to emergency services from VoIP gateways may cross several circuit switched networks to reach the emergency centre. Some circuit switched networks suppress CLI as part of their commercial arrangements. If possible this suppression should not be applied to calls to emergency centres but if geographic numbers have to be used this may be difficult.

It may not be necessary for all of these requirements to be met in all countries; in respect of emergency calls from mobile phones, for example, the specific location of the caller.

5 OBSTACLES TO PROVIDING ACCESS TO EMERGENCY CALLING

This section describes the main problems to be overcome in meeting the requirements listed in the previous section. For the purpose of this discussion, it is assumed that most emergency call centres in European countries will, for the foreseeable future, be connected to the PSTN only for receiving emergency calls; that is, a capability to receive native IP emergency calls will not exist for some time.

5.1 Identifying emergency calls

The number used to make emergency calls varies from one country to another; it is estimated there exist approximately 60 national emergency numbers worldwide. For VoIP services that can be used nomadically, it may be difficult for VoIP client software to recognise that the number dialled for a particular call is an emergency number.

Even where a number is recognised as an emergency number, it may be difficult to guarantee that each server involved in handling a VoIP call can recognise that a particular call is an emergency call. The recognition of an emergency number may be further complicated if any servers are located outside the country in which an emergency call originates, and a different emergency number is in use in that country.

The relevance of the above depends strongly on the implemented solution. As long as the users terminal or client SW for all calls always - i.e. also in case of international usage - connects to the “home” server, the task of emergency number

recognition should be no serious problem. On the contrary if in the future terminals should provide location information (e.g. gathered from the network at startup/login) internationally supplied terminals and client SW would be required to have full knowledge on national emergency numbering.

It is proposed that all clients recognize 911 and 112 as emergency numbers In addition the clients should support the home emergency numbers and the emergency numbers of the country where the device is currently located. There is a requirement to get this information from the infrastructure (e.g. the DNS). After recognition as an emergency number the client would – based on previous collected knowledge of its geographic position, e.g position delivery by means of enhanced DHCP protocol from the network side as additional information in addition to IP address allocation - provide this position to its outgoing VoIP proxy. The proxy would relay the position information to an emergency database to get back the URI of the appropriate Emergency Response Centre for the current location. Based on this URI and a subsequent DNS resolution the proxy will be able to establish the connection to the appropriate Emergency Response Centre. In a scenario where there is no outgoing proxy the client could do the database retrieval and connection establishment to the appropriate Emergency Response Centre itself.

This arrangement would then be similar to that used with GSM mobile phones. The GSM mobile phone standard includes 112 as an emergency number, no matter what other local emergency number are applicable. This is valuable for foreign travelers, who may not know a local one.

5.2 Determining country of caller and routing to this country

In some cases, an emergency call may originate in one country but traverse servers outside that country. This may be common when a VoIP service is used nomadically, but may also occur in circumstances where servers for VoIP services are located other than in the country in which a user is normally based.

It may be difficult for a VoIP service to obtain information about the country in which a user making an emergency call is located. Even where a VoIP service has this information, it may be difficult for the VoIP service to route an emergency call across national borders. If the call will be carried via the Internet to the destination country, it will be necessary to find a PSTN gateway in that country and ensure that the called party number will enable an emergency call centre to be reached. Alternatively, an emergency call may be dropped into the PSTN in the country in which a VoIP server is located, but it may then be difficult to route an emergency call across national borders. This is because emergency numbers, such as 112, are not normally used for cross-border routing..

Routing of emergency calls via national borders on the PSTN is possible only in some cases and even then a specific national knowledge is necessary. So is it possible to make an emergency call from Skype to the Vienna Police by dialing +431133. So this option should not be considered.

Having a gateway (e.g. for 112 in each country) would be helpful, if all further call routing in the country would be handled from the specialized 112 Emergency Response Centre and no further local knowledge would be necessary. The more sophisticated solution of course would be to support VoIP providers by providing default proxies as described above for this purpose, but it is unclear who would provide such a service in what timeframe and how setup and ongoing costs should be born. Considering that peoples' lives are at stake here and high quality requirements are possible to be imposed on the providers of such a service this could turn out to evolve as lengthy discussion.

