Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Revision of the Commission's Rules	)	
To Ensure Compatibility with	)	CC Docket No. 94-102
Enhanced 911 Emergency Calling Systems	)	RM-8143
	)	

Comment by Richard Levine (Beta Scientific Laboratory, Inc.)

Note: This document includes a tutorial appendix (p.9) and a glossary (p.20) following the main text.

1. **Executive Summary:** Responding to the Further Notice of Proposed Rulemaking (01-175) released May 25, 2001, Richard Levine of Beta Scientific Laboratory, Inc. (Beta), submits a proposed general technological solution for emergency call back, applicable to all non-initialized cellular radiotelephones, which will further the goals of the Commission's 911 rules, is technically feasible, and offers an economically cost-effective solution to this issue.[1] This system requires only software upgrades (no new hardware) to existing switches and PSAP systems in the PSTN and wireless networks. Several signaling variations on the same basic structure are feasible to quickly and flexibly accommodate MSC switches and PSAP systems with various levels of signaling capability, although the technology objective is to ultimately have a high uniform level of capability in all parts of the PSTN and cellular network. Most of the required software upgrades are needed in any case for MSCs to meet the previous goals laid down for the cellular network with regard to Phase I and II of E911 and Local Number Portability (LNP), so development resources are synergistically deployed in this instance rather than being diverted or in competition with other objectives. This new technology requires each non-initialized cellular radiotelephone to ultimately have a unique pseudonumber[2] MIN, although non-unique MIN values can be temporarily accommodated. Beta makes a conditional offer to be the source of "last resort" to change the MIN of each non-initialized radiotelephone to a unique pseudonumber, without cost to the service provider or the end user, in those cases where the MIN cannot be conveniently changed by other methods. We respond to each point on which the Commission invited comment in this document, based on the use of this new technology or another technology having equivalent capability regarding all the issues raised.

2. **Part of a Planned Comprehensive Upgrade:** The new technological solution offered here "works," in both the technological and economic sense of that word, because it is only one aspect of a comprehensive technology solution to a number of different but technologically related issues in the wired and wireless public switched telephone network (PSTN). The application of this new technology to the problem at hand is summarized briefly in this paragraph and described in Figure 1 and in Appendix A. This new technology, sometimes called

---

[1] This document refers to a cellular radiotelephone that is designed to use a 34 bit binary MIN as described in applicable standards TIA-553, IS-54, IS-95, IS-136 (and others), but is not currently fitted with a "working" or "authorized" MIN value. A similar but simpler application of the same principles is also applicable to PCS-1900 radiotelephones that are covered by GSM standards, but the GSM version is not described here for brevity, and because most non-initialized radiotelephones of concern to the Commission have a 34 bit MIN.

[2] In our terminology, a pseudonumber includes *any* binary value of the correct length that translates according to the existing rules for binary mapping of a decimal number in a particular telecommunications system. Consequently some values do not map into a decimal number, thus being non-dialable. Examples are given later in the text. Note that others may use this word for certain types of decimal values, different from our usage.

"System Beta," was previously presented to the Commission in a comment filed by Levine Aug 30, 1999, under prior Docket 99-200, and is also described in US Patent 6,076,121. The patent may be viewed in full via the web page www.uspto.gov. This new technology has several aspects, some going far beyond the purposes of this particular document. The support for emergency call back is achieved by using our proposed new data base(s) and switch as an "orphanage" MSC/HLR for all the "orphan" cellular radiotelephones that are non-initialized and do not have a normal home HLR in a working cellular system (and also, at least temporarily, certain radiotelephones that have a "normal" MIN but are out of service and/or duplicate the MIN of another radiotelephone). The orphanage MSC has no cells or base radios, and uses no radio spectrum. It is connected to the voice channels of the PSTN, the SS7 signaling network of the PSTN, and the IS-41 network of the working North American cellular MSCs. Its major purpose is to maintain temporary HLR data base records for radiotelephones that have made a 911 , and to act as an intermediate target for an emergency call back from PSAPs to non-initialized radiotelephones. The PSTN is illustrated in Fig.1 via a cloud graphic symbol, indicating that an indefinite number of intermediate PSTN switches may be present in the voice channels. Simple software upgrades must be installed at selected MSC, PSAP and other network switches to exploit existing capabilities of SS7 and IS-41 and telephone signaling. The orphanage MSC provides a call back path to a disconnected emergency radiotelephone caller by means of a temporary orphanage HLR record that will be constructed there in the normal course of events according to standard IS-41 methodology whenever a non-initialized radiotelephone makes a 911 call. This one-way message does not delay the 911 call completion because there is no reply required and the serving MSCs need not wait to put through the 911 call. The callback dialing is provided in several technological forms compatible with both today's predominant MF PSAP signaling technology, and also compatible with technology upgrades that are needed in any case to meet increased service demands and prior FCC mandates, without diverting development resources.

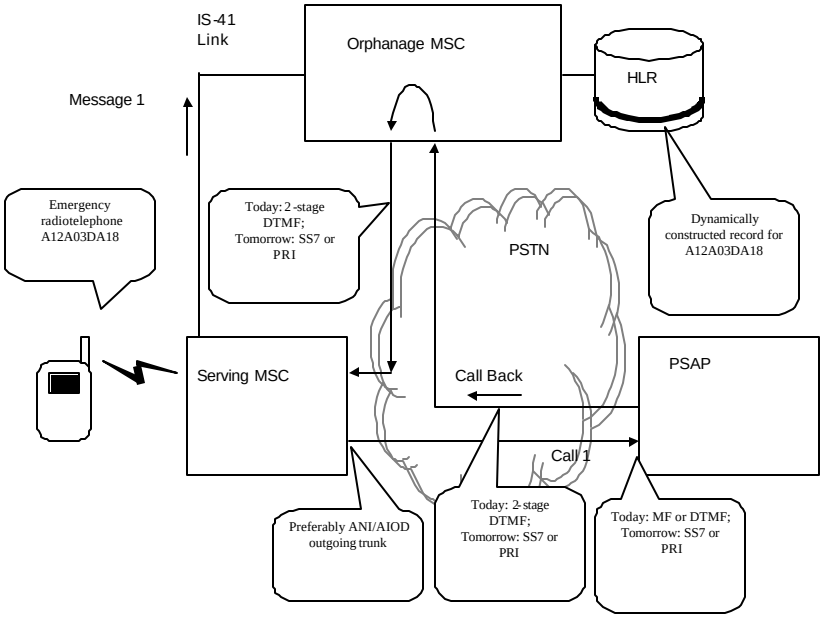

Figure 1. Block Diagram of Emergency Call Back

3. **Similar to Existing Proven Technologies:** Persons having a technological grounding in IS-41 and LNP/LRN system operation will recognize that this new technology uses IS-41 roamer call delivery and Local Number Portability technologies. While noting the similarity, we also point out that it avoids contentious intellectual property issues because it need not use a TLDN to complete the call back.

4. **Emergency Call Back - Unchanged PSAP Staff Perception:** When a staff member at a PSAP receives an emergency call from a non-initialized cellular radiotelephone conforming to this new technology, a call-back number is displayed on the PSAP staff member's answering position. In this new technology it may not be the

usual 10 digit decimal telephone number, but instead it may display as a stored 10 character letter-number string such as for example A12-A03-DA1B. If the call is disconnected, either intentionally or non-intentionally, and the PSAP desires to call back that particular emergency radiotelephone, the PSAP staff member then auto-dials that stored call back number. Internally, the new technology causes the PSAP to be ultimately connected via the PSTN to a (trunk) line on the serving MSC that will then connect to that designated radiotelephone, via the medium of our new orphanage MSC/HLR. To the PSAP staff member, this call back is just like any other call back. There are several specific alternative methods inside the PSTN for completing that connection, which are provided so that different PSAPs and different MSCs with different levels of technological signaling capability can be accommodated for rapid deployment of emergency call back capability. The PSAP staff member need not understand the specific internal technology, since his/her actions are unchanged vis-à-vis previous technology.

5. **This New Technology Supports a Gradual Transition:** A software upgrade in a particular PSAP and a particular cellular MSC enables the new technology there. The new software can be upgraded gradually nationwide, in conformance with software upgrades scheduled in the normal course of business for each switch and PSAP. The workability of the system as a whole does not require a prior nationwide software upgrade of all switches. The software upgrades required are mostly coincident with upgrades that are also necessary for prior FCC mandated goals as well, so there is no diversion of resources but rather a synergistic commonality of resource deployment.

6. **We Conditionally Offer to Provide the Orphanage HLR/MSC:** We propose to furnish and operate the orphanage MSC/HLR with no charge to the wired and cellular service providers nor to the users of non-initialized radiotelephones, provided that the overall new technology, including aspects going beyond those described in this document, are installed and used in the overall wired and wireless networks. The orphanage HLR will then be a logical partition or logical aspect of the overall FP data base described in Appendix A.

7. **Software Upgrades Provide Easy Transition:** Various levels of software upgrades can be used, each higher grade providing faster call setup and more comprehensive capabilities. It is desirable to make as few intermediate software upgrades as can be in order to minimize "churn" of the software and its associated costs, thus emphasizing the importance and value of a coordinated upgrade of the signaling capabilities of all the affected switches and PSAPs. The new technology can be installed at the first level of signaling by making the following changes in just the serving MSC and PSAP (all other capabilities are provided by the orphanage MSC/HLR):

a. MSC Upgrades: 1) The serving MSC must send normal IS-41 roaming call delivery message(s) to the orphanage MSC/HLR when the emergency radiotelephone appears or makes a call, even for a 911 call when authentication is not required, but it must not wait for a reply before putting through the 911 call. 2) The serving MSC must translate the over-the-air MIN into a 10 symbol MIN according to an agreed-upon algorithm, and present that 10 symbol MIN to the PSAP at the beginning of the MSC-PSAP portion of the emergency 911 call, according to an agreed-upon coding using MF or DTMF. 3) The serving MSC must allocate at least one incoming number to be used for so-called "roamer port" or 2-stage DTMF dialing[3], and it must page using the 34 bit translated version of the incoming pseudonumber MIN incoming to that 2-stage incoming port.

b. PSAP Upgrades: 1) The PSAP must store and display the pseudonumber MIN appearing in translated MF or DTMF format at the beginning of an incoming call[4]. 2) When a call back is initiated, all non-

[3] A roamer port with two stage dialing capability was formerly used by all MSCs before IS-41 roaming call delivery was standardized, and is still in use on many MSCs.

