In general, the trial was conducted under strict control. Many of the test sites that CPS considered "valid" were relatively unobstructed sites with good visibility of surrounding base stations. We were able to perform very little indoor testing, and the indoor tests we did manage to perform provided poor location data.

The measurement data were communicated from the handset to the network using SMS, and the results were sent back to the phone using SMS. Because the yield depended on the ability of SMS messages to be transferred through the network, no meaningful yield can be determined. Cingular and other carriers who will deploy E-OTD will utilize layer-3 messaging to communicate measurement data between the handset and the network, rather than SMS. This will result in more favorable yields.

9.1. Stationary Phone

Test calls made with a stationary phone produced the following Erroneous accuracy figures: 140 m 67%, and 371 m 95%. The number of calls was not reported.

9.2. Non-Stationary Phone

Test calls made with a phone that had moved within 3 minutes of placing the test call produced the following accuracy figures: 250 m 67%, and 400 m 95%. The number of calls was not reported.

9.3. Summary Result

Without access to the individual test points, Cingular is only able to average the results obtained with the stationary and non-stationary phones. The summary result is then 195 m 67%, and 386 m 95%.

10. Summary of all Trials

The following table is a summary of the results of all of the trials. These comments apply to the data in the table:

1. *For U.S. Wireless, and CPS, the accuracies are quoted only for the set of calls that were located.* If a call was not located at all, it was not included in the calculation. While this is, strictly speaking, an invalid method of statistical analysis, we are providing the benefit of the doubt to the vendors that they will be able to achieve higher yields in real deployments. Note that unsuccessful yields will lower the number of samples in the population, and will therefore make the 67% and 95% accuracies worse, when the confidence level is applied.

2. The separate "Best 67%" 67% accuracy and "Best 95%" 95% accuracy are used. They are not valid 90% confidence levels when used together (see Section 4.1).

3. The yields of U.S. Wireless and CPS technologies were the result of factors that are not indicative of how the technology would perform in a real deployment. For example, the yield of the E-OTD technology was dependent upon successful SMS messaging between the handset and the network. Since an actual deployment of E-OTD would not rely on SMS for data transfer, the yield achieved in the trial is not meaningful.

4. The RF Mapping accuracy decays rapidly as the test calls are made from points more than a few tens of meters from the points at which the system has been calibrated. We therefore break down the RF Mapping results into "On-Grid" accuracies, which are the accuracies achieved when the test calls are made on a route that has been previously calibrated, and the "Off-Grid" accuracies, which are the accuracies achieved when the test calls are made from locations more than 30 m from the calibration route, but still within the RadioCamera coverage area.

5. U.S. Wireless, CPS, and SigmaOne technologies were not tested indoors.

6. Due to limitations of the technology at the time of the trial, E-OTD was not tested when an active call was in progress and the test mobile had not changed location within 3 minutes of placing the test call.

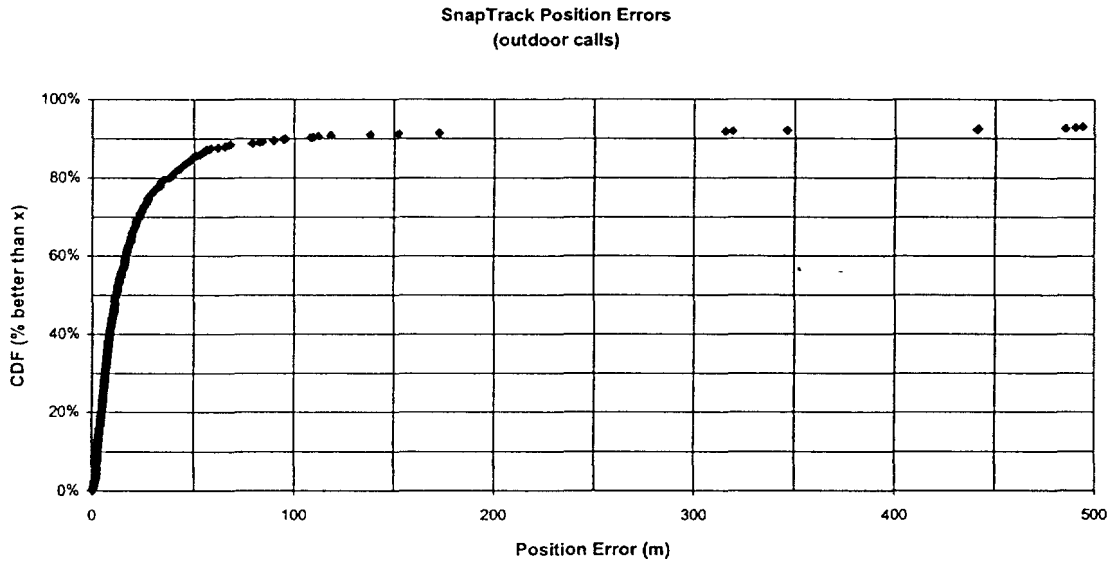
7. The "Best" and "Erroneous" U.S. Wireless accuracies are the same due to the large number of sample calls that were placed.

