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FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

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October 23, 2001

Ms. Magalie Roman Salas  
Office of the Secretary  
Federal Communications Commission  
445 Twelfth Street, SW  
The Portals – Room TW-B204F  
Washington, DC 20445

**Re: Ex Parte Presentation in Re: ET Docket No. 00-221**

Dear Ms. Salas:

Pursuant to Section 1.206 of the Commission's rules, MicroTrax™ hereby provides notice and disclosure of its meeting with Peter Tenhula. The meeting occurred on Wednesday, October 17, 2001. Present on behalf of MicroTrax™ were Mr. Brian Holt, Mr. Ron Glover, and the undersigned.

The matters discussed included a review of the Comments and Reply Comments previously filed by MicroTrax™ in this docket, which are a matter of record. In addition, MicroTrax™ presented a discussion of the potential benefits of a personal location and monitoring service in connection with public safety for police and firemen and for the general public in matters of national disaster and terrorist circumstances. The matters discussed are contained generally in the attached slides drawn from a PowerPoint presentation.

In addition, MicroTrax™ raised the issue of the amount of relocation compensation required for the successful bidder with respect to the 2385-2390 MHz band. Those costs are generally found in pages from the attached NTIA Special Publication 01-44 *Assessment of Electromagnetic Spectrum Reallocation*.

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Ms. Magalie Roman Salas

October 23, 2001

Page 2

Should you have any questions with respect to this meeting or with respect to this letter, kindly contact the undersigned.

Sincerely,



Gregg P. Skall

cc: Mr. Peter A. Tenhula (8-B201)  
Mr. Brian Holt  
Mr. Ron Glover

# ASSESSMENT OF ELECTROMAGNETIC SPECTRUM REALLOCATION

Response to Title X of the  
National Defense Authorization Act for Fiscal Year 2000



Special Publication

The Army has permanent assignments recorded in this band. However, the bulk of the Army assignments are temporary assignments from the tactical radio relay equipment during training and operations that are not recorded in the national database as are the permanent assignments. The training and operational exercises are situational and vary in size and typically the number of tactical assignments can range in the tens to the hundreds per exercise.

**Energy.** The DOE also uses this band for warehouse materials management and range airborne telemetry at the Nevada Test Site. DOE estimates that the cost to re-accommodate the warehouse materials management and range telemetry systems would be \$300,000.

In balancing the public benefit and impact (mission and cost) to the Federal Government, the 1432-1435 MHz band was reallocated for non-Federal use on a mixed-use basis. This will preserve the investment made by the Federal Government and permit essential military operations to continue, while making additional spectrum available for the development of commercial wireless applications. However, essential military airborne operations at the sites listed in Table 3-11 and their associated airspace will be protected indefinitely.

### **2385-2390 MHz BAND**

The 2385-2390 MHz band is a part of the larger 2360-2390 MHz band that is used in conjunction with the 1435-1525 MHz band for aeronautical telemetry (ATM) functions. The 2360-2390 MHz band is allocated on a primary basis to the Federal Government for the mobile and radiolocation services. Specifically, for aeronautical flight test, radars used for scientific observation, and telemetry in support for commercial launch vehicles. The military uses this band to support telemetry in the flight testing of aircraft, spacecraft, and missiles at nine major military test ranges and numerous test facilities. The use of flight test telemetry is the only way to insure that the DoD accepts a fully tested quality product. This band is used to support such programs as the F-22, the Joint Strike Fighter, B-1, B-2, F-18 E/F, and the Ballistic Missile Defense Program. To minimize the operational impact on flight test programs that are ongoing and planned to begin in the near future continued Federal use of the 2385-2390 MHz band at the selected sites listed in Table 3-12 will continue for two years after the scheduled reallocation date (2005).

NASA has two test centers that use the 2360-2390 MHz band in conjunction with the Scientific Balloon Program and the Aeronautical Telemetry Program for unmanned air vehicle. The Scientific Balloon Program currently conducts 12 to 16 flights per year. NASA's use of the band for aeronautical telemetry averages two to four hours per day, however, it is anticipated that the total usage will increase.

NASA states that the loss of any portion of the 2360-2390 MHz band will impact the Scientific Balloon Program, which is a joint program with the Canadians. NASA states that the

**TABLE 3-11: SITES AT WHICH FEDERAL SYSTEMS IN THE 1432-1435 MHz BAND WILL BE PROTECTED INDEFINITELY**

Location	Coordinates	Protection Radius
China Lake/Edwards AFB, CA	35° 29' N 117° 16' W	100 km
White Sands Missile Range/Holloman AFB, NM	32° 11' N 106° 20' W	160 km
Utah Test and Training Range/Dugway Proving Ground Hill AFB, UT	40° 57' N 113° 05' W	160 km
Patuxent River, MD	38° 17' N 076° 24' W	70 km
Nellis AFB, NV	37° 29' N 114° 14' W	130 km
Fort Huachuca, AZ	31° 33' N 110° 18' W	80 km
Eglin AFB, Tyndall AFB, FL, Gulfport ANG Range, MS Fort Rucker, AL	30° 28' N 086° 31' W	140 km
Yuma Proving Ground, AZ	32° 29' N 114° 20' W	160 km
Fort Greely, AK	63° 47' N 145° 52' W	80 km
Redstone Arsenal, AL	34° 35' N 086° 35' W	80 km
Alpena Range, MI	44° 23' N 083° 20' W	80 km
Camp Shelby, MS	31° 20' N 089° 18' W	80 km
ATTEC <sup>a</sup>	24° 30' N 078° 00' W	80 km
MCAS Beaufort, SC	32° 26' N 080° 40' W	160 km
MCAS Cherry Point, NC	34° 54' N 076° 53' W	100 km
NAS Cecil Field, FL	30° 13' N 081° 53' W	160 km
NAS Fallon, NV	39° 30' N 118° 46' W	100 km
NAS Oceana, VA	36° 49' N 076° 01' W	100 km
NAS Whidbey Island, WA	48° 21' N 122° 39' W	70 km
NCTAMS, GUM <sup>a</sup>	13° 35' N 144° 51' E	80 km
Lemoore, CA	36° 20' N 119° 57' W	120 km
Naval Space Operations Center, MF	44° 24' N 068° 01' W	80 km
Savannah River, SC	33° 15' N 081° 39' W	3 km

<sup>a</sup> This site is located outside of the continental United States

new transmitters purchased for the Scientific Balloon Program are multi-band and tunable over the entire 2300-2399.5 MHz band. However, NASA believes that the congestion that currently exists in the band will make it impossible to relocate this activity and that other spectrum will have to be found. NASA states that unavailability of spectrum will mean the loss of three flights per year from resulting from inadequate ground support or not having options to avoid frequency conflicts. NASA states that the direct impact could be expected during the heaviest flight schedule periods of March through October each year. NASA maintains that because of the time-sensitive nature of many of these experiments, delays resulting from the loss of spectrum will probably have the impact of tarnishing the reliability of the scientific balloon support capabilities.