[4] Because the emergency radiotelephone has its "home" at the orphanage MSC/HLR, it is possible to allow the subscriber to pre-enter useful background information at the related FP data base. Such information could include the name, home address, alternate telephone number, and medical background information concerning the person who ordinarily uses the emergency radiotelephone. This information can be made immediately accessible to the PSAP and would be of value to the PSAP staff in obtaining optimal emergency response. It would require further technological means, not described here because this goes beyond the scope of the immediate issues raised here by the Commission.

decimal pseudonumbers must be auto-dialed via 2-stage dialing via the orphanage MSC/HLR. 3) The PSAP must provide for automatic clean up of "stale" emergency call back MINs from its memory after an appropriate time since the last call, with case-by-case approval of the staff member involved.

A further upgrade of the new signaling technology to even more rapidly connect wireless call backs via the orphanage MSC and the PSTN using pseudonumber routing would require upgrade of the signaling at the MSC and the PSAP to SS7 or PRI (instead of MF or DTMF). The basic capabilities just described would continue, with improved signaling. A coordinated routing table software upgrade would also be required in the several hundred tandem/transit routing data tables of the PSTN to accommodate non-decimal network addresses, and software upgrades in just those end switching offices that provide specific new technology features. These software upgrades are straightforward and relatively simple and can be incorporated into regularly scheduled software upgrades that occur in the normal course of business. There are good and sufficient reasons, described in Appendix A, to make these further software upgrades in all telephone switches everywhere in North America, but they are not necessary everywhere for the purpose of emergency call back alone.

8. **Uses Unique Pseudonumber MIN in Each Radiotelephone; We Offer to Change MINs Free if Necessary:** This new technology requires that each non-initialized radiotelephone ultimately has a pseudonumber MIN value that, in general, is non-decimal and not dialable via a decimal digit telephone dial (thus not depleting numbering resources). Any technological proposal whatever (not just this one) for "paging" a unique radiotelephone can function properly in general only with a unique[5] MIN in each emergency radiotelephone. There are three ways to install a unique pseudonumber MIN in each non-initialized radiotelephone.

a) First, we propose that the Commission issue a prospective order that each new non-initialized radiotelephone be manufactured with a unique value pseudonumber non-decimal MIN, chosen from a specific substantially consecutive list to be furnished to each manufacturer. We describe in Appendix A how this can be accomplished at negligible cost.

b) Second, each radiotelephone that is capable of being modified via OATS, or by a proprietary over-the-air activation system which sets up the MIN value by means of a radio signal, should be set to a unique pseudonumber value via such remote means at the earliest opportunity. Because most of the steps traditionally associated with initialization are not in effect here, the cost to the service provider will be minimal, as described in Appendix A.

c) Third, for the remaining category of non-initialized cellular radiotelephones, that are mostly much older, and that require physical handling to change the MIN, including replacement of the NAM chip or physical connection of a test cable by a technician, we offer to provide such changes without cost to the service providers or to the owners/users of such radiotelephones, provided that the overall new technology is installed and used in the wired and cellular telephone networks as described before.

9. **Handles Lapsed Service "Third Category" Radiotelephones:** We believe that our particular new technology is the only proposal that addresses the type of non-initialized radiotelephones called the "third category" by the Commission, *i.e.* phones for which the service subscription has lapsed but that continue to be held by the original owner, or are given to friends or family members for emergency use, and which the Commission had tentatively concluded could not effectively be handled in

[5] Note that we will temporarily store data in the orphanage HLR as a stopgap measure, regarding a decimal cellular MIN that has been removed from service but is still present in the radiotelephone. This will work *temporarily* even when that MIN duplicates an MIN in another working radiotelephone, provided that both radiotelephones with the same MIN are not present in the same cell of the serving base radio system simultaneously during a page. In the case in which the two radiotelephones having the same MIN are both located in the same cellular system (same MSC) when paging of that MIN value occurs, duplicate response is inevitable. Therefore, the plan for this new technology is to change the MIN of such an out-of-service radiotelephone to a pseudonumber MIN at the first opportunity.

the absence of a general technical solution to the call back problem,. We stress this point even though continued use of the "old" MIN can be served by our new technology only for a limited time and an ultimate upgrade to a unique pseudonumber non-decimal MIN is ultimately necessary. This is, however, evidence that our particular new technology proposal is indeed the type of general technical solution desired by the Commission. The economic aspect of this proposal is, of course, conditional upon the terms under which we offer our free services to the industry and the public.

10. **Unique Pseudonumber MIN Minimizes the Possibility of Untraceable Annoyance Calls.** PSAPs have experienced a number of annoyance or harassing telephone calls made using non-initialized radiotelephones having a non-unique decimal MIN. These are more than just annoying because they also block PSAP lines and block real emergency calls in certain circumstances. Use of a unique pseudonumber non-decimal MIN values, as described here, would at best totally prevent, or at least greatly alleviate such annoyance calls. Those people who engage in this type of harassment would then need to contend with the fact that each such handset can be called back and uniquely traced based on its unique pseudonumber MIN. There is more background to this that is omitted here.

11. **No New Required Network Hardware, and Software Upgrade Gives Shared Benefits:** In general, this new technology requires only software (not hardware) changes in the wired and wireless network (other than the orphanage MSC/HLR). The preferred way to implement the "new" FP data base(s) is to modify the software in the existing LNP/LRN data base(s) and enlarge the scope of the types of data stored there. An alternative, but acceptable, method is to install an auxiliary data base and processor that is physically separate from the existing LNP/LRN data base, but shares the SS7 signaling links that lead from originating switches to the LNP/LRN data base and connects to the existing IS-41 cellular signaling network. Such an auxiliary data base would be furnished and operated by us if necessary, with this offer subject to the same conditions already noted. There are strong parallels between the core process in the new technology and the core process in LNP/LRN technology. Obvious synergy and lower cost is achieved by using the same (or closely co-located) data base(s) and the same SS7 links, rather than overbuilding with parallel installations of the same type of hardware for various different purposes. In general, a significant advantage of this new technology is that it serves a large number of diverse objectives using the same hardware and software, thus reducing the cost of installation, maintenance and use for each particular purpose.

12. **Does Not Compete for Development Resources:** This shared functional use of the same software upgrades, together with existing hardware and transmission facilities, means that this particular new technology will not have the negative effect of diverting cellular carrier resources from speedy compliance with other worthy mandated projects such as Phase I and II of E911, or implementation of LNP/LRN capability, and the like. For example, location data for Phase I and II requires extensive data communication links between the MSC and various servers (e.g., differential GPS servers); links that will also handle the current purposes and will use SS7 and IP signaling protocols. Unlike previous proposals that involve overbuilding special hardware and facilities, this new technology shares existing equipment and facilities and thus would not result in parallel call delivery systems.

12. **WEIAD Review Invited:** This new technological solution to the call back problem has not yet been presented to the Wireless E911 Implementation Ad Hoc Group (WEIAD). However, we are ready and eager to present it, and based on our present understanding of the basis of their objections to other proposals, we believe that they will conclude that this new technology overcomes most of their previous objections, both technical and economic.

13. **No Known Intellectual Property Issues:** To the best of our knowledge, all patents necessary for implementation of the proposed new technology are owned by the present inventor. The inventor offers to make certain specific aspects of the system noted (installation and operation of the orphanage MSC/HLR, and MIN value changes for those cellular radiotelephones that require physical handling) available to the service providers and the public without charge (and without patent royalty charges), provided that all other aspects of the new technology are implemented and used by the telephone industry, even those aspects beyond the scope of the present document. Please note that certain other aspects of the invention, beyond the specific emergency call back issue addressed in this document, are expected to be revenue-producing for Beta, which is the economic basis for providing these specific services free of charge.

14. **We Endorse WCA "No-Release-Signal" Proposal; Further Technological Anti-Dropped-Call Measures are Also Desirable but Difficult:** In the FNOPR, the Commission noted that WCA advocates a modification to 911-only handsets to prevent the handset from sending a hang up signal during a 911 call. While we appreciate and endorse this suggestion, we wish to bring to the attention of the Commission that radiotelephone connections are sometimes broken due to temporary loss of signal or temporary interference or radio noise as well, a problem that would not be addressed by that particular suggestion alone. In contrast to TIA-553, IS-54, IS-95 and IS-136, the GSM system design permits an operator-optional "automatic reconnect" process that comes into action if a call in progress is unintentionally disconnected due to loss of radio signal, or radio noise or interference. Those GSM systems that support automatic reconnect usually reconnect the call on a different carrier frequency than the earlier disconnected carrier frequency, which helps to avoid interference, if that was the cause of the unintentional disconnect. We point this out only to bring to the Commission's attention that a more comprehensive desirable improvement is needed in future industry standards and future manufactured radiotelephones and base system software upgrades for North America. However, such a comprehensive revision of the standards and equipment designs is not an immediately feasible upgrade to existing radiotelephones, due to the extensive modifications that would be needed in the call setup software. Of course this is only an incidental point and not a high priority item, if this new technology is put in place and meanwhile solves the issue of call back to emergency radiotelephones.