To facilitate short term solutions regarding the situation where the emergency call is originated by the subscriber outside his home country but routed to and recognized at his home service provider it will be necessary for geographic numbers to be introduced for access to emergency centres and for the coverage of each emergency centre to be published and linked with these numbers. Calls to these numbers would normally be treated in the same way as other calls and not receive priority within the networks. If possible it would be useful if a single number could be used for a whole country with calls being distributed to local emergency centres as necessary. This arrangement would facilitate emergency calls from VoIP in the short term and so offer some improvement. In practice having a single number for access to emergency centres for a whole country with full functionality will only be available in a few countries. Generally it is better to accept any option that gives access even with some quality degradation than to have a situation where there is no access to emergency calls at all.

5.3 Determining appropriate emergency call centre and routing to this centre

Many countries have more than one emergency call centre, with each centre being responsible for a distinct and separate geographical area. When emergency calls originate on the (fixed) PSTN, the CLI associated with the calling user is typically used to find the appropriate emergency call centre (often routing is based only on the NDC part of the CLI)

For emergency calls that originate on a mobile network, mobile networks in some countries route emergency calls by determining the general location of the caller from the location of the mobile switching centre through which the call is routed or the mobile cell in which the call originates.

Before dealing with the situation in VoIP based services in the following the basic methods are described that are used today's fixed and mobile networks when interconnecting with the incumbents network, where typically all (most) emergency response centres are connected physically.

A first method for routing to the appropriate emergency response centre is based on conveying the telephone area code (NDC) associated with the originating geographic location on the PoI to the terminating (incumbent) network. This area code is filled into the called party number in front of the emergency number by the origination network before conveying to the terminating (incumbent) network. Based on this additional information to the called emergency number the incumbent network can route the call to the corresponding emergency response centre. If the call is originating from a network termination point with an assigned geographic number, the area code can straightforward be taken from the CLI. Nevertheless there are other fixed network scenarios, where the CLI is not a geographic number (e.g. national numbers for private networks) and therefore the area code cannot be directly be taken out of the CLI. The latter is always true in the mobile case, where the originating mobile network has to derive the area code based on available radio cell information of the caller.

A second generic method is based on directly addressing the geographic number of the individual emergency response centres, that address the lines of the individual regional emergency response centres. If there is a publicly available information on the (emergency individual) mapping of calling location and resulting geographic number of the appropriate emergency response centre, each originating network operator can already provide this geographic number on the PoI to the terminating (incumbent) network.

It should be stressed that there has to be an agreement between the other operators and the incumbent, which method is applied in the interconnection contract.

Now looking on VoIP services there is a very similar situation compared with competitive PSTN or mobile operators. The "only" problem remaining is to get the calling location with an accuracy sufficient for identifying the correct emergency response centre. If that information is available, e.g. provision of a (most probably) fixed service, then the above principles can be applied in an identical manner! For nomadic services user provided location information (e.g. at login) or more sophisticated technical solutions might be used, the latter being in focus of current standardization activities.
If no other possibilities are available user provision of location at startup/login time may be considered – at least as an additional source of information.

A complementary short term measure could be to increase the awareness for VoIP and associated potential problems (e.g. wrong routing of emergency calls) and evaluation of (or improving) capabilities for handling these situations at the emergency services.

5.4 Making location of caller available to emergency call centre

It is helpful to emergency call centres to have access to information about the specific location of a user making an emergency call so that, if the user is not able to reliably indicate his or her location, it remains possible for an emergency service response vehicle to be dispatched to the user's specific location.

The EU Universal Service Directive requires that, to the extent it is technically feasible, network operators must make information available to emergency call centres about the location of a user making an emergency call. For emergency calls that originate on the PSTN, this is generally achieved by making the CLI associated with a user making an emergency call available to emergency call centres, and giving emergency call centres access to a database from which they can determine the address of a calling user via the CLI. (the same principle can be used with VoIP calls, as stated above)

For emergency calls from mobile phones, general location information is available to emergency call centres in only a few countries, *and even fewer countries have implemented arrangements to enable emergency call centres to obtain precise information about the location of a user making an emergency call.*[However, several techniques have been devised for

obtaining precise location information – some based on network capabilities (e.g. so-called triangulation from at least three base stations) and others on handset capabilities (e.g. based on GPS, which remarkably is an obligation for all mobile handsets in Japan in the near future) – and for making this information rapidly available to emergency call centres. Regulatory requirements have been imposed on mobile network operators in the United States to provide information about the location of a user making an emergency call, including the level of accuracy that this information must meet.

