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(54) **GATEWAY AND HYBRID SOLUTIONS FOR WIRELESS LOCATION**

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G01S 3/02 (2006.01)

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,646,580 A 2/1972 Fuller et al. 325/53

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 177 203 A2 9/1985

(Continued)

OTHER PUBLICATIONS

Lepkofker; U.S. Appl. No. 08/246,149 Entitled Individual Location System; May 19, 1994.

(Continued)

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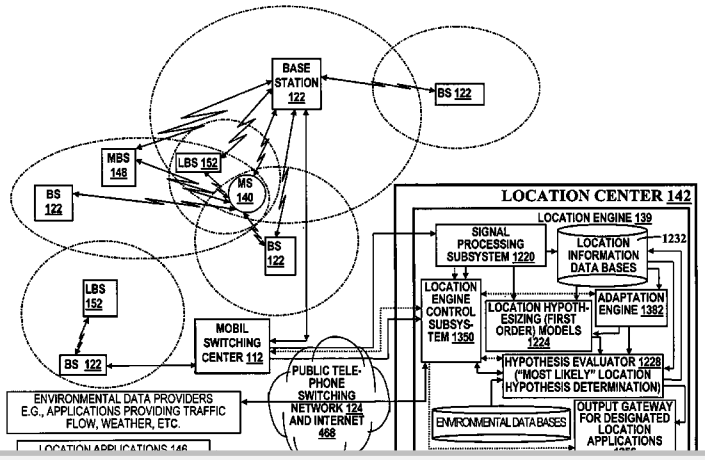
(57) **ABSTRACT**

A location system is disclosed for commercial wireless telecommunication infrastructures. The system is an end-to-end solution having one or more location centers for outputting requested locations of commercially available handsets or mobile stations (MS) based on, e.g., CDMA, AMPS, NAMPS or TDMA communication standards, for processing both local MS location requests and more global MS location requests via, e.g., Internet communication between a distributed network of location centers. The system uses a plurality of MS locating technologies including those based on: (1) two-way TOA and TDOA; (2) pattern recognition; (3) distributed antenna provisioning; and (4) supplemental information from various types of very low cost non-infrastructure base stations for communicating via a typical commercial wireless base station infrastructure or a public telephone switching network. Accordingly, the traditional MS location difficulties, such as multipath, poor location accuracy and poor coverage are alleviated via such technologies in combination with strategies for: (a) automatically adapting and calibrating system performance according to environmental and geographical changes; (b) automatically capturing location signal data for continual enhancement of a self-maintaining historical data base retaining predictive location signal data; (c) evaluating MS locations according to both heuristics and constraints related to, e.g., terrain, MS velocity and MS path extrapolation from tracking and (d) adjusting likely MS locations adaptively and statistically so that the system becomes progressively more comprehensive and accurate. Further, the system can be modularly configured for use in location signaling environments ranging from urban, dense urban, suburban, rural, mountain to low traffic or isolated roadways. Accordingly, the system is useful for 911 emergency calls, tracking, routing, people and animal location including applications for confinement to and exclusion from certain areas.

