Q #	Section Number	Question	Answered (✓/✗)
	(cont.)	d) How will the dynamic information be expected to be merged with the call? What data flow management information is necessary?	
4.	8.2	***Characteristics of Preferred Solution*** The list of characteristics given to describe BellSouth's preferred solution is by no means definitive. Respondents are invited to: a) provide their view of the list. b) comment on each of the characteristics. c) provide an opinion on any additional ones that may enable clarification or provide completeness.	
5.		***Network Centric Solution*** Respondents are asked to give their views on the network centric, straw-man solution as outlined above. Specifically: a) Is this solution consistent with the PSAP requirements as stated earlier? b) Is the straw-man consistent with the characteristics outlined for the preferred solution? c) Does a solution exist that may have less impact on the network? Would you suggest a different solution?	
6.		***Mobile Subscriber Terminal based Solution*** Respondents are asked to give their views on this straw-man solution as outlined. Specifically: a) Is the straw-man consistent with the characteristics outlined for BellSouth's preferred solution? b) Does a solution exist that may have no impact on the network? c) What are the advantages and disadvantages of an MST-based solution versus a network-centric one? Please elaborate, quantify or provide supporting information where possible. *d)* What architectural changes are required to facilitate an MST-based solution (referencing Figures 8.1 and 8.2)?	
7.	8.2 *(cont.)*	***Subscriber terminal criteria*** Respondents are invited to give their views regarding this criteria, and to state any opposing rationale. Specifically, respondents are asked to address the following: *a)* What would affect the viability of a first stage implementation limited to operation with the installed subscriber terminal base?	

Q #	Section Number	Question	Answered (✓/✗)
	(cont.)	b) Would such an approach be compatible with the PSAP requirements outlined in section 8.1? c) Under what circumstances would location system performance improvements dictate modification of the subscriber terminal? d) What impact does an MST-based solution have on the terminal? Specifically, addressing cost, size, weight, battery life / talktime, and user-interface. e) How will the impact on the MST by incorporating location capability alter the current trends in terminal evolution (lower cost, smaller size, multi-mode (air-interface), multi-frequency, multi-service capability (voice, data, image), etc.)? f) Give your view of how the location capability can be implemented in the expected lifecycle of terminal product development. g) Provide your view of how an MST equipped with location capability can be upgraded or enhanced to exploit improving location technology performance and functionality. In particular, how would you address the upgrading of a significant installed base of location-equipped MSTs created during continuous deployment and evolution?	
8.	*(cont.*	***Multi-mode criteria*** Respondents are invited to give their opinion of this criteria, and to state any opposing rationale. Specifically, respondents are asked to address the following: a) What location technology would meet the requirements for the existing dual-mode systems of analog and digital technologies in use today, including digital systems employing digital control channels? b) What combinations of multi-mode standards are likely to be supported in the timeframes of this RFI? Is one location technology suitable for all combinations? If not, which location technologies are likely to support each combination? c) How viable is an implementation that provides location finding capability independent of the CMRS technology? What are the issues effecting such a capability? d) In what timeframes would such a location technology exist? What needs to happen in order to facilitate its development, or change the timeframes? e) What would be the benefits of deploying a CMRS technology-	

Q #	Section Number	Question	Answered (✓/✗)
		dependent location technology? f) If CMRS technology-dependent, then which CMRS technology would be required? How would the location technology accommodate "roaming" subscribers?	
9.		***Location Accuracy criteria*** Respondents are asked to provide information and commentary on this criteria by addressing the following: a) What are the fundamental limitations affecting location accuracy with a particular location technology? b) What are the issues affecting accuracy in a network-centric as opposed to a mobile radio subscriber terminal solution? c) Which technologies, in your opinion, will best meet the needs of the criteria for improving accuracy over time? What are these projected improvements? d) What will affect the dynamic availability of 'precise' location information to a PSAP, over the zero to ten seconds timeframe? e) What techniques might be used to improve the location information without over-burdening the location technology, such as supplementary or supporting databases, intelligent peripherals, etc.?	
10.		***Evolution and flexibility criteria*** Respondents are invited to give their opinion of this criteria, and to state any opposing rationale. Specifically, respondents are asked to address the following: a) What would be the impact of requiring improving location accuracy and performance? Over what time frames? b) Which technologies would offer this capability? c) Is it likely that a single technology would offer this flexibility? d) Does the technology support incremental improvements and/or implementation? How; upgrade or change-out? What functionality is provided at each step? e) What eventual redundancy might be expected, and at what cost?	
11.	*(cont.)*	***Network Integration*** Respondents are invited to give their opinion of this view of network integration, and to state any opposing rationale. Specifically, respondents are asked to address the following: a) Do you agree with the four levels of network integration outlined in Section 8.2.2 and the corresponding impact on the wireless system?	