Making location information available to emergency call centres for users making emergency calls via nomadic VoIP services is likely to be comparable with the complexity in case of mobile services, at least if WiFi or Wimax based VoIP scenarios are included. In case of nomadic VoIP access on fixed lines the calling location in principle should be obtainable with higher accuracy then in the wireless case.

5.5 Making number of caller available to emergency call centre

It is useful for emergency call centres to have access to a number for the user making an emergency call, so that the call can be returned if necessary; for example, if the call is interrupted, or an emergency service vehicle wishes to obtain additional information about the emergency.

This requirement is difficult to fulfil reasonably, if there is no static telephone number associated with the VoIP subscriber. This may be the case e.g. for current outgoing only VoIP services. Of course, if there is no incoming VoIP service for the calling VoIP user at all, then obviously there will be no solution for call back of the emergency service centre to the calling user, regardless if there is a CLI or not.

If there is an incoming VoIP service the problem is most easily solved by assigning (nomadic) telephone numbers to those VoIP subscribers. All other solutions, e.g. temporary assignment of telephone numbers at gateways etc. are only acceptable as interim solutions, if at all.

In general the issue of how to handle emergency calls needs much further study taking account of different national situations and the experience of national emergency centres. Solutions need to balance the problems that may be caused by spam and false calls and the risks of rejecting calls from real emergencies.

6 CURRENT ACTIVITIES TO FIND SOLUTIONS

In describing the obstacles to providing access to emergency calling, it was not at all the intention to suggest that emergency calls cannot be made available based on VoIP On the contrary, from the above it can be seen that based on assigning a telephone number and outgoing and incoming VoIP service the only main problem that remains is the goal of identifying the callers location in an accuracy at least sufficient for routing the calls to the correct emergency response centre. In general around this focus there are activities underway in several fora and organisations to find universal solutions. The main centres of this activity are described below.

Generally two stages might be differentiated. In the first stage there is no impact on infrastructure and basic processes at emergency centres, i.e. only changes outside the emergency centre responsibilities are considered. In the second stage there is an all IP infrastructure including IP connectivity of emergency response centres. In absence of unavoidable national PSTN peculiarities the latter scenario is in the focus of international standardisation activities at IETF, nevertheless it is clear that in reality a long mixed period of stage one in parallel with stage two will have to be considered at the national level.

6.1 IETF

Internet technologies are available to describe location and to manage call routing. Within the IETF the working group Emergency Context Resolution with Internet Technologies (ECRIT) was established, in 2005. This working group will describe when these technologies may be appropriate and how they may be used. Explicitly outside the scope of this group is the question of pre-emption or prioritization of emergency services traffic. This group is considering emergency services calls which might be made by any user of the Internet, as opposed to government or military services that may impose very different authentication and routing requirements.

The group will show how the availability of location data and call routing information at different steps in session setup would enable communication between a user and a relevant emergency response centre. Though the term "call routing" is used, it should be understood that some of the mechanisms which will be described might be used to enable other types of media streams. Video and text messaging, for example, might be used to request emergency services.

While this group anticipates a close working relationship with groups such as NENA and ETSI EMTEL, any solution presented must be useful regardless of jurisdiction, and it must be possible to use without a single, central authority. Further, it must be possible for multiple delegations within a jurisdiction to be handled independently, as call routing for specific emergency types may be independent. This working group cares about privacy and security concerns, will address them within its documents, and aims at the following goals:

- Informational RFC containing terminology definitions and the requirements
- An Informational document describing the threats and security considerations
- A Best Current Practice (BCP) describing how to identify a session set-up request is to an emergency response centre
- A BCP describing strategies for associating session originators with physical locations
- A BCP or Standards Track RFC describing how to route an emergency call based on location information
- A BCP describing how to discover the media stream types an ERC supports

An example for requirements in the category "basic" and "must" which are important for emergency call handling (and have been at least partly considered in ECRIT) are:[2]

Must requirements:

- From any with the Internet connected device it MUST be possible at any time to contact the Emergency Response Centre responsible for the current location without dependency on a certain protocol infrastructure (e.g. SIP proxies) and with the most appropriate method for communication for the user, the device and the Emergency Response Centre, e.g. voice, text and video.