15. **Does Not Require TLDN Use:** The Commission sought comment on whether a variation on the use of Temporary Local Directory Numbers (TLDNs), presently used for roamers, could be employed to provide call back capability for non-initialized radiotelephones. While this is indeed feasible, it would require a distinct TLDN to be reserved for every 911 call from a non-initialized radiotelephone, until the PSAP is able to indicate that there is no more need to call back to that radiotelephone. There is also apparently a legal intellectual property rights issue regarding use of TLDNs. The new technology described here can avoid that issue because it supports several different methods for completing the call without TLDNs. (See Appendix A.) Aside from having the capability to avoid those technical and legal issues associated with the use of TLDNs, the new technology in its ultimate form also inherently prevents individuals outside of a PSAP from inadvertently or maliciously dialing a dialable TLDN, an incident that would block PSAP access to the emergency radiotelephone.

16. **No Costs to Service Provider; No Impact on Numbering Resources:** In this regard, please note that, under the new technology described here, each non-initialized radiotelephone indeed ultimately has a unique non-decimal pseudonumber MIN value for call back capability, but there are no known technical or economic impediments to their use. There is no maintenance cost to the service provider because all the costly data base activities are borne by the orphanage MSC/HLR, and there is no impact on numbering resources because the pseudonumber non-decimal MINs do not consume dialable decimal numbers. Again, please note that the term pseudonumber as used by Beta since 1998 may differ from the meaning of the same term as used by others.

17. **We Support the Proposal that all Non-initialized Radiotelephones be Labeled:** They should be labeled, regardless of whether they are sourced via carrier-donation, ex-user donation, or other distribution channels. Suggested Labeling Details: We suggest that the Commission require visible and tactile (e.g. Braille) labeling on all 911-only radiotelephones, and further that the Commission establish a standard label design and minimum label size, bearing the legend "911 only" or words or symbols to that effect. We also suggest that the label indicate if the particular radiotelephone is TTY/TDD compatible. We strongly recommend that the Spanish and French languages be used (where appropriate) in addition to English text, due to their widespread use in various parts of North America. Further, we suggest that 112 or *2 be indicated as an alternative to 911, if it is eventually adopted in North America, as it has been already adopted in the European Union and other countries. We further suggest that those 911-only radiotelephones that have no callback capability be clearly labeled to indicate this as well, unless or until they are upgraded to allow callback capability. In saying this, we emphasize that merely labeling a radiotelephone to indicate that it does not have call back capability is a temporary stopgap measure only, intended to make clear to a person affected by an emergency situation that they should not await a call back from the PSAP. In our view, labeling alone does not meet the emergency needs of the public. We agree with the Commission's view that labeling alone is insufficient to ensure the benefits of the E911 requirements because it cannot take the place of a PSAP's ability to re-contact a 911 caller if the PSAP needs vital information concerning the caller's location or specific emergency needs. Many emergency situations exist where an unexpected disconnect occurs and the victim is not able to dial 911 again after an initial call is disconnected, so a label indicating no call back capability is not a solution to the problem.

18. **This New Technology Allows the Commission to *Require* all Radiotelephones to Support Emergency Call Back:** If the Commission requires the use of at least one technologically and economically feasible method to enable emergency call back, we endorse the proposal that the Commission require that all 911-only handsets permit call back via a method approved by the Commission, and furthermore we suggest that a feasible calendar timetable be established by the Commission for upgrade of all existing non-initialized radiotelephones to include such capability or, if they cannot be so upgraded (for example, a radiotelephone requiring a NAM chip that is no longer available), such non-upgradeable radiotelephones should be taken totally out of service. Conversely, if no technological method for emergency call back is mandated by the Commission and put in place by the industry, then the Commission should not restrict operation to just those radiotelephones that can support call back, since limited emergency communication capability is clearly better than none.

19. **This Technological Solution is Appropriate for Donated Handsets:** In this new technology, the only required modification of a radiotelephone is to change its MIN to a unique pseudonumber non-decimal value. Therefore, we assert that this solution is appropriate for donated handsets. This change does not prevent the handset from later having its MIN changed again to a decimal dialable MIN and then being returned to normal service in the normal manner, if the subscriber and the service provider agree to do so. Bear in mind that all such radiotelephones can either have their MIN modified over-the-air at minimal cost, or they can be modified at no cost to the service provider nor to the end user under our conditional offer. In our orphanage HLR we propose to temporarily recognize and process "old" decimal MIN values that are out of service, but this is a stopgap measure only and our ultimate plan is to change the MIN in such an emergency use radiotelephone to a unique pseudonumber MIN.

20. **No Negative Impact on Numbering Resources in This New Technology:** The Commission expressed concern that limited initialization, as suggested by the CTIA, could exacerbate the scarcity of numbering resources. Please bear in mind that the new technology described here does not exacerbate the scarcity of numbering resources, since the pseudonumber non-decimal MIN values assigned to these radiotelephones do not consume dialable decimal telephone numbers. There are over 7 Billion such pseudonumber non-decimal MIN values (see Appendix A). We propose to reserve 1 Billion of these pseudonumber non-decimal MINs for emergency call back purposes, leaving over 6 billion for other purposes.

21. **Minimal Costs to Service Providers for Limited Pseudonumber MIN Initialization:** The cost of limited initialization to carriers was a concern about which the Commission invited comment. This concern was no doubt motivated by the costs involved in the previous process of initializing *ordinary* decimal MIN values for in-service radiotelephones, where the service provider was responsible for all types of MIN changes, both over-the-air and those that require physical handling of the radiotelephone. In the new technology proposal, the carriers or service providers are only requested to change those MINs in radiotelephones that can have their MIN reset over-the-air. Another contrast is that in the previous technology, the MIN is chosen from a list of available unassigned dialable MIN values pre-reserved for that particular service provider, and each particular MIN must be data-linked to the billed subscriber, and the MIN and related information must be stored semi-permanently in the service provider's own HLR, and other related administrative tasks must be carried out. The activities after the first word "and" in the previous sentence are the major initialization cost activities! Please note that in the new technology described here the service provider has only the responsibility of changing the MIN of certain radiotelephones via over-the-air methods. This pseudonumber MIN is chosen consecutively from a list of available unassigned pseudonumber MIN values pre-reserved for that particular service provider. Changing the MIN of an ex-subscriber is an important protective measure for the service provider in any case, since it prevents that radiotelephone from making calls (except 911 calls) everywhere due to the inherent properties of the pseudonumber non-decimal MIN. Costs to the service provider are further reduced because this new technology does not require record keeping or coordinating against a master data base or billing information on the part of the service provider, since we (not the former service provider) offer to operate and maintain the orphanage HLR and all related data regarding each pseudonumber MIN according to our conditional offer, and these costs are thus no longer the responsibility of the previous service provider.

22. **A Technologically Complete Solution to Emergency Call Back is Warranted to Serve the Public Interest, Convenience and Necessity:** The Commission sought comment on its tentative conclusion that a solution to the call back problem for 911-only phones is warranted because it will help to ensure that PSAPs obtain sufficient information to deliver emergency 911 services to consumers whose sole purpose in purchasing a wireless phone is obtaining access to those emergency services. We strongly agree that a mandated technological solution to the call

back problem for 911-only radiotelephones is appropriate. A radiotelephone that can only make a 911 call but cannot receive a call is certainly better than no communication at all, but is severely inferior to an emergency radiotelephone that can both make and receive emergency calls. Particularly when a technologically and economically feasible solution is at hand, as this new technology is, such a requirement is fully justified.

23. **A Unique Pseudonumber MIN in each Radiotelephone is Better than Use of the Same MIN in all Emergency Telephones:** The practice (e.g. by Magnavox) of using a the same decimal but non-dialable MIN in all emergency radiotelephones is inferior, with regard to utility and public safety, to the use of a unique pseudonumber MIN value in each emergency radiotelephone, and the latter should be mandated in place of the former alternative at the earliest calendar date as described previously. The use of the same MIN in all emergency radiotelephones causes major problems with emergency call back, as the Commission has correctly indicated. Without a unique MIN value in each telephone, there is no sure way to page and connect to a particular radiotelephone under all circumstances, particularly when two radiotelephones having the same MIN are in the same cell. A distinct pseudonumber non-decimal MIN, in the range of values indicating emergency service only, will still notify the service provider and notify the PSAP that the caller's handset is an emergency-only handset in this new technology. Since the capability to call back the emergency radiotelephone having a unique pseudonumber MIN value can be determined by the analysis of the MIN, both the MSC and the PSAP can immediately determine if a call back is permitted or not. (See Appendix A.) The PSAP staff thus has the same warning to quickly gather such location information from the caller as before, so nothing is gained by use of the same MIN in all emergency radiotelephones vis-à-vis a unique pseudonumber MIN in each emergency radiotelephone. The use of a unique pseudonumber MIN in each radiotelephone also discourages annoyance 911 calls, as already noted, because they are no longer anonymous. Furthermore, this new technology provides the option for the end user to voluntarily pre-provide other supplementary health or emergency related information in the orphan HLR and FP data base, if so desired, for optional access by the PSAP staff. (This capability is not described in detail in the present document but is noted in Appendix A.)

24. **Cost of a Unique Pseudonumber MIN in Each Newly Manufactured Emergency Radiotelephone is Negligible:** To install a unique pseudonumber non-decimal MIN in each new emergency radiotelephone, the manufacturer is pre-assigned a list of substantially consecutive pseudonumber MIN values. This is just the same manner in which the manufacturer is pre-assigned a list of substantially consecutive ESN values. These unique pseudonumber MIN values can be placed consecutively in each manufactured radiotelephone by precisely the same processes used now to consecutively place a unique ESN in each manufactured radiotelephone. The manufacturer will likely place a visible label displaying the pseudonumber MIN value and the ESN value on each such radiotelephone, but other than that there are no further record keeping or coordinating responsibilities of the manufacturer. All global data regarding each pseudonumber MIN will be maintained in the orphanage HLR by us, under our conditional offer, at no cost to the manufacturer.

