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(54) **SYSTEMS AND METHODS FOR DETERMINING REPLACEMENT COMMUNICATION FACILITY**

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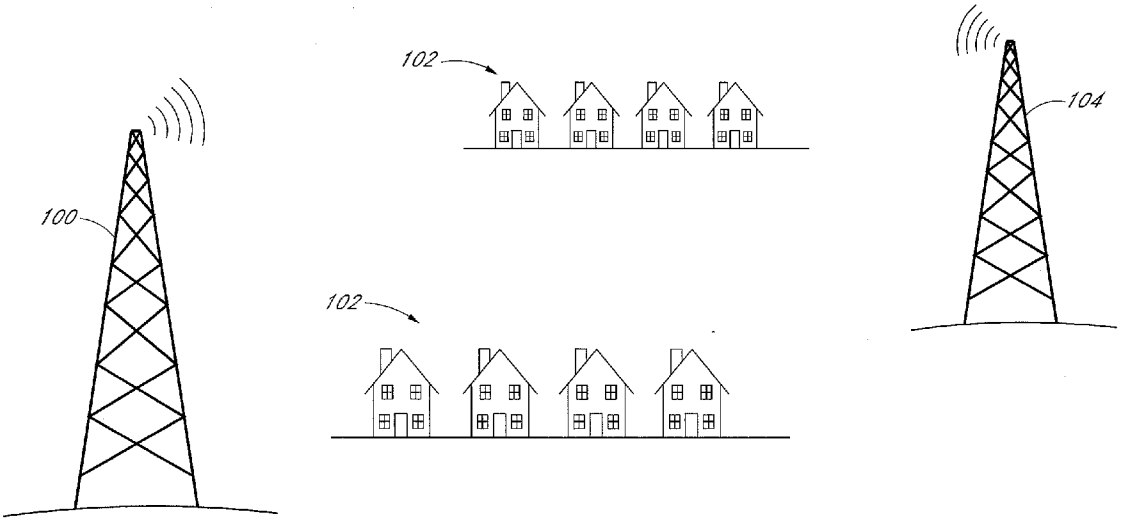
(52) **U.S. Cl.** **455/450**

(57) **ABSTRACT**

A computer-based program performs calculations to analyze, vary, test, manage, and/or improve the performance of channels and/or frequencies in the communication spectrum. The program varies parameters of a point of communication, such as the location, transmission power, channel frequency, antenna height, and the like, alone or in combination, to measure, test, and/or evaluate which parameter changes increase the market coverage of a target market or area. In some scenarios, changes to one point of communication cause the regulations governing the broadcast relationship between one or more nearby points of communication to be violated. When this occurs, the program determines which of the parameters, such as the location, transmission power, channel and/or frequency, antenna height, and the like, alone or in combination, of the point of communication interfering with the increased market coverage scenario to vary to overcome the conflict with communications and/or regulatory law. In addition, the program can determine simultaneously which of the parameters of multiple points of communication to vary to overcome the conflict with communications and/or regulatory law. The program outputs multiple solutions with varying degrees of difficulty and varying amounts of performance improvement.



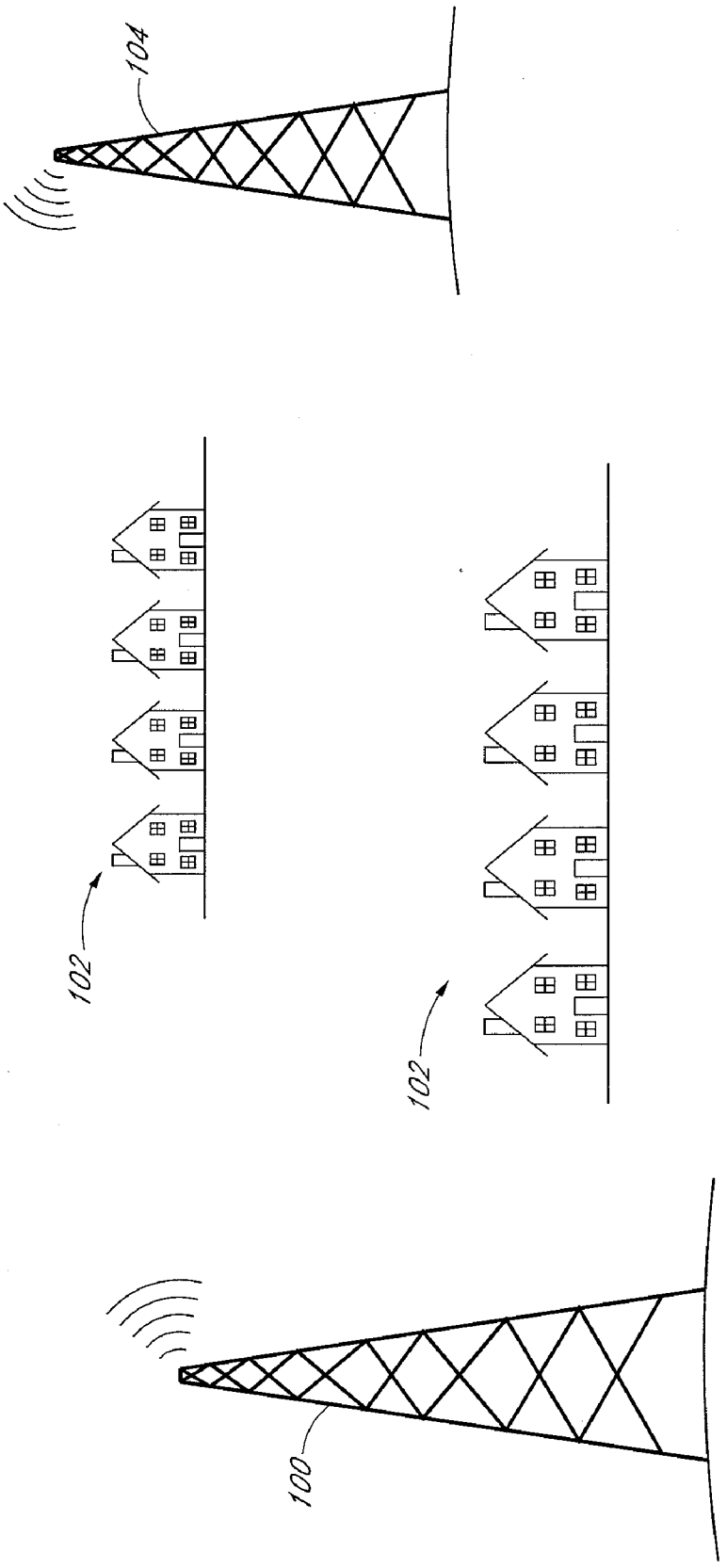


FIG. 1

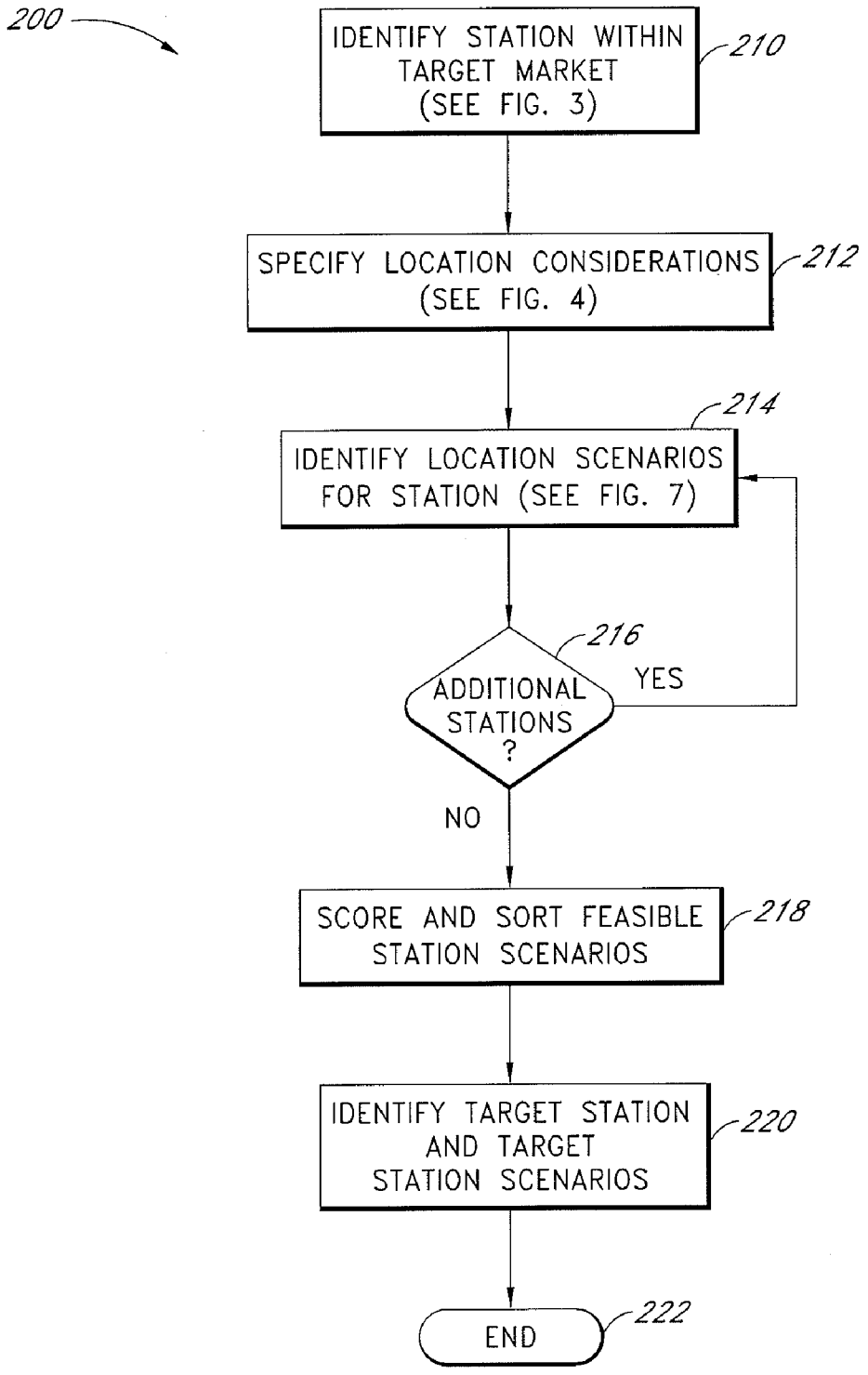

200
IDENTIFY STATION WITHIN TARGET MARKET (SEE FIG. 3)
210
SPECIFY LOCATION CONSIDERATIONS (SEE FIG. 4)
212
214
IDENTIFY LOCATION SCENARIOS FOR STATION (SEE FIG. 7)
216
ADDITIONAL STATIONS ?
YES
NO
SCORE AND SORT FEASIBLE STATION SCENARIOS
218
IDENTIFY TARGET STATION AND TARGET STATION SCENARIOS
220
END
222

FIG. 2

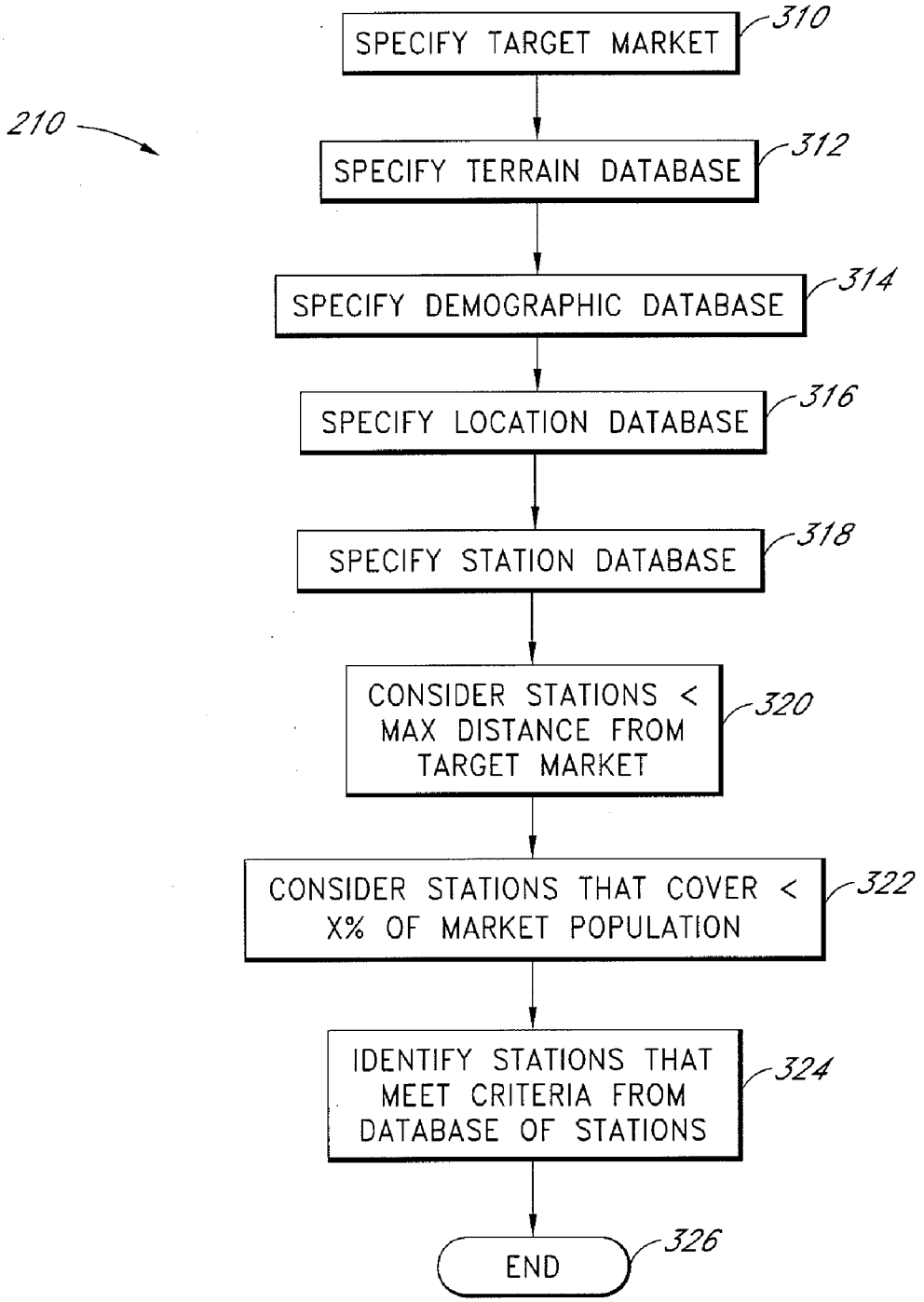

210
SPECIFY TARGET MARKET
310
SPECIFY TERRAIN DATABASE
312
SPECIFY DEMOGRAPHIC DATABASE
314
SPECIFY LOCATION DATABASE
316
SPECIFY STATION DATABASE
318
CONSIDER STATIONS < MAX DISTANCE FROM TARGET MARKET
320
CONSIDER STATIONS THAT COVER < X% OF MARKET POPULATION
322
IDENTIFY STATIONS THAT MEET CRITERIA FROM DATABASE OF STATIONS
324
END
326

FIG. 3

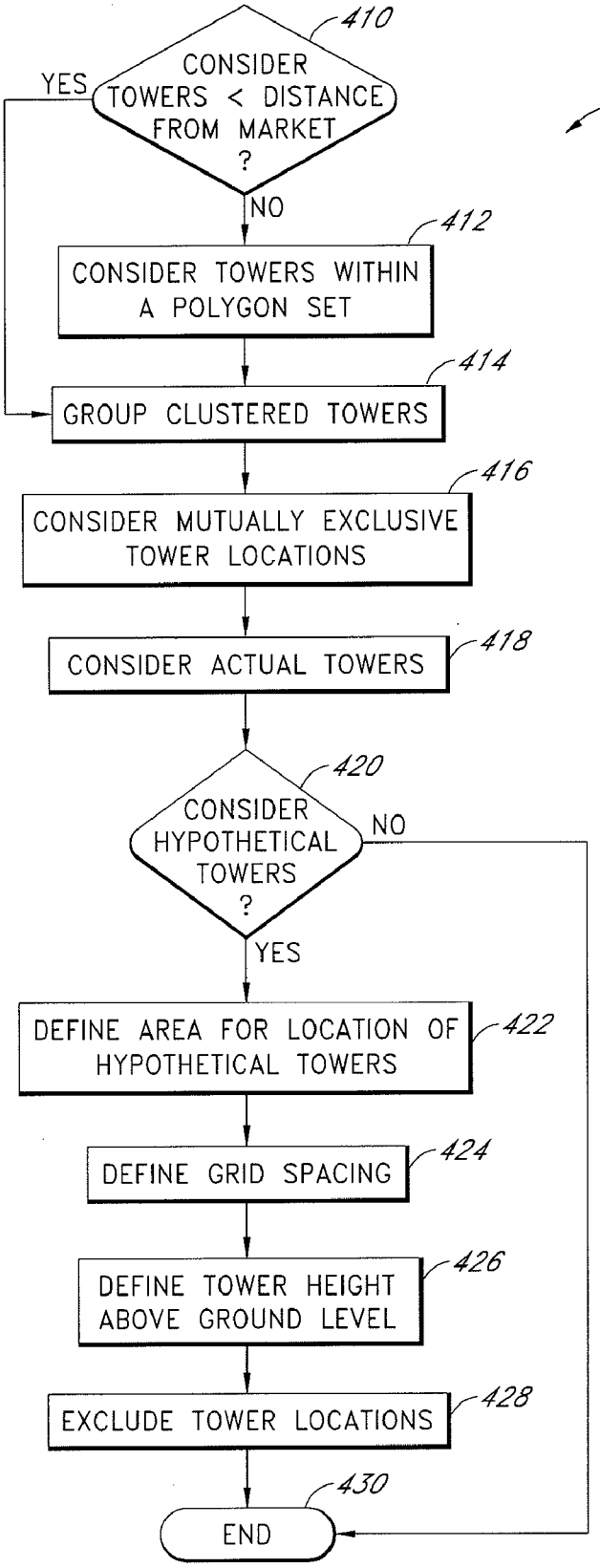

410
CONSIDER TOWERS < DISTANCE FROM MARKET ?
YES
NO
212
412
CONSIDER TOWERS WITHIN A POLYGON SET
414
GROUP CLUSTERED TOWERS
416
CONSIDER MUTUALLY EXCLUSIVE TOWER LOCATIONS
418
CONSIDER ACTUAL TOWERS
420
CONSIDER HYPOTHETICAL TOWERS ?
NO
YES
422
DEFINE AREA FOR LOCATION OF HYPOTHETICAL TOWERS
424
DEFINE GRID SPACING
426
DEFINE TOWER HEIGHT ABOVE GROUND LEVEL
428
EXCLUDE TOWER LOCATIONS
430
END

FIG. 4

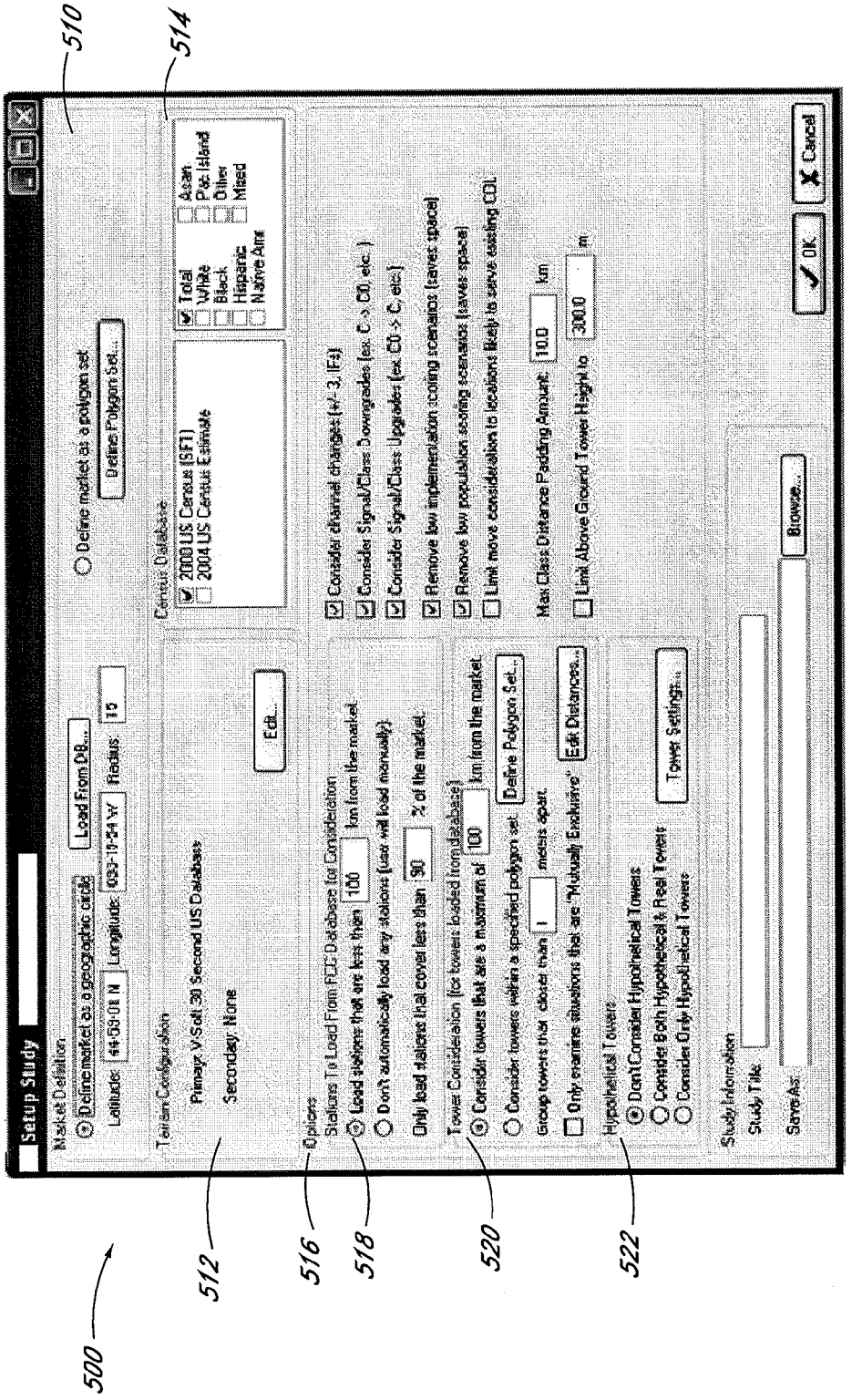

500
510
512
514
516
518
520
522
Setup Study
Market Definition
Define market as a geographic circle
Load From DB...
Latitude:
Longitude:
Radius:
Define market as a polygon set
Define Polygon Set...
Census Database
2000 US Census (SF1)
2004 US Census Estimate
Total
White
Black
Hispanic
Native Amr
Asian
Pac Island
Other
Mixed
Terrain Configuration
Primary: V-Soil 30 Second US Database
Secondary: None
Edit...
Options
Stations To Load From FCC Database for Consideration
Load stations that are less than 100 km from the market
Don't automatically load any stations (user will load manually)
Only load stations that cover less than 90 % of the market
Consider channel changes (+/- 3, IF's)
Consider Signal/Class Downgrades (ex: C -> C0, etc.)
Consider Signal/Class Upgrades (ex: C0 -> C, etc.)
Remove low implementation scoring scenarios (saves space)
Remove low population scoring scenarios (saves space)
Limit move consideration to locations likely to serve existing COI
Towers Consideration (for towers loaded from database)
Consider towers that are a maximum of 100 km from the market
Consider towers within a specified polygon set
Define Polygon Set...
Group towers that are closer than 1 meters apart.
Only examine situations that are "Mutually Exclusive"
Edit Distances...
Max Class Distance Padding Amount: 10.0 km
Limit Above Ground Tower Height to: 300.0 m
Hypothetical Towers
Don't Consider Hypothetical Towers
Consider Both Hypothetical & Real Towers
Consider Only Hypothetical Towers
Tower Settings...
Study Information
Study Title:
Save As:
Browse...
OK
Cancel

FIG. 5

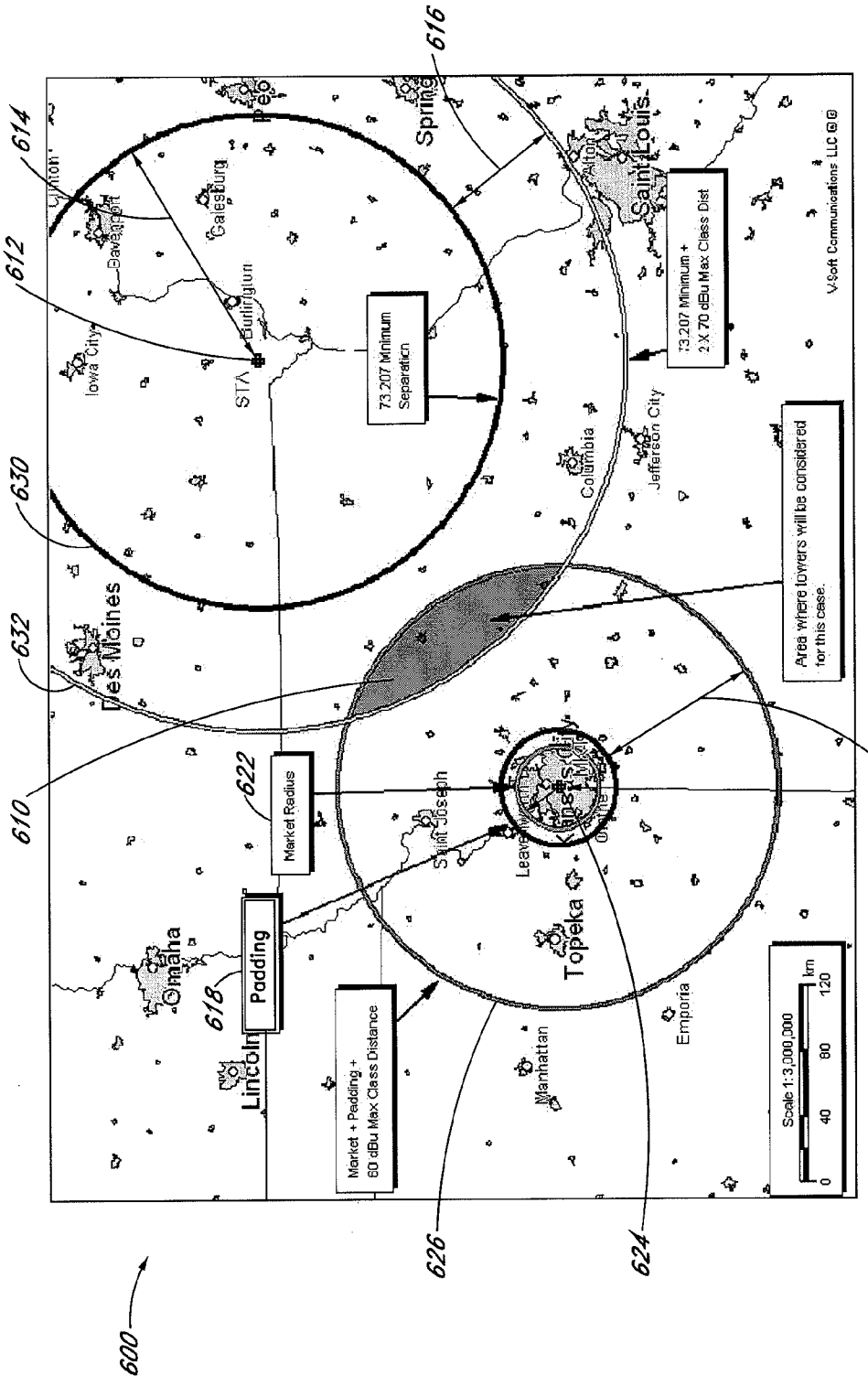

600
610
612
614
616
618
620
622
624
626
630
632
Des Moines
Omaha
Lincoln
Topeka
Saint Louis
Springfield
Columbia
Jefferson City
Iowa City
Burlington
Galesburg
Davenport
Emporia
Manhattan
St Joseph
Padding
Market Radius
Market + Padding + 60 dBu Max Class Distance
73.207 Minimum Separation
73.207 Minimum + 2 X 70 dBu Max Class Dist
Area where towers will be considered for this case.
Scale 1:3,000,000
0 40 80 120 km
V-Soft Communications LLC