- To achieve this, the device MUST be able to retrieve its current location from the access provider, from the infrastructure, via GPS, ... or as a last resort, from the user itself. The service provider MUST not withhold this information.

- The capability to locate the responsible Emergency Response Centre by the device or UA must be available in the public Infrastructure (e.g. the DNS) without the additional need for a service provider.

- The possibility to make contact to the proper Emergency Response Centre has to be verified (checked) at the time of connection to the Internet and in periodic intervals and the result has to be indicated to the user and/or the User Agent.
  (Note: the result may also depend on national policy)

- The possibility to make contact to the proper Emergency Response Centre has to be verified (checked) at the time of connection to the Internet and in periodic intervals and the result has to be indicated to the user and/or the User Agent.
  - The indication may have three states:
  - Emergency calls not possible
  - Emergency calls possible

- Contact established, but emergency calls not allowed by national policy + reason
  (e.g. identification or location required)

- The end-user must be able to use in addition to the tbd. default emergency URIs (e.g. sos@example.com) and the internationally defined emergency numbers (911,112) also the locally defined emergency numbers and the numbers familiar from home. This information must also be available within the public Infrastructure (e.g. DNS)

- The fact that an emergency call is placed must be recognized by the device and by all involved equipment along the path to be able to take proper action (e.g. call handling, call routing, prioritizing, etc).

- For a transient time the device and the UA may use the help of servers (e.g. ESRP) to provide the connectivity to the Emergency Response Centre, especially if it is not yet connected to the Internet

[2] The list is based on a presentation by Richard Stastny, ÖFEG.

Should requirements

Transmission of the current location of the contacting device to the Emergency Response Centre. If this transmission requires end-user permission or can be pulled by the Emergency Response Centre may be a national policy matter.

Capability to hold the call and/or re-contact the contacting device from the Emergency Response Centre in case of disruption or later query for a tbd. period of time. This should also be possible from conventional Emergency Response Centres via temporary (virtual) E.164 numbers

Identification of the contacting person or device. The level of identification required may be a national policy matter.

Safeguards to protect the emergency infrastructure and the Emergency Response Centre facilities against malicious attacks, especially to prevent DoS attacks (needs work)

Provide all possible means of communication, not only speech, but also text (IM), Video, etc., (for disabled persons and better display of the situation)

Capabilities to contact an Emergency Response Centre by automatic means and for the transfer of additional information (alarm equipment, cars, buses, trucks with dangerous loads, ...)

Several other IETF working groups are engaged in projects to address problems of making emergency calls from VoIP services. These projects include:

- Developing methods by which DHCP servers can manage and make available location information corresponding to end systems in a network[3]
- Specifying a requirement for authoritative databases of civil addresses, correlations of civil addresses with latitude and longitude, and boundaries of the jurisdictions of individual emergency call centres, to be established in the DNS[4]

This work provides building blocks for the development of more complete solutions by the National Emergency Number Association (NENA)(see chp. 6.3),.

6.2 ETSI

A Special Committee (SC) on Emergency Telecommunications (EMTEL) was established in ETSI in 2005 with the responsibility to:

- solicit and capture the requirements from the stakeholders (including National Authorities responsible for provisioning emergency communications, End Users, the European Commission, Communication Service Providers, network operators, manufacturers and other interested parties).
- The scenarios to be considered include communication (others to be added if required with Board approval):
  - of citizens with authorities/organisations,
  - between authorities/organisations,
  - from authorities/organisations to the citizens,
  - amongst citizens,
- develop a consensus amongst the stakeholders and reflect this in a requirement document, which will be used by the technical bodies of Standards Development Organizations. This will address both operational and technical needs,
- input requirements to all concerned TB's, including those TBs responsible for NGN aspects, on definition and optimization of the generic network architectures that will support horizontal integration of different standards under a common umbrella of requirements for EMTEL,
- provide requirements on issues of network security, network integrity, network behaviour in emergency situations, and emergency telecommunications needs in networks,

[3] DHCP stands for Dynamic Host Configuration Protocol, a protocol for dynamically assigning IP addresses to devices on a network. See the RFC 3825 by James Polk, John Schnizlein and Marc Linsner of Cisco Systems, entitled Dynamic Host Configuration Protocol Option for Coordinate-based Location Configuration Information, and an Internet Draft by Henning Schulzrinne of Columbia University, entitled Dynamic Host Configuration Protocol (DHCPv4 and DHCPv6) Option for Civic Addresses (draft-ietf-geopriv-dhcp-civil-05).