Q #	Section Number	Question	Answered (✓/×)
	(cont.)	If no, why? b) Is there another way of addressing network integration that would provide a different view of the impact on the wireless system? c) Is there a clear migration path to eventual full network integration? Upgrade, no throw-away parts?	
12.		***Network Migration*** Respondents are invited to give their opinion of this criteria, and to state any opposing rationale. Specifically, respondents are asked to address the following: a) Will the choice of a location technology preclude the migration from one level of integration to another? Is migration of benefit or essential to meet future requirements? b) Is full network integration (such as Integration Level 4) a realistic goal? Under what conditions would full integration not be a reasonable approach? c) What would a proposed migration path look like? What are the likely timescales? d) What is the impact on the network of migration towards full integration? What parts of the network are likely to be affected by such upgrading? e) Would the hardware and software used in the initial deployment of the location technology be disposed of or re-used?	
13.	(cont.)	***System costs*** a) What are the location technology costs? b) How does cost vary with functionality? Are there any cost breakpoints for performance? c) Where in the network would the costs of a wireless location technology be distributed? d) How would the distribution of these costs change as upgrades are made? e) What types of maintenance costs for the location technology may exist? How may these change over time? f) Will there be any additional communications network maintenance costs to support the location technology? g) Although, proposals are not requested at this time, Respondents are invited to supply information on budgetary planning costs for several size deployments, such as might be expected throughout the US. These would include cellular systems for huge metropolises	

Q #	Section Number	Question	Answered (✓/✗)
	(cont.)	(ie. Los Angeles, CA), major cities (ie. Atlanta, GA), topographically variant sites (ie. Birmingham, AL), rural areas (ie. Tupelo-Corinth, MS (BTA #449)) and for PCS in an area such as Charlotte, NC.	
14.		***Additional commercial benefits*** Respondents are invited to comment on or to provide information about additional services, value-added services or mechanisms by which additional commercial benefit might be accrued by leveraging location technology. a) What value-added services would be enabled or enhanced by a wireless location technology? b) How do these services depend on network vs. mobile subscriber location based capability ? c) What market data do you have to support any new service opportunities? d) What are the benefits, and in what timeframes would these benefits be available? e) Would you be interested in participating in any such service provision? How? f) Would providing these services have any impact on the cost, structure or operation of the network? g) Would these services follow the same migration path as the 911 capability? h) Would additional value-added services have any impact on the 911 capability? Would providing these services have any impact on the time to deliver a wireless 911 capability?	
15.	*9.1*	***Impact on the Network*** Respondents are invited to discuss their views on the issues that affect the impact on the wireless network. Respondents should provide comment on the relative importance of the above issues. In addition, they are asked to provide information on the following particular issues.	
16.	*(cont.)*	***Accuracy and Availability of Location information*** a) How does the location system recognize a 911 call, or initiate a 911 location function? b) What is the form of the location data?	

Q #	Section Number	Question	Answered (✓/✗)
	(cont.)	c) What is the timing and availability of location information once a 911 call has been initiated? Is it on-demand or continually available? d) Can non-911 calls be included? e) Can the location of a mobile subscriber terminal be determined for a land initiated call (such as for a 911 PSAP call back)?	
17.		***Network Interconnection*** a) How is location information acquired and transferred into the wireless network? b) What wireless network interfaces are required? c) What other infrastructure interconnections are necessary? d) How is transfer and hand-off between base stations, cell sites and different networks possible? e) If the proposed location system is an "overlay", what additional equipment is required?	
18.		***Impact on Network Architecture*** a) If one considers the four levels of integration as described in section 8.2.2, how do these issues change relative to their importance/priority for each level? b) How are the data flows managed, for synchronizing or mapping location information with a corresponding call? c) How will the various cellular and PCS architectures/configurations be supported by the location technology, such as macro, micro and pico-cells; hierarchical and overlay networks; distributed antenna systems (ie. in-tunnel systems, in-building, wireless local loop access, etc.); cell repeaters, enhancers and transcoders; 3-dimensional cell structures for high rise buildings; etc.? d) What are the requirements for network signaling? e) Can these be addressed by existing or additional AIN or intelligent peripheral functionality? f) Are there other issues that may have the same or more influence on the network architecture?	
19.	*(cont.)*	***Inter-system Performance*** a) What, if any, is the impact of channel coding and wireless network signaling security? b) Is any system interference probable?	