25. **New Technology Makes Call Back Capability Equally Feasible for New vs. Old Radiotelephones:** Based on previous technological proposals, the Commission pondered the contrast between requiring call back capability only for newly manufactured emergency radiotelephones, in contrast to already existing emergency radiotelephones. In this new technology, the only change needed in a cellular radiotelephone to make it capable of emergency call back is to change its MIN to a unique pseudonumber MIN value. The costs of this are mainly borne by us. Therefore, provided that this, or an equally capable technological solution is mandated, we suggest that the Commission mandate that *all* emergency radiotelephones have callback capability. All the other relevant software changes occur in the MSCs and the network, and support the capability for all such radiotelephones. A feasible schedule should be established by the commission to upgrade all emergency radiotelephones to have call back capability, and all emergency radiotelephones that are, for whatever peculiar reasons, incapable of being feasibly upgraded to contain a unique pseudonumber MIN, should be taken out of service by a suitable date specified by the Commission.

26. **Compatible with WCA Proposal for Shared ESN; Unique Pseudonumber Technology 'Fixes' the Commission's Ambiguous Paging Concern:** The Commission invited comments on the proposal to allow a second non-initialized radiotelephone to have its ESN set to the same value as that of another service-initialized radiotelephone owned by the same subscriber. This proposal was initially made in the context of using the same decimal dialable MIN value in both radiotelephones as well as the same ESN. When a distinct pseudonumber MIN value is used in each of the two (or more) radiotelephones, they can each be paged independently of the others

without ambiguity. The common ESN value can be used, optionally, to indicate that these distinct different radiotelephones all belong to the same subscriber, which may be valuable for certain special services. Thus, in the context of the new technology, the use of a common ESN value does not have any of the objectionable properties noted by the Commission, although use of this shared ESN value is by no means necessary for our new technology. Therefore we have no specific positive or negative recommendation with regard to this particular proposal.

27. **Offer to Give Further Information:** We recognize that this comment proposes new technological concepts that are very novel and different in the context of traditional methods in the telecommunications industry. Due to the constraints of brevity, even given the further explanatory text given in Appendix A, we expect that some readers who do not have strong technology grounding may find this document to be somewhat difficult reading. We stand ready to provide supplementary explanatory and descriptive material to the Commission and other interested persons in a mutually convenient manner, such as a tutorial presentation or discussion open to the general public.

Respectfully submitted,

Richard C. Levine, Sc.D., P.E.
Beta Scientific Laboratory, Inc.
PO Box 836224
Richardson, TX 75083-6224
Telephone +1 972 233 4552
e-mail: R.Levine@Betalab.org
(Also: Adjunct Professor of Electrical Engineering
Graduate Telecommunications Program
Southern Methodist University
Dallas, TX 75275)

* * * * * *

Appendix A: Description of US Patent 6,076,121 Applied to Emergency Wireless Callback

A1.1 This appendix briefly describes the new technology referenced in this document. It is sometimes called "System Beta." It makes use of a central data base[6] (in general the FP data base, but in this case a logical sector of that data base called the "orphanage HLR") in conjunction with the telephone network, ultimately using a message-based signaling system such as Common Channel Signaling System No. 7 (SS7) in the North American PSTN, and/or IS-41 or MAP for cellular switch networks, but temporarily using DTMF in-band messages as a workable substitute. A data base used for the types of number translation described here is sometimes called a Service Control Point (SCP) and a network that makes use of such data-base translations is sometimes called an Advanced Intelligent Network (AIN). In general, the FP data base stores functional purpose codes that describe the *intended* functional purpose(s) of incoming (destination) and outgoing (origination) calls to and from those telephone lines that are included in the FP data base. In order to focus attention on the problem at hand, we will describe only a few aspects of this data base here. To address the particular problem of emergency call back addressed in this document, it is permissible but not necessary to allow subscribers to enter or modify their own FP codes from their own telephone dial, which greatly simplifies and reduces the cost and extent of the network software upgrade for this limited purpose. Previously published estimates of the total North American software upgrade costs for all aspects of System Beta do not apply to this limited application, since only MSC cellular switches and PSAPs need to be software upgraded for the first generation of service.

A1.2 Some examples of the logical significance of certain FP codes include the following: This line is a fax line; this line is a teenager's line (various specific teen age groups will have distinct FP codes); this line is a non-initialized radiotelephone; this line is a radio pager; this line is an emergency service line (fire, police, ambulance, FEMA, etc.); this line is a telemarketing originator; this line will not accept telemarketing calls; this line is a PSAP; this line belongs to a person who has a food allergy that could cause coma; who could experience a heart attack; a diabetic coma; an epileptic coma. Further codes include: this is the accounts payable department; this line is used

[6] For reliability or other reasons, there may be more than one FP data base, just as there is presently more than one LNP/LRN data base in use.

for a teletypewriter or teleprinter device for the deaf; the user of this line prefers to speak Spanish if available; the user of this line can *only* speak Spanish; etc. etc. One line may have distinct FP codes for origination vs. destination uses, and one line may have multiple FP codes. For the issues addressed in this document, the most significant FP codes are those that describe a PSAP or an emergency service line.

A1.3 Figure 1 describes only the aspects of the new technology relevant to the emergency call back issue. When a cellular radiotelephone having pseudonumber MIN A12-A03-DA1B dials 911, the call is routed via the visited[7] serving MSC, through the PSTN, to the nearest PSAP. Concurrently, the visited serving MSC sends message 1 via the existing IS-41 data communications link to the orphanage MSC/HLR, indicating that radiotelephone A12-A03-DA1B is visiting that particular serving MSC, and the orphanage MSC dynamically builds a HLR data record (or modifies a previously built record) for this particular radiotelephone. If the call becomes disconnected and the PSAP wishes to call back to that radiotelephone, it places a call via the orphanage MSC. Using today's technology, this call back is preferably made using DTMF (Touch Tone) signaling and two-stage dialing from the PSAP to the orphanage MSC and then to the serving MSC. The details of how the non-decimal number A12-A03-DA1B is represented and handled, and the calling processes, are explained in more detail in succeeding paragraphs. In the future, as all PSAP equipment and all switches are upgraded to handle Local Number Portability (LNP) and Signaling System 7 (SS7) (or PRI signaling as a substitute in some installations), the speed and simplicity of the signaling and call setup will improve, but the basic signal paths will be similar.

A1.4 Pseudonumbers Used for Emergency-only MINs: In order to immediately identify those radiotelephones that are only intended for making emergency calls, and to avoid consuming valuable decimal telephone number resources, each emergency-only radiotelephone is set up with a pseudonumber non-decimal MIN value within a pre-specified numeric range. In the overall scope of System Beta, certain non-wireless lines such as, for example, the fax line or teenager's secondary lines of various subscribers will also be designated by a non-decimal pseudonumber. We will also temporarily handle certain decimal MIN values as a stopgap measure in order to provide a higher level of service for 911 callers who have not installed a non-decimal pseudonumber MIN, although this cannot continue indefinitely because it may create duplicate responses to paging messages in certain circumstances. A pseudonumber is a binary number that is compatible with internal network switching and routing. It is not usually necessary nor useful for a subscriber to know the pseudonumber of, for example, his or her own fax or other secondary line under System Beta. A non-decimal pseudonumber cannot be dialed from an ordinary decimal labeled telephone dial (although it could be dialed directly from an originator using SS7 or PRI capability in special circumstances such as being an authorized PSAP). Without giving a general discourse on different binary formats, we will show two examples that are representative of the binary coded decimal (BCD) format used for SS7 and ISDN PRI signaling. The following table shows a typical 10 digit telephone number in decimal and Binary form respectively:

Decimal	2	1	2	7	6	5	4	3	2	1	
Binary	0010	0001	0010	0111	0110	0101	0100	0011	0010	0001	1111

Notice that a four bit 1111 code is appended to the end of this string of bits to unmistakably indicate the end of the telephone number. The binary code 1111 is reserved for this purpose in SS7 BCD coding, leaving 15 other binary codes, of which only 10 number codes are used in the prior art for representing decimal digits. In the addressing and routing of telephone calls, it is relatively simple to in corporate the 5 codes that are not used in the prior art as well, by a simple process of selectively enlarging certain routing tables in the transit switches of the PSTN. (This is not required for the first generation of emergency cellular call back.) Several different sets of symbols have been used for these non-decimal digits in telecom and computer documentation. One popular set of symbols is the so-called hexadecimal digit symbols, in which A represents 1010, B represents 1011, C represents 1100, D represents 1101, E represents 1110 and F represents 1111 (the "end" indicator code). The choice is arbitrary.

Here is an example of a non-decimal pseudonumber comprising 10 digit symbols:

[7] Because the emergency radiotelephone has a pseudonumber non-decimal MIN it is an "orphan," not having a "home" in any working MSC. Therefore it is treated as a "visitor" in every working MSC.

Hexadecimal	A	1	2	A	0	3	D	A	1	8	
Binary	1010	0001	0010	1010	0000	0011	1101	1010	0001	1000	1111

With 15 choices for each digit, there can be over 191 decillion internally distinct 10 digit telephone numbers in the North American PSTN. (One decillion is written as a 1 with thirty three zeros after it.) Of course, this does not increase the quantity of dialable decimal telephone numbers, which is still 7,920,000 distinct dialable decimal numbers in each area code in the NANP. However, the number of distinct dialable decimal telephone numbers in each area code today is more than sufficient to give each employed head of household two dialable telephone numbers (one for business and another for residence) plus at least one number for each head of household not included in the previous group, and at least one separate main number for each business organization. The number exhaustion problem can thus be solved and the installation of new area codes can be halted and ultimately rolled back (existing multiple area codes with a common geographic boundary can eventually be recombined) provided that most of the secondary lines for such people and business organizations use non-decimal pseudonumbers and are reached via the FP data base translation process, rather than via dialing distinct dialable decimal numbers for each secondary line. The FP data base translation connects a caller to the correct matching secondary line even when the decimal number of the primary line is dialed.