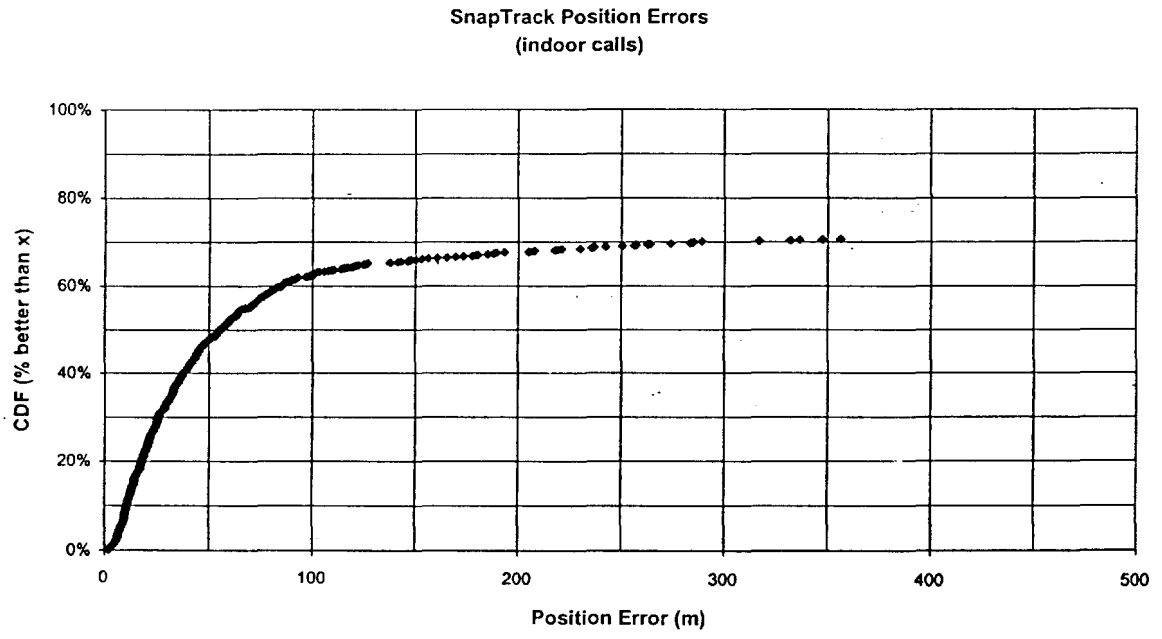
	TECHNOLOGY / VENDOR		Number of calls	Best 67% accuracy (m) (90% confidence)	Best 95% accuracy (m) (90% confidence)	Erroneous 67% accuracy (m)	Erroneous 95% accuracy (m)	Yield	Meets FCC mandate in this environment?
ALL CALLS	EOTD	CPS	N/A	N/A	N/A	195	386	N/A	No
	TDOA/AOA	SigmaOne	N/A	N/A	N/A	166	319	N/A	No
	A-GPS	SnapTrack	1328	76.0	Insufficient Yield	67.3	Insufficent Yield	80.7%	No
	RF Mapping	U.S. Wireless	13733	127	1281	127	1281	N/A	No
OUTDOOR	EOTD	CPS	N/A	N/A	N/A	195	386	N/A	No
	TDOA/AOA	SigmaOne	N/A	N/A	N/A	166	319	N/A	No
	A-GPS	SnapTrack	481	23.4	1770	20.8	1081	97.7%	No
	RF Mapping	U.S. Wireless	13733	127	1281	127	1281	N/A	No
INDOOR	EOTD	CPS	0	N/A	N/A	N/A	N/A	N/A	?
	TDOA/AOA	SigmaOne	0	N/A	N/A	N/A	N/A	N/A	?
	A-GPS	SnapTrack	847	256	Insufficient Yield	180	Insufficient Yield	71.1%	No
	RF Mapping	U.S. Wireless	0	N/A	N/A	N/A	N/A	N/A	?
ON GRID	RF Mapping	U.S. Wireless	7703	90.7	1096	90.7	1096	N/A	No
OFF GRID	RF Mapping	U.S. Wireless	6030	210	1411	210	1411	N/A	No