The DOE uses this band for an airborne ranging system that supports Sandia National Laboratory research and development at Edwards AFB, California and in New Mexico

Cornell University operates the NAIC under a cooperative agreement with NSF. NAIC in turn, operates a megawatt planetary research radar occupying 20 MHz of bandwidth centered at 2380 MHz as part of the \$100 million Arecibo Observatory in Puerto Rico. It is the world's largest radio telescope and radar station. Radar echoes from objects such as comets, planets, and the Moon contain information about surface properties, orbit and object size. This enables controllers, for example, to guide spacecraft accurately to specific positions on other planets. The Arecibo Planetary Radar is also used to keep track of space debris, and to detect minor objects in the solar system. It is one of the only two such facilities, the other being part of NASA's Deep Space Network, at Goldstone, California. Some bi-static radar applications require simultaneous operations at both facilities.

Specific impact of the reallocation of the 2385-2390 MHz band on the Federal agencies is presented below:

*Air Force.* The Air Force states that reallocation of the 2385-2390 MHz band will cost them hundreds of millions of dollars for their major test ranges. Their estimate assumes that suitable spectrum will be available for relocation such that current equipment can be re-tuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs will be significantly higher.

*Navy.* The Navy states that the loss of the 2385-2390 MHz band will result in program slippages that will impact their ability to test and field aircraft weapon systems. The Navy maintains that losing this additional spectrum will delay the F-18 E/F test and evaluation program as well as other projects at major test ranges. The Navy estimates that the total reallocation cost will exceed \$100 million. This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be re-tuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs will be significantly higher.

**TABLE 3-12: SITES AT WHICH FEDERAL AND COMMERCIAL SYSTEMS IN THE 2385-2390 MHz BAND WILL CONTINUE TO OPERATE UNTIL 2007 <sup>a</sup>**

Location	Coordinates	Radius of Operation
Yuma Proving Ground, AZ	32°54' N 114°20' W	160 km
Nellis AFB, NV	37°48' N 116°28' W	160 km
White Sands Missile Range, NM	32°58' N 106°23' W	160 km
Utah Test Range, UT	40°12' N 112°54' W	160 km
China Lake, CA	35°40' N 117°41' W	160 km
Eglin, AFB, FL	30°30' N 86°30' W	160 km
Cape Canaveral, FL	28°33' N 80°34' W	160 km
Seattle, WA	47°32' N 122°18' W	160 km
St Louis, MO	38°45' N 90°22' W	160 km
Palm Beach County, FL	26°54' N 76°25' W	80 km
Barking Sands, HI <sup>b</sup>	22°07' N 159°40' W	160 km
Roosevelt Roads, PR <sup>b</sup>	18°14' N 65°38' W	160 km
Glasgow, MT	48°25' N 106°32' W	160 km
Edwards AFB, CA	34°54' N 117°53' W	100 km
Patuxent River, MD	38°17' N 76°25' W	100 km
Wichita, KS	37°40' N 97°26' W	160 km
Roswell, NM	33°18' N 104°32' W	160 km

<sup>a</sup> The DoD has raised concerns about the need to include additional military sites in this band. NTIA will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

<sup>b</sup> This site is located outside of the continental United States.

Army. The Army also uses this band for a variety of in-flight telemetry and other telemetry uses. The Army states that their use will be accommodated in the remaining telemetry spectrum, but programs will be more expensive due to more testing time required to gather data. The Army estimates that the reallocation cost for the 2385-2390 MHz band segment will exceed \$20 million.

This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be re-tuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs will be significantly higher.

The military has a continuing need to flight test operational, as well as developmental aircraft. The loss of spectrum will cause a decrease in the number of simultaneous test flights that can occur. This creates additional costs for the flight test programs. Programs that may incur increased costs or delays include the F22, Airborne Laser, F-16, F-15, B-1, B-2, B-52, and Joint Strike Fighter Programs.

*National Aeronautics and Space Administration.* NASA states that their ATM Program would also suffer as a result of losing more spectrum in the 2360-2390 MHz band. NASA maintains that losing more spectrum without identifying spectrum to replace it is only delaying the problem to a time when it will become more serious because projects are going to higher data rates and higher resolution video. NASA states that studies on data compression have shown only minimal gains in bandwidth resolution which will not come close to keeping up with the increases in bandwidth requirements for ATM. NASA states that the transmitters used in their ATM Program are tunable, and if they are able to re-tune within the same band the estimated reallocation cost will be minimal.

*Energy.* The DOE states that their airborne ranging system has an 11 MHz bandwidth, with the ground uplink operating at 2315.48 MHz and the airborne downlink operating at 2379.8 MHz. The DOE states that the reallocation of the 2385-2390 MHz band will not cause a substantial impact to the airborne downlink if 1) the authorized bandwidth can be reduced slightly from 11 MHz to 10.4 MHz and 2) the new private sector service has equipment that is not susceptible to relatively low-level emissions from the adjacent band. The DOE believes that since small frequency adjustments can be made to their system there should be no substantial impact.

In balancing the public benefits and the impact to the Federal Government, the 2385-2390 MHz is reallocated for exclusive non-Federal use in 2005. The Federal Government will retain the rest of the band (i.e., 2360-2385 MHz) to satisfy current and future ATM flight test spectrum requirements. A large majority of the equipment that operates in the 2360-2390 MHz band is tunable providing a great deal of flexibility within the band. The loss of this spectrum will have an impact on simultaneous ATM flight test operations at some test ranges. To provide protection to the Arecibo Planetary Radar, airborne transmissions and space-to-Earth transmissions will be prohibited in Puerto Rico.

In order to provide adequate time for engineering studies on spectrum efficient modulation techniques, budgeting, and modification of equipment it will require until 2005 to reallocate this band for non-Federal use. To minimize the operational impact on flight test programs that are ongoing or planned to begin in the near future, continued Federal and commercial use of the

2385-2390 MHz band at the selected sites in Table 3-12 will continue for two years after the scheduled reallocation date.

### Reallocation Costs Summary of Bands Reallocated Under BBA-97

Every effort has been made to insure that the bands identified for reallocation under BBA-97 meet the band selection criteria of Title III. However, the displaced Federal functions resulting from the reallocation must, in most cases, be preserved at a considerable cost to the Federal Government. The Federal agencies maintain that, in order to meet the time constraints of Title III of BBA-97, it is only possible to provide preliminary reallocation costs estimates since accurate data will require extensive cost and engineering analysis. Furthermore, the task of estimating reallocation costs becomes more complex as available spectrum continues to diminish. Table 3-13 summarizes the Federal reallocation costs for each of the affected Federal agencies.