A1.5 As indicated in the main body of the document, the preferred data base platform for the FP data base already exists in the form of the LNP/LRN data base(s), which is/are already built (although more capacity will be needed) independent of System Beta, and the extra SS7 links are also built and paid for to carry the SS7 message traffic required for each call. System Beta will indeed enlarge the quantity of entries in this data base, but so will the natural expected growth in the quantity of ported telephone numbers! Some minor platform modifications such as a physically separate FP data base vis-à-vis the LNP/LRN data base(s) are also feasible, of course. The use of existing hardware and facilities, with minor software modifications, is one of the hallmarks that make System Beta an extremely simple, rapid and low cost capability to implement in the PSTN and cellular networks. If the telephone industry is unwilling to enlarge the functionality of existing LNP/LRN data bases, a physically separate data base can be installed for the FP codes and the other functions of the orphanage HLR/MSC, but sharing the SS7 signaling links is necessary to gain the essential economy of shared usage.

A1.6 Objections and Responses: System Beta technology has met with indifference in previous appeals to the telephone industry. There have been several objections to System Beta during the few years that it has been open to scrutiny by the telephone industry. There is a response to each such objection, but the telephone industry has, in general, been uninterested in installing System Beta despite the solution of the previous technically based objections. The major objections in the past have concerned handling of incoming calls from foreign countries outside of North America, modifications of the LNP/LRN data bases, and certain uses of consumer Caller ID. Each of these questions has been addressed via methods that meet with the approval of technological network experts. In the case of international calls, a dialed prefix compatible with ITU-T recommendations can be implemented to provide proper routing for incoming calls. If the telephone industry is unwilling to allow the public to access existing LNP/LRN data bases or enlarge their functionality, a physically separate data base platform can be installed that shares the same SS7 links. In the case of Caller ID, first take note that in most cases this new technology can work quite well with existing 10-digit decimal Caller ID, since a call back will automatically be controlled by the preset FP codes of the line that makes the call back and thus will go to the appropriate line at the other end. Furthermore, it is notable that the NANP must inevitably be expanded to more than 10 digits unless System Beta or some other technological solution is used. Such expansion of the NANP will make all existing consumer Caller ID equipment obsolete. Anticipating this possible situation, the TIA TR-41 standards committee on consumer premises telephone equipment has already issued standards for consumer Caller ID equipment to handle up to 23 digits instead of the present 10 digits. This inherently solves the objection to use of more than 10 caller ID digits. Some objections have also been raised regarding lines with different applicable FP codes during different calls, (like a small office line used both for voice and fax) but a simple method for handling this has been developed as well. There are also apparently some business based objections that have not been made public. The details of all of these specific cases are not repeated here, but they are mentioned in the spirit of full disclosure. In considering the possible use of this new technology, the Commission should allow any objections to be heard and responded to.

A1.7 System Beta also has a number of useful applications for both general users and for various types of disabled users that cannot be achieved in any other way integrated into the PSTN, if at all. Some of these are described at the end of this Appendix in paragraph A1.20.

A1.8 Application of System Beta to Emergency Cellular Call Back: The proposed method for handling emergency call back to non-initialized radiotelephones has many similarities to the existing method for handling roaming cellular subscribers already standardized in IS-41 (and similarly in the MAP portion of the GSM standards, which are not described here for the sake of brevity). First consider ordinary (non-emergency) roaming service with a radiotelephone having an ordinary initialized MIN. For ordinary roaming service, each ordinary cellular radiotelephone has a distinct identification number (namely its MIN, or its IMSI for GSM radiotelephones). A HLR data base, at the logical network home location of each ordinary radiotelephone, maintains a permanent data record for each ordinary cellular radiotelephone. The logical network location of the HLR can be determined at the visited or serving MSC via analysis of the leading digits of the MIN, so that the visited serving MSC can send data messages via the IS-41 network to the correct HLR, in order to authenticate the visiting radiotelephone when it makes a call in the visited MSC system. The HLR stores the identity of the visited MSC at least as long as is necessary to handle any further call deliveries to that visited MSC. A call *to* the roaming radiotelephone is call-forwarded through the home MSC to the visited serving MSC. The visiting radiotelephone identifies itself to the visited MSC via radio using its MIN and usually also its ESN, and certain other authentication parameters (authentication details are omitted from this discussion since they do not apply to emergency calls). If the visiting radiotelephone is successfully authenticated when it originates a call, the dialed call is put through. Unless the radiotelephone has indicated in its HLR record that it should not receive any calls while roaming, when a call is directed toward the roaming radiotelephone, the HLR can request a dialable TLDN from the visited MSC that can be used temporarily to forward calls to the radiotelephone while it is in the cell(s) of that visited serving MSC. (Our new technology has an alternative way to accomplish this without the TLDN.)

A1.9 When an ordinary PSTN originator (not a cellular radiotelephone) dials the dialable decimal telephone number (ordinary decimal MIN) of a roaming radiotelephone, the landline PSTN routes that call to the home MSC of that radiotelephone. The PSTN determines the logical PSTN network location of the home MSC via analysis of the leading decimal digits of the decimal MIN. This incoming call is then call-forwarded by the home MSC to the visited serving MSC using the TLDN as the dialable decimal target number for the call forwarding process.

A1.10 The emergency call back procedure is very similar to the ordinary mobile roaming scenario just stated. For emergency service, each emergency cellular radiotelephone ultimately has a unique identification number (namely its pseudonumber MIN, for the types of radiotelephones discussed in this document). All these emergency radiotelephones have the same logical network home location, in the orphanage HLR/MSC that we offer to maintain and operate. The logical network location of the orphanage HLR can be determined at the visited or serving MSC via analysis of the pseudonumber MIN. For a temporary calendar time interval and as a temporary stopgap methodology only, the orphanage MSC and HLR will also handle certain nominally ordinary MINs to support emergency call backs to a not-in-service radiotelephone. Typically this is the result of a subscriber who ceases to use cellular service (explicitly cancels service, or stops paying the bill, etc.) but retains the radiotelephone and makes no effort to modify the MIN in that radiotelephone. (In such a case, the first IS-41 message from the visited MSC to the normal HLR indicated by the visiting radiotelephone's MIN will produce a "no service" or "not in this HLR" response. If this occurs and the call is a 911 call, the visited MSC can then send a IS-41 message to the orphanage MSC/HLR and we will give temporary service in this case for call back.) When a radiotelephone makes a 911 call, the visited serving MSC is not required to authenticate that radiotelephone. However, we propose that the visited serving MSC send the IS-41 messages to the orphanage MSC/HLR, as described here, and also proceed to connect the 911 call. This is done because our objective is to always put through the 911 call and always technologically support emergency call back, regardless of other circumstances. Consider, for example, a situation in which a victim of a violent crime is able to wrest a cellular radiotelephone away from an attacking criminal and then attempts to place a 911 call. Our objective in such a case is clear, even if that particular radiotelephone would normally be denied service because it is known to be stolen, a "clone," etc. Similarly, even if the MIN in an out-of-service

radiotelephone is obsolete or forbidden or duplicates the MIN of another working radiotelephone, we can and will give it emergency service if technologically possible[8].

A1.11 The following two tables will give examples to show how a pseudonumber MIN value is represented in binary format. The algorithm relating the decimal and binary forms of a MIN can be described as follows: The 10 digit decimal MIN value is separated into three groups of three decimal digits each, and also a single isolated decimal digit. The single digit is represented in binary in a BCD code similar to that used for SS7 BCD coding. The three three-decimal-digit groups are each mapped into a 10 bit binary value by converting the decimal representation into a 10 bit binary representation. Thus the following example shows how a decimal MIN 212 765 4321 is represented in binary:

Decimal	212	765	4	321
Binary	0011010100	1011111101	0100	0101000001

The following example shows the same pseudonumber binary MIN value of the previous non-decimal example, mapped into a 10 digit value via a proposed 10 character mapping (other mappings are also possible):

Decimal or [9]Hexadecimal	A12	A03	D	A18
Binary	1111111001	1111101011	1101	1111111111

There are 7,179,869,184 pseudonumber values for the 43 bit binary MIN that cannot be mapped into a 10 digit all-decimal value. We can reserve 1 billion of these for use exclusively to identify non-initialized emergency radiotelephones without unduly restricting the number of such telephones in use (this is more than the total number of present cellular radiotelephones worldwide, now about 500 million), while still leaving 6,179,869,184 pseudonumber non-decimal MIN values for other special purposes. There are also, of course, also the ordinary 10,000,000,000 MIN values that each maps exactly into a 10 digit decimal value[10]. In the example above we have shown some of the values as a hexadecimal digit group. This is based on one of many possible unique mappings (not shown here in full) between each non-decimal pseudonumber MIN value and a corresponding BCD binary code compatible with SS7, even though the two kinds of binary-to-decimal mapping algorithms are fundamentally distinct. A 10 character mapping like this one is convenient for use with SS7, PRI or MF (using an agreed upon tone sequence in MF). Furthermore, it is possible to establish a mapping into decimal numbers as well, which is useful for certain special dialing signaling systems like DTMF or MF.

---

[8] Of course, attempting to maintain a duplicated decimal MIN indefinitely in the orphanage data base invites such problems as trying to page a duplicated MIN, which could lead to multiple or interfering radio responses in the visited MSC. That is why we do so only as a stopgap measure, with the ultimate objective of changing each such out-of-service MIN value in the radiotelephone to a unique pseudonumber MIN.

[9] A mapping merely relates a symbol from one set uniquely to a symbol from another set for convenience in using pre-existing signaling symbol sets. For example, here the hex characters A12 are used according to a proposed rule to represent the binary number 1111111001, but the binary value of A12 according to traditional hex-binary conversion is 1010 0001 0010 which has 12 bits instead of 10.