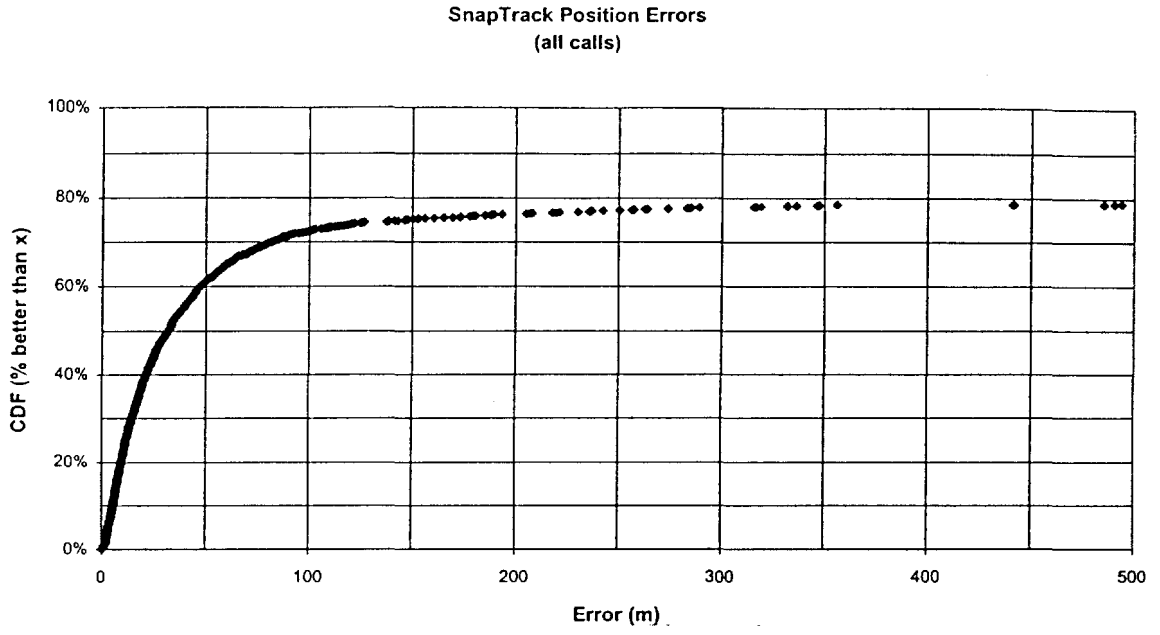
Table 9.1: Summary trial results

Appendix A. Cumulative Distribution Functions

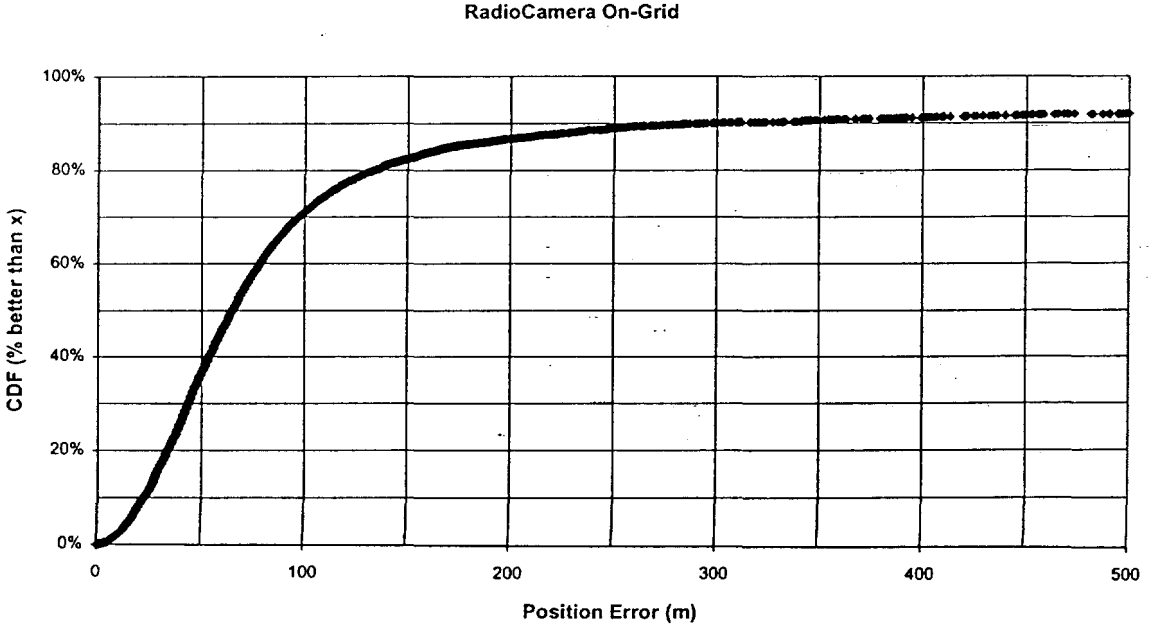
A.1 SnapTrack



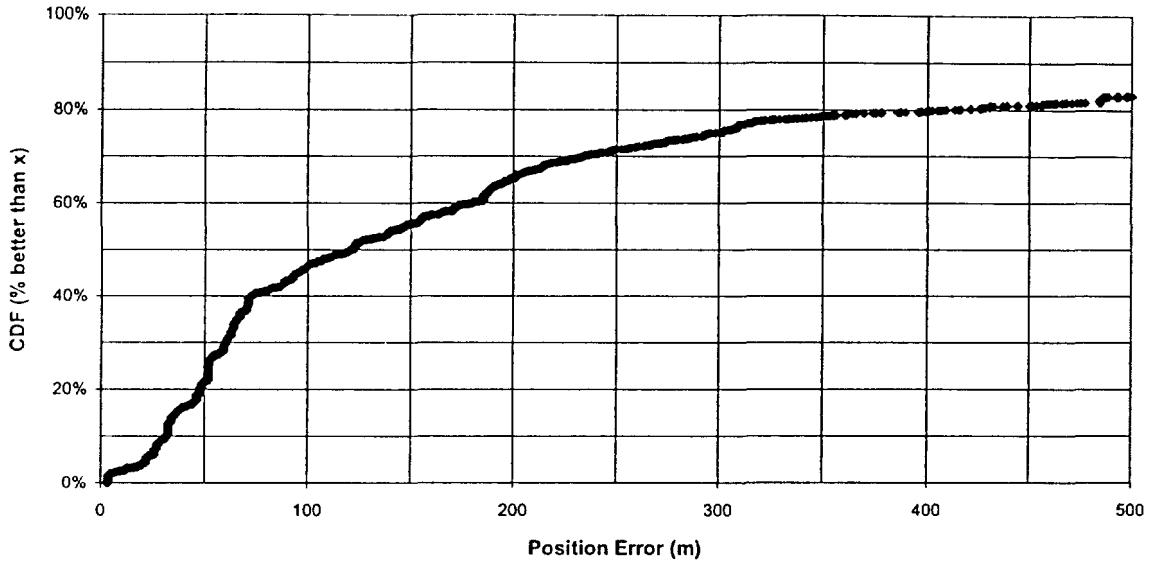




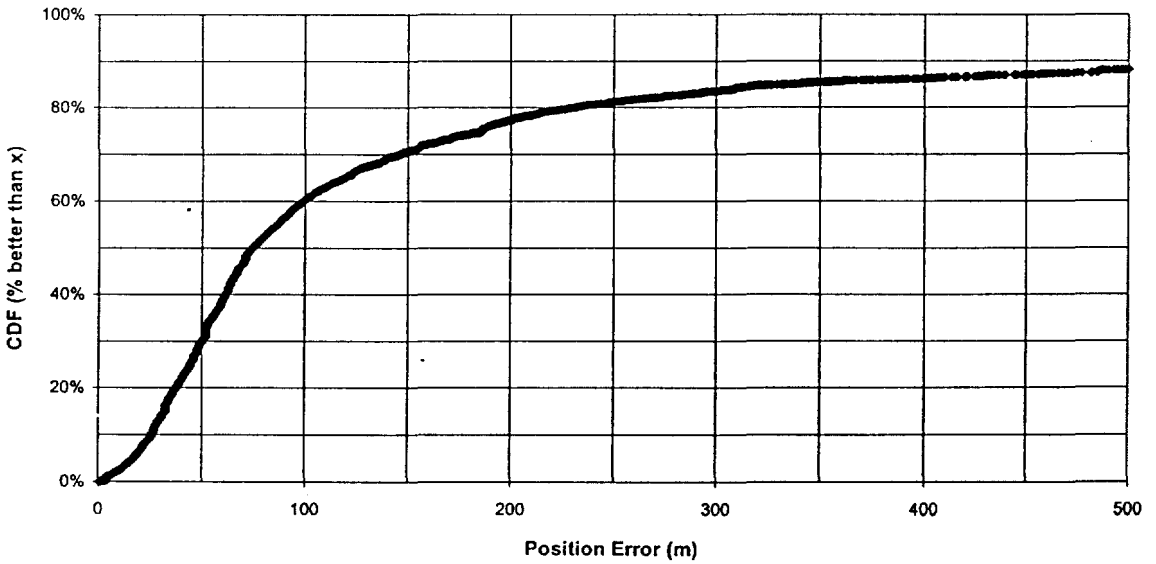
A.2 U.S. Wireless



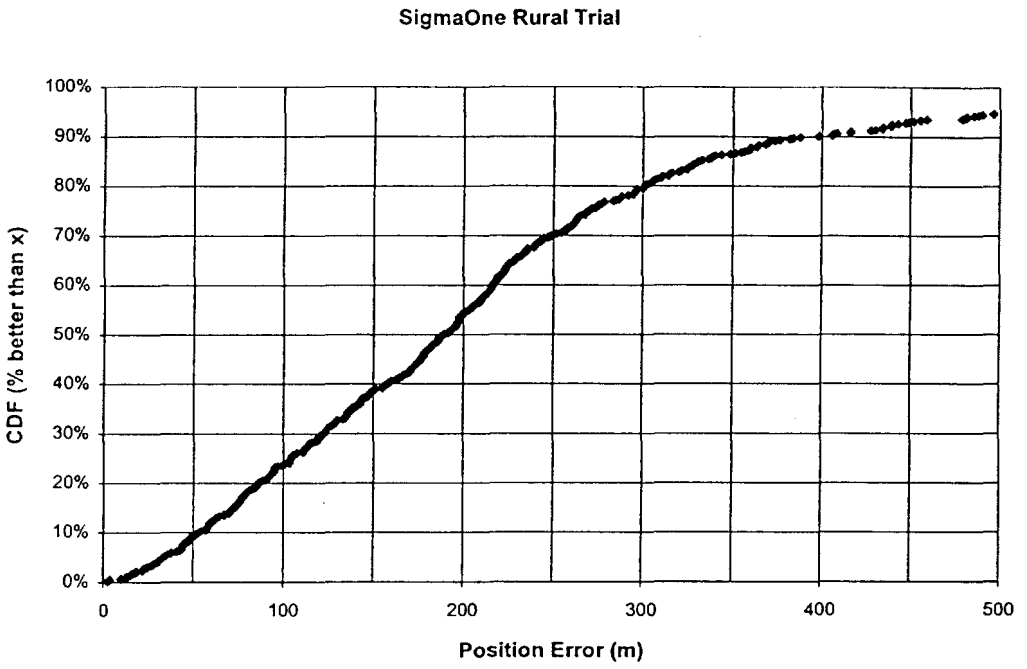
RadioCamera Off-Grid



RadioCamera (On and Off Grid)



A.3 SigmaOne


SigmaOne Rural Trial
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
CDF (% better than x)
0
100
200
300
400
500
Position Error (m)

ATTACHMENT E

ATTACHMENT E

DECLARATION OF DR. ANDREW W. CLEGG

I, Dr. Andrew W. Clegg, hereby declare and state as follows:

I have a PhD in Radio Astronomy and Electrical Engineering from Cornell University (1991) and have been employed as a Principal Member of the Technical Staff for Cingular Wireless LLC ("Cingular") since its inception. Prior to joining Cingular, I was a Senior Manager for BellSouth Cellular Corporation (1999 – 2000), and a Senior Engineer for BellSouth Mobility DCS (1997-1999). Previously, I was a Senior Engineer for Comsearch (1996-97), an Adjunct Program Manager for the National Science Foundation Electromagnetic Compatibility Unit (1994-95), and a Staff Scientist for the Naval Research Laboratory, Remote Sensing Division (1991-95). I make this Declaration in support of Cingular's Petition for Limited Waiver of Section 20.18(f) (the "Petition"). All facts stated herein are based upon my personal knowledge.