[4] See an expired Internet draft by Brian Rosen of Marconi, entitled Emergency Call Information in the Domain Name System (draft-rosen-dsn-sos-01).

- take the lead for the interface between ETSI and CEC/EFTA and other pertinent bodies, notably NATO, ITU groups, the CEPT European Radiocommunications Office and relevant CEN and CENELEC committees in conjunction with the ETSI Secretariat, with respect to emergency communications issues,
- ensure that the requirements that it has approved are taken into account by the relevant TB's in conjunction with the Operational Co-ordination Group,
- co-ordinate the ETSI positions on EMTEL related issues.

6.3 National Emergency Number Association (US)

The National Emergency Number Association (NENA), an organisation representing emergency call centres and equipment vendors in the United States with an interest in emergency call handling, is specifying a three-phase set of solutions for handling of emergency calls from VoIP services.

The first phase is intended for near-immediate implementation and involves:

- Termination of emergency calls by a PSTN operator
- Routing of emergency calls based on the local number for each emergency call centre, rather than the national emergency number
- Provision of no information about the location of a person making an emergency call, nor a phone number for returning the call.

The second phase is intended as a medium-term implementation which provides a reasonable level of functionality without requiring any changes to the procedures or infrastructure deployed in emergency call centres. This phase will involve:

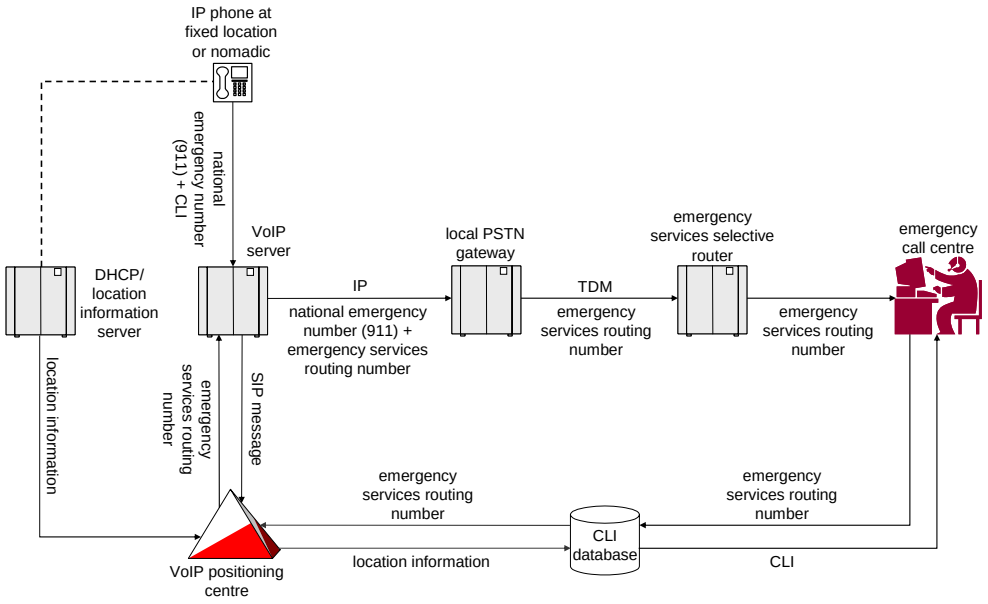
- Supporting calls from both VoIP users at fixed locations and nomadic VoIP users by building on the existing architecture for routing of emergency calls made from mobile phones to emergency call centres
- Capturing information about the location of a person making an emergency call and making this accessible to emergency call centres by building on existing arrangements for providing location information for emergency calls from mobile phones
- Providing a phone number by which an emergency call can be returned.