[10] If we restrict the first 20 binary bits to a single value (corresponding, for example, to a specific area code and central office code) there are still 15,360 distinct different pseudonumber MIN values, of which 5,360 are non-decimal and 10,000 are decimal values (0000 through 9999).

A1.12 Incidentally, it is noteworthy that the 34 bit MIN coding shown above is used on the setup or control channels in both the radio uplink and downlink directions, but not for the dialed digits in the uplink radio direction. A BCD format similar, but not identical, to the SS7 format is used for that purpose.

A1.13 A cellular base and visited serving MSC system can analyze the MIN coming from a radiotelephone without need for connection to a central data base. The analysis determines whether it represents a decimal value or a non-decimal value. By means of a simple table lookup algorithm, certain substantially consecutive pseudonumber MIN values can be reserved for use in emergency radiotelephones, and all such emergency radiotelephones by design have their logical HLR at the orphanage MSC, so there is no ambiguity regarding the logical network location of the orphanage HLR. As noted before, an otherwise ordinary MIN that is rejected by its nominal HLR can also be handled by the orphanage HLR as well, although we only propose to do this as a temporary stopgap measure.

A1.14 To elaborate the description of the new technology with reference to Figure 1, when a non-initialized emergency radiotelephone appears in a visited cellular system and immediately attempts to make call 1 to the PSAP, the visited or serving MSC also sends data message 1 (via an appropriate IS-41 data network link) to the orphanage HLR, just as in the case of an ordinary radiotelephone. It is not necessary to authenticate the emergency radiotelephone because it dialed 911. However, it is very simple to make the software modifications that cause the visited serving MSC to send such a message since that is already the standard operating procedure for an ordinary radiotelephone. As a result of message 1 from the visited serving MSC to the orphanage HLR, the orphanage HLR dynamically constructs a data record for this particular radiotelephone, and now "knows" that this emergency radiotelephone is visiting this particular serving MSC. If the emergency call should be handed off to another MSC during the 911 emergency call, the orphanage HLR will be informed of the correct visited serving MSC, via pre-existing industry standard IS-41 inter-system handoff procedures, not described here or in the figure. Following standard IS-41 procedures, the visited serving MSC may also send a message to the HLR containing a TLDN for delivering incoming calls to the emergency telephone, but this is not required in this new technology. In this new technology there are several alternative ways to establish such a connection without a TLDN, as well. These alternatives are supported by the new technology for various reasons, including avoidance of contentious intellectual property issues and giving an earlier calendar data accessibility for PSAPs that do not have the most complete software upgrades, and compatibility with various different types of MSCs, among other reasons. The objective is not to intentionally have multiple different methodologies for a long calendar time, but rather to ultimately provide the most sophisticated method to all MSCs and PSAPs, and to minimize the "churn" that would occur with multiple software upgrades.

A1.15 In general, when an existing PSAP receives a 911 call, it also receives the telephone number (MIN) of the emergency caller (and some other data as well, such as a cell number under E911 Phase 1), via one of several different technological signaling methods. The choice of a specific technology used is usually based on the type of signaling technology already in place in the local PSTN that serves the PSAP. The signaling technology may be SS7, ISDN PRI, MF, DTMF or even consumer Caller ID technology with modem tones transmitted between the first two ringing bursts (although the PSAP sees all originator numbers and is not blocked due to originator privacy option settings that would block ordinary Caller ID). The overwhelming majority of existing PSAP installations use MF signaling for this purpose. There is also a well known problem in the industry regarding certain subscriber related equipment, like certain PBX installations that incorrectly identify a single originator telephone number for all outgoing calls regardless of the specific PBX extension that originated the call, or certain MSC installations that indicate an originator telephone number for all outgoing calls regardless of the particular cellular radiotelephone that originated the call. This problem is sometimes called "imprecise AIOD" or "imprecise ANI" and it affects all technological methods that attempt to identify the specific originating extension or radiotelephone. It does not indicate a flaw in the new technology. It does highlight certain technology gaps in the existing PSTN[11]. Completely

[11] This problem has repeatedly been called to the attention of the Commission in connection with emergency service problems. For example: Comments of Associated Public Safety Communications Officers, Inc. (filed January 28, 1993 relevant to Docket 94-102, RM-8143). Many older PBXs have the technological capability to provide precise ANI/AIOD but this capability is seldom activated because the only historical application for this (before 911 call backs) was for the local PSTN service provider to use the ANI/AIOD in preparing an itemized bill, and extra-cost service. Since most subscribers can obtain the equivalent information internally from the PBX (so-called station

separate from the new technology described here, several industry efforts are underway to correct this problem because it leads to difficulty with several other services as well. However, in the case of an MSC with imprecise ANI/AIOD, our new technology can provide some improvements and work-arounds for imprecise ANI/AIOD while waiting for a more comprehensive signaling upgrade in these specific installations.

A1.16 In this new technology there are several choices regarding the technical signaling method to describe the call back number to the PSAP when the 911 call is first made by the emergency radiotelephone. The new technology will support all of these for an indefinite calendar interval, using the appropriate choice of signaling method for each MSC and each PSAP to maintain compatibility. The more significant choices are listed here, although this is not a complete and exhaustive list, and it omits the use of a TLDN, which is also a technically viable alternate choice as well:

a. An important (but hopefully temporary) signaling choice is the very widespread use of MF signaling (or in some cases DTMF signaling) between the visited serving MSC and the PSTN, and occasionally between the PSAP and the PSTN. (Most PSAPs *originate* calls via DTMF dialing, not MF.) We propose to map the pseudonumber MIN of the radiotelephone that makes the 911 call onto a suitable MF code sequence (several methods exist aside from the one example shown here). This requires matching software upgrades in the serving MSC, the PSAP MF receiver software, and in some cases the intermediate MF signaling software in the PSTN. In some installations, the present MSC software can only generate four digit ANI/AIOD, and this must be upgraded as well. As an alternative to mapping a non-decimal number into a sequence of MF codes, a non-decimal MIN can also be transmitted by using DTMF with all 8 frequency tones instead of the usual 7 tones (that is, including the so-called "4th column" tone). This encodes 16 distinct symbols and is similar to the use of a 16 button dial, that is already used in AUTOVON and certain other private networks. However, there will be installations in which the existing PSTN will not pass the MF sequences defined for this purpose but will treat them as errors. In this case, the visited serving MSC must pass a special decimal number representation of the pseudonumber MIN where appropriate.

a.1 In this special case, a mapping of a non-decimal MIN onto a decimal number sequence can be accomplished by several methods for the purpose of sending the pseudonumber MIN from the visited serving MSC to the PSAP, of which only a few are listed here: 1) Map the 1 billion emergency pseudonumber MIN values into 1 billion decimal values of ten digits each that are not dialable under the North American Numbering Plan. For example, use the decimal numbers 0XX XXX XXXX, where X represents any of the ten *decimal* digit values. 2) Use more than 10 decimal digits with an appropriate mapping to transmit the pseudonumber MIN to the PSAP. 3) Transmit two strings of MF digits, each being 10 or less digits. These examples apply to the case where the visited serving MSC can compose an AIOD number value representative of the particular radiotelephone, and send it to the PSTN. Cases where full ANI/AIOD capability is not available (e.g., imprecise ANI/AIOD) are described later.

b. At this point, the PSAP "knows" the pseudonumber MIN[12] of the emergency radiotelephone that dialed 911. To call back to the emergency radiotelephone, the PSAP must first contact the orphanage MSC by "ordinary" network switching. The simplest temporary way to do this for a presently restricted system is to use so-called "roamer port" or "two stage dialing" at both the orphanage MSC and the visited serving MSC. Two stage dialing capability is already available in most MSC call processing software, since it was historically a widely used method for providing roaming call delivery

---

detail billing analysis), itemized bill preparation by the local service provider is an optional service that has faded away, and many newer PBXs no longer include ANI/AIOD capability in their standard capabilities. However, this capability can be added via software upgrades to most PBXs and to the PSTN end switches that communicate with the PBX, and we also have a temporary solution for MSCs (but not for PBXs), described later.

[12] When the pseudonumber is displayed on a screen for human viewing the non-decimal digits can be displayed as hexadecimal digits or via any display mapping choice that the industry agrees on, but this display format is only a minor item, not central to establishing the call back.

prior to the use of IS-41 roaming call delivery. Each MSC provides a dialable (but often non-published) access number, typically with several channels to support multiple simultaneous conversations. The PSAP dials the access number of the orphanage MSC via the PSTN, and upon automatically being answered, outpulses the pseudonumber MIN value using an in-band tone signaling method such as DTMF (or MF) according to one of the encoding methods described here. The MIN is analyzed and compared to the dynamically previously created orphanage HLR data record, which discloses which serving MSC it is currently visiting. Following this, the call is forwarded to the roamer port of the visited serving MSC, again via two stage dialing, and the binary pseudonumber MIN of the emergency radiotelephone is paged, and after connection the voice channel is used for the voice conversation. This process requires some simple software upgrades in the visited serving MSC to reformat the pseudonumber MIN (conversion from the format received via the orphanage MSC into the 34 bit format pseudonumber MIN for paging the call back), but it does not require the visited serving MSC to dedicate a TLDN or to historically retain any specific HLR or VLR information about the original 911 call made by the emergency radiotelephone. Continued malicious or accidental access to the access line(s) on these MSC can be prevented by verification of the originator calling line ID (using existing PSTN technology), by requiring the PSAP to authenticate by a preliminary in-band signal, by passing only calls from PSAPs identified by a PSAP code in the FP data base, and/or a combination of these and other authentication methods. There are some other methods as well, but they are not stated here for the sake of brevity.