77 Claims, 62 Drawing Sheets



U.S. PATENT DOCUMENTS

3,886,553	A	5/1975	Bates	343/112 R
4,023,176	A	5/1977	Currie et al.	343/113 R
4,232,313	A	11/1980	Fleishman	343/6 R
4,347,618	A	8/1982	Kavouras et al.	375/37
4,438,439	A	3/1984	Shreve	343/449
4,475,010	A	10/1984	Huensch et al.	179/2 EB
RE31,962	E	7/1985	Brodeur	343/389
4,542,744	A	9/1985	Barnes et al.	128/660
4,630,057	A	12/1986	Martin	342/358
4,636,795	A	1/1987	Dano	342/387
4,651,157	A	3/1987	Gray et al.	342/457
4,670,758	A	6/1987	Campbell	342/458
4,700,374	A	10/1987	Bini	379/60
4,721,958	A	1/1988	Jenkin	342/13
4,740,792	A	4/1988	Sagey et al.	342/457
4,742,357	A	5/1988	Rackley	342/457
4,799,062	A	1/1989	Sanderford, Jr. et al.	342/450
4,857,840	A	8/1989	Lanchais	324/207
4,860,352	A	8/1989	Laurance et al.	380/23
4,864,313	A	9/1989	Konneker	342/457
4,876,550	A	10/1989	Kelly	342/451
4,879,713	A	11/1989	Ichiyoshi	370/75
4,888,593	A	12/1989	Friedman et al.	342/387
4,914,689	A	4/1990	Quade et al.	379/142
4,952,772	A	8/1990	Zana	219/124.34
4,990,922	A	2/1991	Young et al.	342/52
4,992,796	A	2/1991	Apostolos	342/156
5,003,317	A	3/1991	Gray et al.	342/457
5,008,679	A	4/1991	Effland et al.	342/353
5,017,926	A	5/1991	Ames et al.	342/353
5,034,898	A	7/1991	Lu et al.	364/513
5,043,736	A	8/1991	Darnell et al.	342/357
5,045,852	A	9/1991	Mitchell et al.	341/51
5,055,851	A	10/1991	Sheffer	342/457
5,075,694	A	12/1991	Donnangelo et al.	342/455
5,092,343	A	3/1992	Spitzer et al.	128/733
5,099,245	A	3/1992	Sagey	342/357
5,111,209	A	5/1992	Toriyama	342/357
5,119,102	A	6/1992	Barnard	342/357
5,119,104	A	6/1992	Heller	342/450
5,136,686	A	8/1992	Koza	395/13
5,142,590	A	8/1992	Carpenter et al.	382/14
5,155,490	A	10/1992	Spradley et al.	342/357
5,163,004	A	11/1992	Rentz	364/460
5,166,694	A	11/1992	Russell et al.	342/457
5,177,489	A	1/1993	Hatch	342/357
5,184,347	A	2/1993	Farwell et al.	370/94.1
5,191,342	A	3/1993	Alsup et al.	342/465
5,193,110	A	3/1993	Jones et al.	379/94
5,202,829	A	4/1993	Geier	
5,208,756	A	5/1993	Song	364/706
5,212,765	A	5/1993	Skeirik	395/11
5,212,804	A	5/1993	Choate	455/33.1
5,214,789	A	5/1993	George	455/33.2
5,216,611	A	6/1993	McElreath	364/454
5,218,367	A	6/1993	Sheffer et al.	342/457
5,218,618	A	6/1993	Sagey	375/1
5,218,716	A	6/1993	Comroe et al.	455/33
5,223,844	A	6/1993	Mansell et al.	342/357
5,225,842	A	7/1993	Brown et al.	342/357
5,233,541	A	8/1993	Corwin et al.	364/516
5,235,633	A	8/1993	Dennison et al.	379/60
5,243,530	A	9/1993	Stanifer et al.	364/452
5,251,273	A	10/1993	Betts et al.	382/57
5,260,711	A	11/1993	Sterzer	342/375
5,278,892	A	1/1994	Bolliger et al.	379/60
5,280,295	A	1/1994	Kelley et al.	342/463
5,280,472	A	1/1994	Gilhousen et al.	370/18
5,282,261	A	1/1994	Skeirik	395/22
5,295,180	A	3/1994	Vendetti et al.	379/59
5,311,195	A	5/1994	Mathis et al.	342/357
5,317,323	A	5/1994	Kennedy et al.	342/457
5,319,374	A	6/1994	Desai et al.	342/387
5,325,419	A	6/1994	Connolly et al.	379/60
5,327,144	A	7/1994	Stilp et al.	342/387
5,331,550	A	7/1994	Stafford et al.	364/413.02
5,343,209	A	8/1994	Sennott et al.	
5,349,631	A	9/1994	Lee	379/59
5,359,521	A	10/1994	Kyrtsos et al.	364/449
5,363,110	A	11/1994	Inamiya	342/357
5,365,447	A	11/1994	Dennis	364/449
5,365,450	A	11/1994	Schuchman et al.	364/449
5,365,516	A	11/1994	Jandrell	370/18
5,365,544	A	11/1994	Schilling	375/1
5,373,456	A	12/1994	Ferkinhoff et al.	364/574
5,379,224	A	1/1995	Brown et al.	364/449
5,388,147	A	2/1995	Grimes	379/59
5,388,259	A	2/1995	Fleischman et al.	395/600
5,389,934	A	2/1995	Kass	342/357
5,390,339	A	2/1995	Bruckert et al.	455/33.2
5,392,052	A	2/1995	Eberwine	342/357
5,394,158	A	2/1995	Chia	342/457
5,394,435	A	2/1995	Weerackody	375/206
5,395,366	A	3/1995	D'Andrea et al.	604/890.1
5,398,302	A	3/1995	Thrift	395/23
5,402,520	A	3/1995	Schnitta	395/22
5,402,524	A	3/1995	Bauman et al.	395/50
5,408,586	A	4/1995	Skeirik	395/23
5,408,588	A	4/1995	Ulug	395/23
5,410,737	A	4/1995	Jones	455/56.1
5,416,712	A	5/1995	Geier et al.	
5,420,914	A	5/1995	Blumhardt	379/114
5,422,813	A	6/1995	Schuchman et al.	364/449
5,426,745	A	6/1995	Baji et al.	395/375
5,434,927	A	7/1995	Brady et al.	382/104
5,438,644	A	8/1995	Fu	395/22
5,444,451	A	8/1995	Johnson et al.	342/453
5,448,754	A	9/1995	Ho et al.	455/34.1
5,457,736	A	10/1995	Cain et al.	379/60
5,473,602	A	12/1995	McKenna et al.	370/60
5,479,397	A	12/1995	Lee	370/18
5,479,482	A	12/1995	Grimes	379/59
5,485,163	A	1/1996	Singer	342/457
5,506,864	A	4/1996	Schilling	375/205
5,508,707	A	4/1996	LeBlanc et al.	342/457
5,508,708	A	4/1996	Ghosh et al.	342/457
5,512,908	A	4/1996	Herrick	342/387
5,513,111	A	4/1996	Wortham	
5,513,243	A	4/1996	Kage	379/58
5,513,246	A	4/1996	Jonsson et al.	379/60
5,515,285	A	5/1996	Garrett, Sr. et al.	701/300
5,515,378	A	5/1996	Roy, III et al.	370/95.1
5,515,419	A	5/1996	Sheffer	379/58
5,517,667	A	5/1996	Wang	395/24
5,519,760	A	5/1996	Borkowski et al.	379/59
5,526,001	A	6/1996	Rose et al.	342/442
5,526,357	A	6/1996	Jandrell	370/95.2
5,526,466	A	6/1996	Takizawa	395/2.62
5,537,460	A	7/1996	Holliday, Jr. et al.	379/59
5,546,445	A	8/1996	Dennison et al.	379/60
5,555,257	A	9/1996	Dent	370/95.1
5,555,286	A	9/1996	Tendler	
5,561,704	A	10/1996	Salimando	379/58
5,563,611	A	10/1996	McGann et al.	342/389
5,563,931	A	10/1996	Bishop et al.	379/59
5,564,079	A	10/1996	Olsson	455/54.1
5,570,412	A	10/1996	LeBlanc	379/58
5,572,218	A	11/1996	Cohen et al.	342/357
5,574,648	A	11/1996	Pilley	364/439
5,577,169	A	11/1996	Prezioso	395/61