**TABLE 3-13: ESTIMATED REALLOCATION COSTS SUMMARY FOR SPECTRUM REALLOCATED UNDER BBA-97**

Federal Agency	Frequency Band (MHz)	Estimated Reallocation Costs <sup>a</sup>
DoD	216-220, 1432-1435, 2385-2390	\$165-\$363 million <sup>b</sup>
Energy	216-220 & 1432-1435	\$2 million
Interior	216-220	\$2 million
Justice	216-220	\$7 million
NASA	2385-2390	\$4 million
Treasury	216-220	\$20 million <sup>c</sup>
<b>TOTAL</b>		<b>\$200-\$398 million</b>

<sup>a</sup> These estimated reallocation costs are reimbursable in pursuant to the National Defense Act for FY1999.

<sup>b</sup> A revised and combined reallocation costs for the Department of Defense (i.e., Army, Navy, and Air Force) is provided in the DoD Letter Report to the Chairman of the Committee on Armed Services of the United States Senate (The Hon. Strom Thurmond), Dec. 16, 1999 (see Appendix B). However, due to some reclaimed spectrum (i.e., 139-140.5 MHz, 141.5-143 MHz, and 1385-1390 MHz bands) the *total* DoD estimated reallocation costs for BBA-97 is adjusted to \$165-\$363 million.

<sup>c</sup> This is a revised reallocation cost from the \$4 million specified in the NTIA Spectrum Reallocation Report (Response to BBA-97).

In December 1998, the DoD provided the Chairman of the Committee on Armed Services of the Senate, the Honorable Strom Thurmond, with a report detailing the DoD's reallocation costs impacts on both the OBRA-93 and BBA-97 legislation. This report is in response to Section 1064 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999. As a result of the reallocation costs study provided by DoD in this report and due to the reclamation of some bands that were reallocated under BBA-97, the reallocation costs estimate originally specified in the NTIA report in 1997 has been modified as shown in the table below.

## **OVERALL ESTIMATED REALLOCATION COSTS SUMMARY**

The overall estimated reallocation costs includes costs for all frequency bands reallocated under OBRA-93 and BBA-97, notwithstanding some bands were reclaimed by the President for continued Federal use. In pursuant to the National Defense Act for Fiscal Year 1999, private sector entities are required to reimburse Federal users for relocations due to reallocation of spectrum assignments through competitive bidding. Further, the legislation sets forth that spectrum reallocated under BBA-97 and the 1710-1755 MHz band, which was reallocated under OBRA-93, are subject to mandatory reimbursement.

Table 3-14 provides the overall estimated reallocation costs summary, including the reimbursable and non-reimbursable relocation costs. Note that in the 1390-1400 MHz band and, specifically, in the 1710-1755 MHz band, some agencies have already started the relocation process well before the enactment of the Defense Act for Fiscal Year 1999. Since, the expended costs during this relocation process were Congressionally appropriated funds, these expended costs are non-reimbursable, as can be seen in Table 3-14.

## **POTENTIAL PUBLIC BENEFITS FROM REALLOCATED SPECTRUM**

Under the requirements of Title VI of OBRA-93, the Secretary of Commerce submitted a report to the President, the Congress, and the FCC identifying and recommending for reallocation bands of frequencies that are the most likely to have the greatest potential for productive uses and public benefits under the Communications Act of 1934, as amended, if allocated for non-Federal use.

The report identified the following factors in Section 113 of Title VI of OBRA-93, which have been used to address the public benefits of reallocating Federal Government spectrum (*see* NTIA Special Publication 95-32): a) the extent to which equipment is or will be available that is capable of utilizing the band; b) the proximity of frequencies that are already assigned for commercial or other non-Federal use; c) the extent to which, in general, commercial users could share the frequency with amateur radio licensees; and d) the activities of foreign government in making frequencies available for experimentation or commercial assignments in order to support

domestic manufactures of equipment. These were some of the key factors in the final identification of the reallocated spectrum in pursuant to OBRA-93.

Similarly, the criteria of Title III of BBA-97 in identifying spectrum for reallocation involves consideration of two overriding and sometimes conflicting factors: (1) the impact on the Federal agencies, in terms of mission, costs, and potential reduction of services to the public, and (2) the benefits expected to be realized by the public. In complying with the requirements and band selection criteria of Title III, the selected spectrum for reallocation, in pursuant to BBA-97, established a reasonable balance between these criteria, among other things.

This subsection provides the potential benefits that the public may realize (or may have already realized) due to the reallocation of spectrum, as conjectured in the FCC's Policy Statement Paper,<sup>10</sup> and other FCC and NTIA documents. The FCC paper was the main source of information upon which the discussion on public benefits evolved that, in some cases, entire paragraph were extracted from this paper and presented herein. Usually, a band-by band presentation delineating these public benefits is preferred, however, in some cases where bands are paired to maximize the potential benefits to the public, they are grouped to facilitate a simpler discussion. Note that only spectrum reallocated under the mandates of OBRA-93 and BBA-97 are discussed below.

#### ***216-220 MHz Band***

This band was originally allocated on a shared basis to the Government and non-Government for various radio services. This band was reallocated to the non-Government on a mixed-use basis in pursuant to BBA-97. Currently, this is one of the bands that the Commission has not made any proposed allocation for additional services. The 218-219 MHz portion of the band has already been auctioned for Interactive Video and Data Service operations. In addition, the band has a potential for new non-Federal fixed and mobile communications services. This band could also be used as an expansion to the existing non-Federal services.

#### ***1390-1400 MHz, 1427-1432 MHz, and 1432-1435 MHz Bands***

A number of parties, including the Land Mobile Communications Council (LMCC) have expressed a need for additional spectrum for private land mobile use.<sup>11</sup> Private land mobile radio

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<sup>10</sup> The FCC Statement Policy, *Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium*, (November 18, 1999)

<sup>11</sup> *Id* at 11.

**TABLE 3-14 OVERALL ESTIMATED REALLOCATION COSTS SUMMARY FOR SPECTRUM REALLOCATED UNDER OBRA-93 AND BBA-97**

Agency	FREQUENCY BANDS (MHz)											
	NON-REIMBURSABLE (Millions)								REIMBURSABLE (Millions)			
	1390-1400	1427-1432	1670-1675	1710-1755	2300-2310	2390-2450	3650-3700	4940-4990	216-220	1432-1435	1710-1755	2385-2390
USDA											\$48	
DOE									\$1.5	\$0.3	\$3	
DOC			\$35-55									
DoD <sup>a</sup>	\$152-\$272	\$23				\$51			\$0.37-\$1	\$44-\$147	\$38-\$138	\$120-\$215
DOI									\$2		\$8-13	
DOJ				\$132 <sup>b</sup>					\$7		\$55	
NASA											\$1	\$4
TREA									\$20 <sup>c</sup>		\$4-46 <sup>d</sup>	
TRAN	\$35 <sup>e</sup>			\$43 <sup>e</sup>							\$109	
<b>Total Non-Reimbursable = \$471 - \$611</b>									<b>Total Reimbursable = \$465-\$811</b>			

<sup>a</sup> The DoD reallocation costs were derived from the DoD Letter Report to the Chairman of the Committee on Armed Services of the United States Senate (The Hon. Strom Thurmond), Dec. 16, 1998.