FIG. 6

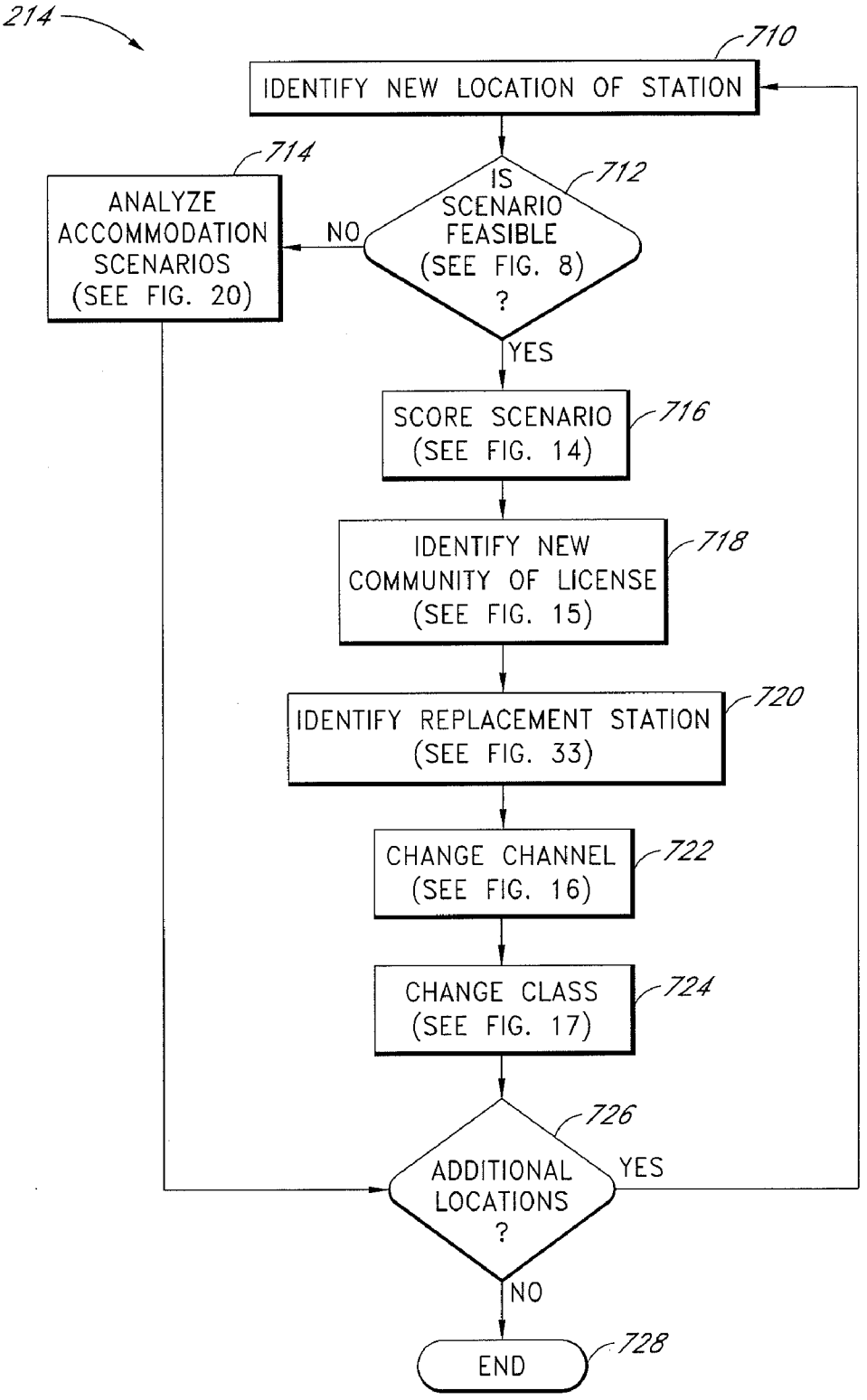

214
710
IDENTIFY NEW LOCATION OF STATION
712
IS SCENARIO FEASIBLE (SEE FIG. 8) ?
NO
714
ANALYZE ACCOMMODATION SCENARIOS (SEE FIG. 20)
YES
716
SCORE SCENARIO (SEE FIG. 14)
718
IDENTIFY NEW COMMUNITY OF LICENSE (SEE FIG. 15)
720
IDENTIFY REPLACEMENT STATION (SEE FIG. 33)
722
CHANGE CHANNEL (SEE FIG. 16)
724
CHANGE CLASS (SEE FIG. 17)
726
ADDITIONAL LOCATIONS ?
YES
NO
728
END

FIG. 7

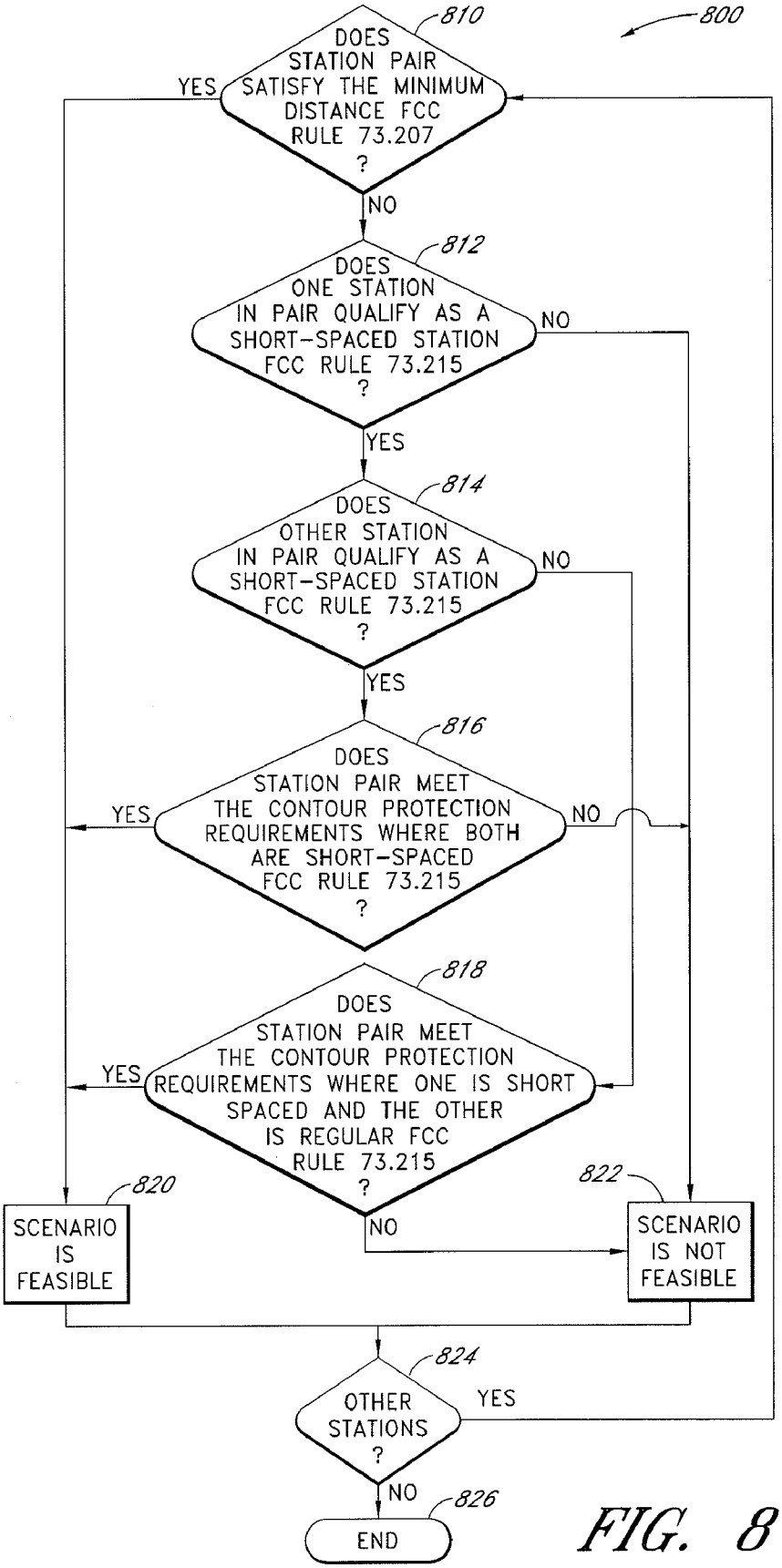

800
810
DOES STATION PAIR SATISFY THE MINIMUM DISTANCE FCC RULE 73.207 ?
YES
NO
812
DOES ONE STATION IN PAIR QUALIFY AS A SHORT-SPACED STATION FCC RULE 73.215 ?
NO
YES
814
DOES OTHER STATION IN PAIR QUALIFY AS A SHORT-SPACED STATION FCC RULE 73.215 ?
NO
YES
816
DOES STATION PAIR MEET THE CONTOUR PROTECTION REQUIREMENTS WHERE BOTH ARE SHORT-SPACED FCC RULE 73.215 ?
YES
NO
818
DOES STATION PAIR MEET THE CONTOUR PROTECTION REQUIREMENTS WHERE ONE IS SHORT SPACED AND THE OTHER IS REGULAR FCC RULE 73.215 ?
YES
NO
820
SCENARIO IS FEASIBLE
822
SCENARIO IS NOT FEASIBLE
824
OTHER STATIONS ?
YES
NO
826
END

FIG. 8

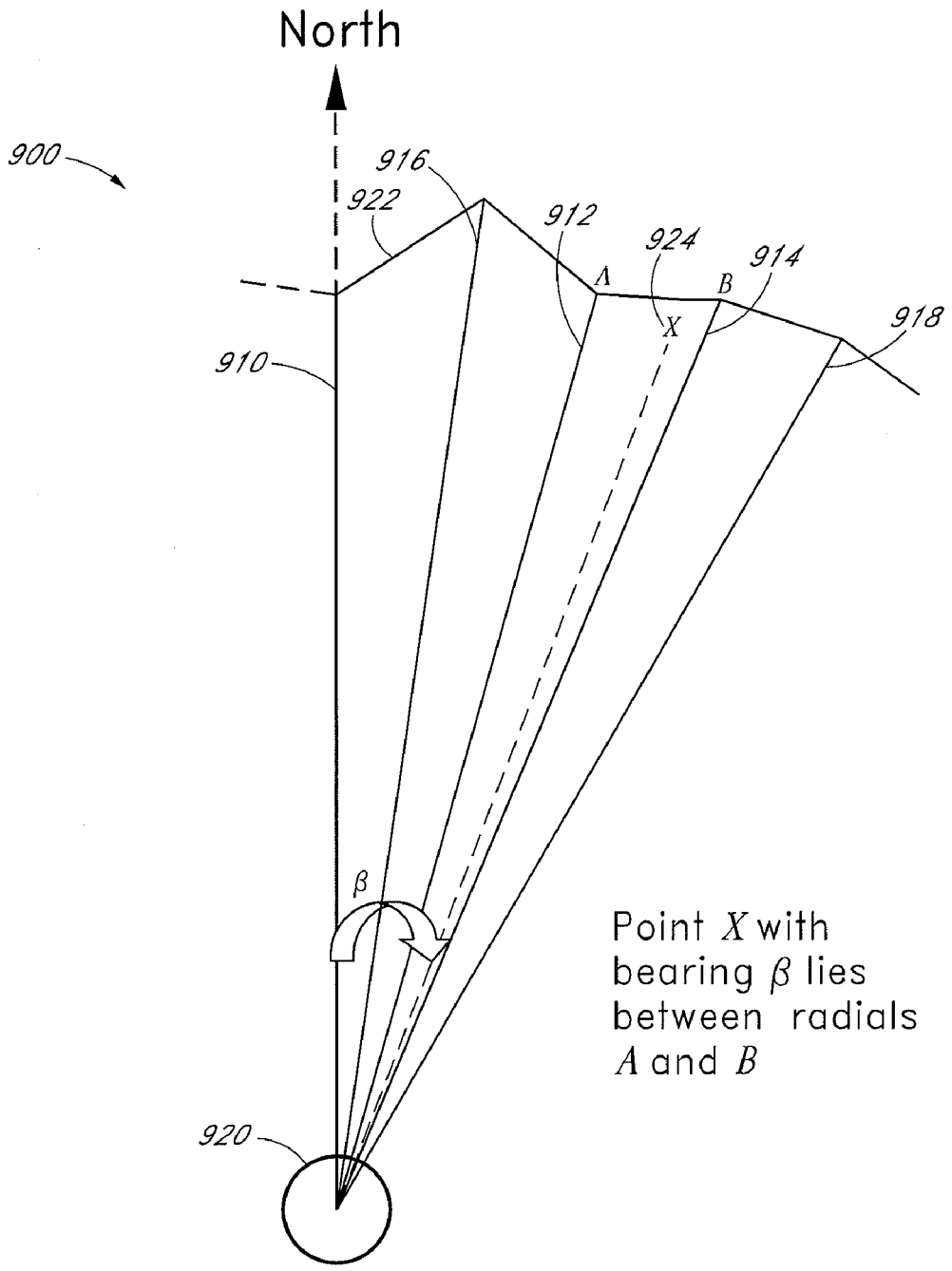

North
900
916
922
912
924
914
A
B
X
918
910
β
Point X with bearing β lies between radials A and B
920

FIG. 9

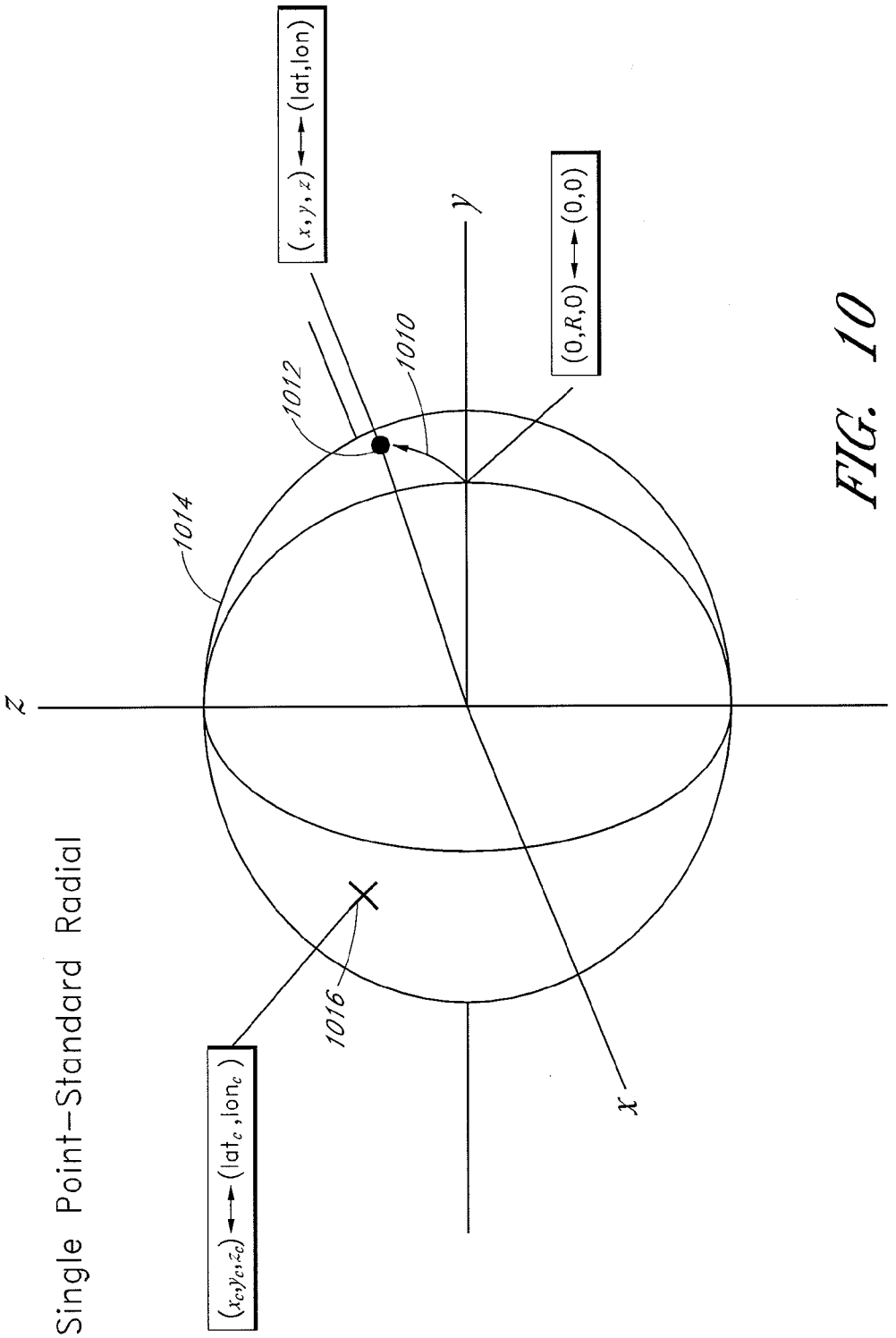

Single Point–Standard Radial
$(x_c, y_c, z_c) \longleftrightarrow (lat_c, lon_c)$
$(x, y, z) \longleftrightarrow (lat, lon)$
$(0, R, 0) \longleftrightarrow (0,0)$
1010
1012
1014
1016
x
y
z

FIG. 10

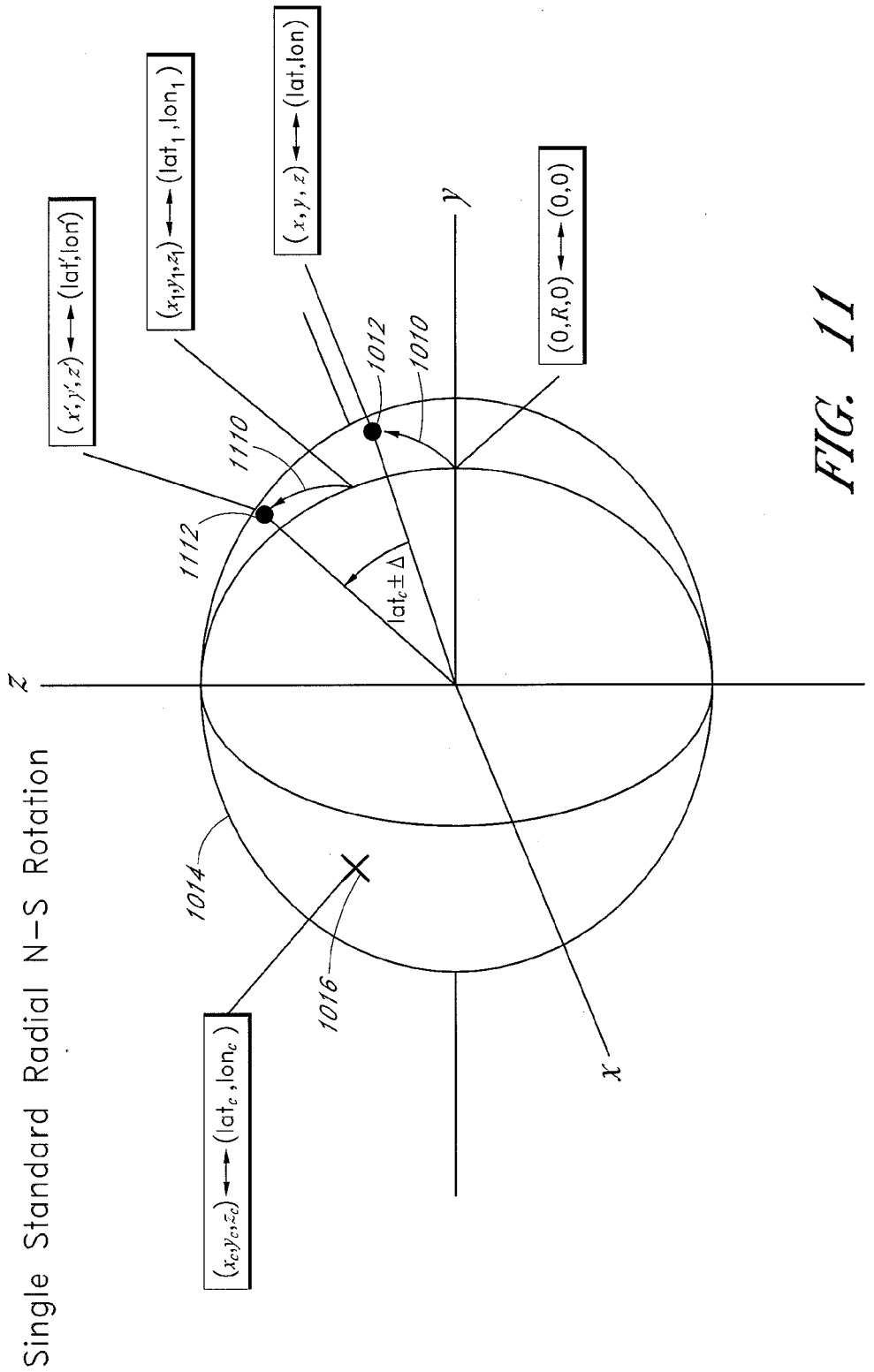

Single Standard Radial N-S Rotation
$(x',y',z') \longleftrightarrow (lat',lon')$
$(x_1,y_1,z_1) \longleftrightarrow (lat_1, lon_1)$
$(x, y, z) \longleftrightarrow (lat, lon)$
$(0,R,0) \longleftrightarrow (0,0)$
$(x_c,y_c,z_c) \longleftrightarrow (lat_c, lon_c)$
1110
1112
1012
1010
1014
1016
$lat_c \pm \Delta$
z
y
x

FIG. 11

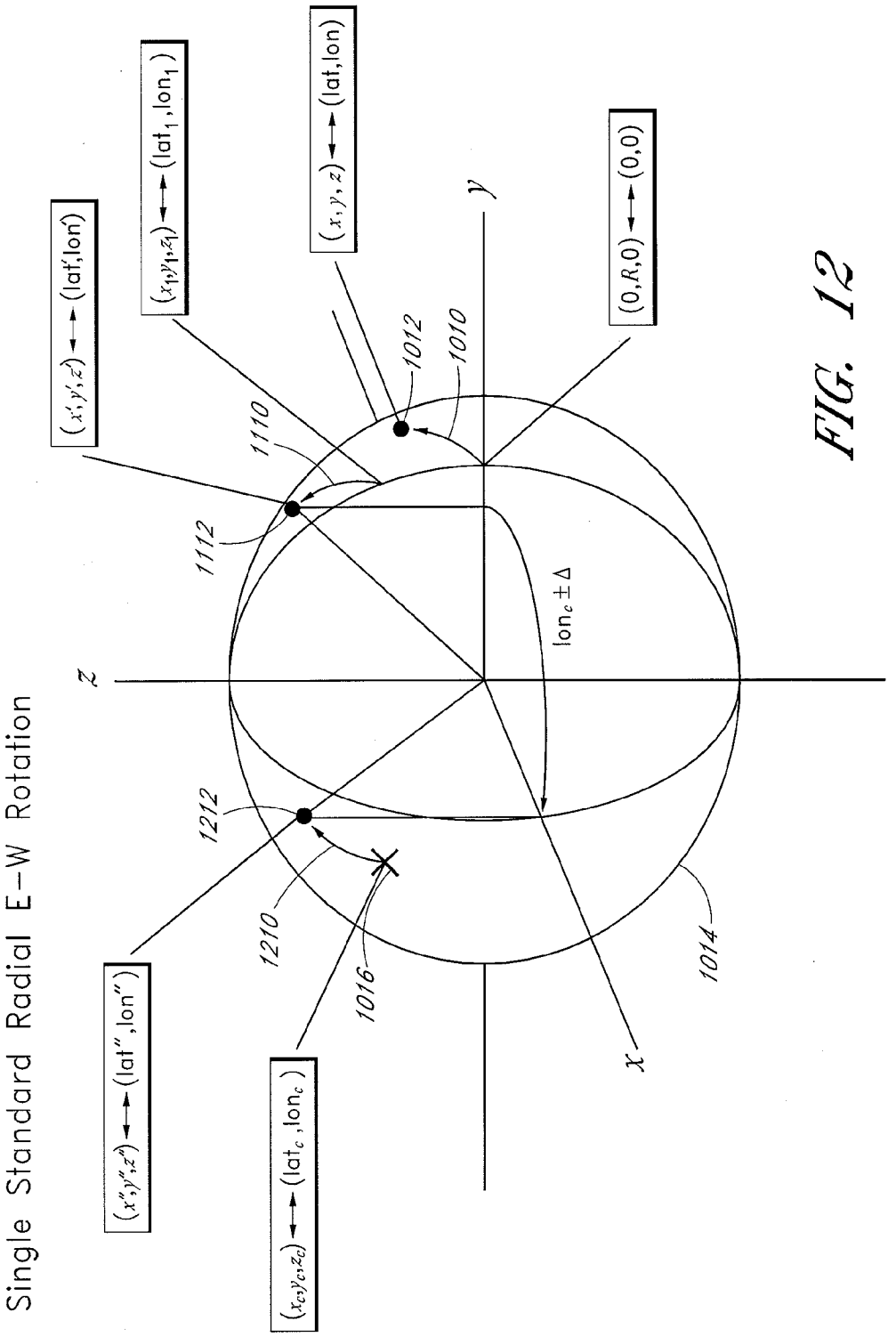

Single Standard Radial E-W Rotation
$(x',y',z') \leftrightarrow (lat',lon')$
$(x_1,y_1,z_1) \leftrightarrow (lat_1,lon_1)$
$(x,y,z) \leftrightarrow (lat,lon)$
$(0,R,0) \leftrightarrow (0,0)$
$(x'',y'',z'') \leftrightarrow (lat'',lon'')$
$(x_c,y_c,z_c) \leftrightarrow (lat_c,lon_c)$
1110
1112
1012
1010
1212
1210
1016
1014
$lon_c \pm \Delta$
z
y
x