5,583,513	A	12/1996	Cohen	342/357
5,583,517	A	12/1996	Yokev et al.	342/457
5,588,038	A	12/1996	Snyder	379/57
5,592,180	A	1/1997	Yokev et al.	342/450
5,594,425	A	1/1997	Ladner et al.	340/825.06
5,594,740	A	1/1997	LaDue	379/59
5,594,782	A	1/1997	Zicker et al.	379/63
5,596,625	A	1/1997	LeBlanc	379/60
5,600,705	A	2/1997	Maenpaa	379/58
5,600,706	A	2/1997	Dunn et al.	379/59
5,602,903	A	2/1997	LeBlanc et al.	379/60
5,604,765	A	2/1997	Bruno et al.	375/200
5,608,410	A	3/1997	Stilp et al.	342/387
5,610,815	A	3/1997	Gudat et al.	364/424.027
5,610,972	A	3/1997	Emery et al.	379/58
5,611,704	A	3/1997	Kamizono et al.	439/164
5,612,703	A	3/1997	Mallinckrodt	342/457
5,613,041	A	3/1997	Keeler et al.	395/23
5,613,205	A	3/1997	Dufour	455/33.2
5,614,914	A	3/1997	Bolgiano et al.	342/364
5,617,565	A	4/1997	Augenbraum et al.	395/604
5,619,552	A	4/1997	Karppanen et al.	379/60
5,621,848	A	4/1997	Wang	395/2.2
5,625,668	A	4/1997	Loomis et al.	379/58
5,625,748	A	4/1997	McDonough et al.	395/2.6
5,627,547	A	5/1997	Ramaswamy et al.	
5,629,707	A	5/1997	Heuvel et al.	342/357
5,631,469	A	5/1997	Carrieri et al.	250/341.5
5,634,051	A	5/1997	Thomson	395/605
5,638,486	A	6/1997	Wang et al.	395/2.45
5,640,103	A	6/1997	Petsche et al.	324/772
5,646,630	A	7/1997	Sheynblat et al.	342/357
5,649,065	A	7/1997	Lo et al.	395/23
5,652,570	A	7/1997	Lepkofker	340/573
5,657,487	A	8/1997	Doner	455/456
5,663,734	A	9/1997	Krasner	342/357
5,673,322	A	9/1997	Pepe et al.	380/49
5,675,344	A	10/1997	Tong et al.	342/457
5,675,788	A	10/1997	Husick et al.	395/615
5,686,924	A	11/1997	Trimble et al.	342/357
5,701,328	A	12/1997	Schuchman et al.	375/204
5,710,758	A	1/1998	Soliman et al.	370/241
5,710,918	A	1/1998	Lagarde et al.	395/610
5,717,406	A	2/1998	Sanderford et al.	342/457
5,719,584	A	2/1998	Otto	342/465
5,724,047	A	3/1998	Lioio et al.	342/442
5,724,648	A	3/1998	Shaughnessy et al.	455/56.1
5,724,660	A	3/1998	Kauser et al.	455/456
5,727,057	A	3/1998	Emery et al.	379/211
5,729,549	A	3/1998	Kostreski et al.	370/522
5,732,074	A	3/1998	Spaur et al.	370/313
5,732,354	A	3/1998	MacDonald	455/456
5,736,964	A	4/1998	Ghosh et al.	342/457
5,737,431	A	4/1998	Brandstein et al.	381/92
5,740,048	A	4/1998	Abel et al.	701/200
5,742,509	A	4/1998	Goldberg et al.	364/449.5
5,742,905	A	4/1998	Pepe et al.	455/461
5,754,955	A	5/1998	Ekbatani	455/422
5,764,756	A	6/1998	Onweller	379/242
5,774,802	A	6/1998	Tell et al.	455/408
5,774,805	A	6/1998	Zicker	455/426
5,774,829	A	6/1998	Cisneros et al.	701/213
5,774,869	A	6/1998	Toader	705/10
5,786,773	A	7/1998	Murphy	340/947
5,787,235	A	7/1998	Smith et al.	395/50
5,787,354	A	7/1998	Gray et al.	455/456
5,790,953	A	8/1998	Wang et al.	455/435
5,790,974	A	8/1998	Tognazzini	701/204
5,799,016	A	8/1998	Onweller	370/401
5,802,454	A	9/1998	Goshay et al.	455/31.2
5,802,518	A	9/1998	Karaev et al.	707/9