<sup>b</sup> Through FY2000, \$32 million has already been expended by DOJ in converting fixed microwave systems to leased wireline. The \$32 million was a Congressionally appropriated fund.

<sup>c</sup> This is a revised reallocation cost from the \$4 million specified in the NTIA Spectrum Reallocation Report (Response to BBA-97).

<sup>d</sup> This is an updated cost recently provided by the Treasury. The higher cost is based on whether the Rainbow Microwave System in Hawaii, which is currently on the protected list, is subject to reimbursement.

<sup>e</sup> FAA has already expended \$12.7 million, as of July 2000, in relocating radars from the 1390-1400 MHz band and \$43 million in relocating fixed microwave systems from the 1710-1755 MHz band. The \$12.7 and \$43 millions were Congressionally appropriated funds.

systems are used by business to meet their specialized mobile communications requirements. The LMCC requests additional spectrum to relieve congestion in the existing private land mobile radio bands and to provide opportunities for use of new, spectrum efficient technologies that would improve and enhance business radio communications. To provide benefits to private land mobile users, the Commission considered establishing a new Land Mobile Communications Service in 15 MHz of spectrum, of which 10 MHz would be derived from the 1390-1395 MHz, 1427-1429 MHz and 1432-1435 MHz bands.<sup>12</sup> The Commission has stated that these bands, while not contiguous, are sufficiently close together to allow manufactures to design cost effective equipment.

Another group that might benefit from the reallocation of these bands from the Federal Government to non-Government use is the little Low Earth Orbit (LEO) satellite group. LEO satellite operators are seeking spectrum for feeder links in the region of this spectrum. As such, the Commission will consider the impact of allocations for other services on the possible use of these bands for little LEO feeder links.

The other five MHz portion of the 1390-1400 MHz band (i.e., 1395-1400 MHz) and the three MHz portion of the 1427-1432 MHz band (i.e., 1429-1432 MHz) are planned for allocation to a new wireless service. The potential beneficiaries of these bands are the new Wireless Medical Telemetry Service providers as well as the users. This service will enhance the ability of health providers to offer high quality and cost-effective care to patients with acute and chronic health care needs.<sup>13</sup>

#### ***1670-1675 MHz and 2385-2390 MHz Bands***

The Commission intends to consider allocating the 10 MHz of spectrum at 1670-1675 MHz and 2385-2390 MHz bands for fixed and mobile services and adopt appropriate service rules to permit licensees flexibility in the types of service to be offered and the technologies used to provide those services. The planned reallocation of these bands would provide additional spectrum for expanded development of new services and technologies that may emerge.

#### ***1710-1755 MHz Band***

The Commission is considering to benefit providers of a new flexible-use service available for fixed and mobile wireless services by providing a major allocation of 90 MHz for the

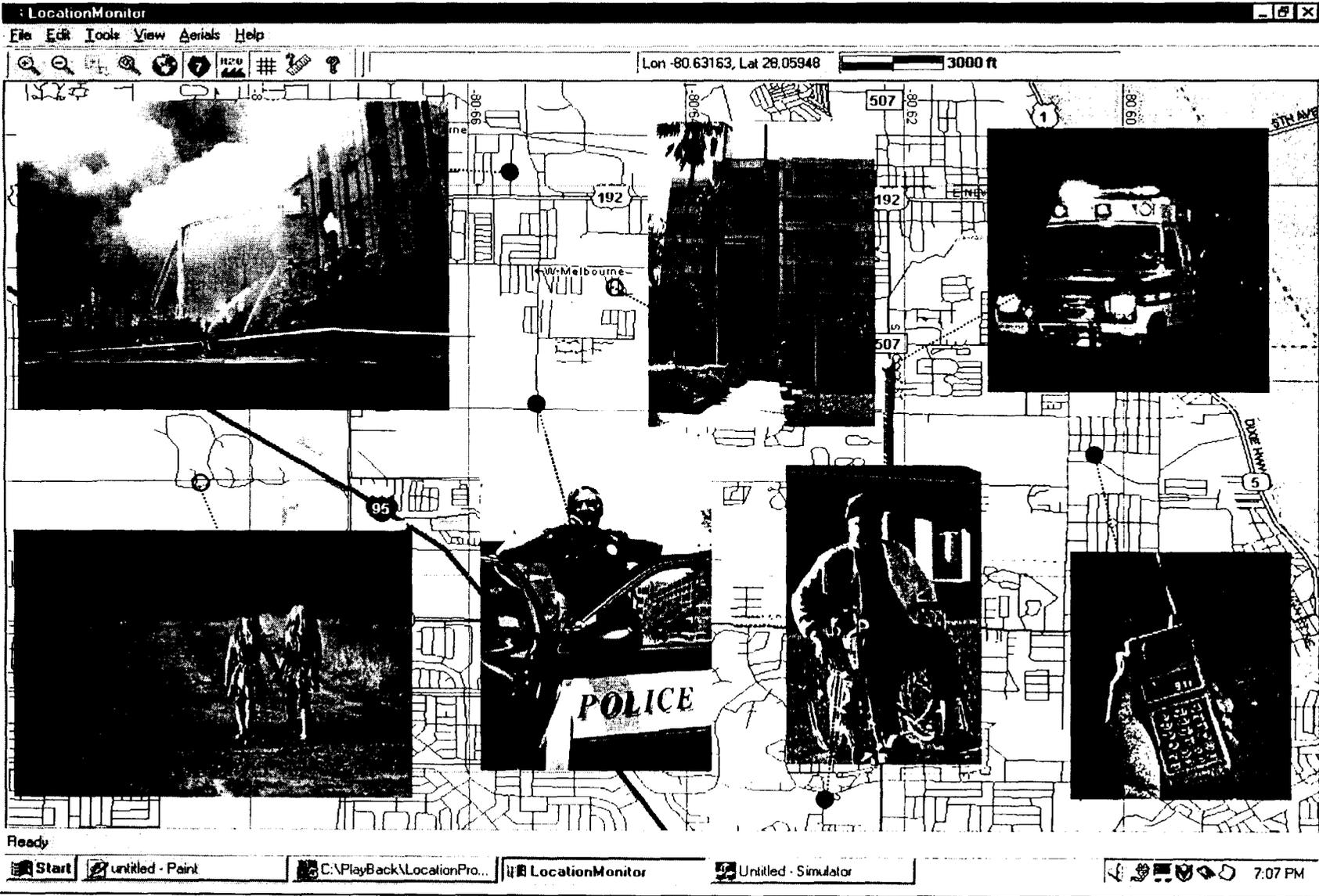
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<sup>12</sup> *Id*