It is envisaged that, in phase 2, IP phones will "learn" their location for the purpose of delivering information about the location of persons making emergency calls. If GPS or a proprietary functionality is available, IP phones obtain their location from this; if not, IP phones obtain their location from DHCP. Modifications to DHCP are being specified for management of location information for end systems in a network and for the controlled provision of this information.[5]

To facilitate easy recognition of a call as an emergency call by client and server software, a special URI – sos*@home-domain* (for example, sos@rtr.at) – is being specified.[6] Mechanisms are being developed to enable VoIP clients to learn the national emergency numbers in the country in which an emergency call is placed.

The architecture for phase 2 is illustrated in figure 1 below.

[5] See especially RFC 3825, and Internet Draft draft-ietf-geopriv-dhcp-civil-05.
[6] See Internet Draft draft-ietf-sipping-sos-00.txt.



Adapted from presentation by Richard Dickinson, Telecommunication Systems Inc (TCS)

Figure 1 – Simplified architecture for NENA second phase solution

Finally, the third phase is regarded as a longer-term solution, and involves end-to-end carriage of emergency calls from VoIP services on IP, and deployment of IP infrastructure in emergency call centres. Location information in this phase is expected to be improved on that available in phase 2, and will require the storage in the DNS of:

- Comprehensive data relating to addresses
- Data enabling the conversion of addresses to latitude and longitude
- Data specifying the boundaries of the areas for which individual emergency call centres are responsible.

The NENA third phase is equivalent to the second stage presented in this Report.

7 STAKEHOLDERS AND RESPONSIBILITIES FOR IMPLEMENTING SOLUTIONS

The key stakeholders in addressing the problems of implementing solutions for accessing emergency calls from VoIP services are likely to be:

- Access providers
- Providers of VoIP services
- Emergency call centre operators
- Emergency service organisations
- Telecommunications regulators
- European and national policy bodies responsible for access to emergency calling.

The key requirement in devising and implementing any solution for accessing emergency calls from VoIP services that the preceding sections of this report have pointed to is ***LOCATION***. Location is critical not so much for enabling emergency service organisations to dispatch emergency vehicles to the location of a person making an emergency call (in practical terms the address information is also currently often provided by the caller himself), but to enable an emergency call to reach the country in which the caller is situated, and to reach the appropriate emergency call centre for the location of the caller.

The two most feasible methods for obtaining this location information seem to be:

- via a manual method, by which the user enters his or her location at the time of subscription (for fixed services), or even login (for nomadic services); or
- from the access provider at the beginning of a session

The second method will certainly be the most reliable one. The access provider is in a good position to provide location information because it should be able to determine the location of every connected device. On a broadband connection, this

location will be the address of the broadband subscriber; on a LAN, the location will be that of the network socket; in a wireless scenario, the location can be regarded as that of the wireless access point (e.g. WiFi, Wimax).

This implies that access providers may need to be responsible for recording this location information, and for making it available (for example, via DHCP servers) in response to an authorised request from a connected IP phone or other device. Access providers may need to upgrade their infrastructure or systems in order to be able to record and provide location information. The legal or at least practical problem may be that due to decoupling of VoIP service and IP-access & transport (in the general internet case) VoIP providers would benefit from technical obligations (and according financial burdens) on commercially fully separated access providers/ ISP's. To say more frankly: the access providers have the effort and others (e.g VoIP or location based services) have the benefit.

There also may need to be a responsibility on vendors that supply IP phones or related devices, or the supplier of the operating system, or the supplier of the client software, to provide a facility for requesting location from the access provider or provide it by other means (e.g. GPS).

It could turn out that emergency calls could end up as a stand alone services that no longer are integrated in general VoIP services and are maybe registered by the users independently from other VoIP service registrations.

Providers of VoIP services may need to be responsible for identifying a call as an emergency call, routing the call appropriately (for example, to a stand alone emergency service provider on wholesale level), and ensuring that the call can be returned for the duration of the emergency.

And finally, emergency call centres that wish to receive specific location information about callers may need to deploy capabilities for accessing this information from Internet servers.

In summary, the responsibilities for implementing a satisfactory solution for making location information available for emergency calls from VoIP services will lie with:

- Access providers
- Vendors of IP phones and the like
- Operating system suppliers
- VoIP client software providers
- Providers of VoIP services
- Emergency call centres.