5,815,417	A	9/1998	Orr et al.	
5,815,538	A	9/1998	Grell et al.	375/356
5,815,814	A	9/1998	Dennison et al.	455/456
RE35,916	E	10/1998	Dennison et al.	455/456
5,819,273	A	10/1998	Vora et al.	707/10
5,819,301	A	10/1998	Rowe et al.	707/513
5,822,539	A	10/1998	Van Hoff	395/200.66
5,832,367	A	11/1998	Bamburak et al.	455/62
5,835,857	A	11/1998	Otten	455/410
5,835,907	A	11/1998	Newman	707/10
5,838,562	A	11/1998	Gudat et al.	364/424.02
5,842,130	A	11/1998	Oprescu-Surcobe et al.	455/456
5,844,522	A	12/1998	Sheffer et al.	342/457
5,845,198	A	12/1998	Bamburak et al.	455/31.1
5,845,267	A	12/1998	Ronen	705/40
5,857,181	A	1/1999	Augenbraun et al.	707/2
5,864,313	A	1/1999	Speck et al.	
5,864,755	A	1/1999	King et al.	455/404
5,867,495	A	2/1999	Elliott et al.	370/352
5,867,799	A	2/1999	Lang et al.	707/1
5,870,029	A	2/1999	Otto et al.	340/825.36
5,872,539	A	2/1999	Mullen	342/357
5,873,040	A	2/1999	Dunn et al.	455/456
5,873,076	A	2/1999	Barr et al.	707/3
5,875,394	A	2/1999	Daly et al.	455/411
5,875,401	A	2/1999	Rochkind	455/466
5,883,598	A	3/1999	Parl et al.	342/457
5,890,068	A	3/1999	Fattouche et al.	455/456
5,892,441	A	4/1999	Woolley et al.	340/539
5,893,091	A	4/1999	Hunt et al.	707/3
5,895,436	A	4/1999	Savoie et al.	
5,901,358	A	5/1999	Petty et al.	455/456
5,903,844	A	5/1999	Bruckert et al.	455/456
5,905,455	A	5/1999	Heger et al.	342/22
5,906,655	A	5/1999	Fan	701/216
5,913,170	A	6/1999	Wortham	455/457
5,914,675	A	6/1999	Tognazzini	340/989
5,917,405	A	6/1999	Joao	340/426
5,917,449	A	6/1999	Sanderford et al.	342/457
5,917,866	A	6/1999	Pon	375/346
5,920,873	A	7/1999	Van Huben et al.	707/202
5,924,090	A	7/1999	Krellenstein	707/5
5,926,133	A	7/1999	Green, Jr.	342/363
5,933,421	A	8/1999	Alamouti et al.	370/330
5,933,822	A	8/1999	Braden-Harder et al.	707/5
5,936,572	A	8/1999	Loomis et al.	342/357
5,943,014	A	8/1999	Gilhousen	342/465
5,945,948	A	8/1999	Buford et al.	342/457
5,949,815	A	9/1999	Pon	375/208
5,952,969	A	9/1999	Hagerman et al.	342/457
5,959,568	A	9/1999	Woolley	342/42
5,963,866	A	10/1999	Palamara et al.	455/456
5,966,658	A	10/1999	Kennedy, III et al.	455/426
5,969,673	A	10/1999	Bickley	
5,973,643	A	10/1999	Hawkes et al.	342/457
5,977,913	A	11/1999	Christ	342/465
5,978,840	A	11/1999	Nguyen et al.	709/217
5,982,324	A	11/1999	Watters et al.	342/357.06
5,982,891	A	11/1999	Ginter et al.	380/4
5,983,214	A	11/1999	Lang et al.	707/1
5,987,329	A	11/1999	Yost et al.	455/456
5,999,124	A	12/1999	Sheynblat	342/357.09
5,999,126	A	12/1999	Ito	342/357.1
6,009,334	A	12/1999	Grubeck et al.	455/456
6,014,102	A	1/2000	Mitzlaff et al.	342/457
6,026,304	A	2/2000	Hilsenrath et al.	455/456
6,028,551	A	2/2000	Schoen et al.	342/357
6,029,161	A	2/2000	Lang et al.	707/1
6,031,490	A	2/2000	Forssén et al.	342/457
6,034,635	A	3/2000	Gilhousen	342/457
6,038,668	A	3/2000	Chipman et al.	713/201