I am personally familiar with Cingular's efforts to implement Phase II location information. Cingular has contacted approximately 19 vendors and I have personally been involved in discussions with all of these vendors. Cingular has been actively seeking Phase II solutions since its inception. Cingular's parent companies SBC and BellSouth were also actively seeking Phase II solutions prior to the creation of Cingular. I was personally involved in BellSouth's efforts and have reviewed reports regarding SBC's efforts. To the best of my knowledge, Cingular has conducted more field trials of a greater variety of location technologies than any other carrier, public safety agency, or location technology vendor. Cingular has tested virtually all location technologies across virtually all environments. Specifically, Cingular has tested Time Difference of Arrival ("TDOA"), Angle of Arrival with TDOA ("AOA/TDOA"), RF Mapping, Enhanced Observed Time Difference of Arrival ("E-OTD"), and Assisted Global Positioning System ("A-GPS") technologies in urban, suburban, and rural environments, as well as in outdoor, indoor, in-vehicle, and in-motion settings. Cingular has also recently tested a switch-based technology in an outdoor suburban environment.

In addition, as part of my duties I previously prepared a report entitled "E-911 Phase II Trial Results" that accurately summarizes the trial results of several E-911 Phase II location technologies, including AOA/TDOA, TDOA, A-GPS, E-OTD and RF mapping systems. The earliest trials were conducted in May 1999 and others continue today. A copy of the report has been appended to the Petition, as Attachment D. The results of the switch-based location technology test are accurately set forth separately in the Waiver Petition.

As Cingular has clearly expressed on many occasions before the FCC and in other public fora, none of the technologies that it has tested can meet the present accuracy requirements contained in Section 20.18. In each and every case, the potential solutions considered by Cingular, SBC, and BellSouth did not satisfy the Commission's accuracy requirements.

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed August 29, 2001

Dr. Andrew W. Clegg

ATTACHMENT F

MOTOROLA

June 5, 2001

Mr. Jim Sheehan
Director of Equipment/Logistics
Triton PCS
1100 Cassatt Road
Berwyn, PA 19312

Dear Jim:

Going forward, Motorola has limited the scope of its research and development for TDMA handsets, and feels that the potential for TDMA handset-based location technology is not promising.

Motorola does not build TDMA network infrastructure and therefore is not in a position to comment on the merits of any TDMA network based location technology. However, Motorola has been a leading supplier of TDMA handsets and has reduced development of TDMA products for a number of reasons. TDMA is, essentially, a second generation technology that does not have a simple transition path to more advanced systems with richer features. In contrast, both GSM and CDMA have well established and recognized migration paths to 2.5 generation and 3rd generation advanced systems. Because of the desires of wireless providers to ensure a next generation transition path, Motorola is realigning resources and portfolios towards GSM and CDMA.

In light of these events, Motorola will have very little new product development for TDMA handsets and, based on an apparent lack of future demand, has not planned for the development of handset-based location technology for TDMA handsets. Therefore, Motorola will not have a handset-based location technology available for the TDMA air interface in time for the October 1, 2001 deadline promulgated by the Commission.

Please let me know if you have any questions.

Regards,

Lenny Frucht

Lenny Frucht
Sr. Regional Business Manager

Personal Communications Sector
1000 Corporate Drive, Suite 600, Fort Lauderdale, Florida – (954) 267-5007, Fax (954) 267-5233

Nokia Mobile Phones

June 8, 2001

Mr. Jim Sheehan
Director, Equipment and Logistics
TritonPCS
1100 Cassatt Road
Berwyn, PA 19312

Dear Jim,

Per our conversation of June 7, 2001 and referencing FCC Docket number 94-102, this letter is intended to clarify for TritonPCS Nokia's intentions with regard to GPS as a location technology solution for TDMA.

Nokia is a major handset vendor for TritonPCS. Nokia has evaluated several possible location technology options for TDMA. Nokia's position with regards to GPS as a location based technology for TDMA is this: due to certain marketing, technical and cost issues, we will not be developing GPS-equipped TDMA handsets. This decision was made because there was insufficient demand for such handsets and Nokia did not believe that they could have been competitive in the market for all product categories due to increased costs and form factor changes.

Thank you Jim. If you have any further questions or concerns, please do not hesitate to contact me.

Regards,

Michael Flemming, Carrier Strategy Manager

Nokia Mobile Phones

16710 N.E. 79th Street, Suite 202
Redmond, WA 98052
(425) 867-5449

Panasonic

Matsushita Mobile Communications Development Corporation of U.S.A.
Corporate Office

1225 Northbrook Parkway
Suite 2-400
Suwanee, GA 30024

770.338.6000
770.338.6210 Fax

May 30, 2001

Mr. Jim Sheehan
Director Equipment and Logistics
Triton PCS
1100 Cassatt Road
Berwin, PA 19312

Dear Mr. Sheehan:

This letter is in response to your inquiry regarding Panasonic's plans to support E-911 functionality. Panasonic TDMA handsets currently in production for the U.S. market do not include specific handset-based technology support for automatic location identification. Several operators have disclosed in public filings their intent to satisfy FCC requirements via network overlay systems which will work with all TDMA handsets, including current and future Panasonic TDMA handsets. Given this along with current technological and market limitations associated with proposed handset-based solutions and anticipated decline in TDMA handset demand, Panasonic intends to focus investigation of alternative handset-based solutions towards future products based on GSM and next generation wireless access technologies.

As always we endeavor to meet and exceed customer and market expectations and hope we can satisfy your future product needs.

Please do not hesitate to contact me should you require further information.