8 CONCLUSIONS

VoIP services are growing rapidly, and it appears inevitable that the nature of certain types and usages of VoIP services will lead to these services being used to make emergency calls in the near future. However, an emergency call made from many types of VoIP services are not currently be assured of reaching an appropriate emergency call centre.

Emergency calls are an important social objective for telecommunications, and it would be unwise to ignore the need to assure access to emergency centres as VoIP services become more common. Consequently, there is a need for European policy-makers and regulators to recognise that it may become urgent very quickly if VoIP services grow as fast as estimated by some consultancies. It would be advisable to take early action to understand fully the problems and possible solutions.

Work in the IETF and NENA to develop solutions for accessing emergency centres from VoIP services is well advanced. The two streams of work are, in fact, closely related, and there is a considerable overlap of people involved in projects related to emergency calls in the two organisations. There is fortunately a recognition in both IETF and NENA that, to address the full implications of the nomadic use of VoIP services, the solutions to enabling emergency calls from VoIP services must be compatible with the emergency calls arrangements in countries other than the United States.

However, it is evident that current work in the IETF is biased on solving the problems as defined by United States emergency call centres and equipment vendors based in the United States. It would be risky to assume that solutions developed primarily for problems defined around circumstances in the United States will work effectively in Europe. Hopefully the cooperation between IETF and EMTEL will ensure that the European requirements are taken sufficiently into account.

Implementing solutions to ensure a reasonably adequate level of access to emergency centres from VoIP services may require assigning responsibilities to entities which are best placed to facilitate this access. This may involve imposing requirements on market parties which, until now, have been subject to little or no regulation (e.g. terminals), or may involve imposing new forms of regulation. There is consequently a need to consider thoroughly:

- The nature of responsibilities associated with enabling access to emergency centres from VoIP services
- The extent of these responsibilities
- The market parties that need to take on the responsibilities
- The alternatives for ensuring that these responsibilities are fulfilled.

The following high-level principles are proposed to guide actions by policy-makers and regulators to address the issues relating to access to emergency centres from VoIP services:

1. VoIP service providers should always inform subscribers if access to emergency centres may not be possible, or if access the correct centre is not possible when the caller is nomadic. If possible, this information should be positively acknowledged by the subscriber at the time of subscription. In these cases the subscribers should be advised to use other means of contacting the emergency services, eg PSTN or mobile. Note: The regulatory issue of whether VoIP services with PSTN interconnection should be allowed if they do not provide access to emergency services is outside the scope of this report.
2. Access to emergency centres should be available from any VoIP terminal that may be used in an emergency.
3. An emergency call from a VoIP terminal should reach an emergency call centre in the country in which the call originates
4. Where possible, an emergency call from a VoIP terminal should reach the specific emergency call centre that is responsible for handling emergency calls for the area in which the caller is located
5. A number should be carried in the CLI for an emergency call from a VoIP terminal so that an emergency call centre can, if necessary, call back during the emergency
6. A geographic number should not be carried in the CLI for an emergency call from a VoIP terminal if it contains or is linked to location information that is incorrect or misleading ("no information is better than a wrong one") unless the signalling also contains a warning that the caller may be nomadic or the emergency centres are given advance information about those numbers that may be used nomadically. Note: Further study is needed for the case where the only number available for call back (see 5 above) contains misleading location information.
7. For the near to medium-term, location information for emergency calls from VoIP terminals should be available to emergency call centres in a way which achieves a reasonable balance between accuracy and cost-effectiveness
8. Although in the short term the arrangements for calls to emergency centres should assume that there are no changes to the existing procedures in the emergency centres, in the medium term, emergency centres should consider how they need to extend their capabilities and procedures in order to handle calls and other forms of communication that originate from Internet users, and should consider having special teams trained to handle calls from nomadic users with such calls being routed to these teams.

Possibilities to support VoIP based emergency calls in the short term are:

- Increase awareness at emergency services of the problems that may arise from VoIP calls
- Provide guidance to VoIP providers on how to deliver calls to the emergency centres and any relevant regulations
- If possible provide VoIP providers with information on the coverage of each emergency centre in the country
- Based on the above provide numbers for the emergency centres that also can be reached from abroad based on international interconnection.

The practicability and effectiveness of these measures depends strongly on the individual national legacy emergency call handling situation and can therefore only be assessed on an national basis.