6,061,064	A	5/2000	Reichlen	345/418
6,064,339	A	5/2000	Wax et al.	342/417
6,064,942	A	5/2000	Johnson et al.	701/213
6,097,958	A	8/2000	Bergen	455/456
6,101,178	A	8/2000	Beal	370/336
6,101,390	A	8/2000	Jayaraman et al.	455/456
6,101,391	A	8/2000	Ishizuka et al.	455/457
6,108,555	A	8/2000	Maloney et al.	455/456
6,157,621	A	12/2000	Brown et al.	370/310
6,167,274	A	12/2000	Smith	455/456
6,185,427	B1	2/2001	Krasner et al.	455/456
6,236,365	B1	5/2001	LeBlanc et al.	342/457
6,240,285	B1	5/2001	Blum et al.	455/404
6,243,587	B1	6/2001	Dent et al.	455/456
6,249,245	B1	6/2001	Watters et al.	342/357.03
6,249,252	B1	6/2001	Dupray	342/450
6,301,463	B1	10/2001	Dao et al.	
6,308,072	B1	10/2001	Labedz et al.	455/448
6,321,092	B1	11/2001	Fitch et al.	455/456
6,324,404	B1	11/2001	Dennison et al.	455/456
6,330,452	B1	12/2001	Fattouche et al.	455/456
6,381,464	B1	4/2002	Vannucci	455/456
6,385,541	B1	5/2002	Blumberg et al.	
6,438,380	B1	8/2002	Bi et al.	455/456
6,549,130	B1	4/2003	Joao	340/539
6,834,195	B2	12/2004	Brandenberg et al.	
6,952,181	B2	10/2005	Karr et al.	342/457