c. The ultimate method is to use the more sophisticated SS7 (or PRI) signaling protocols on all the relevant switches. When both the visited serving MSC and the PSAP utilize SS7 (or PRI), the MSC can send to the PSAP the pseudonumber MIN value of the emergency radiotelephone, mapped into a pseudonumber SS7-type identifier. Because this pseudonumber MIN is dialable via SS7 or PRI, the PSAP can call back "directly," using the pseudonumber, without need to represent it in an alternate mapping form or a need to use two-stage dialing. The call back will again be routed through the orphanage MSC by the PSTN. Use of SS7 or PRI is the ultimate signaling method, but of course it requires simple but essential software upgrades to the visited MSC and to the PSAP, and also to the transit/tandem switches on the path between the MSC and the PSAP, and to the transit/tandem switches between the PSAP and the orphanage MSC, and also those between the orphanage MSC and the visited serving MSC (all three path descriptions may refer to a total of only one or two transit/tandem switches in some cases). The call back is routed from the PSAP to the orphanage MSC, and then to the visited serving MSC by the preferred means of a "special" SS7 IAM message from the PSAP to the orphanage MSC, and a corresponding "special" IAM message from the orphanage MSC to the visited serving MSC. This "special" IAM message resembles a post-translation LNP/LRN IAM message. It routes the connection using the LRN number of the visited serving MSC (or its pre-designated agent switch), and carries the target pseudonumber MIN in the so-called GAP parameter. Therefore, the software development resources used for this purpose are devoted to both upgrading for the new technology and equally for upgrading for LNP/LRN; there is no diversion of development resources required. In general the end switches in the PSTN do not need to be upgraded for this emergency radiotelephone call back purpose alone. A person without special SS7 or special PRI/BRI dialing capability cannot dial or reach the incoming port of this type on an MSC, so there is inherent protection against inadvertent or malicious blocking of the emergency call back line by an unauthorized person. Furthermore, there is at least one aspect in which the software in this instance is simpler than ordinary LNP/LRN software. In the visited serving MSC, unlike a wired LNP/LRN recipient switch, it is not necessary to build and maintain permanent LNP data structures to handle the internal translation of the recipient ported numbers (the visiting pseudonumber MIN values in this case) into a fixed internal physical appearance code. In a cellular MSC, the pseudonumber MIN value received in the IAM GAP parameter is translated to 34 bit binary and used to page for the designated emergency radiotelephone. Once that radiotelephone responds to the paging message in a particular cell, the relationship between the MIN and the cell/frequency/time-slot (or CDMA code for IS-95) is then established dynamically using the pre-existing call processing software of the MSC.

A1.17 It should be clear to the technically grounded reader that various combinations of the same methods already described can also be used for very small PSAP installations which use consumer type Caller ID, DTMF, or the like. A detailed description is omitted for brevity. Again, it is important for a practical system that the variety of

different methodologies used for a single purpose not be more varied than is actually needed. Instead, each choice of methodology should be carefully chosen to minimize the number and complexity of methods that the system supports simultaneously, with a clear common ultimate signaling technology goal in mind for the entire telecommunications industry so that the "churn" due to repeatedly changing from one signaling method to another is minimized. The problem regarding adding new features to the telecommunications network is not just that there are many different signaling systems already in place that must be temporarily catered to. The more serious problem is to avoid squandering resources by developing myriad different signaling interfaces and data bases, each one for a specific limited purpose. Instead the entire industry should carefully plan a common system that supports numerous objectives and clearly converge on the best future signaling technology in the shortest time.

A1.18 Method for Using Imprecise ANI/AIOD from a MSC: We noted above that some MSCs at present only provide imprecise ANI/AIOD to the PSTN. All outgoing calls are identified with a single number characteristic of the entire MSC. It is clear that such a situation must ultimately be corrected by fundamental upgrades in the MSC software and in the interface to the PSTN. The issue of imprecise ANI/AIOD cannot continue indefinitely because this creates a range of problems going far beyond the specific problems of emergency call back[13]. An MSC with this current limitation cannot even identify a radiotelephone with an ordinary in-service MSC to the PSAP, much less a non-initialized radiotelephone! However, a temporary stopgap solution is desirable to uniquely identify each 911 call for emergency call back purposes, until the particular MSC can have its ANI/AIOD interface upgraded. One of the simplest methods is based on the use of clocks accurate to approximately 1 second, available in the visiting serving MSC[14] and the PSAP. (Such clocks are typically already in these switches for billing or other purposes already.) It is also possible to apply this method even when the serving MSC has no clock or does not send the clock time stamp, provided that the latency of the first IS-41 message is known. When the emergency radiotelephone makes a 911 call, the visited serving MSC must include in its first IS-41 message to the orphanage MSC/HLR both the pseudonumber MIN (or ordinary MIN if that is the case) of the radiotelephone that dials 911, and should also include a new time stamp parameter indicating when that call's outpulsing *ends* (and thus "ringing" begins at the PSAP) on the outgoing trunk to the PSTN. Since the signaling delay seldom exceeds 0.7 seconds, and the "ringing" is usually an immediate signal such as "wink-start," this will serve to identify the particular 911 call to the PSAP, despite the imprecise AIOD. To tie together the time identification in the PSAP with the time and MIN identification in the orphanage HLR, the orphanage HLR must then immediately send a message to the PSAP to give this information to the PSAP. This message can be carried via a dial-up modem connection, for example. In this way, the PSAP can build a temporary internal list of the pseudonumber MIN values of those emergency radiotelephones that have called recently, a list that no longer uses the clock time as a parameter[15]. Some MSCs that have imprecise ANI/AIOD do however, identify different outbound trunk groups with different ANI/AIOD numbers, and that information can also be sent to the orphanage MSC/HLR. If a large number of mobile stations all dial 911 substantially simultaneously, as might occur when a large number of cellular subscribers experience a common disaster or emergency, it will be necessary to queue the outgoing calls at the MSC on each distinctly identified trunk group to ensure that they are at least 1 second apart so that they can be distinctly time stamped. In a widespread emergency that motivates a very large number of substantially simultaneous 911 calls from radiotelephones, this intentional queuing delay can obviously be a problem. That is why we present this only as a temporary interim method. This procedure is *not* illustrated in Figure 1. The connection between the PSAP and the orphanage

---

[13] Existing PSTN features such as Caller ID and Automatic Callback features do not work correctly (that is, they are "broken") when the originator is a MSC or PBX with imprecise ANI/AIOD.

[14] This method requires that the MSC can exchange messages with the orphanage HLR. Since PBXs do not do this, this method is not applicable to a PBX.

[15] A handoff of the 911 call to another MSC automatically updates the relevant orphanage HLR data record, but does not change the data thus constructed in the PSAP. Ultimately the PSAP must purge its list of "stale" emergency MINs. This is probably best done by an automatic prompt to the staff member who last spoke to the caller, typically about 20 minutes after the last call ends, asking if the number can be purged. If the staff member is certain that the particular emergency is over and there is no further reason to call that MIN, then he/she can give permission and that entry can be purged. Note that a new entry will be constructed automatically if the emergency radiotelephone calls again.

MSC/HLR can be an occasional dialed connection, and does not require a permanent link between the PSAP and the orphanage MSC/HLR.

A1.19 Methods for Reduction of Ambiguity of Duplicate MIN Values: Until a distinct MIN is placed in all emergency use radiotelephones, situations may arise in which the MIN is fundamentally ambiguous. This situation can be alleviated, but not fundamentally resolved, by means of a cross-index at the orphanage MSC/HLR between each MSC and the PSAP that normally receives calls from that MSC (in some cases, there is no distinct relationship of this type, since a single MSC may call more than one PSAP and vice versa). Consider the case in which two radiotelephones having the same decimal MIN value (for example 000-000-0000) make 911 calls at about the same time. When a call back is desired, the PSAP first accesses the orphanage MSC, which finds a plurality of HLR entries all with the same 000-000-0000 MIN value, but each in general having come from a distinct serving visited MSC. The orphanage HLR can search these and attempt to identify the one that is most likely correct. However, when two or more such calls originate from the same visited serving MSC, there will still be an ambiguity. The ambiguities can be further reduced but not always resolved by such supplementary data as the last known cell number and/or the ESN of each particular emergency radiotelephone. (The details are not given here for brevity.) But ultimately the proper solution is to provision each emergency radiotelephone with a distinct pseudonumber non-decimal MIN.

A1.20 This description is perforce very brief and focuses specifically on the particular application at hand. It is worth noting that the general scope of System Beta addresses a large number of desirable network improvements via the very same network software upgrades. To give the reader background information about these other applications, we list here several other applications arising from the same basic technology with a central FP data base in the telephone network. Of course, many of the applications listed in this paragraph require a more extensive and thus a more costly upgrade of network software, both with regard to the qualitative nature of the upgrade and the number of end switches that must have their software upgraded. However, the wide variety of capabilities that arise from the selfsame software upgrades are an important advantage of this particular technology, since many benefits arise from relatively simple upgrades.

a. The appropriate destination telephone line for a particular call can be chosen automatically by the enhanced telephone network although the destination subscriber uses the same telephone number for all his/her different lines. For example, a call from a fax machine will be automatically directed to the destination person's fax line, even if the originator dials the destination voice number when calling from the originating fax line. It is important to note that callers do not change their existing dialing habits here. The caller needs to remember only one number for each person they call, even though that destination person has multiple lines. Individuals can still retain a separate distinct dialable decimal number for business purposes and a separate number for residential lines. It is also permissible to optionally "share" a line (destination subscriber's choice) such as a fax line so that callers can reach it regardless of whether they dial the destination business or residential number.

b. The majority of individuals with just one residential line, who just make and receive voice calls, will experience no changes whatsoever in the way that they dial and answer calls. There is no change whatsoever in their dialing habits. In contrast, if this new technology is not installed, most of North America will inevitably require all callers to dial 11 or more digits for all calls, local and long distance, due to the inevitable expansion of the NANP to more than 10 digits if this new technology is not installed.