Q #	Section Number	Question	Answered (✓/✗)
	(cont.)	c) Are there any performance limitations due to power control and the signal to noise ratios encountered in wireless systems? d) What is the impact of high speed hand-offs on the determination of location? What is the impact on hand-off through multiple cells, base stations, base station controllers, etc.?	
20.		***Implementation and Future migration*** a) Is any network or infrastructure equipment and systems sharing possible? With cellular, PCS or other wireless networks - Respondents should specify which networks and how? b) If the location technology proposed is an inherent part of the wireless network's radio infrastructure, what system elements (antennas, towers, radio transceivers, interconnections systems, etc.) will be affected? c) What is the development status of any common elements needed for an integrated solution with the respective manufacturers of those sub-systems? What is the potential availability? d) What testing has been undertaken (either as an overlay or integrated system)? e) Are there any implications for implementation? What are the phases of implementation? f) What is the potential for future migration and inclusion of enhancements? g) What are the location technology costs, and how are these distributed over the network?	
21.	*(cont.)*	***System Integration*** Respondents should discuss whether a fully integrated system is the best and ultimate solution. In addition, referring the levels of integration discussed in section 8.2.2 respondents should consider the following for their location technology or proposed solution: a) Is it feasible to expect to migrate from one level of integration to another? b) Do new issues arise as one migrates from one level of integration to another? c) Is there another level of integration which offers better flexibility and performance? d) What is your preferred level of integration?	

Q #	Section Number	Question	Answered (✓/x)
	(cont.)	e) What would be a feasible migration path for implementing a wireless location technology solution today to the eventual preferred level of integration?	
22.		***Standards*** Respondents are invited to comment on the impact of standards needed to implement the various levels of integration discussed previously. a) Which standards will be effected? b) How will these standards be best addressed? By which bodies or fora? c) Are you willing to participate or sponsor any particular standard or working group? d) Are you willing to have your technology become a standard? What licensing arrangements would you consider? e) Is there any activity today that could potentially inhibit or delay the deployment of a wireless location system? f) What are your views about creating an 'industry test-bed' for evaluating wireless location systems? What form would you prefer such a test-bed take?	
23.	9.2	***Proposed Location Technology*** Respondents are asked to provide information on the state of the wireless location technology they are offering, or would propose. Specifically, they are asked to outline their solution for providing emergency 911 wireless access. In addition to the above information, please include responses to the following questions:	
24.	(cont.)	***Accuracy, Timing and Availability*** a) How would you define location accuracy for your location determining technology? How is it expressed (statistically, rms, % error, circular error probability, etc.). Please supply examples. b) What is the accuracy of location of the technology? What will affect the accuracy deviation? c) How is accuracy dependent on time (0 - 10 seconds, and beyond)? d) When is stable location information available? e) Is location accuracy updatable? Dynamic update possible? What is the update period?	

Q #	Section Number	Question	Answered (✓/x)
	(cont.)	f) Is tracking possible? How does tracking capability impact the system (such as performance over time, etc.) What additional system components are required for this capability?	
25.		***Confidence and Reliability*** a) What is the confidence factor attributed to the location data within the quoted time period for your technology? How does this factor vary with time? b) How does the accuracy and repeatability vary for different environments and state how the technology is influenced by external variables, such as multiple cell sites in city or rural areas, single cell configurations, multipath, hilly terrain, dense or urban areas, etc.? Will the accuracy or performance of the location technology depend on any elements of the wireless network, such as databases, the HLR or VLR? If so, what provision is expected to ensure consistency of information, particularly as the caller roams? c) What provision does your technology offer for redundancy, fail-safe or failure recovery? What mechanisms are provided for system monitoring?	
26.		***Coverage*** a) Describe the capability of your system to provide location coverage in both sparsely populated rural areas as well as dense urban environments. b) Can your technology offer both in-building and outside location ability? Does this capability provide tracking of a caller from inside to outside, and vice versa? c) How does the performance of the system change with varying outdoor (environmental) conditions? d) How does the performance vary in a fixed or mobile highway environment? Stationary, low speed vs. high speed? e) Comment on the impact on performance of your technology if the MST is contained in a persons pocket, in a purse or briefcase, or left laying on a seat in a vehicle. Include in your consideration the impact on handsfree capability, time to obtain initial location fix and location data acquisition on PSAP call back. f) How does the performance of the system behave with varying 911 traffic conditions? What limitations might you expect?	