FOREIGN PATENT DOCUMENTS

EP	0 546 758	A2	6/1993
EP	0 689 369	A1	12/1995
EP	0 870 203	B1	12/1996
EP	0 923 817		5/2002
EP	0 811 296	B1	9/2002
GB	1 605 207		6/1975
GB	2 155 720	A	3/1984
WO	WO93/04453		3/1993
WO	WO94/01978		1/1994
WO	WO94/27161		4/1994
WO	WO94/11853		5/1994
WO	WO94/15412		7/1994
WO	95/03598		2/1995
WO	95/07251		12/1995
WO	WO96/14588		5/1996
WO	WO96/20542		7/1996
WO	WO97/01228		1/1997
WO	WO97/22888		6/1997
WO	WO97/24010		7/1997
WO	WO97/26750		7/1997
WO	WO97/38540		10/1997
WO	WO97/41654		11/1997
WO	WO97/50002		12/1997
WO	WO98/00982		1/1998
WO	WO98/10307		3/1998
WO	WO 98/14018		4/1998
WO	WO98/14018		4/1998
WO	PCT/US01/17957		6/2001
WO	WO 01/44998	A2	6/2001
WO	WO 01/95642		12/2001
WO	WO 02/065250	A2	8/2002

OTHER PUBLICATIONS

Maloney et al.; U.S. Appl. No. 60/017,899 Entitled "Enhanced Time-Difference Localization System"; May 17, 1996.

Dupray et al.; U.S. Appl. No. 09/820,584 Entitled "Location Of A Mobile Station Using A Plurality Of Commercial Wireless Infrastructures" filed Mar. 28, 2001.

Before the Federal Communications Commisssion, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; "Comments of Harris Government Communication Systems Division A Division of Harris Corporation", filed Sep. 25, 1996.

Before the Federal Communications Commission, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; "Reply Comments of KSI Inc. and MULIC Inc." filed Oct. 25, 1996.

Before the Federal Communications Commission, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; *ex parte* communication from Cambridge Positioning Systems Ltd. received Apr. 14, 1997 by the Commission.

Before the Federal Communications Commission, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; *ex parte* communication from GeoTek Communications, Inc. received Apr. 14, 1997 by the Commission.

Before the Federal Communications Commission, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; *ex parte* communication from XYPOINT Corporation, Inc. received Jul. 28, 1997 by the Commission.