<sup>13</sup> FCC Notice of Proposed Rule Making, ET Docket 99-255, FCC 99-182, as adopted July 14, 1999

# The Need for Personal Locating and Monitoring Services

# MicroTrax™



***A Locating and Tracking Demonstration***

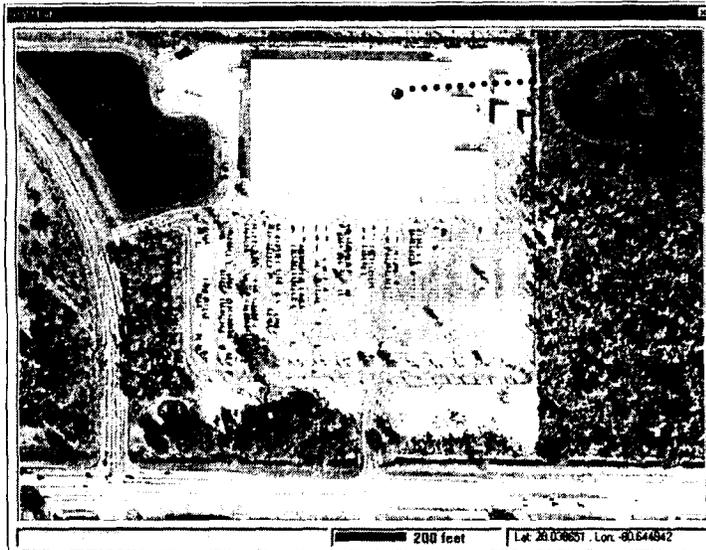
***Need For Personal Locating and Monitoring Service  
(PLMS)***

***Request Your Support for Spectrum Dedicated to PLMS***

# Actual Performance (a)

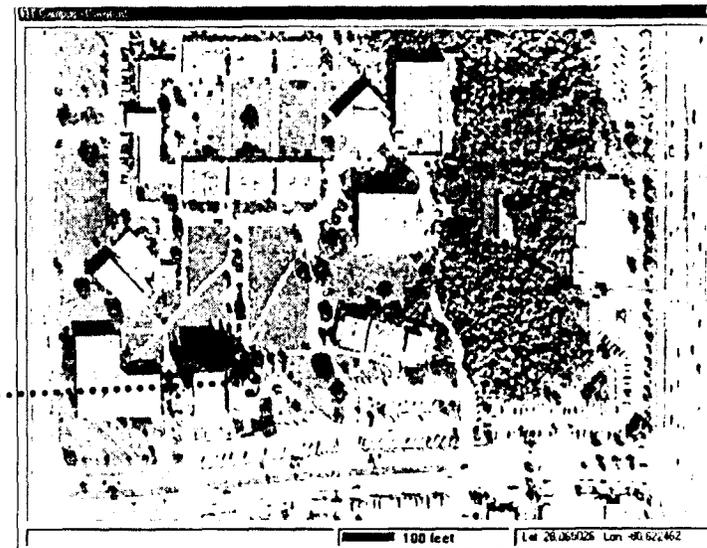
# MicroTrax™

## **MicroTrax™ Accurately Locates and Tracks People and Assets Indoors Where GPS and Cell-Phone Based Systems Fail**



..... **Body-worn Tag Located in  
North-East Corner of Wal-Mart  
Superstore Plotted on "Pull-  
Down" Aerial Photograph\***

**Body-worn Tag Located in  
Sub-basement Stairwell of 7-Story  
Building Where Cell-Phones Fail.  
Location Accuracy 25 Feet\***