Sincerely,

Robert J. Miklosko

Director, Product Planning

EUS/RK/BB-01:073
June 27, 2001

Mr. Bobby K. Adams
Executive Director- Intelligent Networks Products and Services
Cingular Wireless
5565 Glen Ridge Connector
Suite 930
Atlanta, GA 30342

Cc:
Kris Rinne
Bill Clift
Steve Hardin

Re: Ericsson Support for MNLS Technology for E911 Phase 2 compliance

Dear Mr. Adams,

This letter responds to your request that Ericsson provide Cingular with general information regarding MNLS (Mobile Assisted Location System) positioning technology that we are developing as an alternative to support the E911 Phase 2 function.

The Ericsson MPS-T1.2 will have a general availability of Q-4-2001

The MNLS technique makes use of an existing mechanism of TDMA IS-136 and IS-54B handsets, in which the mobile handset makes measurements to assist the wireless system in determining the best cell site to handoff the mobile. In this technique, often referred to as MAHO (mobile-assisted handoff) the mobile is commanded by the wireless system to make signal strength measurements of up to 24 neighboring base stations. The mobile makes these measurements on the continually transmitting strong control channel broadcast from each base station sector to the mobile. In TDMA, the MAHO list is controlled by the operator, and makes measurement on every MAHO candidate channel regardless of signal strength. This provides a list of the broadcast power from multiple cell sectors to a mobile in its current position. Since the MAHO measurements can be made down to the minimum sensitivity level of the phone (-113 dBm), the mobile is able to "hear" sites within a large radius.

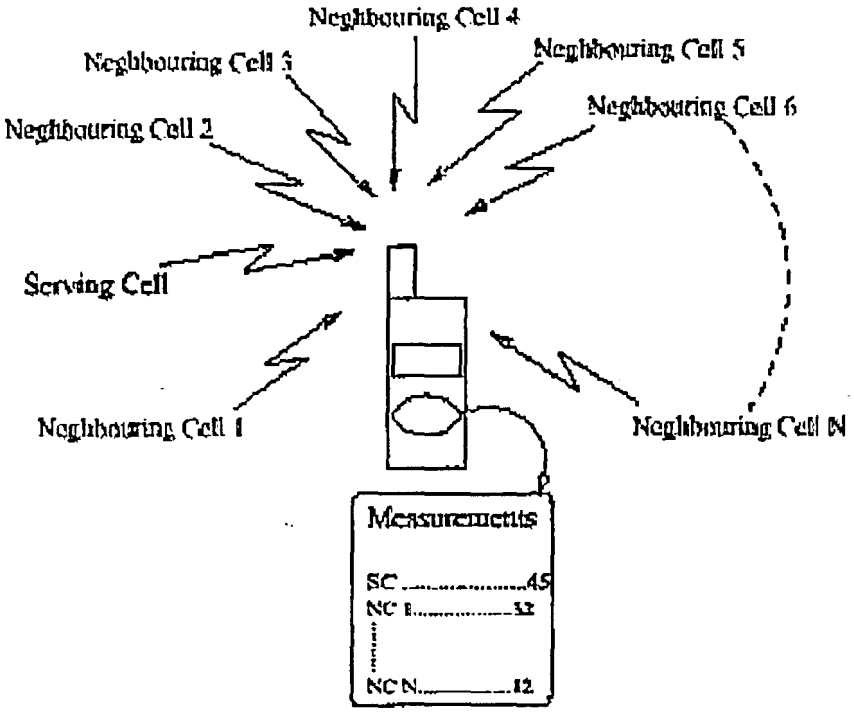


Figure 1: Mobile measures neighboring base stations signal strength

After making these signal strength measurements, the mobile will transmit these reports back to the wireless system. These reports will be sent while the 911 voice call is being setup to the PSAP. (Note: The 911 call is not held or delayed prior to call setup.) Unlike some other network solutions, an advantage of the MNLS system, is that MAHO reports are transmitted from the phone every 1 second during a TDMA call, consequently, this technology could provide the ability to track the 911 call, rather than just an initial location at call setup.

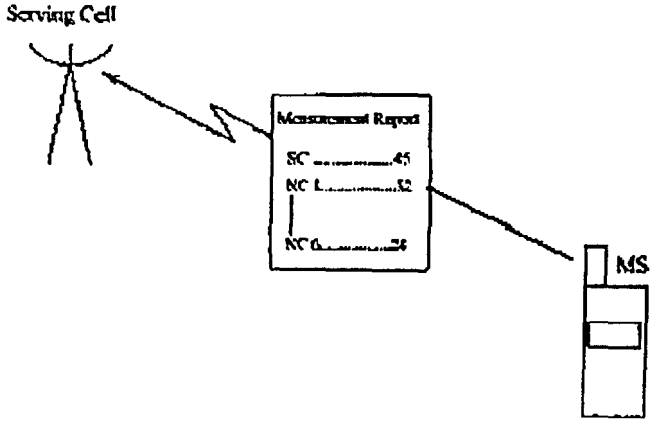


Figure 2: Mobile reports the measurements it made back to the wireless system

The MAHO lists and cell site information are delivered to a processor that can determine mobile location with either, or a combination, of two techniques: the first one called "triangulation", and the second one known as "contour matching".

In the first technique, termed "triangulation", the signal strength from multiple MAHO channels is associated to their cell site location. This then produces a geometric triangulation mathematical problem that can be solved to determine the mobile's location.