FIG. 12

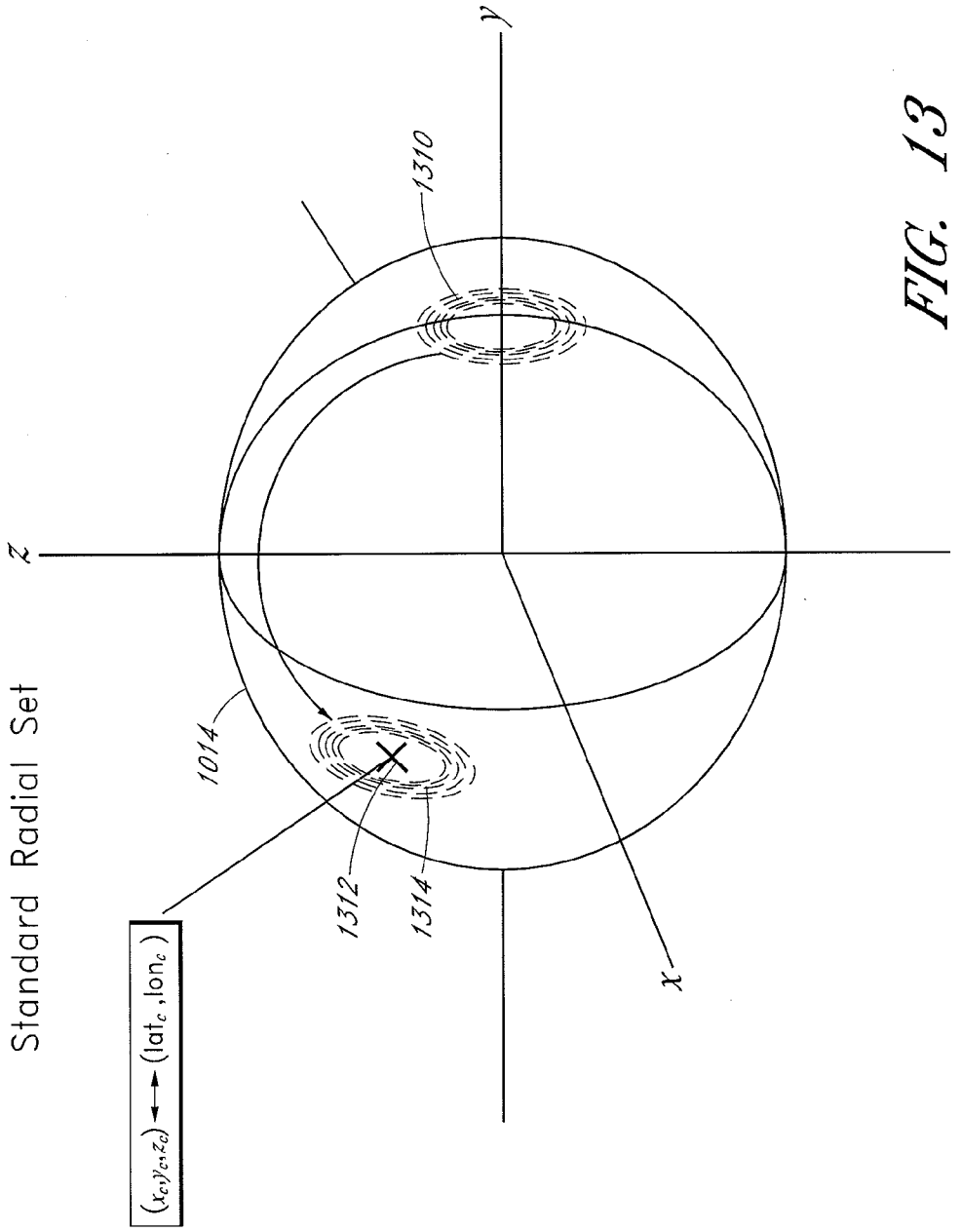

Standard Radial Set
$(x_c, y_c, z_c) \longleftrightarrow (lat_c, lon_c)$
z
y
x
1310
1014
1312
1314

FIG. 13

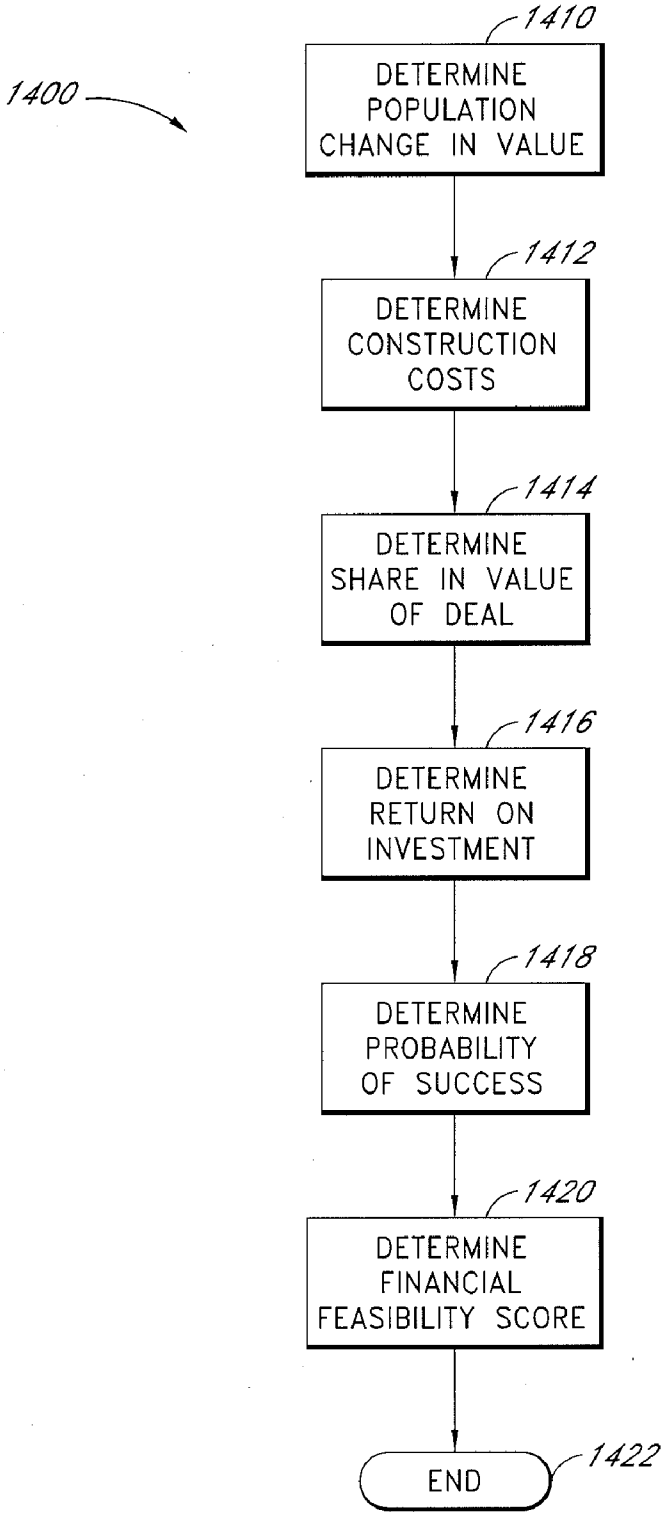

1400
1410
DETERMINE POPULATION CHANGE IN VALUE
1412
DETERMINE CONSTRUCTION COSTS
1414
DETERMINE SHARE IN VALUE OF DEAL
1416
DETERMINE RETURN ON INVESTMENT
1418
DETERMINE PROBABILITY OF SUCCESS
1420
DETERMINE FINANCIAL FEASIBILITY SCORE
END
1422

FIG. 14

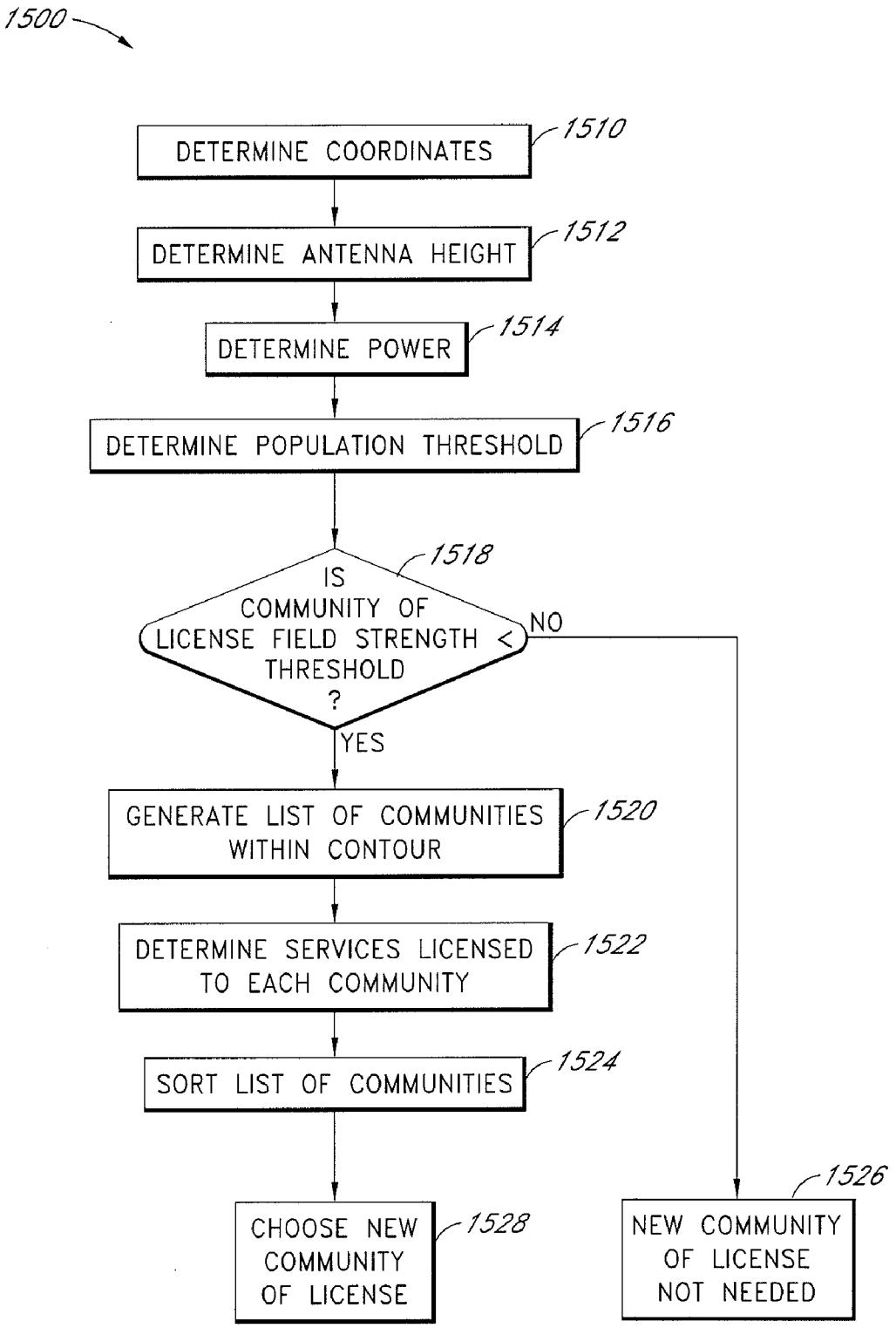

1500
DETERMINE COORDINATES
1510
DETERMINE ANTENNA HEIGHT
1512
DETERMINE POWER
1514
DETERMINE POPULATION THRESHOLD
1516
IS COMMUNITY OF LICENSE FIELD STRENGTH < THRESHOLD ?
1518
NO
YES
GENERATE LIST OF COMMUNITIES WITHIN CONTOUR
1520
DETERMINE SERVICES LICENSED TO EACH COMMUNITY
1522
SORT LIST OF COMMUNITIES
1524
CHOOSE NEW COMMUNITY OF LICENSE
1528
NEW COMMUNITY OF LICENSE NOT NEEDED
1526

FIG. 15

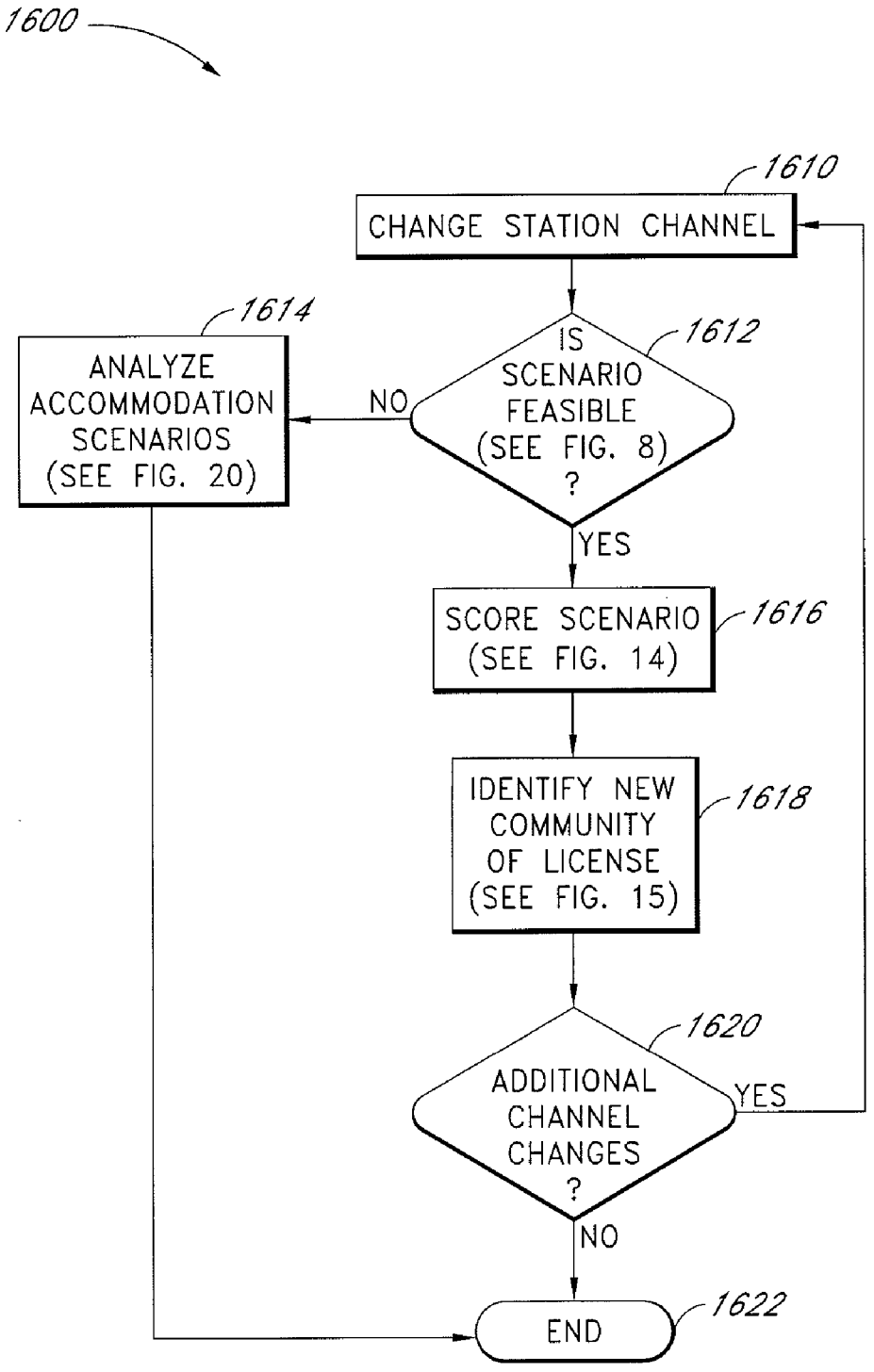

1600
1610
CHANGE STATION CHANNEL
1612
IS SCENARIO FEASIBLE (SEE FIG. 8) ?
NO
1614
ANALYZE ACCOMMODATION SCENARIOS (SEE FIG. 20)
YES
1616
SCORE SCENARIO (SEE FIG. 14)
1618
IDENTIFY NEW COMMUNITY OF LICENSE (SEE FIG. 15)
1620
ADDITIONAL CHANNEL CHANGES ?
YES
NO
1622
END

FIG. 16

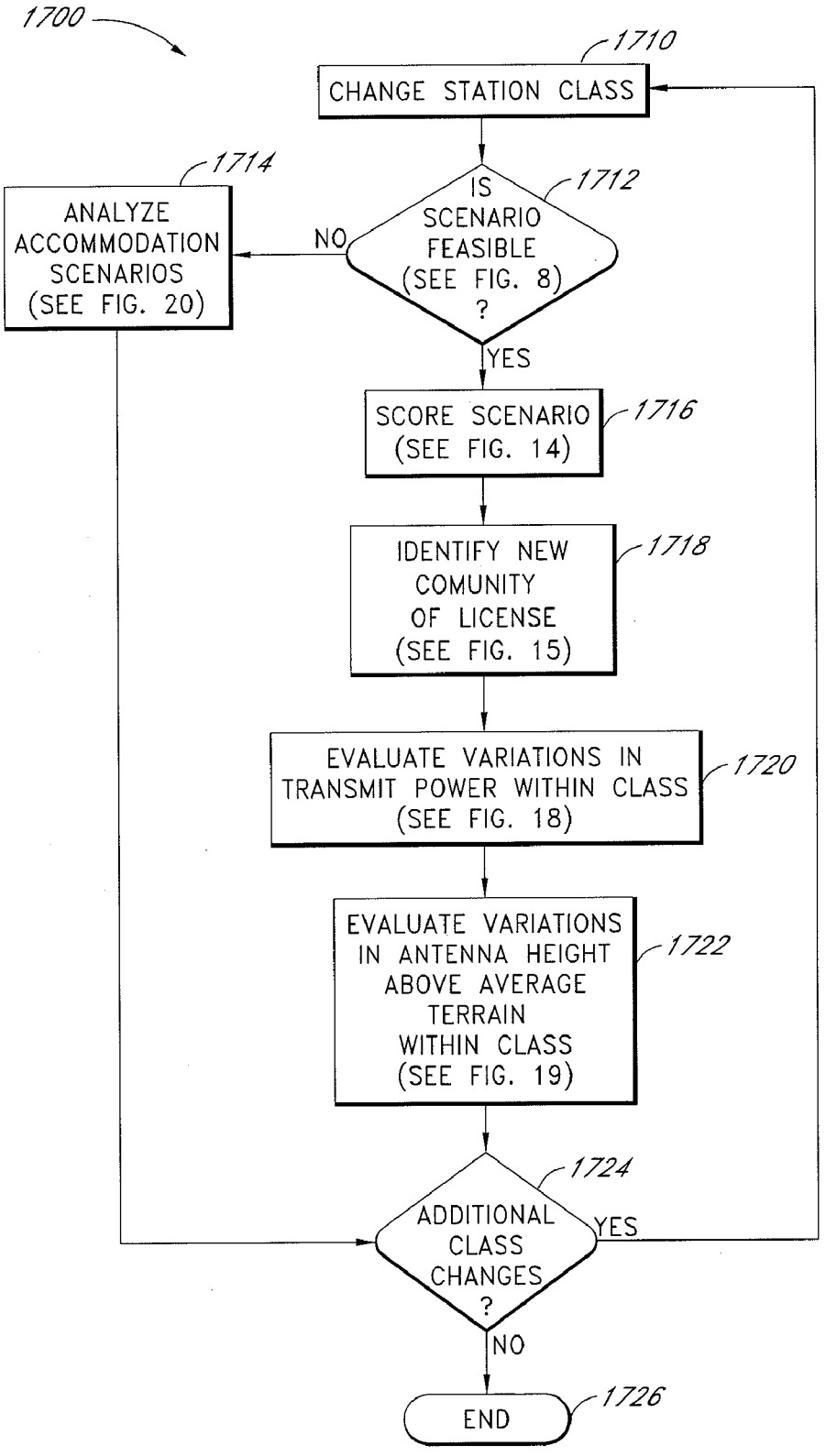

1700
1710
CHANGE STATION CLASS
1712
IS SCENARIO FEASIBLE (SEE FIG. 8) ?
NO
1714
ANALYZE ACCOMMODATION SCENARIOS (SEE FIG. 20)
YES
1716
SCORE SCENARIO (SEE FIG. 14)
1718
IDENTIFY NEW COMUNITY OF LICENSE (SEE FIG. 15)
1720
EVALUATE VARIATIONS IN TRANSMIT POWER WITHIN CLASS (SEE FIG. 18)
1722
EVALUATE VARIATIONS IN ANTENNA HEIGHT ABOVE AVERAGE TERRAIN WITHIN CLASS (SEE FIG. 19)
1724
ADDITIONAL CLASS CHANGES ?
YES
NO
1726
END

FIG. 17

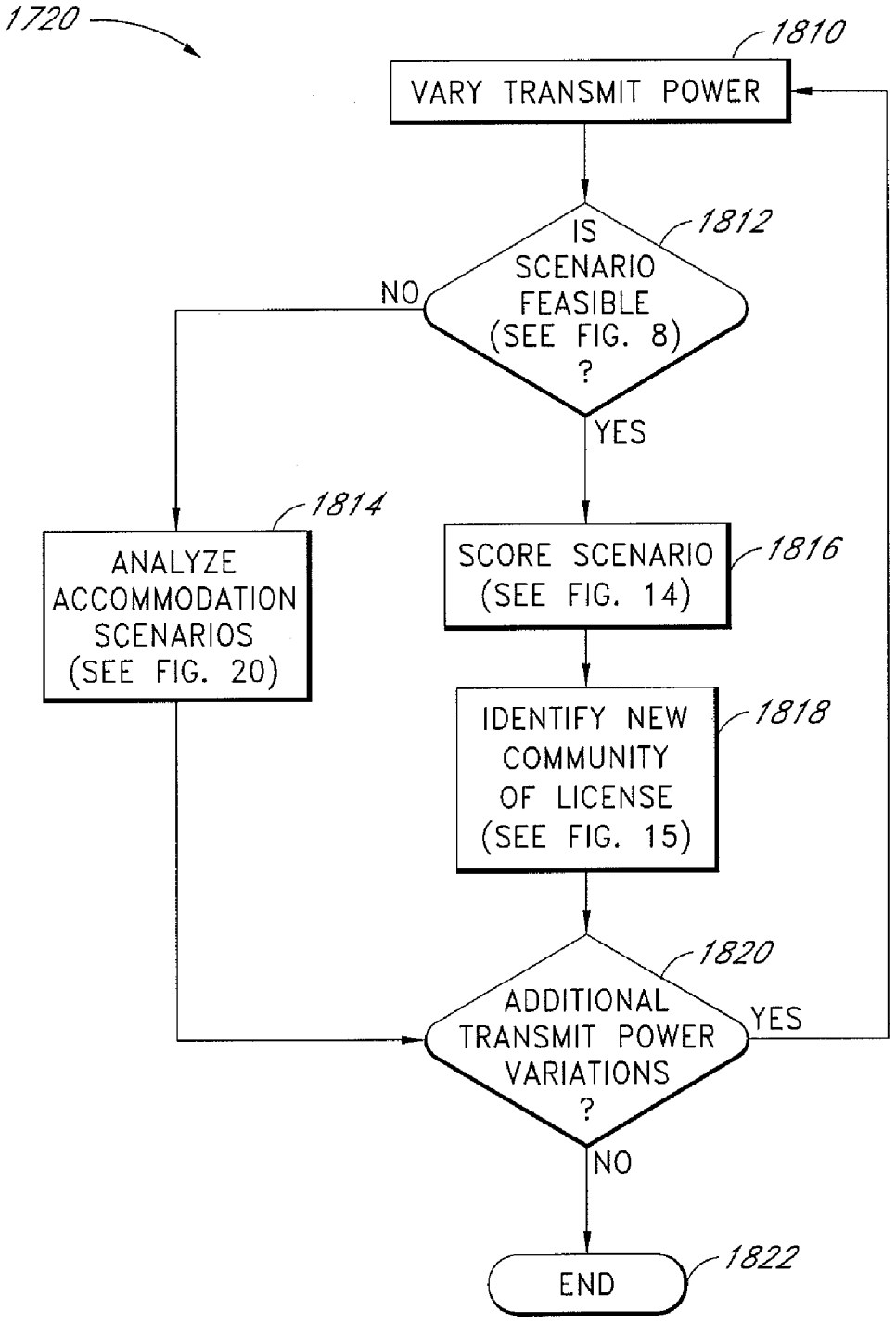

1720
1810
VARY TRANSMIT POWER
1812
IS SCENARIO FEASIBLE (SEE FIG. 8) ?
NO
YES
1814
ANALYZE ACCOMMODATION SCENARIOS (SEE FIG. 20)
SCORE SCENARIO (SEE FIG. 14)
1816
IDENTIFY NEW COMMUNITY OF LICENSE (SEE FIG. 15)
1818
1820
ADDITIONAL TRANSMIT POWER VARIATIONS ?
YES
NO
END
1822

FIG. 18

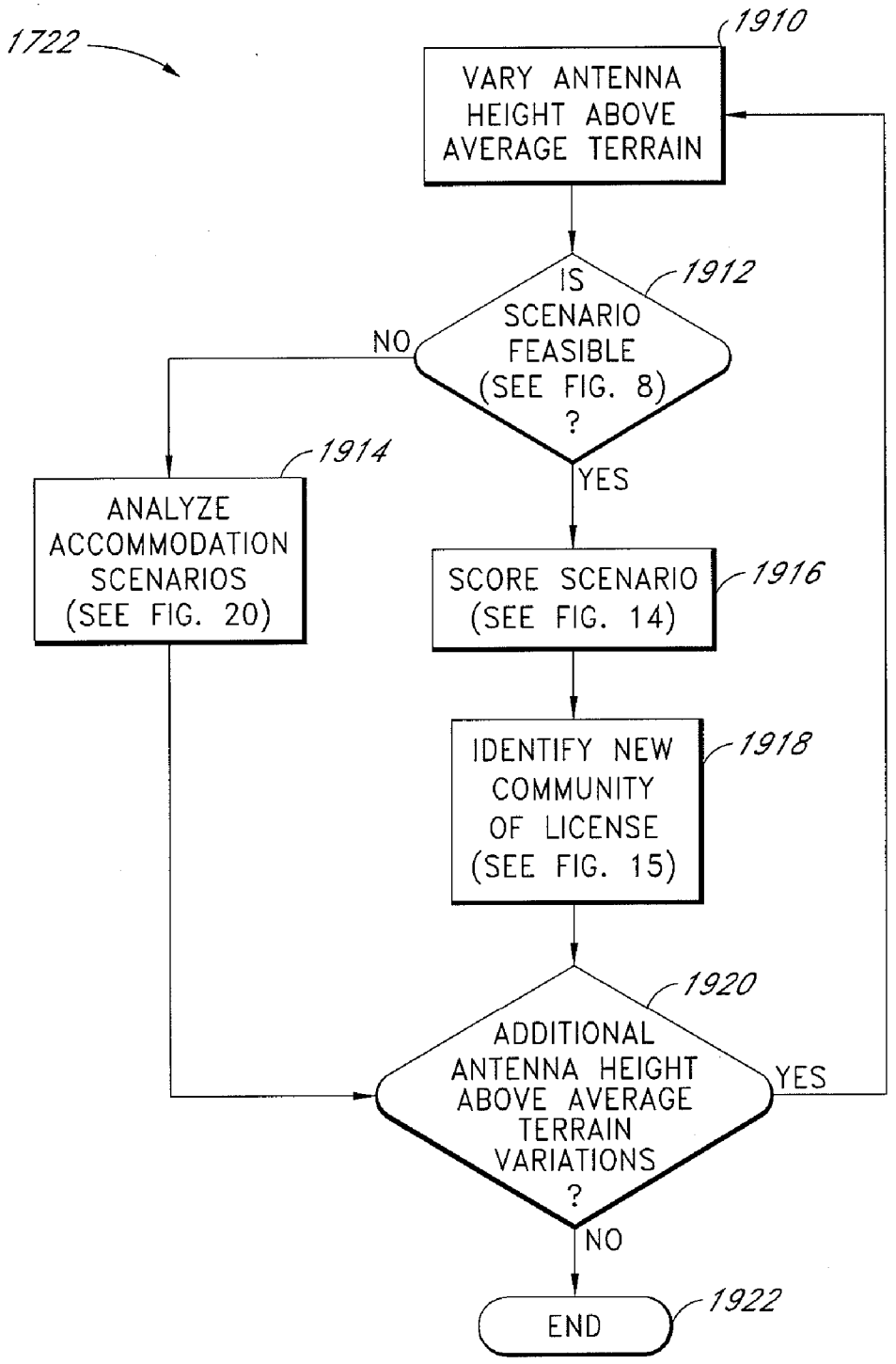

1722
1910
VARY ANTENNA HEIGHT ABOVE AVERAGE TERRAIN
1912
IS SCENARIO FEASIBLE (SEE FIG. 8) ?
NO
YES
1914
ANALYZE ACCOMMODATION SCENARIOS (SEE FIG. 20)
SCORE SCENARIO (SEE FIG. 14)
1916
IDENTIFY NEW COMMUNITY OF LICENSE (SEE FIG. 15)
1918
1920
ADDITIONAL ANTENNA HEIGHT ABOVE AVERAGE TERRAIN VARIATIONS ?
YES
NO
END
1922