Before the Federal Communications Commission, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; *ex parte* communication from National Strategies, Inc., regarding enhanced 911 system trial by TruePosition, Inc. and New Jersey Office of Emergency Telecommunications Services, received Aug. 8, 1997 by the Commission.

Before the Federal Communications Commission, in the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; *ex parte* communication from SnapTrack, Inc., received Jun. 27, 1997 by the Commission.

from http:/www.uswcorp.com/laby.htm., Release concerning RadioCamera™, printed Sep. 14, 1998.

Wylie et al., "The Non-Line of Sight Problem in Mobile Location Estimation".

Evans, 1998, "New Satellites for Personal Communications," *Scientific American*, 278(4):70-77.

Hills, 1998, Terrestrial Wireless Networks, *Scientific American*, 278(4):86-91.

Pelton, 1998, "Telecommunications for the 21st Century," *Scientific American*, 278(4):80-85.

Stutzmann et al., 1998, "Moving Beyond Wireless Voice Systems," *Scientific American*, 278(4):92-93.

Driscoll, "Wireless Caller Locations Systems", 1998, *GSP World Advanstar Communications, Inc.*, www.gpsworld.com/1198/1198driscol.html, pp. 1-8.

Junius et al., "New Methods for Processing GSM Radio Measurement Data: Applications for Locating, Handover, and Network Management", 1994, *Communication Network, Aachen University of Technology*, pp. 338-342.

Low, "Comparison of Urban Propagation Models with CW-Measurements", 1992, *IEEE Deutsche Bundespost Telekom*, pp. 936-942.

"Location Systems and Technologies", 1994, *Wireless Emergency Services JEM Report*, Annex A pp. 42-46 and Appendix A pp. 1-2.

Fechner et al., A Hybrid Neural Network Architecture for Automatic Object Recognition, 1994, *IEEE*, pp. 187-194.