Q #	Section Number	Question	Answered (✓/✗)
27.		***Standards/Multi-mode Capability*** a) Which standards, current and developing, most affect your system? b) Does your technology offer multi-mode compatibility? Which combinations? c) If not, when, ever? What CMRS technology does your system currently support?	
28.		***Implementation*** a) With regard to the wireless location technology you offer, what is the development status of the technology, particularly relative to each of the issues cited in section 9.1? b) What other important network architecture issues does your technology address that were not cited previously? c) What enabling technology developments are required to support your system? Who is developing them? What is their timing? d) What are the critical supporting technologies that must exist in the network to enable your technology? e) Using a chart such as that illustrated in Figure 9.2, map planned or expected developments over time. (Use a consistent scale of your choosing; however, please include an explanation.) f) Which areas of performance are considered important for future developments? Which do you consider key to selecting a location technology? g) If possible, describe the potential evolution path of your technology including improving performance over time. h) What trials, system testing have been undertaken? Are results available? i) What trials or testing have been undertaken in conjunction with a CMRS developer, service provider or network? Are results available? What further testing is planned? j) What other potential commercial benefits can your technology offer, or what other services will it enable?	
29.	9.3 (cont.)	***Technology Timelines*** a) What is the development status of the technology that you offer? b) How and when do you expect location accuracy to improve in the future? c) What development is required to realize your preferred level of integration? d) What is the timeframe for achieving that level of integration?	

Q #	*Section Number*	*Question*	*Answered (✓/x)*
	(cont.)	e) What critical supporting developments are required to facilitate theimplementation of your technology (e.g., air-interfaces, standards, base stations, antennas, etc.)? f) What are the timelines relative to these supporting technologies? Who is developing these technologies? g) What is the migration path from where your technology is today to your preferred level of integration?	
30.	*9.4*	***Alternative solutions*** a) What other technologies exist that can provide a wireless location capability? b) What is the current development status of these technologies? Who is developing them? c) How do these technologies address each of the network impact issues described earlier? d) What will be the major impact on the network (i.e., mobile terminals, base stations, switches, etc.) of an alternative solution? What is required of the network to support an alternative location technology solution? e) What level of integration are alternative solutions capable of addressing now? f) What is the most probable/preferred level of integration as a future solution? What is the migration path to this preferred level of integration? g) What supporting technologies/systems are required to incorporate these alternative location technologies in a wireless E911 application? What is the status of their development? Who is developing these technologies? h) Can alternative solutions co-exist with network-based solutions?	
31.		***Alternative solution benefits*** Respondents are asked to comment on the above (alternative solutions). They should also consider the following: a) What is a likely migration strategy from one technology to another. b) Is there any benefit to multiple technology solutions? c) What would the impact of multiple technologies be on the network? d) What other services or commercial benefits can these alternative technologies support or enable?	

Q #	*Section Number*	*Question*	*Answered (✓/✗)*
32.	*9.5*	***Other Service Considerations*** Respondents are invited to give their views on the issues raised by the examples outlined. a) Are there other such examples? b) How important are these examples? Can the issues raised be ignored? When will they need to be addressed?	
33.		***Implementation*** Respondents are asked to comment on the possible inclusion of the examples in any implementation of location technology. a) What would be their impact on the choice of technology? b) Would they change the technology or network requirements with any significance? c) How might they be included? Short term versus later inclusion?	

APPENDIX A REFERENCES

This RFI is based upon, uses information and refers to several industry documents, working documents and publications to which the recipient may wish to refer for information, research data, or detailed explanations.

Reference	Description
CC Docket No. 94-102	FCC Notice of Proposed Rulemaking, entitled "Revision of the Commission rules to ensure compatibility with enhanced 911 emergency calling systems." October 1994
PCIA Joint Position Paper	PCIA, APCO and NASNA Emergency Access Position Paper. July 1994.
TIA/TR45 JEM Report	Public 800 Mobile and Personal Communications support of Basic 911 and Enhanced 911 Emergency Services. August 1994.
PCIA JEM Report	Wireless support of 911 and Enhanced 911 Emergency Services sponsored by APCO, NASNA, NENA, PCIA, (TIA), and T1P1. October 1994.
PCIA SRD for E911	PCIA sponsored Standards Requirements Document (SRD) for Personal Communications / Enhanced 911 Emergency Calling Systems Features. Final - Ballot version January 1996.
CTIA Position Paper	TIA's position on the deployment of wireless E911 services, as reviewed by the TOPS Council and Public Policy Council, and approved by the Board of Directors on December 15, 1995. Released January 1996.
TIA/TR45.2 *Ad hoc* Group	Sub-committee correspondence "Assumptions and Questions", dated February 6, 1996, addressing the network element interconnection protocol.