FIG. 19

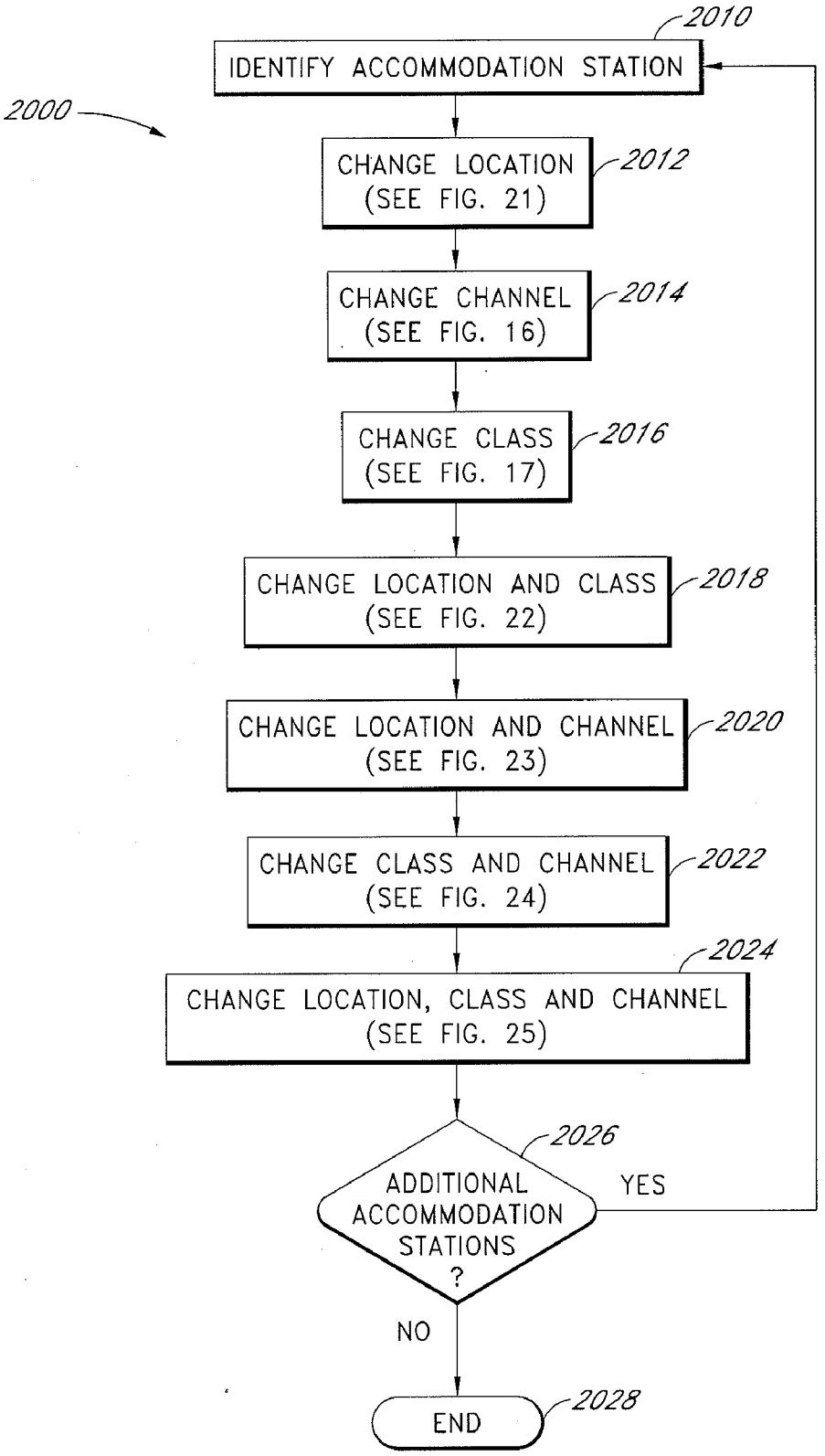

2000
2010
IDENTIFY ACCOMMODATION STATION
CHANGE LOCATION (SEE FIG. 21)
2012
CHANGE CHANNEL (SEE FIG. 16)
2014
CHANGE CLASS (SEE FIG. 17)
2016
CHANGE LOCATION AND CLASS (SEE FIG. 22)
2018
CHANGE LOCATION AND CHANNEL (SEE FIG. 23)
2020
CHANGE CLASS AND CHANNEL (SEE FIG. 24)
2022
CHANGE LOCATION, CLASS AND CHANNEL (SEE FIG. 25)
2024
ADDITIONAL ACCOMMODATION STATIONS ?
2026
YES
NO
END
2028

FIG. 20

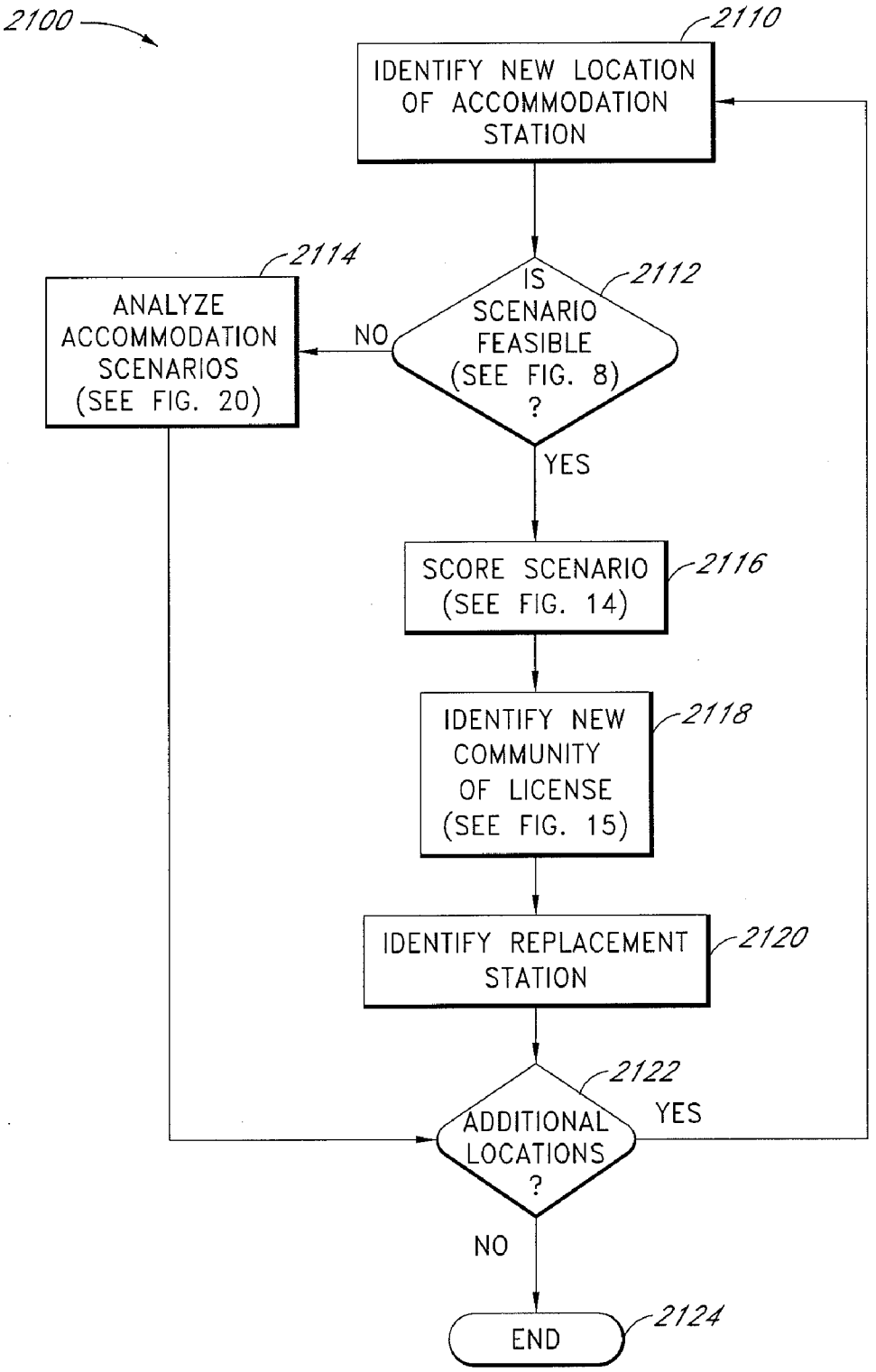

2100
2110
IDENTIFY NEW LOCATION OF ACCOMMODATION STATION
2112
IS SCENARIO FEASIBLE (SEE FIG. 8) ?
NO
2114
ANALYZE ACCOMMODATION SCENARIOS (SEE FIG. 20)
YES
2116
SCORE SCENARIO (SEE FIG. 14)
2118
IDENTIFY NEW COMMUNITY OF LICENSE (SEE FIG. 15)
2120
IDENTIFY REPLACEMENT STATION
2122
ADDITIONAL LOCATIONS ?
YES
NO
2124
END

FIG. 21

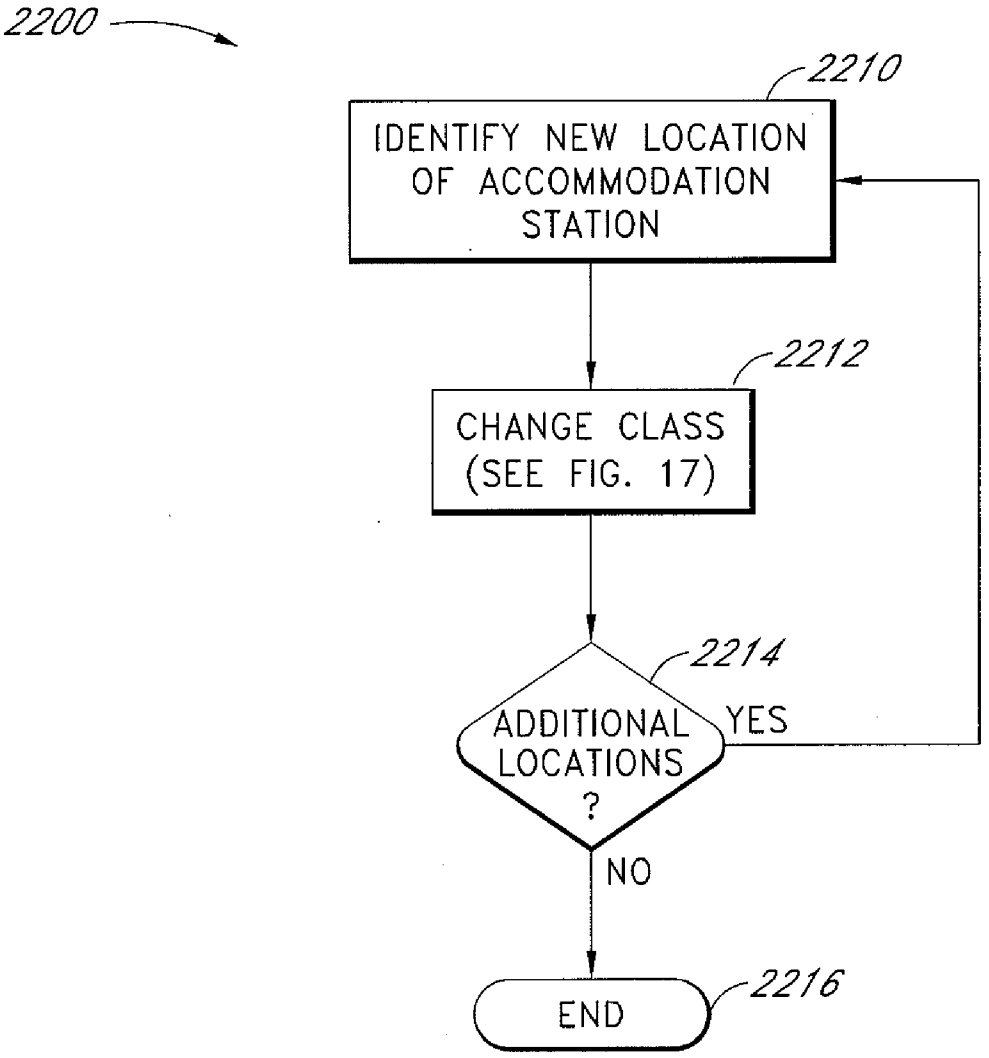

2200
2210
IDENTIFY NEW LOCATION OF ACCOMMODATION STATION
2212
CHANGE CLASS (SEE FIG. 17)
2214
ADDITIONAL LOCATIONS ?
YES
NO
2216
END

FIG. 22

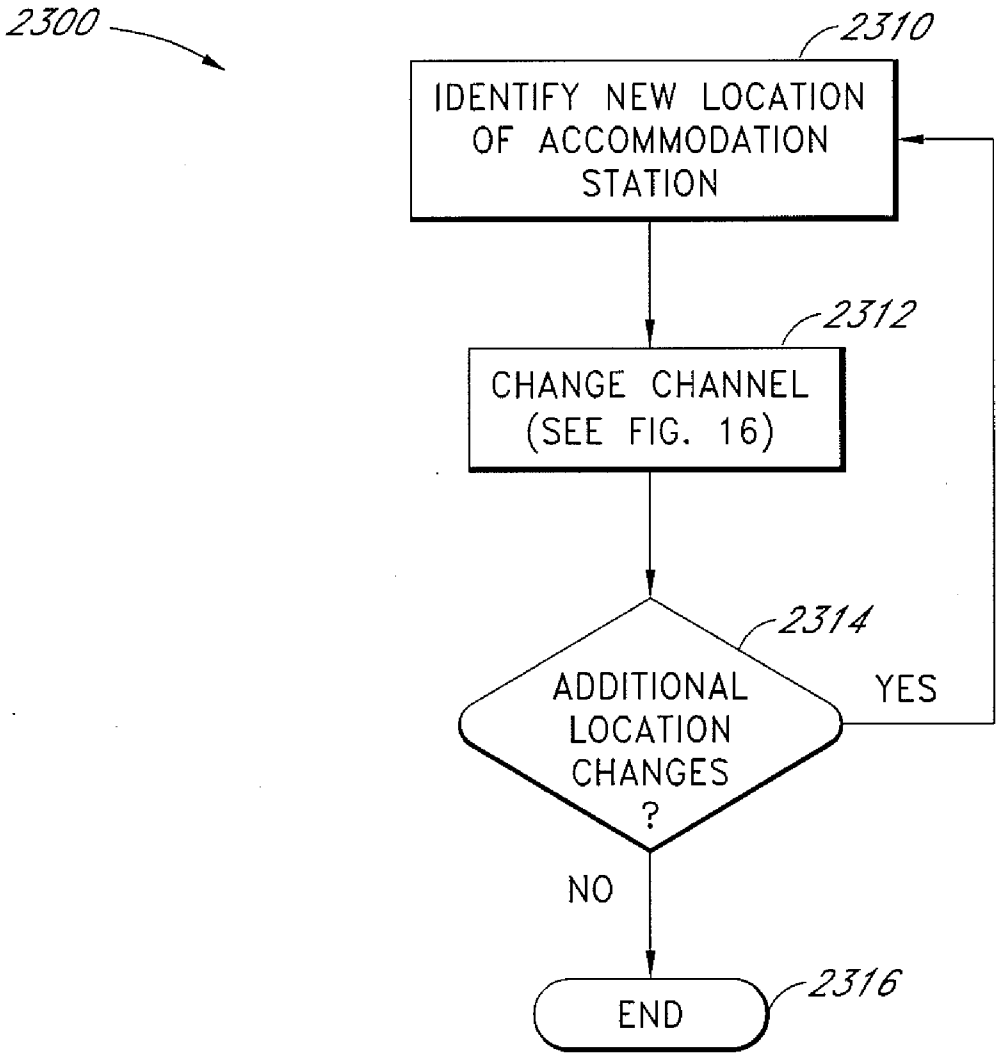

2300
2310
IDENTIFY NEW LOCATION OF ACCOMMODATION STATION
2312
CHANGE CHANNEL (SEE FIG. 16)
2314
ADDITIONAL LOCATION CHANGES ?
YES
NO
2316
END

FIG. 23

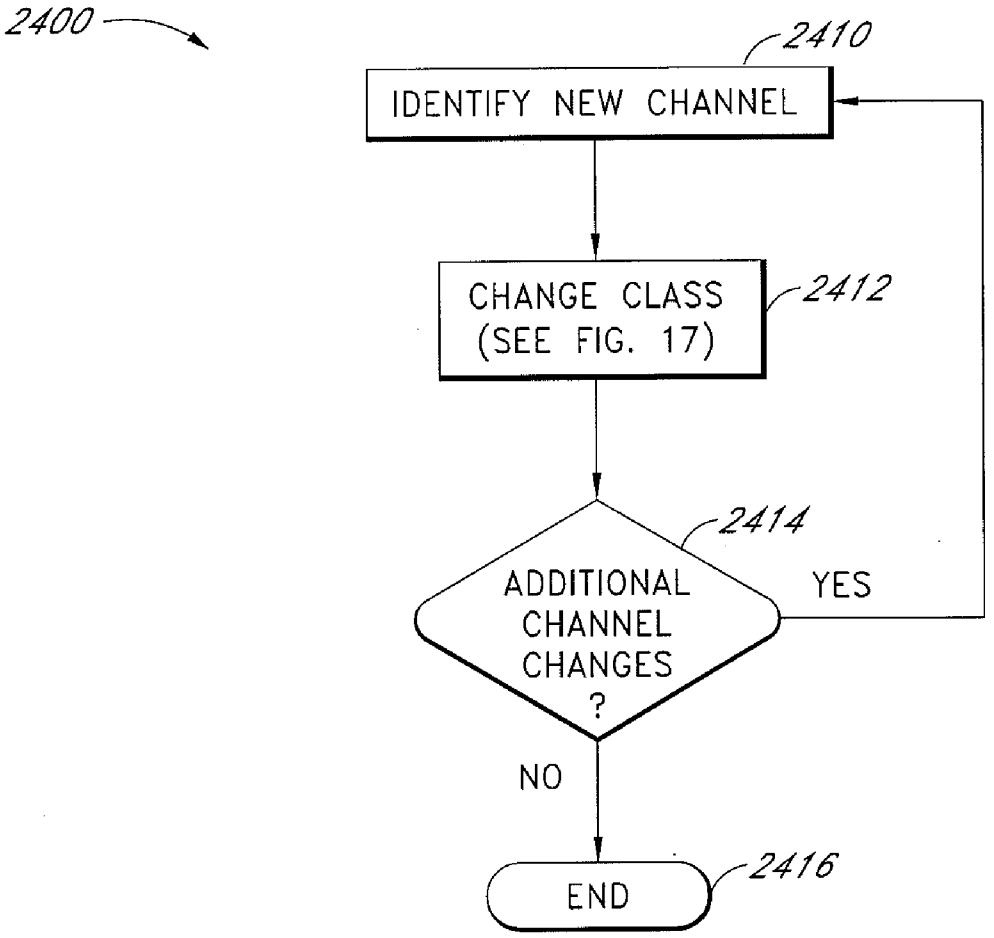

2400
2410
IDENTIFY NEW CHANNEL
CHANGE CLASS (SEE FIG. 17)
2412
2414
ADDITIONAL CHANNEL CHANGES ?
YES
NO
END
2416

FIG. 24

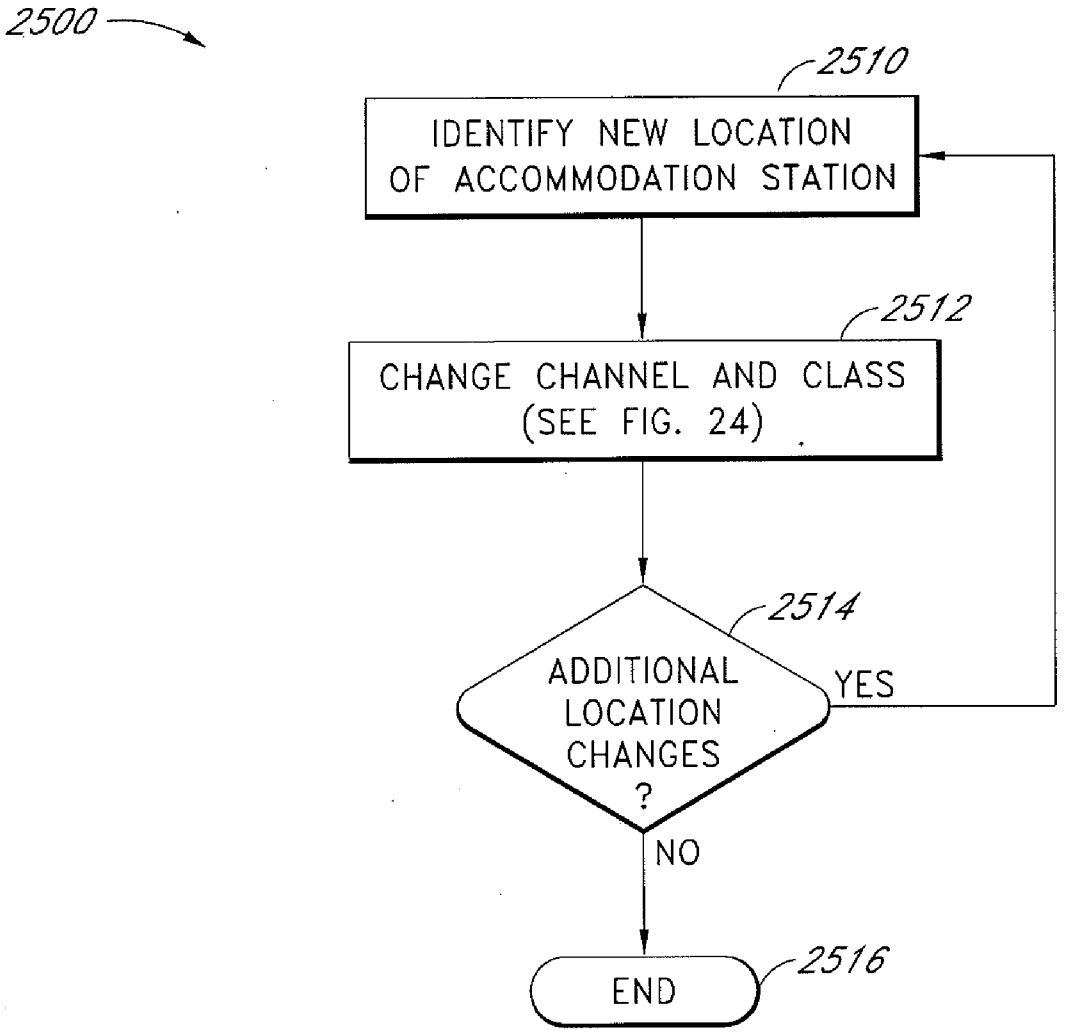

2500
2510
IDENTIFY NEW LOCATION OF ACCOMMODATION STATION
2512
CHANGE CHANNEL AND CLASS (SEE FIG. 24)
2514
ADDITIONAL LOCATION CHANGES ?
YES
NO
2516
END