Mardiraju et al., "Neural Networks for Robust Image Feature Classification: A Comparative Study", 1994, *IEEE*, pp. 423-430.
Sousa et al., "Delay Spread Measurements for the Digital Cellular Channel in Toronto", 1994, *IEEE*, pp. 837-847.
Goldbsmith et al., "A Measurement-Based Model for Predicting Coverage Areas of Urban Microcells", 1993, *IEEE*, pp. 1013-1023.
Ichitsubo et al., "A Statistical Model for Microcellular Multipath Propagation Environment", Prior to Dec. 22, 1997, *Wireless Systems Laboratories*, pp. 1-6.
Wittlenben et al., "A Low Cost Noncoherent Receiver with Adaptive Antenna Combining for High Speed Wireless Lans", Prior to Dec. 22, 1997, *ASCOM Systec AG*, pp. 1-4.
Gaspard et al., "Position Assignment in Digital Cellular Mobile Radio Networks (e.g. GSM) derived from Measurements at the Protocol Interface", Prior to Dec. 22, 1997, pp. 1-5.
Dutta et al., "Modified Adaptive Multiuser Detector for DS-CDMA in Multipath Fading", Prior to Dec. 22, 1997, pp. 1-7.
Gallant, "Neural Network Learning and Expert Systems", 1994, *The MIT Press*, pp. 132-137.
Striglis et al., "A Multistage RAKE Receiver for Improved Capacity of CDMA Systems", 1994, *IEEE Vehicular Technology Conference*, pp. 1-5.
Chan et al., "Multipath Propagation Effects on a CDMA Cellular System", 1994, *IEEE*, pp. 848-855.
Wolfe et al., "Field Strength Prediction in Indoor Environments with Neural Networks", Prior to Dec. 22, 1997, pp. 1-5.
"The Measearch Engine Years: Fit the First", 1992, http://www.conman.org/people/spc/refs/search.hpl.html, pp. 1-3.
Lawrence et al., "Northern Light Search Engine Leads the Pack- Others Fall Behind", May 1, 1998, *Online Newsletter*, 19(5)pp. 1-2.
Johnson, "Smart Technology Busting Out All Over Web", Jun. 15, 1998, *Electronic Engineering Times*, 1012 pp. 1-6.
Notess, "Internet Search Engine Update", Jul. 1, 1998, *Online*, vol. v22:nr, pp. 1-3.
Meadow, "Text Information Retrieval Systems", 1992, *Academic Press*, pp. 204-209.
Iwayama et al., "Cluster-Based Text Catagorization: A Comparison of Category Search Strategies", 1995, *ACM-SIGIR*, pp. 273-279.
Botafogo, "Cluster Analysis for Hypertext Systems", Jun. 1993, *ACM-SIRIG*, pp. 116-124.
Wang Baldonado et al., "SenseMaker: An Information-Exploration Interface Supporting the Contextual Evolution of a User's Interests", 1997, *ACM-CHI*, pp. 11-18.
Baldazo, "Navigating with a Web Compass: Quarterdeck Harnessess Leading-edge "Metasearch" Technology to Create a Smart Agent that Searches the Web and organizes the Results", Mar. 1996, *BYTE*, pp. 97-98.
Weiss et al., "HyPursuit: A Hierarcical Network Search Engine that Exploits Content-Link Hypertext Clustering", 1996, *Hypertext*, pp. 180-193.
Christ, U.S. Appl. No. 60/038,037 Entitled "Method and Apparatus for Tracking and Locating Personnel" filed Feb. 7, 1997.
Maloney; U.S. Appl. No. 60/035,691 Entitled "Robust, Efficient, Localization System" filed Jan. 16, 1997.
Maloney; U.S. Appl. No. 60/017,269 Entitled "Efficient, Dis-
U.S. Appl. No. 08/355,901 Entitled "Micr-Miniature Emergency Geo-Location Beacon System for Personal Security", filed Dec. 13, 1994.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901.
Ergon Proprietary; "Performance Analyses Brief: Microminiature Emergency Locator Systems (MELS)"; May 1996.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Response from Examiner regarding communication filed on Dec. 26, 1995 Dated Jul. 23, 1996.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Examiner Interview Summary Record Dated: Aug. 13, 1996.
Loran; 1992; "Users Handbook 1992 Edition"; *U.S. Coast Guard, Radionavigation Division*; 28 pgs.
Newton; 1981; "The Near-Term Potential of Doppler Location"; *John Hopkins APL Technical Digest*; pp. 16-31.
"ARGOS: Basic Description of the Argos System"; ARGOS; 7 pgs.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Office Action Summary Dated: Mar. 14, 1997.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Office Action Summary Dated: Mar. 17, 1998.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Office Action Summary Dated: Jun. 24, 1998.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Advisory Action Dated: Aug. 11, 1998.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Advisory Action Dated: Sep. 9, 1998.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Advisory Action Dated: Oct. 9, 1998.
Communication from U.S. Patent and Trademark Office Re: U.S. Appl. No. 08/355,901 Advisory Action Dated: Nov. 4, 1998.
Rizzo et al.; "Integration of Location Services in the Open Distributed Office"; *Technical Report 14-94, Computing Laboratory, University of Kent*, Cantebury, United Kingdom; Aug. 1994; pp. 1-14.
Caffery, J. and Stüüber, G. L., "Vehicle Location and Tracking for IVHS in CDMA Microcells," *International Symposium on Personal, Indoor, and Mobile Radio Communications*, pp. 1227-1231, Sep. 1994.
Caffery et al.; "Radio Location in Urban CDMA Microcells"; *International Symposium on Personal, Indoor, and Mobil Radio Communications*, Sep. 1995; 5 pgs.
Beck et al.; "Simulation Results on the Downlink of a Qualcomm-like DS-CDMA-System Over Multipath fading channels"; Sep. 1994 pp. 1-7.
Pop et al.; "Site Engineering for Indoor Wireless Spread Spectrum Communications"; Jun. 2001; 3 pgs.
Caffery et al.; "Overview of Radiolocation in CDMA Cellular Systems"; *IEEE Communications Magazine*; Apr. 1998; pp. 38-45.
Salcic;"AGPCS—An Automatic GSM-based Positioning

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