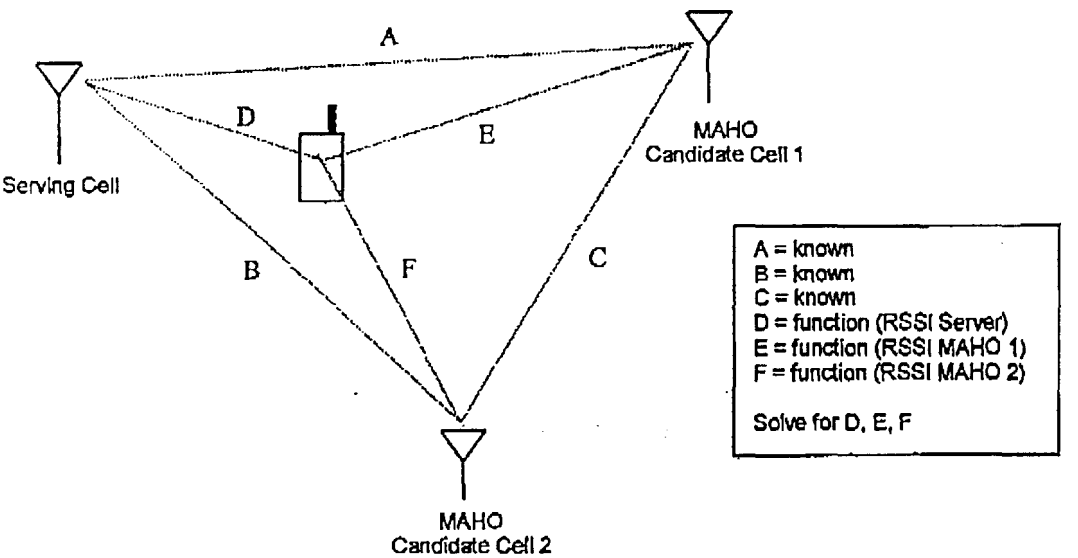


Figure 3: Example of "triangulation" to determine location, 3 sites example.

In the second technique, termed "contour matching", the wireless system receives these measurements and compares these relative signal strength measurements to a specially developed database of stored relative signal strength measurements within the cell serving the call. The wireless system will then determine the location of the mobile by matching it to one of these predetermined grid locations in the database.

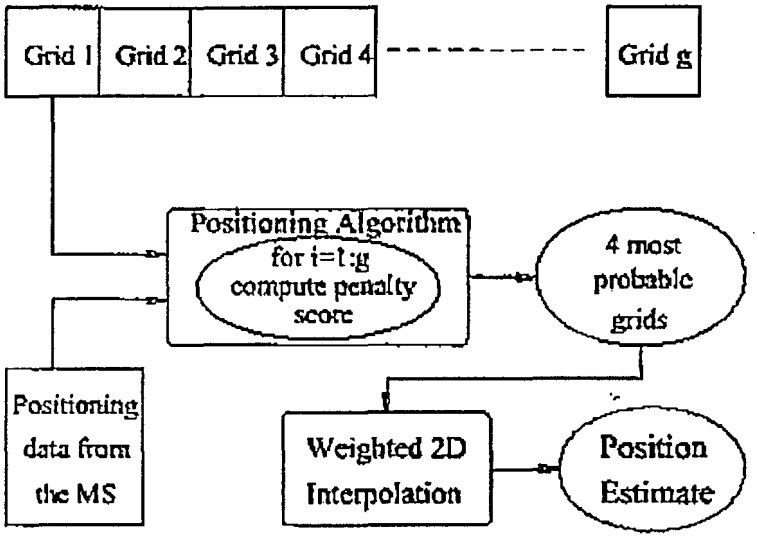


Figure 4: Wireless system determines location by matching DB grids to mobile report

The database for the grid measurements can be created in several different methods. The best method is to use available RF engineering tools to predict the expected received signal strength (RSS) measurements within grids as small as 50 meters. These engineering tools take into account antenna height and type, down-tilt, beam width, effective radiated power, and ground clutter. These predictive measurements can then also be augmented with real world measurements to increase accuracy in difficult areas.

It is possible to use both the triangulation and contour match techniques in combination. In combination, it would allow for the most flexibility.

Status of Standards Efforts:

MNLS is a fully standards-compliant solution that is currently being adopted by TR45.2 AHES (Ad-Hoc on Emergency Services), the industry-PSAP body overseeing wireless E911 standards.

Advantages:

The MNLS has many advantages over other alternate solutions investigated. These advantages include:

1. Legacy handsets – The systems works with all TDMA handsets in the ANSI-41 network. No changes, upgrades or replacements are necessary to these handsets.
2. Roaming support – MNLS will support all TDMA handsets roaming into our network.
3. Non-valid/uninitialized handsets – MNLS will support TDMA phones that do not have a valid account or phone number.
4. High Reliability – MNLS is using the same functionality normally required by the network. Therefore, if problems arise, they will be detected immediately. The integral nature of the MNLS solution to the overall network dramatically increases the reliability of the system.
5. Standards compliant – MNLS is a fully standards compliant (see above).
6. Updated Location – One of the advantages of the MNLS system is the fact that locates can be completed repeatedly on the same 911 call, in order to allow PSAPs additional information, such as direction of travel, etc.
7. Improvement – The accuracy of the system can most likely be improved with ongoing enhancements to the algorithms, and to the location grid database.
8. One of the advantages of the MNLS system is the fact that locates can be completed repeatedly on the same 911 call, in order to allow PSAPs additional information, such as direction of travel, etc.

Accuracy:

The following are the approximate accuracies expected:

All Environments	67%	95%
All Calls	Approx. 250 meters	Approx. 750 meters

Please let me know if we can address any further questions.

Sincerely,

Mikael Stromquist
Vice President and Chief Technical Officer
Ericsson

NORTEL NETWORKS

How the world shares ideas.