FIG. 25

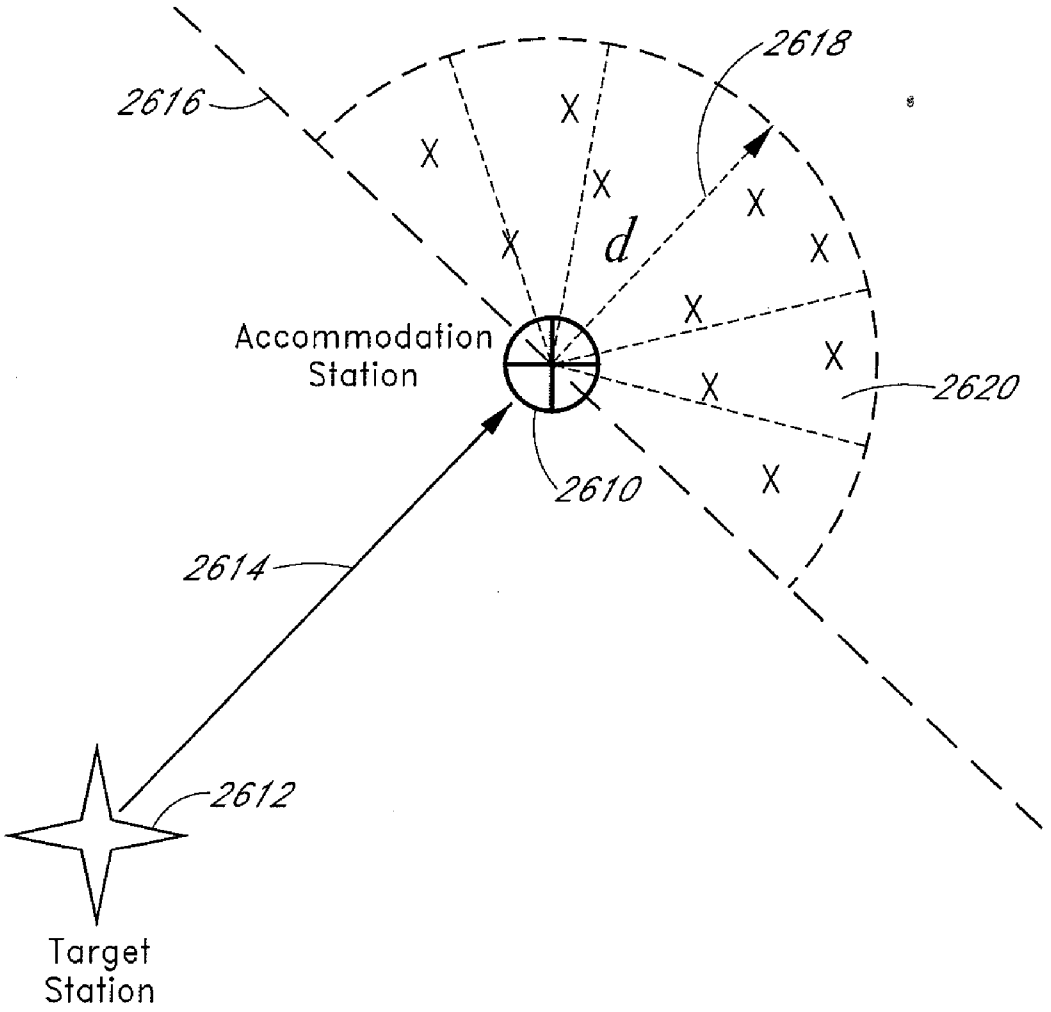

2616
2618
d
Accommodation Station
2620
2610
2614
2612
Target Station

FIG. 26

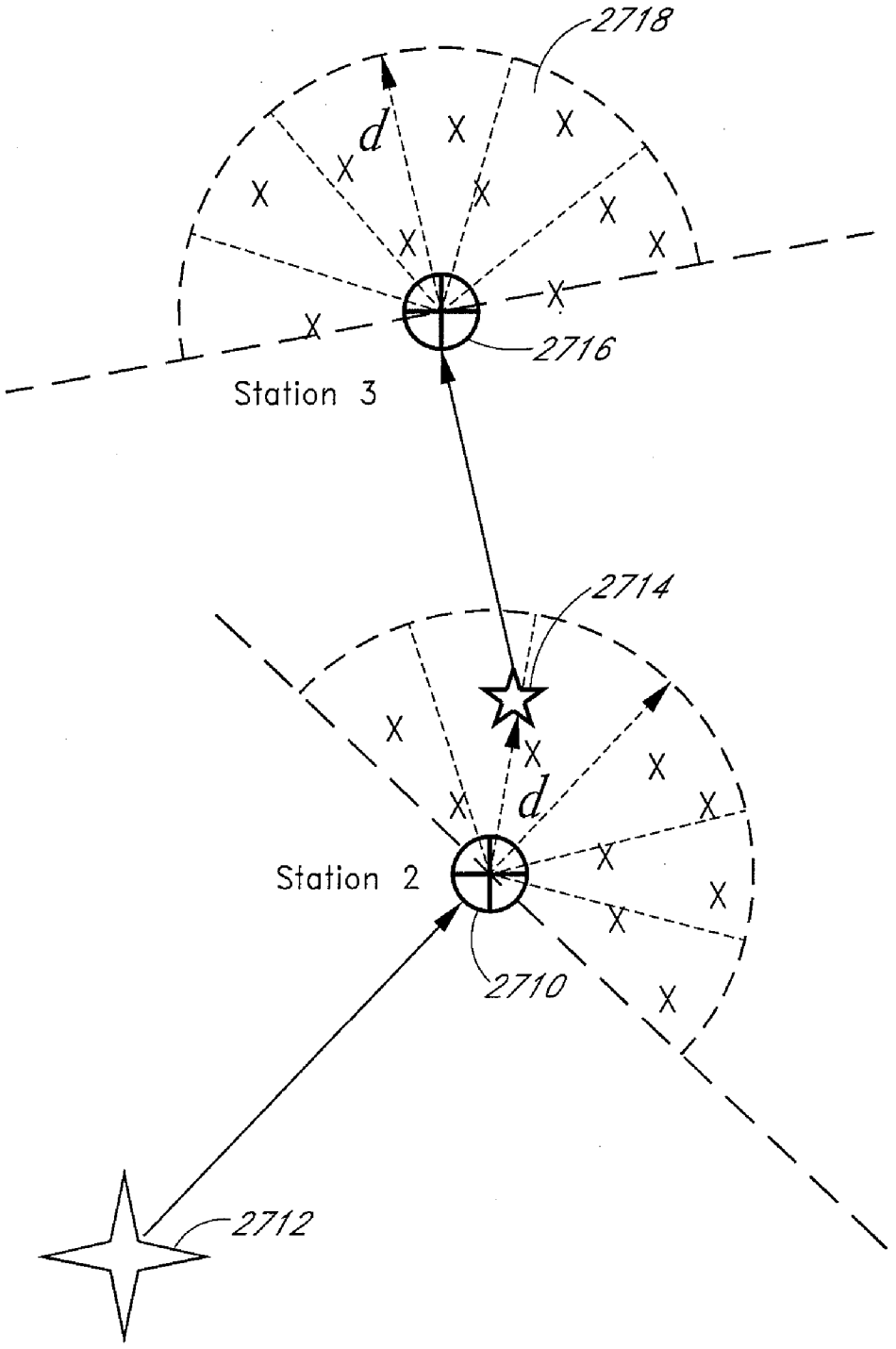


FIG. 27

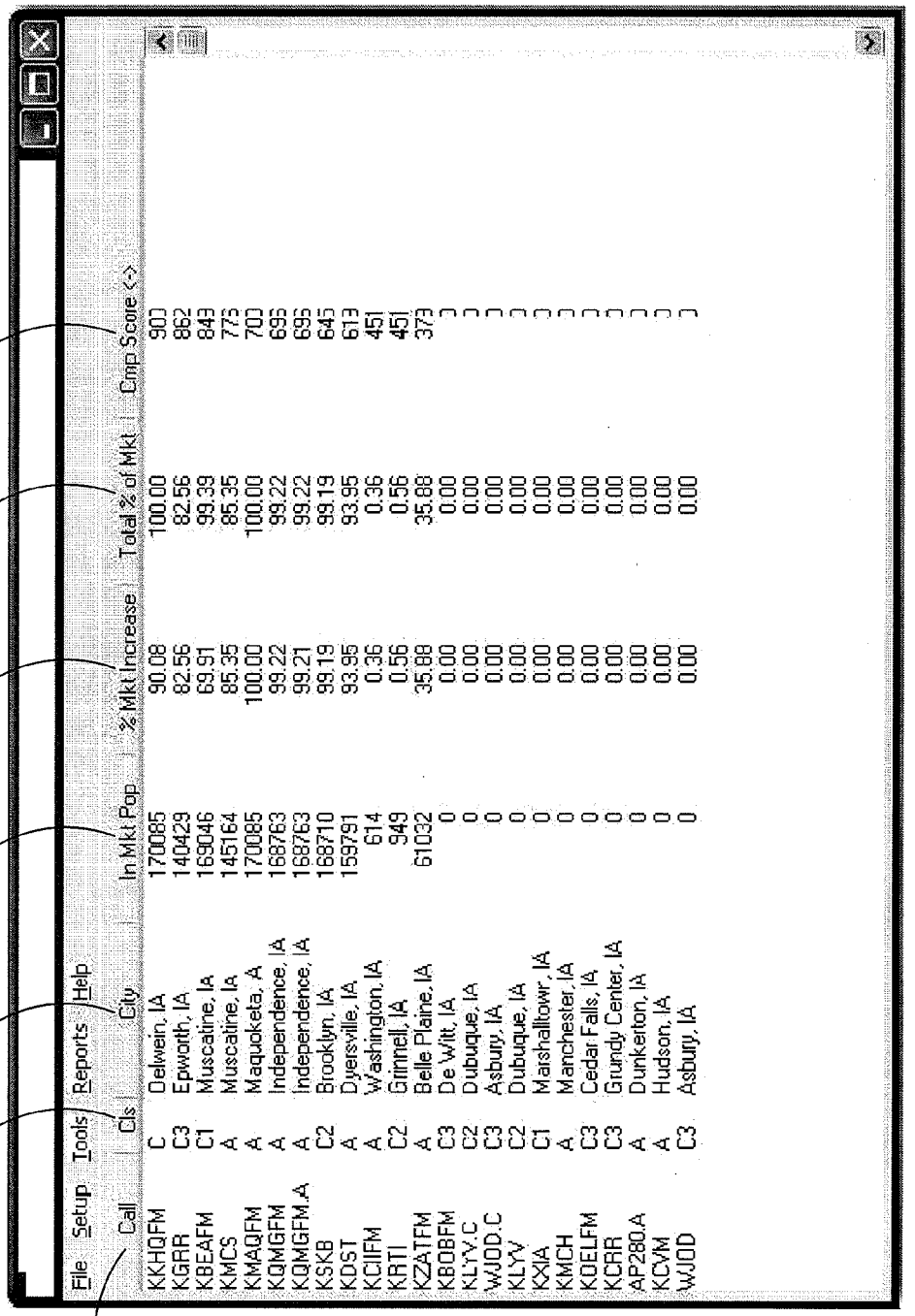

2800
2810
2812
2814
2816
2818
2820
2822
File Setup Tools Reports Help
Call Cls City In Mkt Pop % Mkt Increase Total % of Mkt Cmp Score <->
KKHQFM C Delwein, IA 170085 90.08 100.00 900
KGRR C3 Epworth, IA 140429 82.56 82.56 862
KBEAFM C1 Muscatine, IA 169046 69.91 99.39 849
KMCS A Muscatine, IA 145164 85.35 85.35 775
KMAQFM A Maquoketa, A 170085 100.00 100.00 700
KQMGFM A Independence, IA 168763 99.22 99.22 695
KQMGFM.A A Independence, IA 168763 99.21 99.22 695
KSKB C2 Brooklyn, IA 168710 99.19 99.19 645
KDST A Dyersville, IA 159791 93.95 93.95 619
KCIIFM A Washington, IA 614 0.36 0.36 451
KRTI C2 Grinnell, IA 949 0.56 0.56 451
KZATFM A Belle Plaine, IA 61032 35.88 35.88 373
KBOBFM C3 De Witt, IA 0 0.00 0.00
KLYV.C C2 Dubuque, IA 0 0.00 0.00
WJOD.C C3 Asbury, IA 0 0.00 0.00
KLYV C2 Dubuque, IA 0 0.00 0.00
KXIA C1 Marshalltowr, IA 0 0.00 0.00
KMCH A Manchester, IA 0 0.00 0.00
KDELFM C3 Cedar Falls, IA 0 0.00 0.00
KCRR C3 Grundy Center, IA 0 0.00 0.00
AP280.A A Dunkerton, IA 0 0.00 0.00
KCVM A Hudson, IA 0 0.00 0.00
WJOD C3 Asbury, IA 0 0.00 0.00

FIG. 28

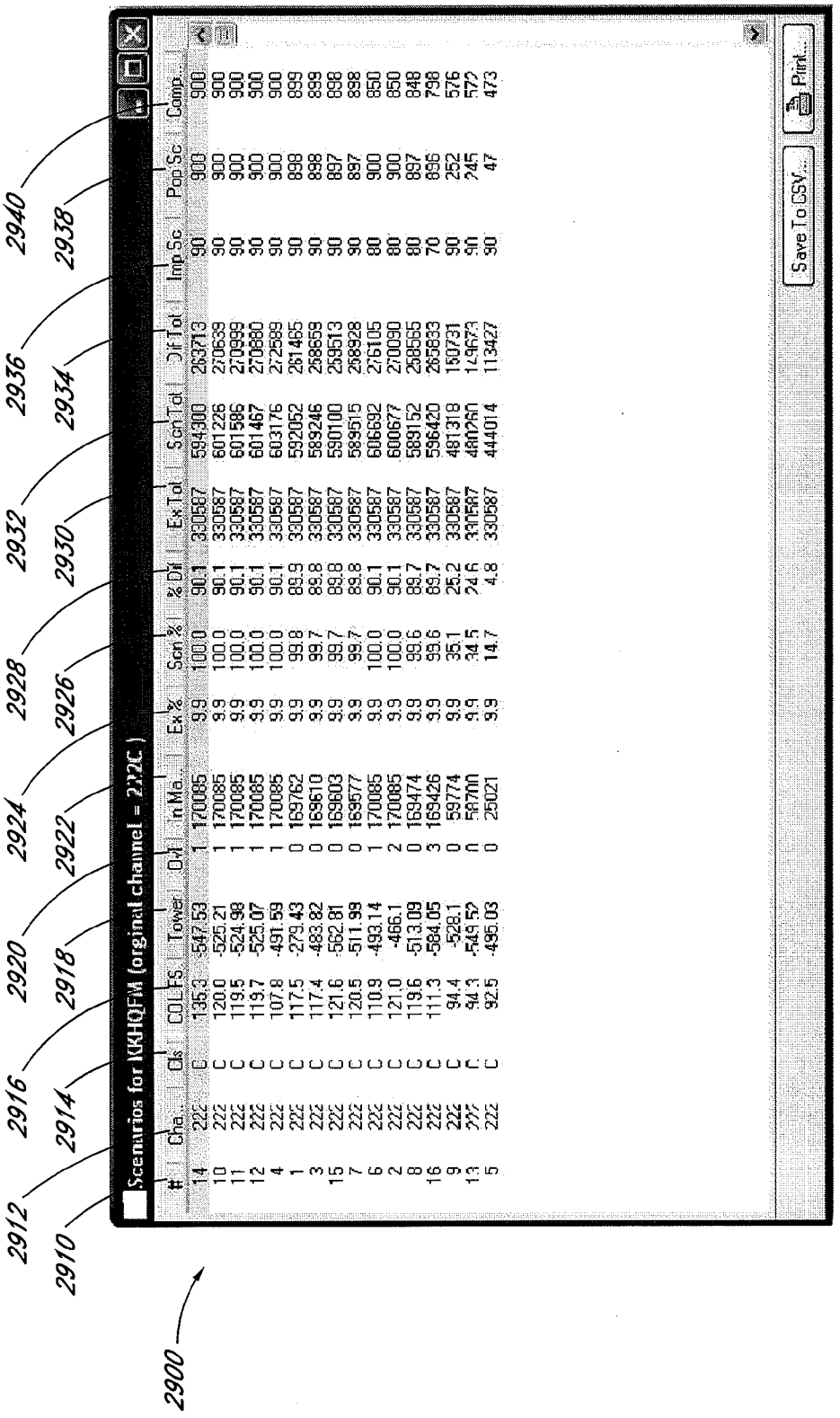

Scenarios for KKHQFM (original channel = 222C)
Save To CSV...
Print...
2900
2910
2912
2914
2916
2918
2920
2922
2924
2926
2928
2930
2932
2934
2936
2938
2940

FIG. 29

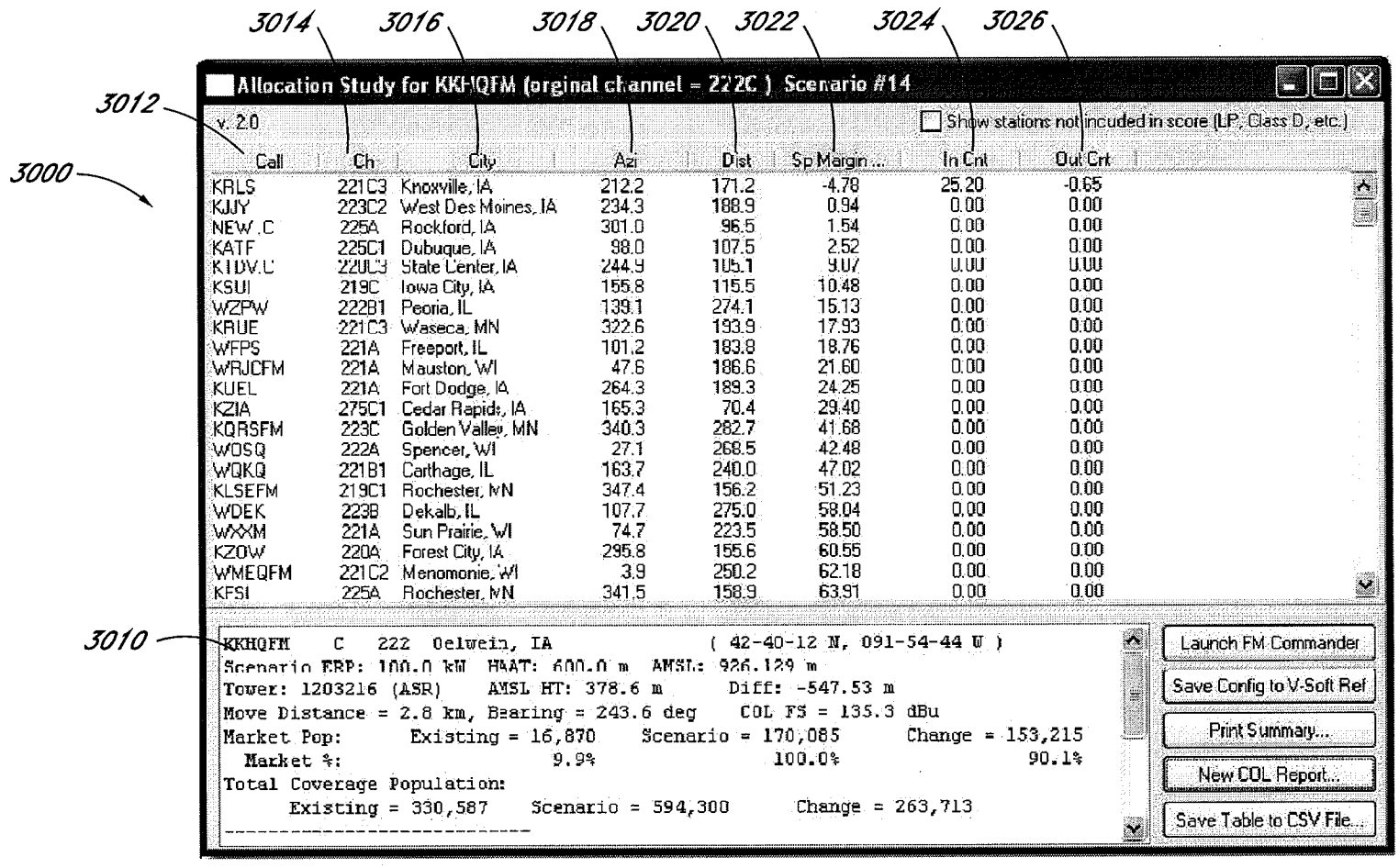
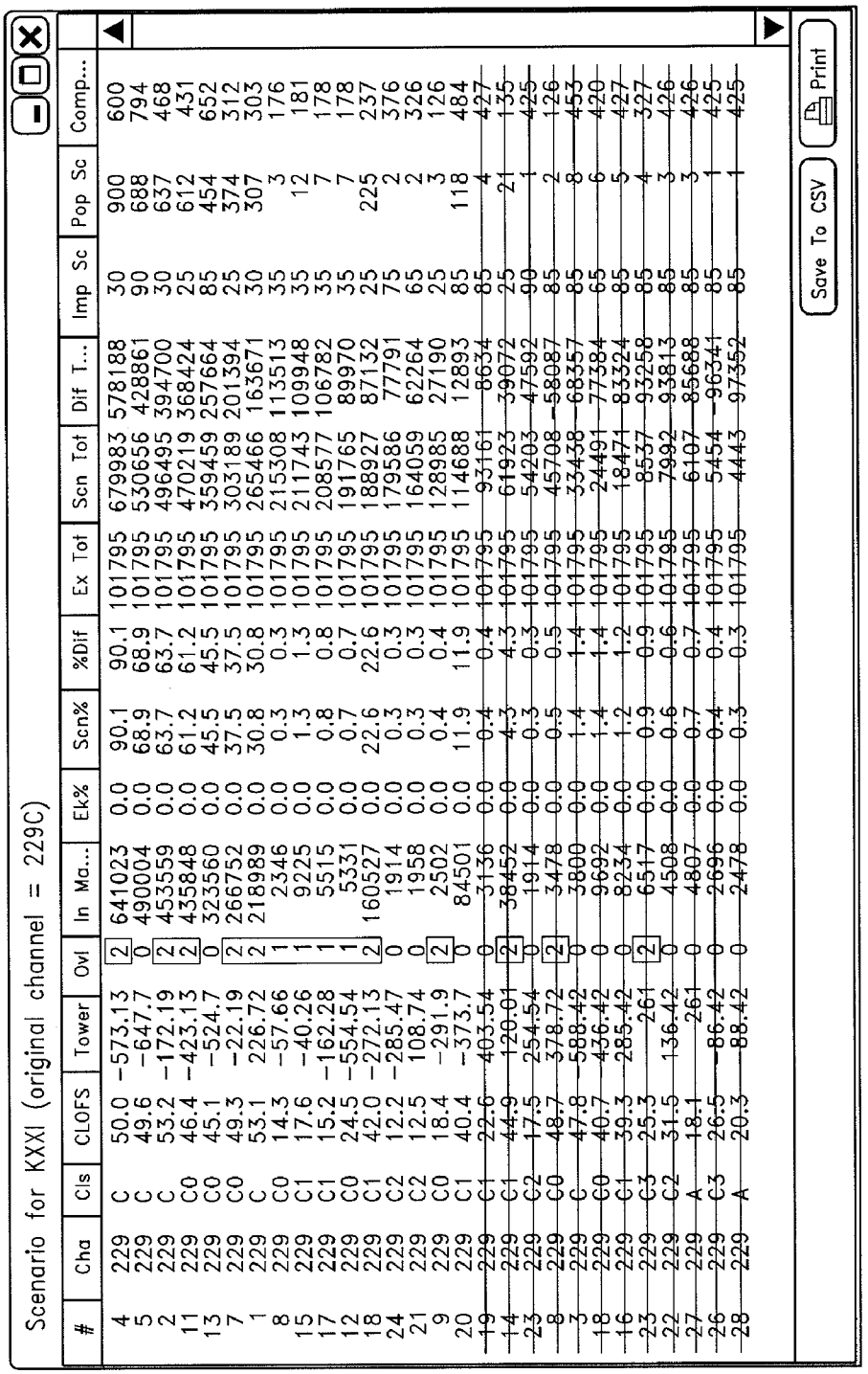

3000
3012
3014
3016
3018
3020
3022
3024
3026
3010
Allocation Study for KKHQFM (orginal channel = 222C) Scenario #14
v. 2.0
Show stations not incuded in score (LP, Class D, etc.)
Call Ch City Azi Dist Sp Margin ... In Cnt Out Cnt
KRLS 221C3 Knoxville, IA 212.2 171.2 -4.78 25.20 -0.65
KJJY 223C2 West Des Moines, IA 234.3 188.9 0.94 0.00 0.00
NEW .C 225A Rockford, IA 301.0 96.5 1.54 0.00 0.00
KATF 225C1 Dubuque, IA 98.0 107.5 2.52 0.00 0.00
KTDV.C 220C3 State Center, IA 244.9 105.1 9.07 0.00 0.00
KSUI 219C Iowa City, IA 155.8 115.5 10.48 0.00 0.00
WZPW 222B1 Peoria, IL 139.1 274.1 15.13 0.00 0.00
KRUE 221C3 Waseca, MN 322.6 193.9 17.93 0.00 0.00
WFPS 221A Freeport, IL 101.2 183.8 18.76 0.00 0.00
WRJCFM 221A Mauston, WI 47.6 186.6 21.60 0.00 0.00
KUEL 221A Fort Dodge, IA 264.3 189.3 24.25 0.00 0.00
KZIA 275C1 Cedar Rapids, IA 165.3 70.4 29.40 0.00 0.00
KQRSFM 223C Golden Valley, MN 340.3 282.7 41.68 0.00 0.00
WOSQ 222A Spencer, WI 27.1 268.5 42.48 0.00 0.00
WQKQ 221B1 Carthage, IL 163.7 240.0 47.02 0.00 0.00
KLSEFM 219C1 Rochester, MN 347.4 156.2 51.23 0.00 0.00
WDEK 223B Dekalb, IL 107.7 275.0 58.04 0.00 0.00
WXXM 221A Sun Prairie, WI 74.7 223.5 58.50 0.00 0.00
KZOW 220A Forest City, IA 295.8 155.6 60.55 0.00 0.00
WMEQFM 221C2 Menomonie, WI 3.9 250.2 62.18 0.00 0.00
KFSI 225A Rochester, MN 341.5 158.9 63.91 0.00 0.00
KKHQFM C 222 Oelwein, IA (42-40-12 N, 091-54-44 W)
Scenario ERP: 100.0 kW HAAT: 600.0 m AMSL: 926.129 m
Tower: 1203216 (ASR) AMSL HT: 378.6 m Diff: -547.53 m
Move Distance = 2.8 km, Bearing = 243.6 deg COL FS = 135.3 dBu
Market Pop: Existing = 16,870 Scenario = 170,085 Change = 153,215
Market %: 9.9% 100.0% 90.1%
Total Coverage Population:
Existing = 330,587 Scenario = 594,300 Change = 263,713
Launch FM Commander
Save Config to V-Soft Ref
Print Summary...
New COL Report...
Save Table to CSV File...

FIG. 30



#	Cha	Cls	CLOFS	Tower	Ovl	In Ma...	Ek%	Scn%	%Dif	Ex Tot	Scn Tot	Dif T...	Imp Sc	Pop Sc	Comp...
4	229	C	50.0	-573.13	2	641023	0.0	90.1	90.1	101795	679983	578188	30	900	600
5	229	C	49.6	-647.7	0	490004	0.0	68.9	68.9	101795	530656	428861	90	688	794
2	229	C	53.2	-172.19	2	453559	0.0	63.7	63.7	101795	496495	394700	30	637	468
11	229	C0	46.4	-423.13	2	435848	0.0	61.2	61.2	101795	470219	368424	25	612	431
13	229	C0	45.1	-524.7	0	323560	0.0	45.5	45.5	101795	359459	257664	85	454	652
7	229	C0	49.3	-22.19	2	266752	0.0	37.5	37.5	101795	303189	201394	25	374	312
1	229	C	53.1	226.72	2	218989	0.0	30.8	30.8	101795	265466	163671	30	307	303
8	229	C0	14.3	-57.66	1	2346	0.0	0.3	0.3	101795	215308	113513	35	3	176
15	229	C1	17.6	-40.26	1	9225	0.0	1.3	1.3	101795	211743	109948	35	12	181
17	229	C1	15.2	-162.28	1	5515	0.0	0.8	0.8	101795	208577	106782	35	7	178
12	229	C0	24.5	-554.54	1	5331	0.0	0.7	0.7	101795	191765	89970	35	7	178
18	229	C1	42.0	-272.13	2	160527	0.0	22.6	22.6	101795	188927	87132	25	225	237
24	229	C2	12.2	-285.47	0	1914	0.0	0.3	0.3	101795	179586	77791	75	2	376
21	229	C2	12.5	108.74	0	1958	0.0	0.3	0.3	101795	164059	62264	65	2	326
9	229	C0	18.4	-291.9	2	2502	0.0	0.4	0.4	101795	128985	27190	25	3	126
20	229	C1	40.4	-373.7	0	84501	0.0	11.9	11.9	101795	114688	12893	85	118	484
19	229	C1	22.6	403.54	0	3136	0.0	0.4	0.4	101795	93161	8634	85	4	427
14	229	C1	44.9	120.01	2	38452	0.0	4.3	4.3	101795	61923	39072	25	21	135
23	229	C2	17.5	254.54	0	1914	0.0	0.3	0.3	101795	54203	47592	90	1	425
8	229	C0	48.7	378.72	2	3478	0.0	0.5	0.5	101795	45708	58087	85	2	126
3	229	C	47.8	588.42	0	3800	0.0	1.4	1.4	101795	33438	68357	85	8	453
18	229	C0	40.7	436.42	0	9692	0.0	1.4	1.4	101795	24491	77304	65	6	420
16	229	C1	39.3	285.42	0	8234	0.0	1.2	1.2	101795	18471	83324	85	5	427
23	229	C3	25.3	261	2	6517	0.0	0.9	0.9	101795	8537	93258	85	4	327
22	229	C2	31.5	136.42	0	4508	0.0	0.6	0.6	101795	7992	93813	85	3	426
27	229	A	18.1	261	0	4807	0.0	0.7	0.7	101795	6107	85688	85	3	426
26	229	C3	26.5	86.42	0	2696	0.0	0.4	0.4	101795	5454	96341	85	1	425
28	229	A	20.3	88.42	0	2478	0.0	0.3	0.3	101795	4443	97352	85	1	425

3100

FIG. 31

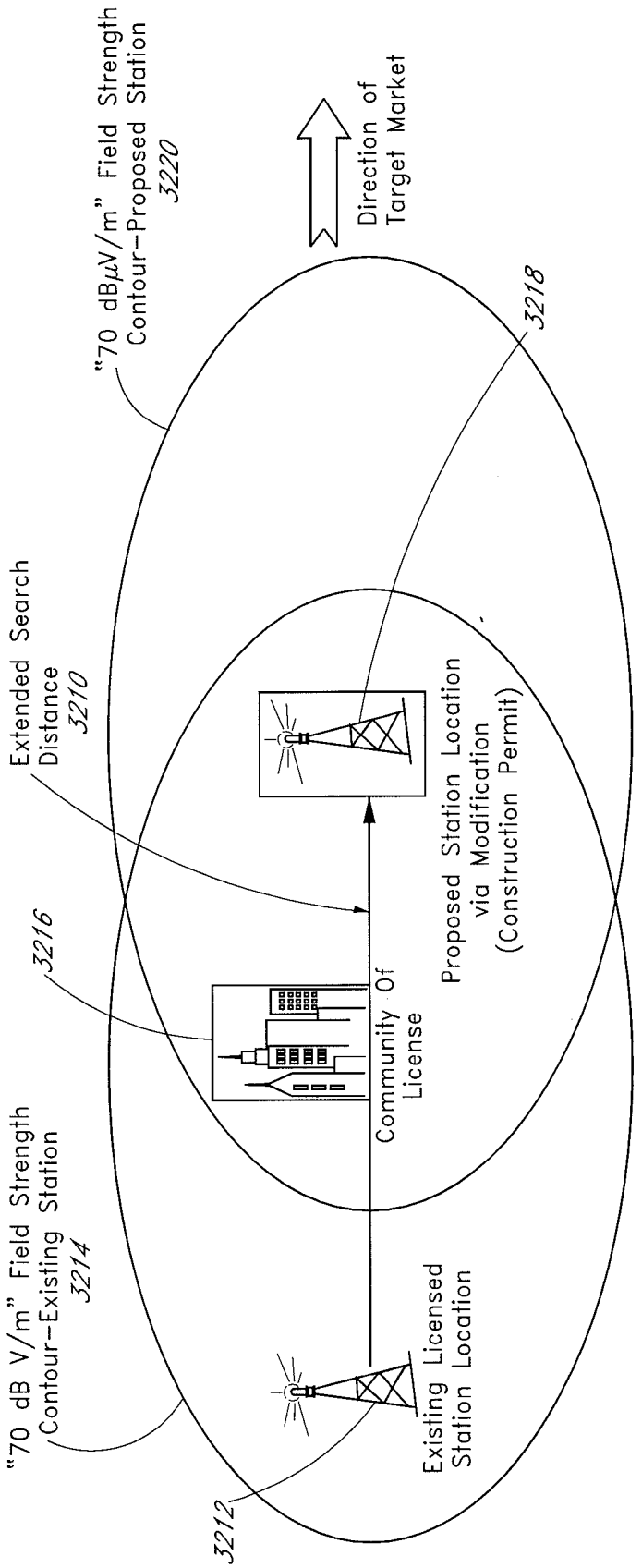

"70 dBμV/m" Field Strength
Contour–Proposed Station
3220
Direction of
Target Market
3218
Extended Search
Distance
3210
3216
Community Of
License
Proposed Station Location
via Modification
(Construction Permit)
"70 dB V/m" Field Strength
Contour–Existing Station
3214
Existing Licensed
Station Location
3212