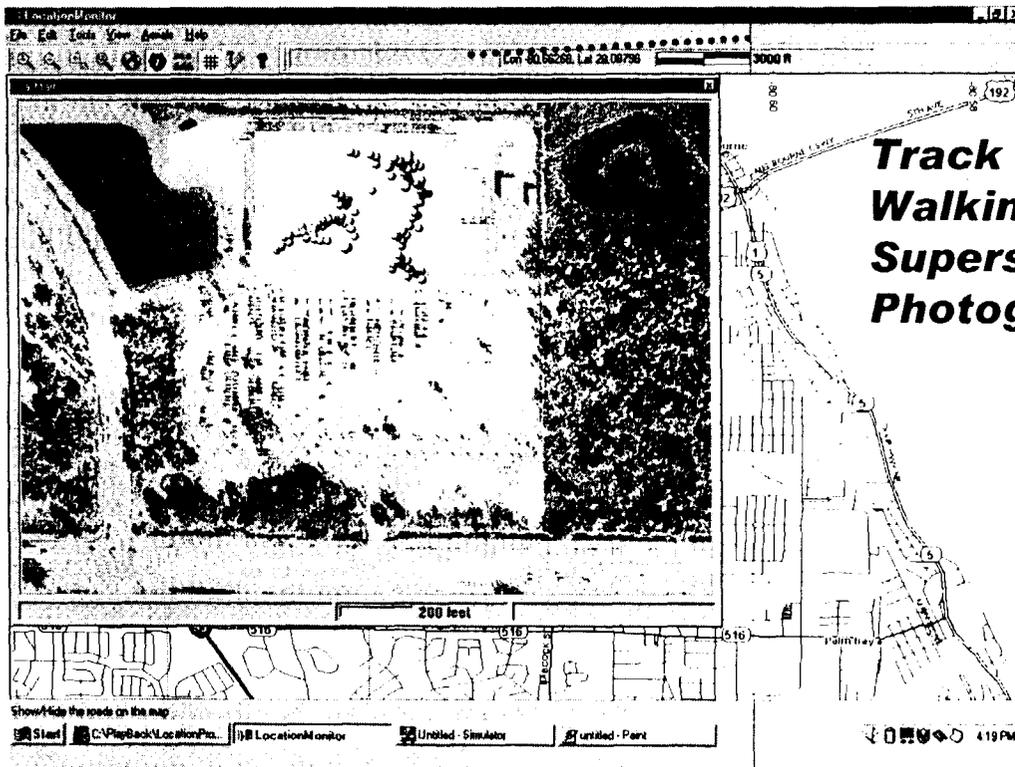


**\*Screen Prints of Display From Actual Demonstration of MicroTrax™ Operating Under FCC Experimental License.**

# Actual Performance (b)

# MicroTrax™

**MicroTrax™ Accurately Locates and Tracks  
People and Assets Indoors  
Where GPS and Cell-Phone Based Systems Fail**



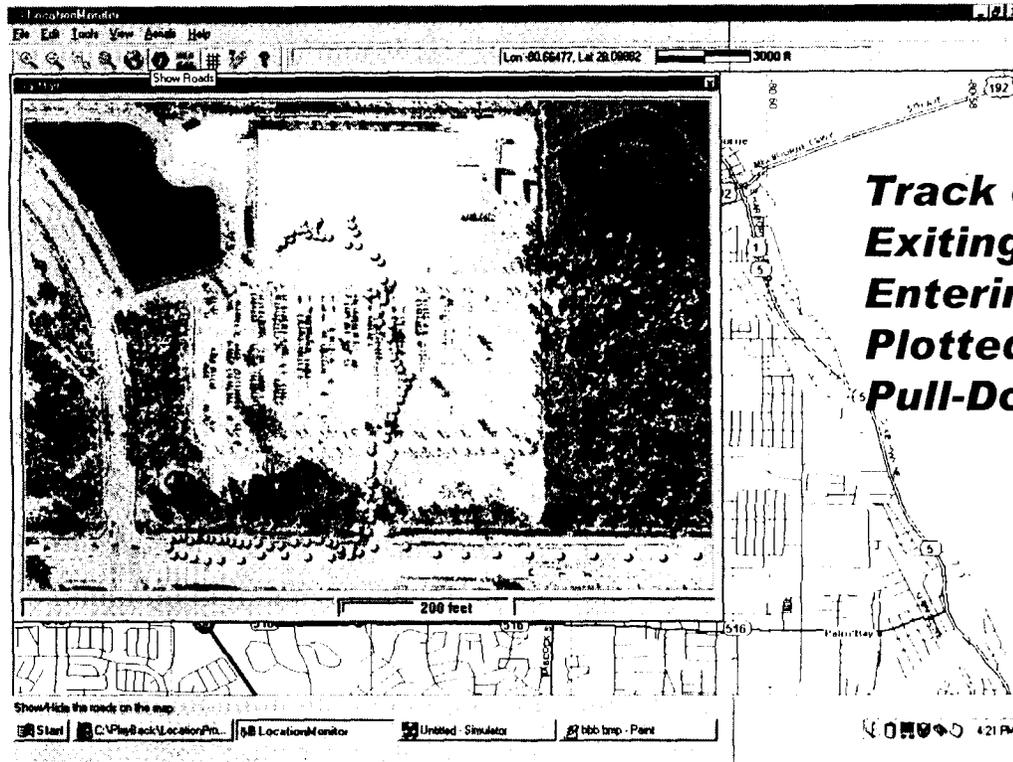
**Track of Person Wearing Tag  
Walking Inside Wal-Mart  
Superstore Plotted on Aerial  
Photograph Pull-Down\***

**\*Screen Prints of Display From Actual Demonstration of MicroTrax™ Operating Under FCC Experimental License.**

# Actual Performance (c)

# MicroTrax™

**MicroTrax™ Accurately Locates and Tracks  
People and Assets Indoors  
Where GPS and Cell-Phone Based Systems Fail**



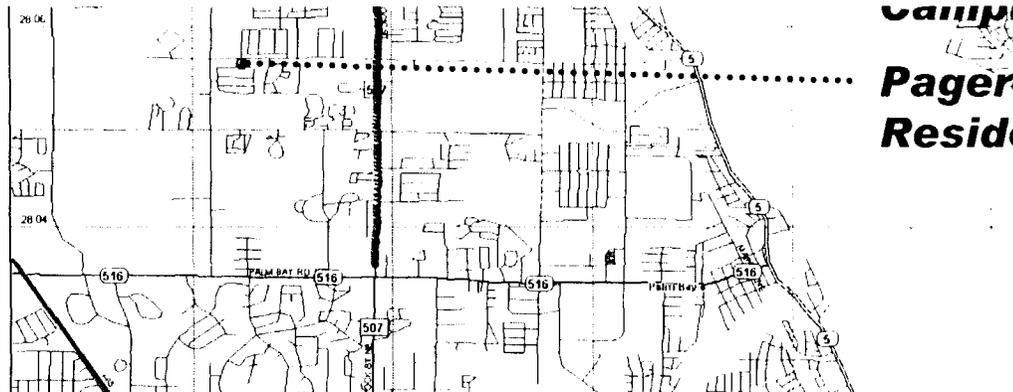
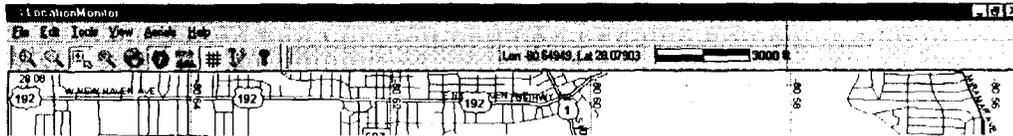
**Track of Person Wearing Tag  
Exiting Wal-Mart Superstore,  
Entering Car and Driving Away  
Plotted on Aerial Photograph  
Pull-Down \***

**\*Screen Prints of Display From Actual Demonstration of MicroTrax™ Operating Under FCC Experimental License.**

# Actual Performance (d)

# MicroTrax™

**MicroTrax™ Accurately Locates and Tracks  
People and Assets Indoors  
Where GPS and Cell-Phone Based Systems Fail**



**Campus flattened on map**

**Pager-Activated Tag Located in  
Residence**

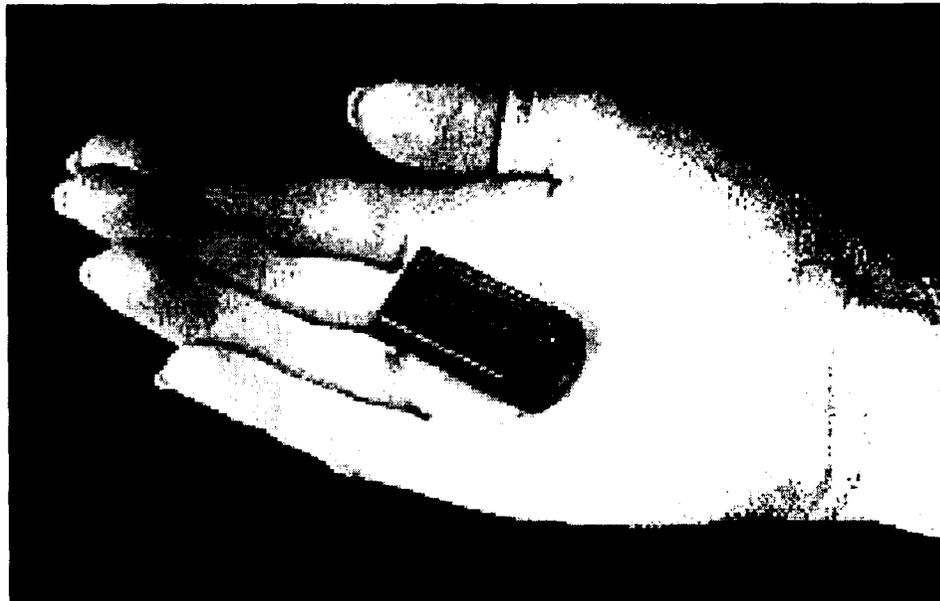
**\*Screen Prints of Display From Actual Demonstration of MicroTrax™ Operating Under FCC Experimental License.**