July 3, 2001

Evans Roberts
Cingular Wireless
5565 Glenridge Connector
Atlanta, GA 30342

Re: TDMA based E911 Phase 2 core network technology and CALEA punch list functionality

Dear Evans:

In this letter, Nortel Networks details its plans for making the E911 Phase 2 core wireless network technology (E911 technology) and the CALEA punch list functionality available.

E911

Nortel Networks is committed to its part in enabling an end-to-end, E911 Phase 2 location information solution. As explained in this letter, Nortel Networks will supply the E911 technology enabling wireless carriers using its DMS-MTX switch, when interworking with other parties and technologies, to convey location information to the Public Safety Answering Point (PSAP).[1] Despite diligent development efforts, the E911 technology will be made generally available after October 1, 2001 as detailed in this letter. [2]

Required Components and Availability Details

The E911 technology for use with the DMS-MTX platform requires a combination of hardware and software which Nortel Networks has designed to operate

[1] The Nortel Networks DMS-MTX switch is generally used by carriers to support TDMA and CDMA wireless protocols. Note that the E911 technology does not support Satellite Assisted Mobile Positioning Systems (SAMPS) based TDMA handset solutions. This handset solution is not supported because Nortel Networks understands that no handset vendor plans market introduction of a SAMPS enabled handset.

[2] By generally available, Nortel Networks means that the product has been adequately tested, any corrections made and offered commercially to all carriers desiring to purchase or license the product or software.

in accordance with the E911 applicable J-STD-036 standard. The functional elements constituting the Nortel Networks E911 technology are switch software, RF Access system software, Mobile Positioning Center (MPC) and Positioning Determining Entity (PDE).

The E911 technology elements will be made generally available by Nortel Networks according to the following schedule.

Component	Role	GA Date
MTX10	Switch software	Q4 2001
NBSS10.1	RF access subsystem	Q4 2001

Nortel Networks will make its combined MPC/PDE generally available in Q2 2002. Because the functions performed by the MPC/PDE are standards based, carriers using the Nortel Networks MTX platform may procure the necessary technology from other vendors and need not wait until Nortel Networks makes its MPC/PDE available to deploy E911. Finally, IOS version 4.0 must be deployed in carriers' networks with equipment from multiple vendors. The IOS software will become generally available in Q1 2002.

This schedule represents Nortel Networks' current plan. This plan could be altered by a number of factors, including unavailability of handsets for testing and resolution of technical issues identified through interoperability testing of the E911 technology with other vendors' technology contributions.

Even after general availability, carriers will need time to deploy the solution across the portions of their networks covered by validated PSAP requests.

MNLS

Nortel Networks is currently evaluating development of Mobile Assisted Network Location System software ("MNLS") for the DMS-MTX switch. Nortel Networks understands that Cingular desires to use MNLS for Cingular's TDMA network through a waiver similar to the one sought by AT&T Wireless in its April 4, 2001 waiver request to the FCC E911 requirements.

Nortel Networks has not yet committed to the development of the MNLS feature, however, a final decision regarding MNLS development is expected within a month. The actual availability date will be determined in conjunction with the development decision and should development commence, availability would occur in the mid 2002 timeframe.

As Cingular is aware, the FCC has not yet approved the AT&T Wireless request. In addition, Nortel Networks feels that MNLS will not meet the FCC accuracy requirements for a network based location solution.

Standards

As noted, the E911 technology is standards based. Applicable standards were only approved and published last year. Generally, 18 to 24 months are needed between standard adoption and development of compatible technology. As you will note from the discussion in the above section entitled "Required Components and Availability Details", Nortel Networks has bested or equaled the usual timelines for delivery of functionality after a standard is published.

Field Trial

Nortel Networks endorses an end-to-end field trial before a more extensive roll-out of the E911 technology takes place. The end-to-end field trial is important because, to address the overall goal of the delivery of location information to a PSAP, the E911 technology must successfully interwork with the E911 components supplied by other vendors as well as technologies supplied by other necessary parties, such as the location technology provider and the Local Exchange Carrier.

The successful conclusion of the trial will provide a validated solution across all necessary technologies and parties. To deploy a solution without an end-to-end field trial could lead to remedying the same issues multiple times in a serial fashion. Nortel Networks does not have the resources to deploy the E911 technology and then correct issues, that may well be identical, simultaneously. Other necessary parties, such as the location solution vendors and Local Exchange Carriers and even wireless carriers, may have similar limitations.

CALEA

Nortel Networks will make six punch list items available in generic software release MTX10. Each item will be individually toggled. As noted above, the MTX10 generic software release will become generally available in Q4 2001, shortly after the initial FCC compliance date of Sept. 30, 2001. Any hardware necessary to achieve compliance with the punch list requirements is available now.

Nortel Networks has moved diligently to develop the CALEA punch list functionality since the standards were adopted for the punch list items in April, 2000. Nortel Networks will begin trialing the CALEA software later this summer with several customers. Nortel Networks plans to test the MTX10 CALEA software with the FBI later this year.

Nortel Networks plans to shortly provide the FCC with its delivery schedule for E911 technology and the CALEA punch list functionality. The FBI will be presented with a copy of the Nortel Networks presentation for purposes of demonstrating when the punch list features will be made available. Your company may want to contact the FBI about CALEA flexible deployment in light of the availability of MTX10 after the Sept. 30 compliance date.

If you should have any questions, please contact Tony Smith, Director, Wireless Regulatory Affairs, Nortel Networks at (972) 685-8779.

Sincerely,

Steve McNitt
Director, Wireless Strategy