FIG. 32

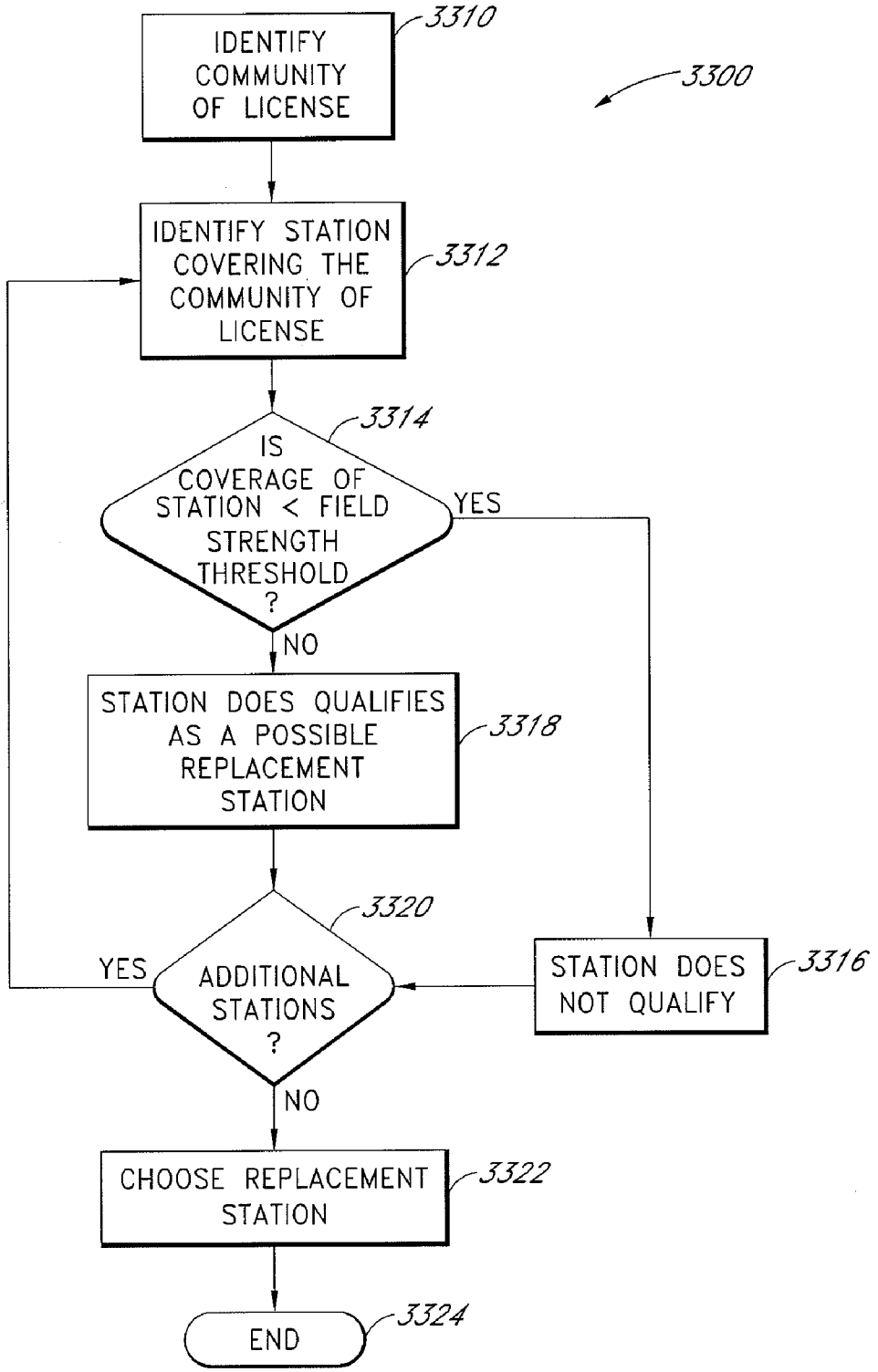

IDENTIFY COMMUNITY OF LICENSE
3310
3300
IDENTIFY STATION COVERING THE COMMUNITY OF LICENSE
3312
IS COVERAGE OF STATION < FIELD STRENGTH THRESHOLD ?
3314
YES
NO
STATION DOES QUALIFIES AS A POSSIBLE REPLACEMENT STATION
3318
ADDITIONAL STATIONS ?
3320
YES
NO
STATION DOES NOT QUALIFY
3316
CHOOSE REPLACEMENT STATION
3322
END
3324

FIG. 33

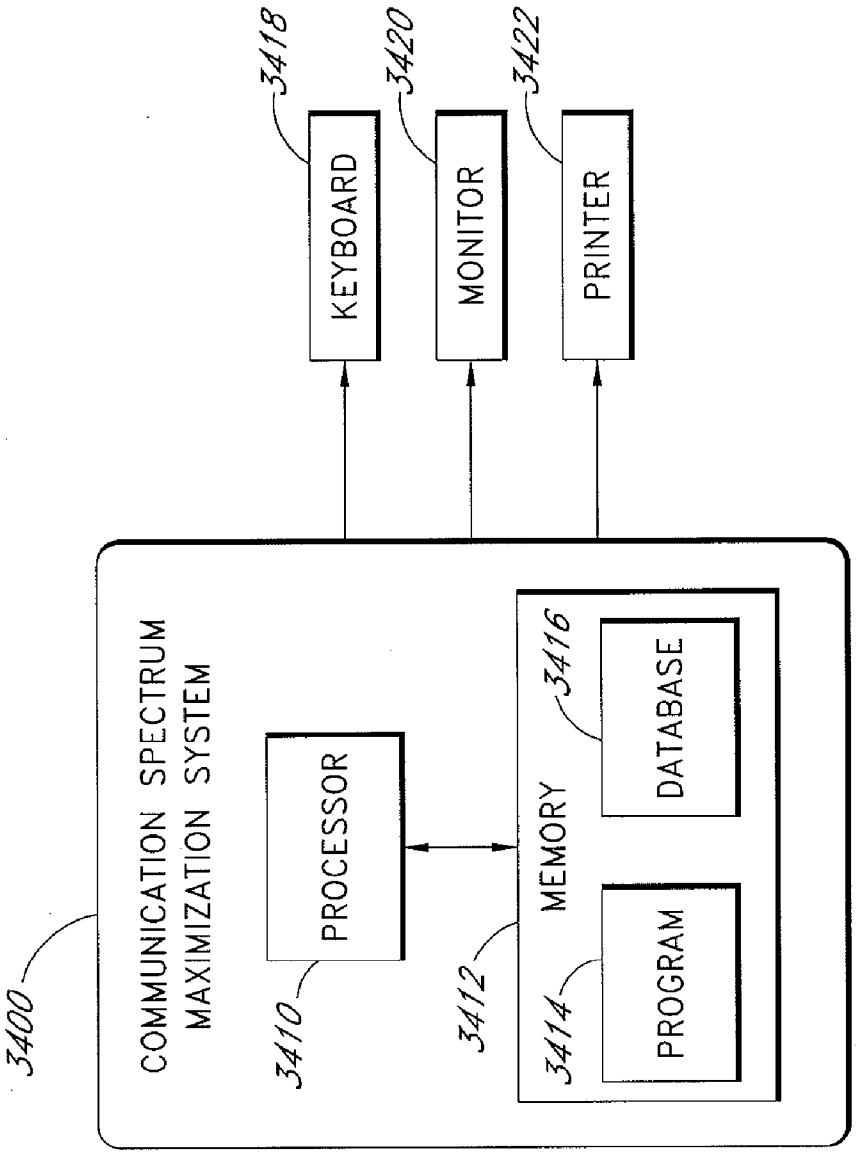

3418
3420
3422
KEYBOARD
MONITOR
PRINTER
COMMUNICATION SPECTRUM MAXIMIZATION SYSTEM
3400
PROCESSOR
3410
MEMORY
3412
3416
DATABASE
3414
PROGRAM

FIG. 34

SYSTEMS AND METHODS FOR DETERMINING REPLACEMENT COMMUNICATION FACILITY

[0001] This application claims the benefit of priority under 35 U.S.C. § 119(e) of U.S. Provisional Application No. 60/785,337 filed on Mar. 23, 2006 and titled COMMUNICATION SPECTRUM MAXIMIZATION SYSTEMS AND METHODS, the entirety of which is hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates generally to systems and methods for analyzing, varying, testing, managing, and/or improving transmission in the communication spectrum.

[0004] 2. Description of the Related Art

[0005] Broadcasting includes the distribution of audio, video, and/or data signals from a point of communication to one or more devices and from the one or more devices to the point of communication.

[0006] There has also been extensive growth in communications throughout the world. Many separate entities are involved. Furthermore, these entities are typically assigned specific portions of the communication spectrum within defined regions.

[0007] For example, communication systems are often regulated by one or more government organizations. In the United States, for instance, the Federal Communications Commission (FCC) licenses radio and television stations. Further, the FCC regulates the broadcast frequency, the transmission power, the distance between stations, and the like so that the communication facilities provide improved service in service coverage areas for the benefit of the public. The FAA (Federal Avionics Administration), in an example, determines the allowable tower height. The FCC confirms that the tower height has been accepted by the FAA before listing the tower in a tower database. The Antenna Structure Registration (ASR) database is an example of an FCC tower database.

[0008] Population growth, changing demographics, and improvements in broadcasting technologies, however, have created needs for new and improved communication techniques. Unfortunately, making improvements and modifications to existing communication systems is a highly complex process as improvements and modifications made to one point of communication may encroach on the rights of other facilities or may violate governmental rules and regulations.

SUMMARY OF THE INVENTION

[0009] Today there are thousands of points of communication in the United States, and many more worldwide. For example, embodiments of the invention can be applied to points of communication that include, but are not limited to, analog transmissions or digital transmissions such as radio, television, wireless, cellular, WI-FI, WiMAX, emergency communications systems, data transmissions, and the like. In these embodiments, the points of communication can represent radio stations, television stations, wireless transmission points, cellular transmission points, satellite transmitters, WI-FI transmission points, WiMAX transmission points, emergency communications systems, data transmission systems, and the like.

[0010] Many of these points of communication can be altered to increase market or area coverage. For example, it is possible to increase the coverage associated with a particular point of communication by changing one or more of the operational parameters. These operational parameters may include by way of example, facility location, broadcast frequency, transmission power, station class, broadcast antenna height, or the like.

[0011] In one embodiment of the invention, a computerized system tests, analyzes, varies, manages, decreases and/or increases one or more potential operational parameters associated with a point of communication to determine the likely improvement in desired coverage. Furthermore, one embodiment of the invention electronically ranks the potential operational parameters based at least in part on user-defined objectives. Such user defined objectives may include, but are not limited to, coverage of target markets, target areas, geographic areas, populations, and/or demographics. Another embodiment evaluates the potential operational parameters with respect to applicable communications and/or regulatory laws.

[0012] For example, an embodiment analyzes and/or varies possible transmission locations and/or orientations associated with allocated communication spectrum. Another embodiment analyzes and/or varies possible transmission locations and/or orientations associated with allocated communication spectrum with respect to applicable communications and/or regulatory laws. The coverage attributes of the signal transmitted from each such location and/or orientation are then calculated and/or analyzed applying user defined parameters to improve the potential of the communication spectrum.

[0013] One embodiment of the invention analyzes user-defined existing transmission location options. Another embodiment analyzes hypothetical transmission location options by applying user-defined parameters. One embodiment maximizes the effective broadcast coverage by optimizing the number, placement, and/or power of "virtual" boosters, "virtual" antennas, "virtual" broadcast sites, and/or "virtual" translators within the user-defined target area. In other words, an embodiment of the invention plots these virtual devices in places where they currently do not exist (and varies their characteristics such as: power, height, polarization, and/or frequency) in order to formulate the ideal combination of transmission components to reach the market or area coverage goal.

[0014] One embodiment locates the "virtual" antenna(s) on existing structures, such as towers and buildings, with heights defined in an accessible database. Another embodiment locates the "virtual" antenna(s) anywhere in the coverage geography at height limits with respect to applicable communications and/or regulatory laws.

[0015] An embodiment analyzes and/or varies signal transmission attributes including, but not limited to, power and/or height, and/or antenna attributes including, but not limited to, orientation, directionalization, and/or polarization. Another embodiment analyzes and/or varies signal transmission attributes including, but not limited to, power and/or height, and/or antenna attributes including, but not limited to, orientation, directionalization, and/or polarization with respect to applicable communications and/or regulatory laws. The various coverages associated with each of

the modified transmission and/or antenna attributes are then calculated and/or analyzed applying user-defined parameters to improve the potential of the communication spectrum. One embodiment varies the effected radiated power at different heights and tests the results against user-defined parameters with respect to applicable communications and/or regulatory laws. Another embodiment varies the orientation, directionalization, and/or polarization of the transmitting antenna and matches that data against specific antenna patterns in order to maximize user-defined coverages of target markets, target areas, geographic areas, and/or population/demographics.

[0016] Another embodiment analyzes channels in a user-defined target area by combining a plurality of channels to meet user-defined coverage objectives in such area. Another embodiment analyzes low signal level areas of a station's field strength contour that can be improved with one or more booster(s), translator(s), and/or repeater(s). An embodiment analyzes and/or varies alternative channels. Another embodiment analyzes and/or varies alternative channels with respect to applicable communications and/or regulatory laws. The coverage attributes of the signal transmitted on each such channel are then calculated and/or analyzed applying user defined parameters to improve the potential of the communication spectrum.

[0017] Another embodiment analyzes and/or varies alternative transmission frequencies. Another embodiment analyzes and/or varies alternative transmission frequencies with respect to applicable communications and/or regulatory laws. The coverage attributes of the signal transmitted on each such frequency are then calculated and/or analyzed applying user defined parameters to improve the potential of the communication spectrum. One embodiment analyzes frequencies to determine spacing attributes relative to other frequency allocations. Another embodiment analyzes frequencies to determine the field strength contour overlap/separation relative to frequency allocations.

[0018] An embodiment combines some or all of its output and external data in order to rank and/or score each of the different spectrum alternatives to maximize user defined objectives. Each spectrum alternative can be assigned one or more numerical scores based at least in part on financial or other indications of feasibility.

[0019] In another embodiment, the performance score is based upon the increase of the coverage of the targeted population and/or demographic. In another embodiment, the complexity score indicates how well each alternative meets spacing requirements. In another embodiment, the complexity score indicates how well each alternative meets spacing requirements with respect to applicable communications and/or regulatory laws. In another embodiment, the efficiency score indicates the feasibility of output scenarios from a financial perspective such as values of various cost factors for each output scenario, including but not limited to, transmitter power, antenna type, FCC filing type, and/or tower height to show how well each alternative meets user-defined financial parameters and/or objectives. In another embodiment, the net present value calculates costs and values involved in meeting the market or area coverage goal of the target station. In another embodiment, the composite score reflects a combination of the performance, complexity, efficiency, net present value and/or other scores in accordance with user-defined criteria.

[0020] An embodiment analyzes partial market or area coverage station(s) that can be combined with a target station to produce enhanced coverage of a user-defined area.

[0021] Another embodiment receives data from a remote signal strength measurement and reporting system. Areas or points can be set in geographic locations in each market or area based upon user-defined criteria. Each area and/or point could have topographical data associated with it along with location data. An embodiment analyzes and/or adjusts the parameters, including but not limited to, transmission power, antenna height, and/or antenna orientation until the coverage characteristics meet the user-defined objectives.

[0022] Another embodiment analyzes the furthest reception points around the perimeter of a target market area using known obstructions, including but not limited to, buildings and/or topography, to model the location for a transmitting tower. Once the tower is located, various parameters, including but not limited to, transmission power, antenna height and/or antenna orientation can be applied to enhance coverage of the field strength contour until it reaches the user-defined coverage objective.

[0023] For purposes of summarizing the invention, certain aspects, advantages, and novel features of the invention have been described herein. It is to be understood that not necessarily all such advantages may be achieved in accordance with any particular embodiment of the invention. Thus, the invention may be embodied or carried out in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] A general architecture that implements the various features of the invention will now be described with reference to the drawings. The drawings and the associated descriptions are provided to illustrate embodiments of the invention and not to limit the scope of the invention.

[0025] FIG. **1** illustrates a target station having a coverage area and a possible accommodation station, according to an embodiment of the invention.

[0026] FIG. **2** is a flow chart of an embodiment of the communication spectrum variation process.

[0027] FIG. **3** is a flow chart illustrating the process of identifying stations within the target area, according to an embodiment of the invention.

[0028] FIG. **4** is a flow chart illustrating the process of specifying location considerations, according to an embodiment of the invention.

[0029] FIG. **5** is a screen shot of an embodiment of a communication spectrum set-up screen, according to an embodiment of the invention.

[0030] FIG. **6** illustrates mutually exclusive tower locations, according to an embodiment of the invention.

[0031] FIG. **7** is a flow chart illustrating the process of analyzing scenarios, according to an embodiment of the invention.

[0032] FIG. **8** is a flow chart illustrating the process of determining whether a scenario is feasible, according to an embodiment of the invention.

[0033] FIG. **9** illustrates field strength contour projections used in determining the field strength contour area coverage of a station and the field strength contour population and/or demographics coverage of a station, according to an embodiment of the invention.

[0034] FIG. **10** is a graphical representation of radial for use in the height above average terrain (HAAT) calculation, according to an embodiment of the invention.

[0035] FIG. **11** is a graphical representation of a north-south radial transformation for use in the HAAT calculation, according to an embodiment of the invention.

[0036] FIG. **12** is a graphical representation of an east-west radial transformation for use in the HAAT calculation, according to an embodiment of the invention.

[0037] FIG. **13** is a graphical representation of a radial set transformation for use in the HAAT calculation, according to an embodiment of the invention.

[0038] FIG. **14** is a flow chart illustrating the financial feasibility/numerical scoring process, according to an embodiment of the invention.

[0039] FIG. **15** is a flow chart illustrating a process to identify a community of license (COL), according to an embodiment of the invention.

[0040] FIG. **16** is a flow chart illustrating a process to identify possible changes of the station channel and/or frequency, according to an embodiment of the invention.

[0041] FIG. **17** is a flow chart illustrating a process to identify possible changes of the station class, according to an embodiment of the invention.

[0042] FIG. **18** is a flow chart illustrating a process to evaluate variations in the transmit power within a station class, according to an embodiment of the invention.

[0043] FIG. **19** is a flow chart illustrating a process to evaluate variations in the antenna HAAT within a station class, according to an embodiment of the invention.

[0044] FIG. **20** is a flow chart illustrating a process to analyze accommodation station scenarios, according to an embodiment of the invention.

[0045] FIG. **21** is a flow chart illustrating a process to identify possible changes of the accommodation station location, according to an embodiment of the invention.

[0046] FIG. **22** is a flow chart illustrating a process to identify possible changes of the accommodation station location and class, according to an embodiment of the invention.

[0047] FIG. **23** is a flow chart illustrating a process to identify possible changes of the accommodation station location, channel and/or frequency according to an embodiment of the invention.

[0048] FIG. **24** is a flow chart illustrating a process to identify possible changes of the accommodation station class, channel and/or frequency according to an embodiment of the invention.

[0049] FIG. **25** is a flow chart illustrating a process to identify possible changes of the accommodation station location, class, channel and/or frequency, according to an embodiment of the invention.

[0050] FIG. **26** is a graphical representation of a single accommodation station location change, according to an embodiment of the invention.

[0051] FIG. **27** is a graphical representation of multiple accommodation station location changes, according to an embodiment of the invention.

[0052] FIG. **28** is a screen shot illustrating a list of possible target stations, according to an embodiment of the invention.

[0053] FIG. **29** is a screen shot illustrating a list of scenarios for a target station, according to an embodiment of the invention.

[0054] FIG. **30** is a screen shot illustrating a list stations having an allocation relationship with the target station, according to an embodiment of the invention.

[0055] FIG. **31** is a screen shot illustrating a list of possible accommodation stations, according to an embodiment of the invention.

[0056] FIG. **32** is a graphical representation of an extended search area, according to an embodiment of the invention.

[0057] FIG. **33** is a flow chart illustrating a process to identify a replacement station, according to an embodiment of the invention.

[0058] FIG. **34** is a schematic of a communication spectrum improvement system, according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0059] In one example of the invention, a computer-based program performs calculations to analyze, vary, test, manage, and/or improve the performance of channels and/or frequencies in the communication spectrum. The program varies parameters of a point of communication, such as the location, transmission power, channel frequency, antenna height, and the like, alone or in combination, to determine which parameter changes improve the market or area coverage of a target market or area. In some scenarios, changes to one point of communication cause the regulations governing the broadcast relationship between nearby points of communication to be violated. When this occurs, the program determines which of the parameters, such as the location, transmission power, channel, frequency, antenna height, and the like, alone or in combination, of the point of communication interfering with the improved market or area coverage scenario to vary to overcome conflicts from communications and/or regulatory laws.

[0060] Referring to FIG. **1**, a market or area **102** receives broadcast coverage from a first point of communication **100**. The market or area **102** can be defined by a geographic area, population, or demographics, such as age, ethnicity, or the like. Embodiments described below relate to increasing the market or area coverage of the first point of communication or the target station **100**. In an embodiment of the invention, the program **3414** varies parameters of the target station **100**, such as the location, transmission power, channel, frequency, antenna height, and the like, alone or in combina-

tion, to determine which parameter changes improve the broadcast coverage of the market or area **102** by the target station **100**.

[**0061**] In some scenarios, changes to the target station **100** cause the regulations governing the broadcast relationship between the target station **100** and a second point of communication or accommodation station **104** to be violated. When this occurs, the program **3414** determines which of the parameters, such as the location, transmission power, channel, frequency, antenna height, and the like, alone or in combination, of the second point of communication or accommodation station **104** to vary to possibly overcome the regulatory conflict between the target station **100** and the accommodation station **104**.

[**0062**] The embodiments described below relate to varying the communication spectrum of FM radio. Thus, the target station **100** and the accommodation station **104** represent FM radio stations in the embodiments described below.

[**0063**] Other embodiments of the invention can be applied to other ranges of the communication spectrum, including, but not limited to analog transmissions, or digital transmissions such as radio, television, wireless, cellular, WI-FI, WiMAX, emergency communications systems, data transmissions and the like. In these embodiments, the points of communication **100**, **104** can represent radio stations, television stations, wireless transmission points, cellular transmission points, satellite transmitters, WI-FI transmission points, WiMAX transmission points, emergency communications systems, data transmission systems, and the like.

[**0064**] FIG. **2** is a flow chart of an embodiment of a communication spectrum maximization process **200**. The communication spectrum maximization process **200** identifies the target radio stations **100** and possible target station scenarios that meet the market criteria. In an embodiment, the market criteria are user-defined. In an embodiment, the target station scenarios comprise changes to the target station **100**. In another embodiment, the target station scenarios comprise changes to the target station **100** and one or more accommodation stations **104**.

[**0065**] In an embodiment, the communication spectrum maximization process **200** is implemented as a computer-based software application or firmware/hardware based application and/or program. A communication spectrum improvement system **3400** comprising a computer **3410**, and memory **3412** is described in detail in FIG. **34**. In an embodiment, the memory **3412** comprises a computer-based software application or firmware/hardware based application and/or program **3414**, which comprises the communication spectrum maximization process **200**, and database information **3416**. In an embodiment, the database information **3416** comprises terrain databases, demographic databases, location databases, station databases, and the like.

[**0066**] In block **210**, the program **3414** identifies target stations **100** that are located within the target market or area **102** and meet the market criteria. In an embodiment, the target market or area **102** and the market criteria are user-defined. For example, the user specifies that the program **3414** identify radio stations in the target market or area **102** that presently broadcast to less than 50% of the target market or area **102**. FIG. **3** describes block **210** in more detail.

[**0067**] In block **212**, the user specifies location related parameters for the program **3414** to consider. For example, the user specifies that the program **3414** consider changing the location of the target station **100** identified in block **210** to both actual radio tower locations and hypothetical radio tower locations, which are within 50 miles of the target market or area **102**. FIG. **4** describes block **212** in more detail.

[**0068**] For example, one embodiment of the invention electronically analyzes multiple alternative locations for the target station **100**, where the alternative locations are different from the location of the target station **100**. In a further embodiment, the invention ranks the alternative locations based at least in part on the variance in one or more user-defined objectives such as the coverage associated with the alternative locations.

[**0069**] The program **3414** identifies location scenarios for the target station **100** in block **214**. The location scenarios comprise, either alone or in combination, changes to the class, transmission power, channel and/or frequency of the target station **100** at each location specified in block **212**. For example, the program **3414** calculates the target market coverage for the radio station identified in block **210** that is relocated to each of the actual and hypothetical tower locations within 50 miles of the target market or area **102**. In addition, the program **3414** varies the channel and/or frequency and/or class/transmission power at each of the locations and calculates the target market coverage.

[**0070**] The program **3414** determines whether the location scenario is feasible or whether the location scenario violates the broadcast coverage regulations between the target station **100** and another station. Conflicts can occur, for example, if the new location of the target station **100** is too close to another radio station, according to FCC Rules. When conflicts occur, the program **3414** determines whether changes to at least one of the location, class, and channel of the conflicted or accommodation station **104** alleviates the conflict. In an embodiment, changes to more than one accommodation station **104** can be cascaded or daisy chained to provide a feasible scenario for the target station **100**.

[**0071**] For example, an embodiment of the invention electronically analyzes one or more alternative operational parameters associated with a communication and electronically determines whether the alternative operational parameters are feasible.

[**0072**] Further, in block **214**, the program **3414** scores the feasible location scenarios. FIG. **7** describes block **214** in more detail.

[**0073**] In block **216**, the program **3414** determines if location scenarios have been considered for the target stations **100** identified in block **210**. If there are additional stations **100**, the program **3414** returns to block **214** and identifies the location scenarios for the next target station **100**. When the location scenarios for the identified target stations **100** have been analyzed, the program **3414** sorts the scored feasible station scenarios in block **218**.