**The MicroTrax Tag**

**MicroTrax™**

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**An Effective PLMS Requires Small Tags  
With Many Months of Battery Life  
Which Are Easily Located Indoors or Outdoors  
With High Accuracy**



***Your Support for Allocation of Spectrum  
to the  
Personal Location and Monitoring Service (PLMS).***

- ***PLMS Will Provide Public Safety, Law Enforcement and Consumer Services Not Available by Other Means***
- ***PLMS Will Be an Important Adjunct to National Security***
- ***Dedicated Spectrum is Required for Effective PLMS***
- ***Service Rules Should Ensure That the Spectrum is Used to Deliver Personal Location and Monitoring Services***

**Spectrum Dedicated to PLMS**

**MicroTrax™**

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***Is Required to Provide:***

- ***National Service***
- ***Accuracy From 1 to 30 Meters***
- ***Body-worn or Hidden Tags***
- ***Indoor/Outdoor Operation***
- ***Location and Monitoring Services  
Versus Another Voice or High Speed Data Service***

## **Dedicated PLMS Spectrum Will Enable Important Public Security and Safety Services**

### **Safety and Emergency Services:**

**Policemen, Paramedics,...**

### **Civil Services:**

**Road Crews, Postal Carriers,...**

### **Special Medical Needs:**

**Alzheimer's, Aged, Infirm,...**

### **Cell-Phone Locator:**

**E9-1-1 Services,...**



**Fixed and Portable PLMS Systems  
Will Locate Firefighters**

**Locating and Monitoring The Firefighter  
“Highest Priority Technology”**

**as Stated by the Firefighter Task Force and  
International Association of Firefighters**



**U.S Statistics:**

**35,000 Fire Departments**

**20% in Metro Areas with High-  
Rises and Warehouses**

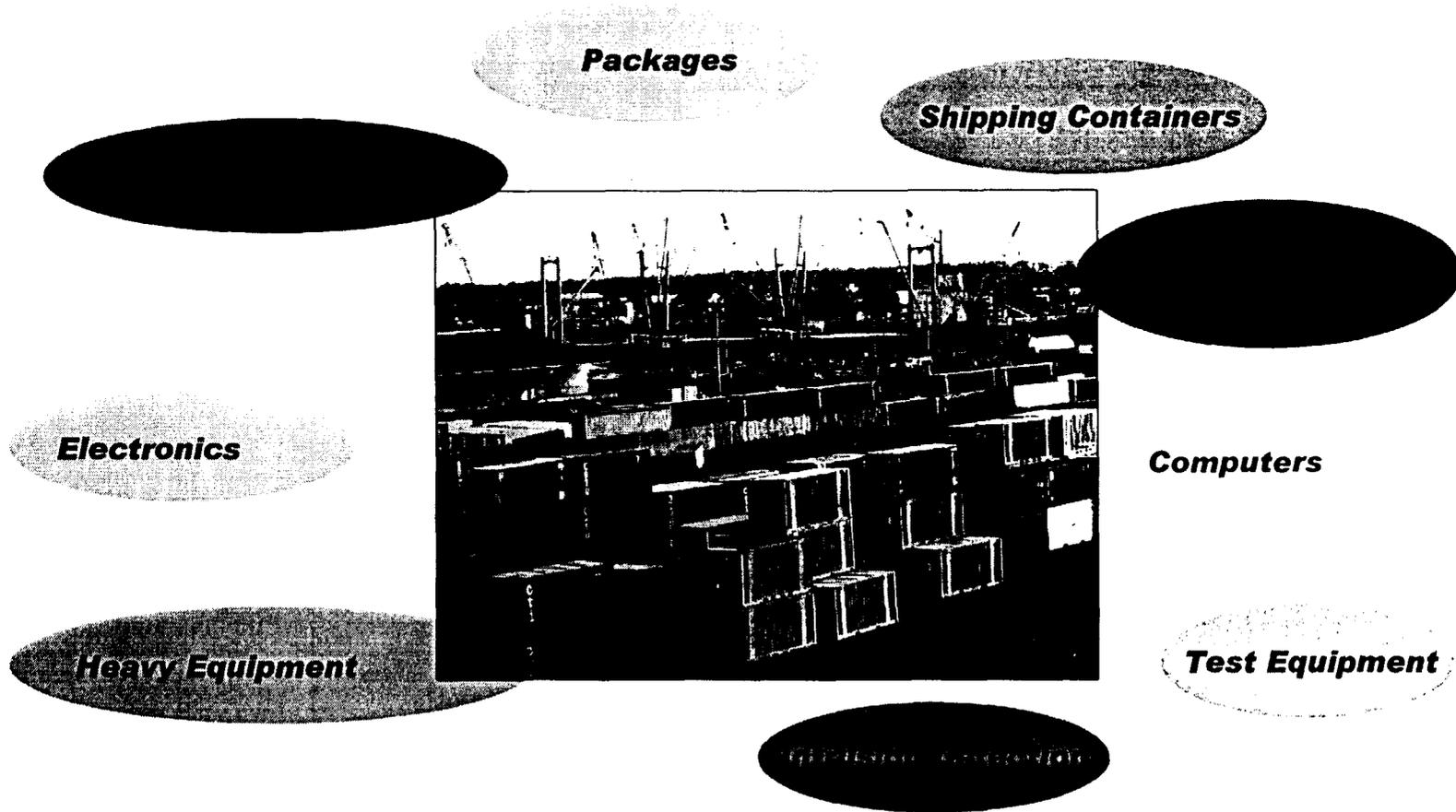
**1.2 Million Firefighters**

**Approximately 125 Deaths Per  
Year in the Line of Duty**

# **Critical Item Tracking and Monitoring**

# **MicroTrax™**

## **PLMS Allows Real-Time Tracking and Monitoring**



# **Offender Tracking & Monitoring    MicroTrax™**

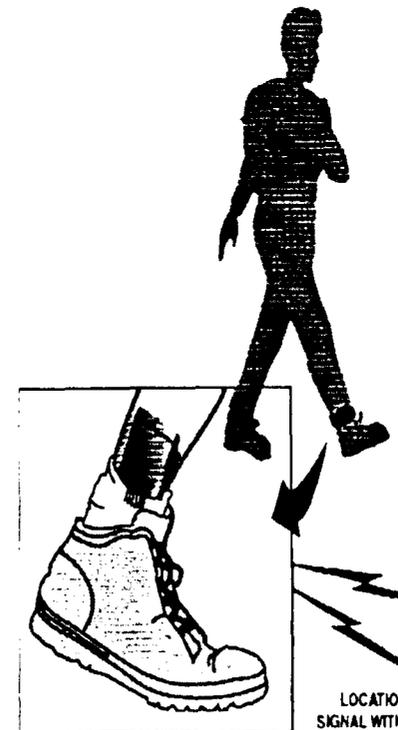
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**PLMS Will Allow 24 X 7 Monitoring Indoors and Outdoors  
With Significant Reductions in Manpower and Cost**