c. The destination subscriber has control of how various voice related calls are handled by such lines as ordinary wire voice line, cellular line, voice mail service, radio pager, etc. One choice is to have the lines ring in sequence if the first, second, etc. are not answered after a designated number of rings. Another choice is to have all the designated lines ring simultaneously, with the actual voice connection going to the first line that answers. Ringing then automatically ceases on the other lines. Calls can be blocked or allowed to ring on one's cellular line based on various criteria such as calls from designated

callers (telephone numbers), calls from other subscribers to the same cellular system[16], etc. The cellular line (or other lines that incur special costs, for example) can be excluded from the groups noted here, so that only those callers who dial a special prefix can reach them. Many other cases are also selectable, but are not described here for the sake of brevity.

d. A line used for different purposes on different calls can be identified and used as simply as it is now. For example, a small office line can be pre-identified to accept both voice and fax calls incoming. The individual subscriber can also set the default outgoing functional purpose to what he or she uses most often, for example, voice. Then the fax machine with a memory dialer (very widely used) can be set to automatically dial a special prefix such as *332 (or 11332 for rotary dialing) at the beginning of all fax calls. Such a dialed prefix will cause the outgoing FP code(s) for that line to temporarily include Fax FP code. The overall telephone system will then return that line to its default outgoing voice FP code condition at the end of each call. In this example, callers do not change their existing dialing habits for voice calls. A fax machine dials the prefix for fax calls. There are a very limited number of cases in which a human caller would dial a prefix manually, and in the vast majority of cases there is no change to the callers' existing dialing habits.

e. Because this new technology reduces the demand for distinct telephone numbers, the proliferation of new area codes can cease and existing multiple area codes sharing the same boundaries can, in most cases, be recombined within about 2 years. Areas that now require 10 digit local dialing (and which would otherwise inevitably require 11 digit local dialing in the future) will now be able to return to 7 digit local dialing. A city like Dallas, Texas, can go back to using one area code instead of the three now in use. And nobody will need to change their signs or stationary, since the other two area codes can continue to be used (optionally) indefinitely if so desired! No automatic alarm dialers or PBXs need to be reprogrammed! The telephone directory will be smaller in size with narrower columns showing only 7 digits! Callers will take less time and make far fewer dialing mistakes! Costs of the approximate magnitude of $150 Billion (according to the Commission's own estimates) will be saved by the public and the telephone industry.

f. Subscribers will be able to automatically block undesired types of calls. For example, subscribers can automatically block all unsolicited sales calls if they so desire. Legitimate telemarketers will now be connected only to those destinations that wish to speak to such callers. Several technological features built into the new technology will help to identify callers who improperly attempt to evade the system to simplify and ensure thorough and fair enforcement.

g. If a subscriber finds that one of several telephone lines (for example, his/her fax line) is temporarily not working, he/she can temporarily assign its FP codes to a second working line and take them "off" the non-working line, and also plug in the fax machine at the second line. In this way, the subscriber will have almost uninterrupted fax service while waiting for repairs to be made.

h. Based on information now at hand, we believe that this system can be adapted to automatically set up calls involving translation or interpretation, by automatically recognizing an incompatibility when the call is dialed, and automatically switching in a third party between the two end users. The two end users may speak different languages or use incompatible technology or equipment. One important application of this is to connect deaf people who use teletypewriters with people who speak and hear normally, by automatically connecting the two via an existing telecommunication relay center. We believe that this service can be greatly improved and the cost of providing such interpretation/ translation can be greatly reduced by using our new technology.

i. Another proposed example of the connection of different nominally incompatible technologies is the automatic connection between ordinary telephone lines at one end and voice over Internet protocol

---

[16] Some cellular service providers allow free air time calls from radiotelephone to radiotelephone within their own cellular system, or to a list of specific other telephone numbers. All of these cases can be accommodated in the FP data base of this new system.

(VoIP) users at the other end, accomplished just as easily as dialing an ordinary telephone call. This new technology would not require added telephone numbers for the VoIP service, but could use the same telephone number that the subscriber already uses for his/her ordinary circuit switched PSTN telephone service.

j. Descriptions of potential medical emergency conditions can be optionally pre-stored in the FP data base and used to notify a PSAP or other authorized emergency service provider, when a 911 call is made, so that rapid diagnosis and treatment is more certain. This is particularly significant when the medical condition may leave the patient incoherent and prevent the victim/patient from describing his or her own medical history, such as for a heart attack, diabetic or epileptic coma, severe allergic reactions, etc. This capability is optional, and can be used independently of the emergency call back capability described here, or in conjunction with it. Since it is stored in the telephone network, this information would be legally protected by the secrecy provisions of the Telecommunications Acts of 1934 and 1996.

A1.21 The point of repeating these benefits (and there are many more as well) is to show that installing this technology in the telephone network solves many problems at once with the same existing hardware and the same software upgrades. In that regard, it is far superior to installing separate hardware and software for each specific purpose, with regard to cost, simplicity and ease of use (by both the telephone industry and the public), reliability, flexibility to add and combine new features and services, early availability, and no diversion of development resources from one objective to another. And there are several things that this new technology does that no other technology can do at all, so there is a qualitative superiority as well as a quantitative superiority.

Glossary

Term	Definition
Agent Switch	A switch typically located just before the MSC or PBX destination switch in a connection path, that typically provides SS7 or other signaling capabilities that the destination switch lacks. May be the same switch as an N-1 switch in some instances.
AIN	Advanced Intelligent Network
AIOD	Automatically Identified Outward Dialing. Precise AIOD identifies the exact originating line, while imprecise AIOD identifies a billing number that is shared by a group of lines/extensions (such as in a PBX) but not the exact line. (This term is typically used for a PBX. See also ANI)
ANI	Automatic Number Identification, a signal identifying the originating telephone number of a call (term used for a PSTN switch. See also AIOD)
AUTOVON	AUTOmatic VOice Network, a private military telephone network.
BCD	Binary Coded Decimal, uses 4 binary bits to encode each decimal digit
CTIA	Cellular Telecommunications Industry Association
DTMF	Dual Tone Multi Frequency, a type of in band tone signaling used for subscriber dialing and end-to-end signaling (also called Touch-Tone)
ESN	Electronic Serial Number, a 32 bit binary number used to identify certain North American cellular radiotelephones.
FEMA	Federal Emergency Management Agency
FNOPR	Further Notice of Proposed Rulemaking
FP	Functional Purpose code.
GAP	General Address Parameter. In an SS7 IAM message used to set up a call to a destination telephone that has been “ported” from a donor switch to a “recipient” switch, the actual destination telephone number as dialed by the originator is carried in this data parameter. In one of the implementations of this new technology for cellular emergency call back, the mapped pseudonumber MIN value is carried in this GAP parameter while a telephone number characteristic of the visited serving MSC is used as the routing number.
GSM	Global System for Mobile communication, a digital cellular standard also describing PCS-1900 service in North America
GPS	Global Positioning System, a location/navigation system that identifies the latitude/ longitude/ altitude of a receiver via comparison of the time delay of radio signals from 3 or more geo-

	stationary GPS satellites. Differential GPS systems also utilize information from a second stationary GPS receiver that is nearby at a known latitude/ longitude/ altitude.
HLR	Home Location Register, a data base that stores data describing all mobile stations or subscribers who use a particular home MSC.
IAM	Initial Address Message. This is the first "call setup" message used in SS7. It contains the routing number (ordinarily the dialed number), the originating telephone number, and other parameters. Post-translation in LNP/LRN technology, the routing number is different from the dialed number if the dialed number has been previously ported to a recipient switch.
IMSI	International Mobile Subscriber Identity, used in GSM radiotelephone subscriber identity modules.
IS-	Interim Standard (issued by TIA), followed by a hyphen and two or more digits to indicate a particular standards document.
ISDN PRI	Integrated Services Digital Network, Primary Rate Interface, referring to a particular type of digital signaling that conveys call processing information in digital packet messages
ITU-T	International Telecommunications Union- Telecom sector, a standards organization formerly known by the initials CCITT
LNP/LRN	Local Number Portability/Location Routing Number, referring to the technology and data base used therein.
MAP	Mobile Access Part. A part of the GSM standards describing messages between different MSCs for roaming support, etc.
MF	Multi-Frequency signaling, a type of in-band tone signaling that is rapidly being replaced by SS7 in the PSTN, but is the de facto signaling method for Caller ID at most PSAPs
MIN	Mobile Identification Number, a 34 bit binary quantity that in its original definition describes a binary number representation of telephone numbers consisting of 10 decimal digits.
MSC	Mobile-service Switching Center, a cellular system switch. (Some documents use the name MTSO, Mobile Telephone Switching Office.)
NAM	Number Assignment Module/Memory (in the radiotelephone) comprising MIN and other data
NANP	North American Numbering Plan
N-1 (switch)	(pronounced as three words: "N minus one") A switch further along the signal path from the originating switch; typically one of the transit switches (perhaps one operated by a different service provider than the originating service provider) but not the destination (N) switch. This N-1 switch may generate a data base query message instead of the originating switch in some instances.
OATS	On-air Activation of Telephone Service, a TIA standard for setting the MIN and other internal identification parameters in a mobile radiotelephone via radio signals.
PBX	Private Branch Exchange
PCS	Personal Communication Service; PCS-1900 is the North American version of GSM
POTS	Plain Old Telephone Service; ordinary voice telephone service
PRI	Primary Rate (ISDN) Interface, incorporates common channel call processing signaling according to ITU-T standards Q931/I.931
PSAP	Public Safety Answering Point/Position.
PSTN	Public Switched Telephone Network
SCP	Service Control Point
SS7	Common Channel Signaling System No. 7, a common channel telephone network signaling system that conveys call processing information via digital packet messages
SCP	Service Control Point
TIA	Telecommunications Industry Association
TLDN	Temporary Local Directory Number
VLR	Visited Location Register, a data base used in a cellular MSC to describe the properties of a radiotelephone that is currently operative in the service area of that MSC
VoIP	Voice over Internet Protocol
WCA	Wireless Consumer's Alliance
WEIAD	Wireless E911 Implementation Ad-Hoc Group