[**0074**] The program **3414** outputs a sorted list of target stations **100** and target station scenarios in block **220**. For example, the program **3414** outputs a list comprising a first radio station, a second radio station, and a third radio station. All three of the radio stations are within 50 miles of the

target market area. The first radio station has the highest feasibility score and increases its market coverage from below 50% to 97% by relocating from its current tower to an existing tower. The second radio station's feasibility score is less than the first radio station and greater than the third radio station's feasibility score. The second radio station increases its market or area coverage from below 50% to 95% by relocating to a hypothetical tower and by changing its broadcast channel, while the third radio station increases its market or area coverage from below 50% to 95% by relocating from its current tower to a existing tower and relocating a fourth radio station to another existing tower. The program **3414** ends in block **222**.

[**0075**] FIG. **3** is a flow chart illustrating the process **210** of identifying stations within the target market or area **102** that are possible candidates for the study, according to an embodiment of the invention. In block **310**, the user specifies the target market or area **102**. In an embodiment, the user defines the target market or area **102** as a geographic circle by specifying a point having latitude and longitude coordinates and a radius. In another embodiment, the user specifies the target market or area **102** as a set of polygons, where each of the polygons is defined by a set of vertices having latitude and longitude coordinates.

[**0076**] In block **312**, the user specifies terrain databases **3416**. In an embodiment the databases are stored in the memory **3412**. The program **3414** uses the terrain databases **3416** to identify terrain information associated with the target market areas specified in block **310**. Examples of terrain databases **3416** are the US Arc-Second USGS (US Geological Survey) Terrain Database comprising 3 arc-second data for the 48 contiguous Untied States, Puerto Rico, and Hawaii; the 30 Second World Terrain Database comprising 30 arc-second data for the world; the 3 second USGS Alaska Terrain Database comprising 3 second data for Alaska; the 30 Second NGDC (National Geophysical Data Center) US Database comprising 30 arc-second NGDC data; the NED (National Elevation Dataset) 3 Second US Database comprising 3 arc-second data for the Untied States that was generated from the 30 meter National Elevation Dataset; the NED 3 Second Alaska Database comprising 3 arc-second data for Alaska that was generated from the 30 meter National Elevation Dataset; the NED 30 Meter Database comprising 30 meter National Elevation Dataset data for the US; the NASA SRTM (Shuttle Radar Topography Mission) 1 Second Database comprising 1 arc-second data for most of the world, which provides 1 arc-second resolution for the United States and 3 arc-second resolution for most of the world; and the like.

[**0077**] In an embodiment, the program **3414** accesses one or more terrain databases **3416**. The program **3414** accesses the primary database to obtain the elevation at a point. If the elevation at the specified point cannot be located in a first database, additional databases can be accessed.

[**0078**] The program **3414** accesses demographic databases **3416**, which are specified in block **314**, to determine the demographics within the target market or area **102**. In an embodiment, the databases are stored in the memory **3412**. Examples of demographic databases **3416** are the 1990 US Census, the 2000 US Census, the 1990 Puerto Rico Census, the 1996 Canada Census, and the like. In an embodiment, the program **3414** can access the total population from the demographic database **3416**, or sub-categories such as race, ethnicity, age, and the like.

[**0079**] The program **3414** accesses location databases **3416**, which are specified in block **316**, to determine the locations of existing points of communication, such as stations, towers, antennas, and the like. In an embodiment, the databases are stored in the memory **3412**. Examples of location databases **3416** are the Antenna Structure Registration (ASR) database, the National Oceanic and Atmospheric Administration (NOAA) database, site management databases, such as the American Tower database, the SBA Communications database, and the like.

[**0080**] Further, the program **3414** accesses station databases **3416**, which are specified in block **318**. In an embodiment, the databases are stored in the memory **3412**. The station databases **3416** comprise the locations of existing points of communication. Examples of station databases are the Consolidated Database System for the FCC's Media Bureau (CDBS) database, the FCCInfo.com database maintained by Cavell, Mertz & Davis, Inc., and the like.

[**0081**] In an embodiment, the program **3414** identifies radio stations within a user-specified distance from the target market or area **102**. In block **320**, the user can optionally specify this distance from the target market or area **102**. For example, the program **3414** identifies the radio stations from the FCC database that are within 50 miles from the center of the target market or area **102**.

[**0082**] In another embodiment, the program **3414** identifies radio stations that cover less than a user-specified percentage of the target market or area **102**. This percentage determines the level at which a station is no longer considered a good candidate because it already covers most of the target market or area **102**. In block **322**, the user can optionally specify this percentage. For example, if the percentage is set to 90%, then any station that already covers at least 90% of the population and/or demographics of the target market or area **102** is not considered. In another embodiment, the user can manually identify stations to be considered.

[**0083**] In block **324**, the program **3414** identifies the radio stations within the target market or area **102** or within the specified distance from the target market or area **102** that meet the percentage of market coverage criterion. In an embodiment, the program **3414** identifies the radio stations from the FCC database of radio stations. The process **210** ends in block **326**.

[**0084**] FIG. **4** is a flow chart illustrating the process **212** of specifying location considerations, according to an embodiment of the invention. The process **212** defines the set of locations that the program **3414** analyzes for each of the candidate radio stations identified by the process **210**. In block **410**, the user can optionally select whether to consider radio station locations or towers within a user-selected distance from the geographic center of the target market or area **102**. In an embodiment, towers comprise stations, repeaters, translators, antennas, self-supporting structures, guyed towers, building rooftop locations, locations suitable for a broadcast antenna, and the like.

[**0085**] In block **412**, the user can select whether to consider radio station locations or towers within a specified

polygon set. This option uses a user-defined polygon set to define the boundaries of the geographic region inside which towers are considered.

[0086] In block **414**, the user can select whether to consider only the tallest tower in a cluster of towers. This option can be used in situations where towers that are clustered within a user-defined distance are grouped together and considered as one tower in the analysis. The location of the tallest tower in the cluster is used as the location for the cluster of towers.

[0087] In block **416**, the user can select whether to limit consideration to those towers that are mutually exclusive with the existing facility being considered and are within the target market area. For example, in the FM radio embodiment, mutually exclusive towers are defined as those towers that are separated from the existing facility by no more than approximately the FCC Rules section 73.207 allocation distance plus an extended search area. In an embodiment, the extended search area is twice the maximum class 70 dBu field strength contour distance.

[0088] In block **418**, the user can optionally select whether to consider existing tower locations. This option considers actual tower locations found in the database of tower locations specified in block **316**.

[0089] In block **420**, the user can optionally select whether to consider hypothetical tower locations. One embodiment locates the hypothetical or virtual antenna(s) on existing structures, such as buildings, with heights in an accessible database. Another embodiment locates the hypothetical or virtual antenna(s) anywhere in the coverage geography at height limits with respect to applicable communications and/or regulatory laws. When the program **3414** considers hypothetical locations, the user has several hypothetical tower consideration options.

[0090] In block **422**, the user specifies a polygon or a set of polygons that define an area where the program **3414** considers hypothetical towers. In block **424**, the user selects the grid spacing for the hypothetical tower area. The program **3414** generates hypothetical towers on a grid at locations inside the polygon boundary area. The user-specified grid spacing defines how far apart each hypothetical tower will be in the grid.

[0091] In block **426**, the user can optionally select to default to the Above Ground Level (AGL) tower height. Hypothetical towers will have their above ground tower height default to this value. For locations near airports or other user-defined polygons, the program **3414** will limit the tower heights as required by communications and/or regulatory laws. For example, the program **3414** calculates the tower height for hypothetical towers near airports based on the FCC Rules section 17.7 glide slope requirements.

[0092] In block **428**, the user can optionally select to exclude hypothetical tower locations within a user-defined distance from a user-defined area, such as a polygon. For example, the program **3414** will exclude possible hypothetical tower locations from airports, National Parks, Indian Reservations, lakes, and any other locations where towers are not permitted or are highly impractical. The process **212** ends in block **430**.

[0093] FIG. **5** is a screen shot of an embodiment of a communication spectrum set-up screen **500**, according to an embodiment of the invention. The set-up screen **500** comprises a market definition section **510**, a terrain configuration section **512**, and a census database section **514**. The user can choose whether to define the market or area **102** as a geographic circle or a polygon set in the market definition section **510**. The terrain configuration section **512** indicates the terrain databases **3416**, which the program **3414** uses. The census database section **514** indicates the census databases **3416** and any sub-categories, which the program **3414** uses to calculate the population and/or demographics of the target market or area **102**.

[0094] The set-up screen **500** further comprises an options section **516**. The options section **516** comprises station options **518**, tower options **520**, and hypothetical tower options **522**. In the example illustrated in FIG. **5**, the station options **518** permit the user to select characteristics of stations to load from an FCC database of stations for inclusion in the study. The "load stations" option permits the user to enter the maximum distance from the market or area **102** that will be searched for stations to include in the study.

[0095] The "don't load" option permits the user to skip searching the database for stations to include in the study. Instead, user-defined stations used in the study are loaded into the program **3414**. The "load stations that cover less than a percentage" option permits the user to set the level at which a station is no longer considered a good candidate because it already covers the market. For example, if this option is set to 90%, then any station that already covers at least 90% of the defined market or area **102**, on a population and/or demographics count basis, will not be examined.

[0096] The tower options **520** permit the user to select characteristics of actual towers locations to include in the study. The "consider towers within a maximum distance from the market" option defines the maximum distance from the market that a tower can be for it to be included in the study. The "consider towers within a specified polygon set" option defines the boundaries of the geographic region inside which tower locations are considered using a polygon set.

[0097] The "group towers" option groups towers that are closer together than a distance and considers the group as a single tower location in the study. The program **3414** uses the height and location of the tallest tower in the group. The "mutually exclusive" option limits consideration to those towers that are mutually exclusive with the existing facility being considered. Mutually exclusive towers are towers that are within the market search area and are separated from the existing facility by no more than approximately an allocation distance plus an extended search area distance. In an embodiment, the allocation distance is the FCC Rules section 73.207 allocation distance. The extended search area distance corresponds to the class of the existing facility, and in an embodiment, the extended search area distance is twice the 70 dBu max class field strength contour distance.

[0098] The hypothetical tower options **522** permit the user to select characteristics of hypothetical tower locations to include in the study. The "tower settings" options permit the user to enter grid spacing, to choose to default to AGL tower height, to choose to exclude towers, and the like. The "don't consider" option uses only real tower locations in the study. The "consider both" option uses both real tower locations

and hypothetical tower locations in the study. The "consider only" option uses only hypothetical tower locations in the study.

[0099] The options section **516** further comprises additional functions. The "consider channel changes" option permits the program **3414** to evaluate channel and/or frequency changes for the station at each location. The "consider signal/class downgrades" option permits the program **3414** to study changing the station being examined to a lower class. In another embodiment, the program **3414** studies changing the station being examined to a higher class. Other options, such as "remove low implementation scoring scenarios" and "remove low population scoring scenarios" remove scenarios from the study that have low implementation scores and low or no coverage of the market or area, respectively, from the study.

[0100] For example, one embodiment of the invention electronically analyzes multiple alternative channels and/or frequencies for the target station **100**, wherein the alternative channels and/or frequencies are different than the channel and/or frequency of the target station **100**. In a further embodiment, the invention ranks the alternative channels and/or frequencies based at least in part on the variance in one or more user-defined objectives such as the coverage associated with the alternative channels and/or frequencies.

[0101] The "limit move consideration" option permits the program **3414** to consider locations that are within the maximum class 70 dBu field strength contour of the community of license of the existing station. If selected, this option narrows the search to regions where the community of license coverage is likely to be maintained at the new location of the station. If not selected, the program **3414** uses locations that are within the market radius plus the maximum class 60 dBu distance plus a padding amount. The "max class distance padding amount" option permits the user to define the padding amount. The "limit above ground tower height" option allows the user to select tower height characteristics. When selected, the program **3414** uses the supplied maximum value for towers where the calculated height is greater than the supplied value. When unselected, the program **3414** uses the height for the towers at which the maximum height above average terrain is attained.

[0102] FIG. **6** is a map **600** illustrating an area in which the program **3414** considers new station locations for an existing point of communication **612**, according to an embodiment of the invention. A first area **630** around the station **612** is defined by the location of the station **612** and a minimum separation radius **614**. In this example, the minimum separation radius **614** is the FCC Rules section 73.207 minimum separation distance for the station **612**. Adding an extended search distance **616** to the minimum separation radius **614** defines a maximum regulatory relocation area **632** around the station **612**. In this example, the extended search distance **616** is approximately twice the 70 dBu maximum class field strength contour distance.

[0103] In FIG. **6**, a market area **626** is the area defined by a point **624** and a radius comprising a market radius **622**, a user defined padding distance **618**, and the 60 dBu maximum class distance **620**.

[0104] In an embodiment where the station locations are limited to mutually exclusive stations or towers, the program **3414** considers stations or towers in a mutually exclusive area **610**, which comprises the overlap of the market consideration area **626** of the target market **624** and the maximum regulatory relocation area **632** of the target station **612**.

[0105] In an embodiment, the extended search distance **616** is related to the class of the existing communication facility **612** under consideration and extends the allowable regulatory relocation distance of the existing station **612** toward the market **626**. In the example illustrated in FIG. **6**, the extended search distance **616** is approximately twice the 70 dBu maximum class field strength contour distance. In another embodiment, the extended search distance is user-defined. In another embodiment, the extended search distance is defined by communications and/or regulatory laws. FIG. **32** describes the extended search distance in further detail.

[0106] FIG. **32** is a graphic representation of an extended search distance **3210** for broadcast radio, according to an embodiment of the invention. The extended search distance **3210** provides an extended search area by taking advantage of allowable regulatory rules. An existing station **3212** has a 70 dBu field strength contour **3214**, which covers its community of license **3216**. For example, the FCC regulations specify that the broadcast station **3212** provide a 70 dBμV/m field strength over both 85% of the area and 85% of the population of the community of license **3216**. A proposed new location **3218** for the existing station **3212** has a 70 dBu field strength contour **3220**, which also covers the community of license **3216**. In an embodiment, the extended search distance **3210** is the distance between the location of the existing broadcast station **3212** and the proposed new location **3218**, while maintaining a minimum field strength (dBμV/m) level over the existing station's community of license **3216** at the proposed new location.

[0107] Broadcast regulations allow the broadcast station **3212** to relocate to another location **3218** as long as the minimum field strength is maintained over the community of license **3216**. In FIG. **32**, the 70 dBμV/m field strength contour **3214** of the radio station at its existing location **3212** and the 70 dBμV/m field strength contour **3220** of the radio station at the proposed location **3218** both provide the minimum field strength requirements for the community of license **3216**, and the locations **3212**, **3218** are separated by the extended search distance **3210**. In an embodiment, this can be accomplished by submitting a minor modification application, such as a construction permit, to a regulatory body, such as the FCC. The new location **3218** is generally in the direction of the target market or area and the extended search distance **3210** increases the allowable regulatory relocation distance of the broadcast station **3212** towards the target market **102** or area of interest.

[0108] In other words, the extended search distance **3210** extends the allowable distance that a broadcast station **3212** can move to cover the target market or area **102**. In an embodiment that uses station locations that are mutually exclusive to the existing facility being considered, the mutually exclusive station locations are station locations separated by no more than the FCC Rules Section 73.207 allocation distance plus the additional extended search distance **3210**. In an embodiment, the program **3414** defaults to the extended search distance **3210** of twice the 70 dBu maximum class field strength contour distance.

[0109] In another embodiment for determining which station locations are to be considered in the study, when the locations are not limited to those likely to serve the existing community of license, the program **3414** considers stations within the market radius+max class 60 dBu distance+padding distance of the market center. In an embodiment, the padding amount is user-defined.

[0110] Once the program **3414** identifies the stations to include in the study and the location consideration information, the program **3414** analyzes scenarios for each of the identified stations. FIG. **7** is a flow chart illustrating the process **214** of analyzing the scenarios, according to an embodiment of the invention. In an embodiment, analyzing comprises generating analyzing, and testing. In block **710**, the program **3414** identifies a possible new location for the target station **100**. In block **712**, the program **3414** determines if the scenario of the target station **100** at the new location is feasible. FIG. **8** describes the process of determining whether the scenario is feasible.

[0111] If the scenario is feasible, the program **3414** scores the scenario in block **716**. FIG. **14** describes the scoring process. In block **718**, the program **3414** identifies a new community of license (COL), if needed. FIG. **15** describes the process of identifying a new community of license. In block **720**, the program **3414** identifies a replacement station, if needed. FIG. **33** describes the process of identifying a replacement station.

[0112] In block **722**, the program **3414** evaluates scenarios for the identified station at the new location and at different channels and/or frequencies. FIG. **16** describes the process of changing the channels and/or frequencies of the station in the location scenario. In block **724**, the program **3414** evaluates scenarios for the identified station at the new location and at different classes. FIG. **17** describes the process of changing the class of the station in the location scenario.

[0113] If the scenario in block **712** is not feasible, the program **3414** analyzes accommodation scenarios in block **714**. FIG. **20** describes the process of evaluating the accommodation scenarios for the infeasible location scenario.

[0114] After analyzing accommodation scenarios and/or evaluating the changes in location, class, channel, and/or frequencies, the program **3414**, in block **726**, determines if there are additional locations to study. If there are additional locations, the program **3414** returns to block **710**, where the steps **710-724** are repeated for the identified station at another location. The program **3414** repeats steps **710-724** until the locations that have been identified for the station have been evaluated. When the identified locations for the station have been evaluated, the process **214** ends in block **728**.

[0115] FIG. **8** is a flow chart illustrating a process **800** of determining whether the scenario is feasible, according to an embodiment of the invention. In an embodiment, a scenario is feasible when it satisfies the FCC Rules sections 73.207 and 73.215. In FIG. **8**, the station pairs comprise the existing station at a new location and/or a new class and/or a new channel and/or frequency, and another station. In block **810**, the program **3414** determines if the station pair is separated by at least a minimum distance. In an embodiment, the FCC Rules section 73.207 defines the minimum distance. If the station pair is farther apart than the minimum distance, the scenario is feasible, and the process **800** moves to block **820**. If the station pair does not meet the minimum distance rule, the process **800** moves to block **812**.

[0116] In block **812**, the program **3414** determines whether at least one of the stations in the station pair is a short-spaced station. In an embodiment, the FCC Rules section 73.215 defines a short-spaced station. If neither of the stations in the pair of stations is a short-spaced station, the scenario is not feasible, and the process **800** moves to block **822**.

[0117] If one of the stations of the station pair is a short spaced station, the program **3414** determines if the other station of the station pair is a short-spaced station in block **814**. If the other station of the station pair is not a short-spaced station, the process **800** moves to block **818**.

[0118] In block **818**, the program **3414** determines if the station pair meets the field strength contour protection requirements where one station is short-spaced and the other station is regular. In an embodiment, the FCC Rules section 73.215 defines the field strength contour protection requirements for a short-spaced station paired with a regular station that is categorized under FCC Rules section 73.207. If the pair of stations does not meet the field strength contour protection requirements, the scenario is not feasible, and the process **800** moves to block **822**. If the pair of stations meets the field strength contour protection requirements, the scenario is feasible, and the process **800** moves to block **820**.

[0119] If both stations in the station pair are short-spaced stations, the process **800** moves to block **816** where the program **3414** determines if the short-spaced station pair meets field strength contour protection requirements. In an embodiment, the FCC Rules section 73.215 defines the field strength contour protection requirements for a short-spaced pair of stations. If the station pair does not meet the field strength contour protection requirements, the scenario is not feasible, and the process **800** moves to block **822**. If the station pair meets the field strength contour protection requirements, the scenario is feasible, and the process **800** moves to block **820**.

[0120] After determining the feasibility of the scenario in block **820** or the infeasibility of the scenario in block **822**, the process moves to block **824**. In block **824**, the process **800** determines if there are additional stations with which to pair the identified station. If there are additional stations, the process **800** moves to block **810**, where the steps **810-822** are repeated with the additional station. The steps **810-824** are repeated for each station pair. When there are no other stations with which to pair the identified station in block **824**, the process **800** ends in block **826**.

[0121] The program **3414** uses several calculation techniques, such as, for example, the grand circle distance calculation, the 360 degree radial contour projection, the AMSL (above mean sea level) calculation, and the radial transformation, in the feasibility determination. The grand circle distance calculation calculates the distance between two stations. In an embodiment, the grand circle distance between the two stations is compared with the spacing requirements for stations according to the FCC Rules sections 73.207 and 73.215, respectively. In the grand circle distance calculation, (lat**1**, lon**1**) is the geographical location

of station **1** in a coordinate system, such as NAD27 (North American Datum) or NAD83, and (lat**2**, lon**2**) is the geographical location of station **2** in the same coordinate system. ρ represents the radius of the earth. The program **3414** first converts the latitude and longitude coordinates to spherical coordinates, then to Cartesian coordinates. Next, the program **3414** calculates the separation angle between the pair of Cartesian coordinates and then calculates the distance between the pair of stations along the curvature of the earth based on the separation angle. The grand circle calculation procedure is outlined below:

[**0122**] Step 1: Convert latitude and longitude to spherical coordinates

slat1=π(90-lat1)/180

slon1=πlon1/180

slat2=π(90-lat2)/180

slon2=πlon2/180

[**0123**] Step 2: Convert spherical coordinates to Cartesian coordinates

$x1=\rho \sin(slat1)\cos(slon1)$

$y1=\rho \sin(slat1)\sin(slon1)$

$z1=\rho \cos(slat1)$

$x2=\rho \sin(slat2)\cos(slon2)$

$y2=\rho \sin(slat2)\sin(slon2)$

$z2=\rho \cos(slat2)$

[**0124**] Step 3: Calculate the separation angle between the pairs of Cartesian coordinates

$\phi=\cos-1(x1x2+y1y2+z1z2)/\rho2$

[**0125**] Step 4: Calculate the grand circle distance based on the separation angle

$d=\phi\rho$

[**0126**] FIG. **9** illustrates a portion of a 360 degree radial contour projection **900** used in determining the field strength contour area coverage of a station and the field strength contour population coverage of a station, according to an embodiment of the invention. In an embodiment, the program **3414** uses the field strength contour projections to determine the field strength contour area coverage of a station and the field strength contour population coverage of a station under the FCC Rules section 73.213.

[**0127**] The contour can be defined by as many radials as are necessary to accurately define the area. FIG. **9** illustrates a portion of a contour **922** and is used to illustrate area coverage calculations. The contour **922** comprises 5 radials: a north radial **910**, radial A **912** having a contour length of L_A and a bearing A, radial B **914** having a contour length of L_B and a bearing B, a fourth radial **916**, and a fifth radial **918**. Point X **924**, having a distance L_X from a tower **920** and a bearing β, lies between the radial A **910** and the radial B **912**. X is within the contour if:

$L_X \leq F\ L_A+(1-F)L_B$ where

$F=B-\beta/B-A.$

[**0128**] To determine the field strength contour coverage area, the market is divided into user-defined tiles. In an embodiment, the tiles can be any size and geometric shape. A tile is considered to be within the contour if a point on the tile is within the contour. In an embodiment, the point is a user-defined point. In another embodiment, the point is the center of the tile. The contour area covered is equal to the sum of the areas of the tiles within the contour.

[**0129**] To determine the field strength contour population coverage, program **3414** uses the population centroids or points in census data, where each centroid or point is associated with a population and/or demographics count. A population and/or demographics is considered to be within the contour if the centroid is within the contour. The field strength contour population covered is equal to the sum of the population and/or demographics of the centroids within the contour.

[**0130**] In an embodiment, evenly-spaced points along evenly-spaced radials on a map are used to determine average elevation above mean sea level (AMSL) within a radio station's coverage area. This in turn determines the height above average terrain (HAAT), which greatly affects a station's range and potential for interference with other stations.

[**0131**] An embodiment of the invention does not use projections to preserve heading and does not require numerical search or approximations to find the points of interest along a radial. An embodiment rotates a standard radial from east to west and from north to south, and reduces computational effort for finding distances. In one embodiment, the earth is approximated by a spherical model. The standard radial(s) are corrected using the radius of the earth at the point of interest and then rotated. In an embodiment, the radius at the equator was used for the standard radials.

[**0132**] In another embodiment, an elliptical model is used to apply the rotation from the standard radial set. These embodiments provide accuracy without increased computational effort. Therefore, methods of calculating radials, according to an embodiment of the invention, are more efficient, since desired accuracy can be achieved with less computational effort.

[**0133**] The AMSL (above mean sea level) calculation calculates the average elevation in meters above sea level for a number of points. Examples of a number of points include, but are not limited to a tower location, a set of radials, or 50 points along a single radial. The height above the average terrain (HAAT) is defined as "antenna height above average terrain". In an embodiment, the average meters above sea level values are pre-processed for a given market or area. In another embodiment, the average meters above sea level values are calculated as a tower location is added to the database.

[**0134**] In another embodiment, the radials used to calculate the elevation above mean sea level and the height above average terrain, as required by the FCC, are calculated by transforming a set of radials centered on the equator and the Greenwich meridian to a set of radials at any tower location. The program **3414** can calculate points for any number of radials with any number of sample points. For example, the FCC Rules section 73.215 requires 50 sample points from 3 km to 16 km along 8 equally spaced radials extending from the center point or station location with one radial due north. The points calculated lie along the surface of the spherical approximation of the earth and are equidistant in terms of the surface length between two points along any radial from 3 km to 16 km.

[**0135**] Given the set of radial points centered at (x, y, z)=(R, 0, 0), the radial set can be rotated to any center point,

such as a station location, using the latitude as a rotation north from the equator and longitude as a rotation clockwise as seen from due north, around the axis extending through the north and south poles of the spherical model of the earth. In an embodiment, the standard set of radial points is stored in a file for use at any arbitrary center point, such as a station location, through a rotation of the standard stored set(s).

[0136] FIG. **10** is a graphical representation of a radial **1010** to a point **1012** for use in the height above average terrain calculation, according to an embodiment of the invention. The radial **1010** is centered on the equator and the Greenwich meridian and the point **1012** has Cartesian coordinates (x, y, z) corresponding to latitude and longitude coordinates (lat, lon). A station is located at a point **1016** on the surface of the earth **1014** at (lat_c, lon_c) corresponding to Cartesian coordinates (x_c, y_c, z_c). The earth **1014** is approximated as a sphere in this embodiment. In another embodiment, the program **3414** approximates the earth **1014** as an ellipsoid.

[0137] FIG. **11** is a graphical representation of a north-south radial transformation for use in the height above average terrain calculation, according to an embodiment of the invention. As illustrated in FIG. **11**, the radial **1010** is rotated north from the equator by an angle of approximately lat_c plus or minus an amount Δ, which preserves the radial length as it is rotated, to create a radial **1110** at a point **1112** having Cartesian coordinates (x', y', z') corresponding to latitude and longitude coordinates (lat', lon').

[0138] FIG. **12** is a graphical representation of an east-west radial transformation for use in the height above average terrain calculation, according to an embodiment of the invention. As illustrated in FIG. **12**, the radial **1110** is rotated clockwise as seen from due north, around the axis extending through the north and south poles of the spherical model of the earth by an angle of approximately lon_c plus or minus an amount Δ, which preserves the radial length as it is rotated, to create a radial **1210**. The radial **1210** extends from a point **1212** having Cartesian coordinates (x", y", z") corresponding to latitude and longitude coordinates (lat", lon") to the point **1016** having Cartesian coordinates (x_c, y_c, z_c) corresponding to latitude and longitude coordinates (lat_c, lon_c).

[0139] FIG. **13** is a graphical representation of a radial set transformation for use in the height above average terrain calculation, according to an embodiment of the invention. FIG. **13** illustrates a radial set **1310** centered at the equator and the Greenwich meridian rotated to any center point **1312**, i.e., tower location at (lat_c, lon_c) corresponding to Cartesian coordinates (x_c, y_c, z_c). The program **3414** rotates the radial set **1310** by $lat_c \pm \Delta$ from the equator and $lon_c \pm \Delta$ as a rotation clockwise as seen from due north, around the axis extending through the north and south poles of the spherical model of the earth **1014** to create a new radial set **1314** centered at the point **1312**.