APPENDIX B GLOSSARY

Acronyms

AIN	Advanced Intelligent Network
ACD	Automatic Call Distribution
ALI	Automatic Location Identification
AMPS	Advanced Mobile Phone System
ANI	Automatic Number Identification
ANSI	American National Standards Institute
APCO	Association of Public Safety Communications Officials International
API	Application Programming Interface
AVL	Automatic Vehicle Location
B911	Basic 911 Service
BSC	Base Site Controller
BTS	Base-station Transceiver System
CAI	Common Air-Interface
CCS	Control Channel Signaling
CDMA	Code Division Multiple Access
CMRS	Commercial Mobile Radio Services
CO	Central Office (PSTN LEC's switching facility)
CTIA	Cellular Telecommunications Industry Association
D-AMPS	Digital AMPS
DMS	Database Management System
E911	Enhanced 911 Service
ESAP	Emergency Services Answering Point
FCC	Federal Communications Commission
GIS	Geographical Information System
GPS	Global Positioning System
GSM	Global System for Mobile telecommunications
HLR/ VLR	Home Location Register / Visitor Location Register
ISM	Industrial, Scientific and Medical allocated frequency band

ITU	International Telecommunications Union
JEM	Joint Experts Meeting
JTC	Joint Technical Committee on wireless access
LEC	Local Exchange Carrier
MAP	Mobility Applications Part
MST	Mobile Subscriber Terminal
MSAG	Master Street Address Guide
MSC	Mobile Station Controller / Mobile Switching Center
MSM	Mobility and Service Management
N-AMPS	Narrowband or Narrow Advanced Mobile Phone System
NASNA	National Association of State Nine-One-One Administrators
NENA	National Emergency Number Association
OA&M	Operations, Administration and Maintenance
OSS	Operational Support Systems
PACS	Personal Access Communications Services
PCIA	Personal Communications Industry Association
PCS	Personal Communications Services
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network (fixed wireline)
RDF	Radio Directional Finding
RFI	Request For Information
SCE	Service Creation Environments
SCP	Service Control Point
SMR	Specialized Mobile Radio
SMS	Short Messaging Service or Service Management Systems
SS7	Signaling System #7
SSP	Service Switching Points
TAG	Technical Ad-hoc Group
TDD / TTY	Telecommunications Devices for the Deaf / Teletypewriter
TDMA	Time Division Multiple Access
TDOA	Time-Difference-Of-Arrival

Definition of Terms

ALI	Automatic Location Identification - the information or mechanism used to facilitate location of a 911 caller
ANI	Automatic Number Identification - the information or mechanism used to identify the callback or subscriber associated telephone number
Base station	Network connection for radio air-interface
Caller ID	Calling party identification (name and/or number)
Cellular	The coverage mechanism by which current mobile telephony is implemented entailing reuse of radio frequencies
Control Channels	Out-of-band signaling channel/network
Cordless	Range limited, low power point to point wireless telephony
Mobile Switching Center	The primary switching and control point used in a mobile telecommunications network to provide network control, manage the various databases and control access to the PSTN and other networks
Multi-mode	Multiple air-interface standards
Roaming	The ability to move between mobile networks
Radio air-interface	The end to end path between handset and base station for a wireless telephony system
psuedoANI	A temporary ANI allocated by a Mobile Switching Center
Smart Antenna	An antenna that reconfigures its radiation pattern based upon subscriber terminals' movements and or characteristics
Mobile Subscriber Terminal	End user equipment (potentially much more than a handset)
Wireless	Radio air-interface based communications

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CERTIFICATE OF SERVICE

I, Phyllis Martin, a secretary in the law firm of Wilkinson, Barker, Knauer & Quinn, do hereby certify that a copy of the foregoing Comments of BellSouth Corporation in CC Docket No. 94-102 was served this 4th day of March, 1996, by first class mail, postage prepaid, to the persons on the attached list:

Phyllis Martin

Phyllis Martin