**Current House Arrest Systems Have a Service Price of  
\$150 Per Month Despite the Fact that They Have  
Significant Limitations:**

**... Only Determine Presence/Absence of the  
Monitored Person at Their Residence.**

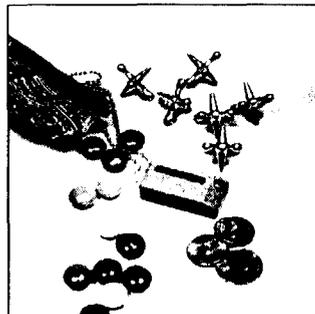
**... Manpower is Required to Install an  
Expensive Receiver in the Residence of  
Each Monitored Person.**



## Market Research Highlights Parental Demand for “LoJack for Kids”

**Demand Consistently High  
Across Multiple Ethnic Groups**

**Small Tag Size Facilitates  
Concealment**



***Your Support for Allocation of Spectrum  
to the  
Personal Location and Monitoring Service (PLMS).***

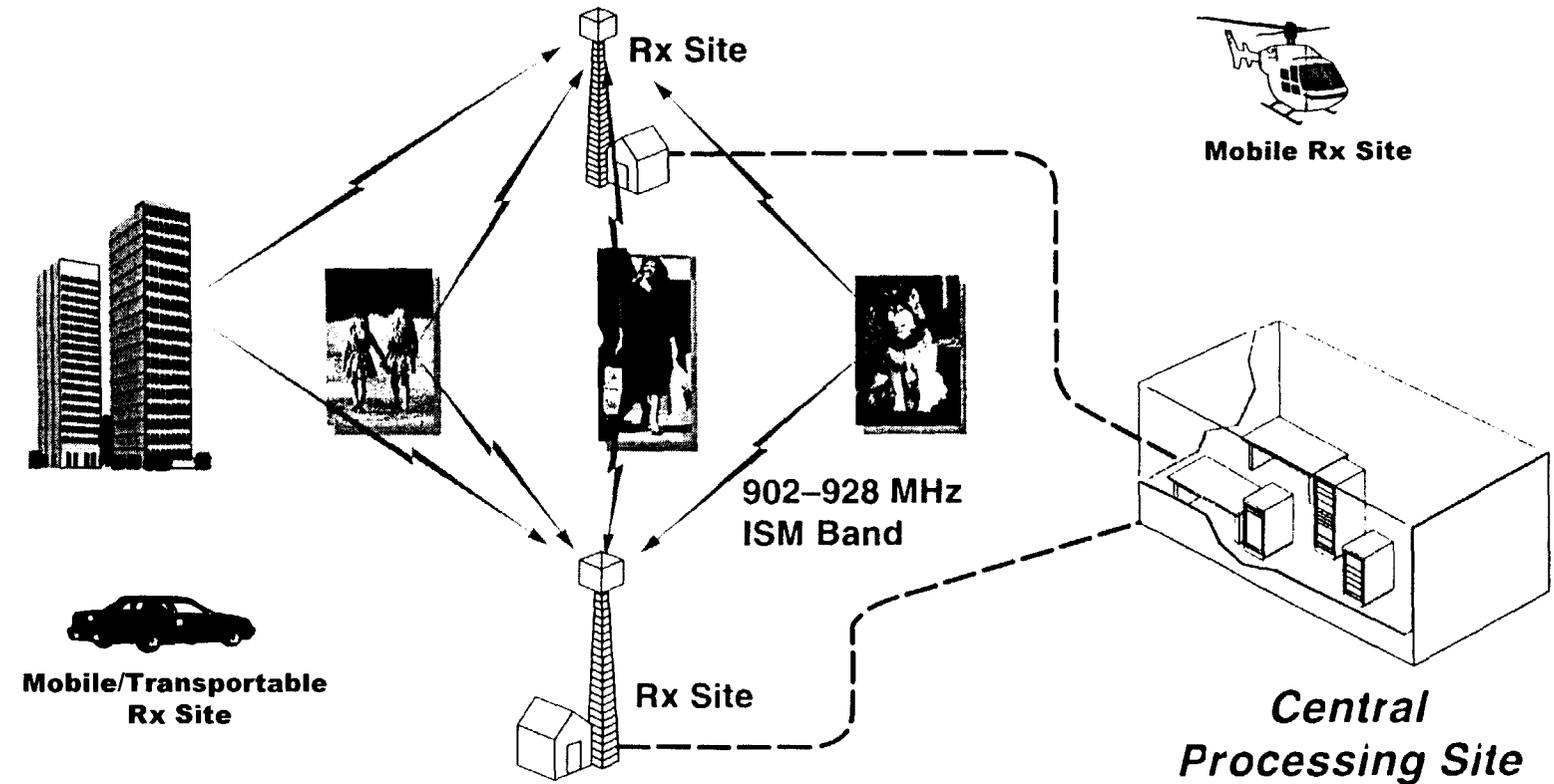
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- ***PLMS Will Be an Important Adjunct to National Security***
- ***Dedicated Spectrum is Required for Effective PLMS***
- ***Service Rules Should Ensure That the Spectrum is Used to Deliver Personal Location and Monitoring Services***

# MicroTrax™ Technology

# MicroTrax™

**Created Specifically for Locating, Tracking and Monitoring**

- Spread Spectrum
- Short Duration Burst
- Digital Modulated ID & Status
- Single Frequency
- AOA & TOA
- High Capacity
- Low Cost Components



**The Location of the Tag is Calculated Using Both Time and Angle of Arrival Data From The Receive Sites.**

## GPS and Cell-Phone Based Systems Do Not Work for Many PLMS Applications

	In-building Operation	Wide-Area Accuracy	Battery Life	Jamming Resistance	Tag Cost/Size	Communication Service Cost
<b>GPS</b>	No	15-100 m	Minutes/Hours	Very Poor	High(\$3X) Deck of Cards	High
<b>MicroTrax™</b>	Robust	7-50 m	Months	Very Good	Low(\$X) Domino	Very Low
<b>Cell Based</b>	Marginal	80-300 m	Hours	Poor	Moderate (\$2X) Deck of Cards	High

**KEY:** Excellent  Marginal  Poor 

***Congress Mandated that the FCC Reallocate and Auction  
Several Bands of Spectrum\****

***MicroTrax™ Petitioned the FCC to Allocate Spectrum for  
Personal Locating and Monitoring Service (PLMS)***

***FCC Issued Notice of Proposed Rulemaking (NPRM)***

***Recognized Pubic Benefit of PLMS and Suggested Bands  
Which Could be Used for PLMS***

***Seeks Comment on Service Rules***

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***\* Balanced Budget Act of 1977 And Omnibus Budget Reconciliation Act of 1993***