[0140] The rotations preserve distance and bearing of the radial set. The center of the radials rotates from (0, 0) corresponding to the equator and the Greenwich meridian to (lat_c, lon_c). Rotation of the individual radial points corrects the rotations to preserve the correct distance along the surface of the earth **1014** by adding or subtracting Δ. For example, 3-16 km radials centered at (0, 0) transform to 3-16 km radials centered at (lat_c, lon_c) after the rotation.

[0141] Many trigonometric transformations are possible to accomplish the rotations. In an embodiment, the first rotation is through the vertical plane and the second rotation is through the horizontal plane. In another embodiment, the first rotation is though the horizontal plane and the second rotation is through the vertical plane. In yet another embodiment, the rotation is a single three-dimensional rotation. Computationally rotating the radials centered at (0, 0) is more computationally efficient than computing radials centered at (lat_c, lon_c).

[0142] One embodiment of the invention analyzes multiple alternative operational parameters associated with a communications broadcast and calculates numerical scores for the alternative operational parameters. In an additional embodiment, the invention ranks the alternative operational parameters based at least in part on the numerical scores. FIG. **14** is a flow chart **1400** illustrating a financial feasibility/numerical scoring process **1400**, according to an embodiment of the invention.

[0143] The financial feasibility/numerical scoring process **1400** calculates a feasibility score for the scenario applied to the identified station. The feasibility score represents a multi-dimensional parameter score based at least in part on the estimated increase in financial value created by each broadcast scenario. These parameters can include but are not limited to a change in the value of target station **100**, accommodation stations **104**, and replacement stations, where the stations' financial value is based at least in part on changes to population and/or demographics coverage and/or other user-defined criteria, the cost of capital, interim operating costs of the target station and other stations, and the probability of success. For example, a scenario that comprises a major change FCC filing results in higher financial costs. Likewise, a scenario that comprises a major change FCC filing for the target station **100**, the accommodation station **104**, or a replacement station decreases the probability of success. In another example, more accommodation stations **104** in the broadcast scenario also reduce the probability of success. Further, other parameters used in calculating the net present value can include but are not limited to the bargaining power of accommodation stations, implementation costs, such as, for example, legal costs, engineering costs, and the like.

[0144] In block **1410**, the program **3414** determines a change in financial value driven by changes in the population and/or demographics covered. In an embodiment, the population and/or demographics coverage loss is the difference between existing population and/or demographics coverage and new population and/or demographics coverage after station modification.

[0145] In block **1412**, the program **3414** determines construction costs. In an embodiment, the construction costs depend on equipment, height of the current station or tower, the number of new stations sharing the tower, the cost of new construction, the cost of a station extension, and the like.

[0146] In block **1414**, the program **3414** determines the share in the value of the deal, and in block **1416**, the program **3414** determines the return on investment. In an embodiment, the return on investment is the time value of money. In an embodiment, the return on investment is a user-defined parameter. In block **1418**, the program **3414** determines the

probability of success. In an embodiment, the probability of success is a user-defined value.

[0147] In block **1420**, the program **3414** determines a financial feasibility score. In an embodiment, the financial feasibility score is a net present value of the target station **100** having new scenario parameter and any costs associated with possible accommodation stations **104**. The process **1400** ends in block **1422**.

[0148] In an embodiment, for the feasible scenario k, the net present value of the target station **100**, given the new station parameters and any accommodation stations **104** is:

$$NPV_k = \frac{\left(\prod_j P_{j,k}^{Success}\right)\left(V_k - \sum_j C_{j,k} - C_k^{Extract}\right)}{(1+r)^n}$$

where

$$C_{j,k} = C_{j,k}^{Pops} + C_{j,k}^{NewTX}$$

is the cost attributed to station j for scenario k and comprises the cost due to a change in population and/or demographics coverage for station j and the cost of a new transmission facility for station j in scenario k,

$$C_k^{Extract} = \sum_j s_j^{Extract}\left(V_k - \sum_i C_{i,k}\right)$$

is the cost of negotiations, lost to accommodation stations, for example, in scenario k,

$$C_{j,k}^{Pops} = \begin{cases} \alpha_j \Delta_{j,k}^{Pops} & \text{if } \Delta_{j,k}^{Pops} < 0 \\ 0 & \text{otherwise} \end{cases}$$

is the cost due to the change in population and/or demographics coverage for station j and represents the difference between existing coverage and new coverage after station modification, and

$$\Delta_{j,k}^{Pops} = Pops(F^{50,50}(ERP_j, HAAT_j, FS), x_j, y_j) - Pops(F^{50,50}(ERP_j^{New}, HAAT_j^{New}, FS), x_j^{New}, y_j^{New})$$

is the change in covered population and/or demographics for station j in scenario k.

[0149] Construction costs, represented by

$$C_{j,k}^{NewTX} = \begin{cases} C^{Antenna} + \dfrac{C^{Extend}}{m_{x_{j,k}^{New}, y_{j,k}^{New}}} & \text{if } H_{x_{j,k}^{New}, y_{j,k}^{New}}^{New} - H_{x_{j,k}^{New}, y_{j,k}^{New}}^{Old} < \delta \\ C^{Antenna} + \dfrac{C^{Construct}}{m_{x_{j,k}^{New}, y_{j,k}^{New}}} & \text{otherwise} \end{cases}$$

depend on equipment, height of current tower, the number of new stations sharing the tower, and the like, where cost of extension is:

$$C_{j,k}^{Extend} = FC^{Extend} + VC^{Extend}\left(H_{x_{j,k}^{New}, y_{j,k}^{New}}^{New} - H_{x_{j,k}^{New}, y_{j,k}^{New}}^{Old}\right)$$

and cost of new construction is:

$$C_{j,k}^{Construct} = FC^{Construct} + VC^{Construct} H_{x_{j,k}^{New}, y_{j,k}^{New}}^{New}$$

where

[0150] $C_{j,k}$ is the cost attributed to station j for scenario k,

[0151] $C_{j,k}^{NewTX}$ is the cost of new transmission facility for station j for scenario k,

[0152] $C_{j,k}^{Pops}$ is the cost due to change in population and/or demographics coverage for station j,

[0153] $C_k^{Extract}$ is the cost of negotiation (lost to accommodations station(s) from NPV of project) in scenario k,

[0154] $C^{Antenna}$ is the cost of an antenna (not including tower),

[0155] $FC^{Construct}$ is the fixed cost to construct a new tower (regardless of height),

[0156] $VC^{Costruct}$ is the variable cost (per meter) to construct a new tower,

[0157] FC^{Extend} is the fixed cost to extend an existing tower (regardless of height),

[0158] VC^{Extend} is the variable cost (per meter) to extend an existing tower,

[0159] $Class_j$ is the class of radio station j,

[0160] ERP_j is the transmission power for station j,

[0161] ERP_j^{New} is the new transmission power for station j in scenario k,

[0162] FS is the field strength in dBu defining a field strength contour using $F^{50,50}$,

[0163] $HAAT_j$ is the height above average terrain for station j,

[0164] $HAAT_{j,k}^{New}$ is the new height above average terrain for station j for scenario k,

[0165] $H_{x,y}$ is the height of existing tower at location (x,y),

[0166] $H^{New}_{x,y,k}$ is the new height of tower (extension of existing or new construction) at location (x,y) in scenario k,

[0167] $m_{x,y,k}$ is the number of accommodation stations being relocated to location (x,y) for a given accommodation scenario k,

[0168] N_k is the number of months to complete scenario k, e.g. 18 months for projects by application; 36 months for projects with rule-making.

[0169] NPV_k is the new present value for scenario k,

[0170] $P_{j,k}^{Success}$ the probability of success for change to station in scenario k,

[0171] r is the return on investment, i.e. "cost of money",

[0172] $S_k^{Extract}$ is the share of base value for target station j, lost to negotiation in scenario k,

[0173] V_j is the base value of station j,

[0174] $x_j,y_{j|}$ is the current geographic location of station j, given as (x,y) coordinates,

[0175] x_j^{New},y_j^{New} is the new geographic location of station j, given as (x,y) coordinates,

[0176] α_j is the marginal value per population and/or demographics covered for station j,

[0177] δ is the parameter reflecting permissible extension of existing tower facilities, e.g. δ=25% would allow extension of a 200 m tower to 250 m without new construction,

[0178] $\Delta_{j,k}^{Pops}$ is the change in covered population and/or demographics for station j in scenario k,

[0179] NPV_k is the new present value of accommodation scenario k,

$|F^{50,50}ERP_j,HAAT_j,FS|$ is the evaluation of geographic locations along the field strength contour defined by FCC's F(50,50) field strength contour, for radio station j, and $Pop_{j,k}|F^{50,50}ERP_j,HAAT_j,FS_i,s_j,y_j|$ is the evaluation of population and/or demographics using the F(50,50) field strength contour at location (x_j,y_j) and a field strength of FS dBu, e.g. 60 dBu for station j in scenario k.

[0180] Other cost components can include but are not limited to changes in operating expenses, interim station operating costs, filing costs, such as FCC filing fees, legal fees, and environmental studies, project development costs, structural analysis, risk assessment, consulting fees, the time value of money for the accommodation stations, financial risk costs for the accommodation stations, and the like.

[0181] A variety of models can be used to calculate the financial feasibility value for the target station **100**, including but not limited to net present value models such as linear, polynomial, exponential, logarithmic, Cobb-Douglas, constant elasticity of substitution, power, or others. The cost components either can be estimated or itemized costs. Changes to the value added to the target station **100** can include values beyond the base value, including but not limited to format change values, portfolio values, and economies of scale and scope.

[0182] Other scoring embodiments can implement additional or different scoring methods. Scenario scoring can be ranked numerically, alphabetically, or other user-defined rankings. In one embodiment, the program **3414** calculates a population improvement score. The population improvement score is a score based on the percentage of population and/or demographics coverage improvement. In an embodiment, the population improvement score is [scenario coverage—existing coverage]×10.

[0183] For example, if the existing station's broadcasts cover 21% of the population and/or demographics of the market (existing configuration) and the station broadcasts to 89% of the population and/or demographics in the market with the changes identified in the scenario (scenario configuration), the population improvement score is (89−21)×10=680. In an embodiment, scenarios that produce less than 90% of the total coverage of the original station configuration are further penalized by multiplying the population improvement score by a factor of less than one.

[0184] In another embodiment, the program **3414** calculates an implementation score. The implementation score indicates how well a particular scenario performs with respect to the FCC allocation process. In one embodiment, the implementation score is a number between 0 and 100, where an implementation score of 0 represents a scenario that the program **3414** determines to be unobtainable and an implementation score of 100 represents a scenario where the regulations concerning the spacing between stations are met.

[0185] In an embodiment, the highest implementation score is 100. This indicates a scenario where the situations meet the spacing requirements. In an embodiment, the FCC Rules comprise the spacing requirements. For each station around the target station **100** that does not meet the spacing requirement with the target station **100**, the program **3414** deducts points from the implementations score. In another embodiment, for situations where the spacing requirements are not met and the field strength contour overlaps are 10 km, 9 km, 7 km, and 6 km on the direct line for co-channel stations, first adjacent stations, second adjacent stations, third adjacent stations and intermediate frequencies, such as the 53rd and 54th adjacent stations, respectively, then the program **3414** subtracts additional points from the implementation score.

[0186] In a further embodiment, if the scenario involves a class downgrade, then the program **3414** deducts points from the implementation score. Finally, in yet another embodiment, if the target station **100** under the scenario configuration does not cover the community of license point with a 70 dBu signal, then the program **3414** deducts points from the implementation score. The implementation score is 0 if there are more than a user-defined quantity of stations where the spacing requirements are not met or if there is more than one station where the FCC Rules section 73.215 table of minimum distance separations for short spacings are not met, according to other embodiments of the invention.

[0187] In a further embodiment, the program **3414** calculates a composite score. The composite score combines the implementation score and the population improvement score. In an embodiment, the composite score is [(10× implementation score)+population improvement score]/2.

[0188] A community of license in broadcasting, for example, is the community that a radio station or television station is officially licensed or allocated to serve by the applicable broadcast regulatory body. Stations cover the community of license with their broadcast signal, while the transmitter itself can be some distance away.

[0189] In the FM radio example, a station's 70 dBu field strength contour is the area that the station's broadcast signal reaches with at least a signal strength of approximately 70 dBu. In the FM radio example, a radio station's 70 dBu field strength contour typically is required to cover approximately 85% or more of the area and approximately 85% or more of the population and/or demographics of the station's community of license.

[0190] If the new station scenario creates a situation where a station's field strength contour as measured from the new location is less than the requirements over the population

and area of the existing COL, the program **3414** identifies new COL candidates for the scenario. The program **3414** uses the set of station scenario coordinates, the effective radiated power (ERP) of the scenario transmitter, the above mean sea level (AMSL) height of the scenario transmitter, the height above average terrain, and the like to determine new community of license candidates.

[**0191**] FIG. **15** is a flow chart illustrating a process **1500** to identify a community of license (COL), according to an embodiment of the invention. In block **1510**, the program **3414** determines the latitude and the longitude of the scenario station. In block **1512**, the program **3414** determines the antenna height, such as the above mean sea level height or the height above average terrain, for example, of the scenario station. In block **1514**, the program **3414** determines the power, such as the effective radiated power, for example, of the scenario station.

[**0192**] For example, an embodiment of the invention electronically analyzes one or more operational parameters for a communications broadcast and electronically determines whether the alternative operational parameters are associated with a need to obtain a new community. A further embodiment of the invention then identifies one or more community candidates that can accommodate the alternative operational parameters.

[**0193**] In block **1516**, the program **3414** determines the population and/or demographics threshold of the communities to consider. In an embodiment, the user can define a minimum population and/or demographics percentage and/or a minimum area percentage of the candidates community of license covered by the signal.

[**0194**] In block **1518**, the program **3414** uses the above mean sea level elevation, height above average terrain, and effective radiated power to calculate a 70 dBu field strength contour at the latitude and longitude coordinate point. In an embodiment, the program **3414** calculates the 70 dBu field strength contour of the station scenario using an omnidirectional antenna pattern.

[**0195**] The program **3414** determines whether the community of license field strength of the new station scenario is less than a threshold. In an embodiment, the threshold is the requirement that the 70 dBu field strength contour cover at least 85% of both the area and the population of the community of license. If the requirements are met, the process **1500** moves to block **1526**, where a new community of license is not needed for the scenario.

[**0196**] If the requirements are not met, the process **1500** moves to block **1520**, where the program **3414** generates a list of communities within the field strength signal contour. In an embodiment, the field strength signal contour is the 70 dBu field strength contour. In another embodiment, the program **3414** generates a list of communities that are within a user-specified percentage of the FCC required field strength contour of the station. In another embodiment, the program **3414** generates a list of communities that are at least partially covered by a user-defined station field strength contour of the new station scenario. In an embodiment, communities will be determined using data polygons from the U.S. Census Bureau TIGER (Topologically Integrated Geographic Encoding and Referencing) system.

[**0197**] For each new community of license candidate identified in the field strength signal contour, the program **3414** identifies the population and/or demographics and percentage of the population and/or demographics covered for each community. The population and/or demographics is based on data in a census database **3414**. In an embodiment, the census database **3416** is a US Census database. The program **3414** further identifies the geographic area of the community of license candidate polygon, the size of the area and the percentage of the area covered by the field strength signal contour.

[**0198**] In block **1522**, the program **3414** determines the services licensed to each of the communities listed in block **1520**. In an embodiment, the program **3414** determines the number of services that are licensed to each community by matching the community name string from the polygon data with the community names contained in the appropriate FCC database **3416**, such as, for example, the FCC AM and FM databases. In an embodiment, station data records that cannot be matched to the community name in the polygon data by string comparison are excluded.

[**0199**] In an embodiment, the program **3414** uses the community polygon's geographic centroid to determine if the community is part of an urban area. If the centroid is located within an urban area as defined by an urban area database **3416**, such as the TIGER Urban Area database, for example, then the community is considered as part of that urban area.

[**0200**] In block **1524**, the program **3414** sorts the list of community of license candidates. In an embodiment, the community of license candidates are ranked and listed in ascending order of number of licensed services, and secondarily ranked and listed in descending order of population and/or demographics for those community of license candidates with the same number of services. In this embodiment, the top of the list comprises community of license candidates with no licensed services, such as no AM or FM stations, for example, ranked in descending order of population and/or demographics. A new community of license for the new station scenario is chosen based on the number of licensed services and the population and/or demographics in block **1528**.

[**0201**] An example of a report listing community of license candidates is shown below. This report lists five community of license candidates, and indicates the population and area of the community, population and area covered by the station scenario, the percent of the population and area covered by the station scenario, the number of licensed services in the community, and the urban area associated with the community.

Community of License Search

[**0202**] Latitude: 42-40-12 N Longitude: 091-54-44 W

[**0203**] ERP: 100.0 kW AMSL Height: 926.129 m

[**0204**] Existing Facility COL: Oelwein, Iowa

[**0205**] Population Database: 2000 US Census (SF1)

[**0206**] Primary Terrain: 30 Second US Database

[**0207**] Cities where less than 85.0% are covered are not included.

[**0208**] Cities with a population less than 3000 are not included.

Marion, Iowa:

[0209] Population: 26,667 Covered: 26,663 Percentage: 100.0

[0210] Area (sq. km): 45.25 Covered: 43.75 Percentage: 96.7

[0211] Number of Services: 0 Urban Area: Cedar Rapids, Iowa

Evansdale, Iowa:

[0212] Population: 4,475 Covered: 4,475 Percentage: 100.0

[0213] Area (sq. km): 11.25 Covered: 11.25 Percentage: 100.0

[0214] Number of Services: 0 Urban Area: Waterloo, Iowa

Monticello, Iowa:

[0215] Population: 3,664 Covered: 3,607 Percentage: 98.4

[0216] Area (sq. km): 17.50 Covered: 11.00 Percentage: 62.9

[0217] Number of Services: 0 Urban Area: Monticello, Iowa

Oelwein, Iowa:

[0218] Population: 6,692 Covered: 6,692 Percentage: 100.0

[0219] Area (sq. km): 13.75 Covered: 13.75 Percentage: 100.0

[0220] Number of Services: 1 Urban Area: Oelwein, Iowa

[0221] Services: KOEL(950)

Hiawatha, Iowa:

[0222] Population: 6,483 Covered: 6,483 Percentage: 100.0

[0223] Area (sq. km): 11.00 Covered: 11.00 Percentage: 100.0

[0224] Number of Services: 1 Urban Area: Cedar Rapids, Iowa

[0225] Services: KWOF-FM(206)

[0226] If the target station **100** having a community of license is relocated such that the target station **100** in the new location scenario does not cover the community of license, the program **3414** identifies candidate replacement stations. The replacement station replaces the target station **100** in the community of license. For business reasons, the owner of the target station **100** may desire a replacement station that covers a user-defined target market or area **102**. In other embodiments, regulations can require a replacement station to continue service to the community. For example, the FCC requires a new community of license station to replace the target station **100**, if the target station **100** is the only station licensed service to the community of license and it is relocated outside of the community of license.

[0227] In an embodiment, replacement stations comprise FM and AM radio stations. In an embodiment, the program **3414** identifies existing stations that cover the community of license required by the FCC or specified by a user-defined target market or area **102** and evaluates these stations as possible replacement stations for the target station **100**. In another embodiment, the program **3414** identifies and evaluates new station scenarios that cover the community of license required by the FCC or specified by a user-defined target market or area **102** to identify replacement station candidates. Replacement stations may be determined independently in the same process as a new scenario or as part of a target station scenario.

[0228] FIG. **33** is a flow chart illustrating a process **3300** to identify a replacement station, according to an embodiment of the invention. In block **3310**, the program **3414** identifies the community of license needing a replacement station. In block **3312**, the program **3414** identifies a station whose broadcast coverage area covers the community of license.

[0229] For example, one embodiment of the invention analyzes one or more alternative operational parameters of a point of communication and determines whether the alternative operational parameters are associated with a need to obtain a replacement station. A further embodiment identifies one or more points of communication that could function as the replacement station.

[0230] In block **3314**, the program **3414** determines if the station's coverage is less than a threshold. In an embodiment, the threshold is that the 70 dBu field strength contour cover at least 85% of both the area and the population and/or demographics of the community of license. If the threshold is not met, the process **3300** moves to block **3316**, where the station does not qualify as a replacement station.

[0231] If the threshold is met, the process **3300** moves to block **3318**, where the station qualifies as a possible replacement station. In block **3320**, the program **3414** checks for additional stations.

[0232] If there are additional stations, the process moves to block **3312**, where blocks **3312-3318** are repeated. The program **3414** repeats steps **3312-3318** until the replacement station candidates have been evaluated. When the replacement station candidates have been evaluated, the process moves to block **3322**, where a replacement station is chosen. The process ends in block **3324**. In another embodiment, the program **3414** identifies replacement station candidates in the same way as a new scenario, as described in FIG. **2**.

[0233] FIG. **16** is a flow chart illustrating a process **1600** to identify possible scenarios comprising changes of the station channel and/or frequency, according to an embodiment of the invention. In block **1610**, the program **3414** analyzes a station scenario where the station channel and/or frequency have changed.

[0234] In an embodiment, the program **3414** changes the channel of the scenario station by at least one of ±1, ±2, ±3 ±53, and ±54 broadcast channels. In another embodiment, the program **3414** changes the broadcast frequency of the scenario station by at least one of ±10.6 MHz and ±10.8 MHz.

[0235] In block **1612**, the program **3414** determines if the scenario of the station at the new location and new channel and/or frequency is feasible. In an embodiment, the program **3414** performs a feasibility analysis on each channel change and/or frequency change to determine if it is allowable under

FCC and other applicable regulations and laws. FIG. **8** describes the feasibility process.

[**0236**] If the scenario is feasible, the program **3414** scores the scenario in block **1616**. FIG. **14** describes the scoring process. In block **1618**, the program **3414** identifies a new community of license (COL) if needed. FIG. **15** describes the process of identifying a new community of license.

[**0237**] If the scenario in block **1612** is not feasible, the program **3414** analyzes accommodation scenarios in block **1614**. FIG. **20** describes the process of analyzing accommodation scenarios.

[**0238**] After analyzing accommodation scenarios and/or evaluating the channel and/or frequency change scenario, the program **3414**, in block **1620**, determines if there are additional channel and/or frequency changes to evaluate. If there are additional channel and/or frequency changes, the program **3414** returns to block **1610**, where the steps **1610-1620** are repeated for the identified station at another channel and/or frequency. The program **3414** repeats steps **1610-1620** until the channel and/or frequency changes for the station have been evaluated. When the channel and/or frequency changes for the station have been evaluated, the process **1600** ends in block **1622**.

[**0239**] FIG. **17** is a flow chart illustrating a process to identify possible scenarios comprising changes of the station class, according to an embodiment of the invention. In block **1710**, the program **3414** analyzes a station scenario where the station class has changed. In the FM radio example, possible station classes are A, B, B**1**, C**0**, C**1**, C**2**, C**3**, and the like.

[**0240**] For example, in one embodiment, a computerized method improves the operation of the target station **100** by electronically analyzing multiple alternative classes for the target station **100**, wherein the alternative classes are different than the class of the target station **100**. In another embodiment, the computerized method ranks the alternative classes based at least in part on the variance in one or more user-defined objectives such as the coverage associated with the alternative classes.

[**0241**] In block **1712**, the program **3414** determines if the scenario of the station at the new location and new class is feasible. In an embodiment, the program **3414** performs a feasibility analysis on each class change to determine if it is allowable under FCC and other applicable regulations and laws. FIG. **8** describes the feasibility process.

[**0242**] If the scenario is feasible, the program **3414** scores the scenario in block **1716**. The scoring process is described in FIG. **14**. In block **1718**, the program **3414** identifies a new Community of License (COL) if needed. FIG. **15** describes the process of identifying a new community of license.

[**0243**] In block **1720**, the program **3414** evaluates variations in the transmit power within each class as allowed by FCC regulations. FIG. **18** describes the process of evaluating variations in the transmit power. In block **1722**, the program **3414** evaluates variations in the antenna height above average terrain (HAAT) within each class as allowed by FCC regulations. FIG. **19** describes the process of evaluating variations in the antenna height above average terrain.

[**0244**] If the scenario in block **1712** is not feasible, the program **3414** analyzes accommodation scenarios in block **1714**. FIG. **20** describes the process of analyzing accommodation scenarios.

[**0245**] After analyzing accommodation scenarios and/or evaluating the class change, transmit power variations, and/or height above average terrain variations, the program **3414**, in block **1724**, determines if there are additional class changes to evaluate. If there are additional class changes, the program **3414** returns to block **1710**, where the steps **1710-1722** are repeated for the identified station at another class, transmit power and/or height above average terrain. The program **3414** repeats steps **1710-1722** until the identified class, transmit power and/or height above average terrain changes for the station have been evaluated. When the identified class, transmit power and/or height above average terrain changes for the station have been evaluated, the process **1700** ends in block **1726**.

[**0246**] FIG. **18** is a flow chart illustrating a process **1800** to evaluate variations in the transmit power within a station class, according to an embodiment of the invention. In block **1810**, the program **3414** varies the transmit power of the scenario station.

[**0247**] In block **1812**, the program **3414** determines if the scenario of the station at the new transmit power is feasible. In an embodiment, the program **3414** varies the transmit power within each class as allowed by applicable communications and/or regulatory laws. In an embodiment, the program **3414** performs a feasibility analysis on each variation in the transmit power to determine if it is allowable under applicable communications and/or regulatory laws. FIG. **8** describes the feasibility process.

[**0248**] If the scenario is feasible, the program **3414** scores the scenario in block **1816**. FIG. **14** describes the scoring process. In block **1818**, the program **3414** identifies a new community of license if needed. FIG. **15** describes the process of identifying a new community of license.

[**0249**] If the scenario in block **1812** is not feasible, the program **3414** analyzes accommodation scenarios in block **1814**. FIG. **20** describes the process of analyzing accommodation scenarios **1814**.

[**0250**] After analyzing accommodation scenarios, the program **3414**, in block **1820**, determines if there are additional variations in the transmit power to evaluate. If there are additional variations, the program **3414** returns to block **1810**, where the steps **1810-1820** are repeated for the identified station at another transmit frequency. The program **3414** repeats steps **1810-1820** until the identified transmit power variations for the station have been evaluated. When the identified transmit power variations for the station have been evaluated, the process **1800** ends in block **1822**.

[**0251**] FIG. **19** is a flow chart illustrating a process to evaluate variations in the antenna HAAT within a station class, according to an embodiment of the invention. In block **1910**, the program **3414** varies the antenna height above average terrain of the scenario station.

[**0252**] In block **1912**, the program **3414** determines if the scenario of the station at the new antenna height above average terrain is feasible. In an embodiment, the program **3414** varies the antenna height above average terrain within each class as allowed by applicable communications and/or regulatory laws. In an embodiment, the program **3414** performs a feasibility analysis on each variation in the antenna height above average terrain to determine if it is

allowable under applicable communications and/or regulatory laws. The feasibility process is described in FIG. **8**.

[**0253**] If the scenario is feasible, the program **3414** scores the scenario in block **1916**. The scoring process is described in FIG. **14**. In block **1918**, the program **3414** identifies a new community of license if needed. FIG. **15** describes the process of identifying a new community of license.

[**0254**] If the scenario in block **1912** is not feasible, the program **3414** analyzes accommodation scenarios in block **1914**. FIG. **20** describes the process of analyzing accommodation scenarios.

[**0255**] After analyzing accommodation scenarios, the program **3414**, in block **1920**, determines if there are additional variations in the antenna height above average terrain to evaluate. If there are additional variations, the program **3414** returns to block **1910**, where the steps **1910-1920** are repeated for the identified station at another antenna height above average terrain. The program **3414** repeats steps **1910-1920** until the identified antenna height above average terrain variations for the station have been evaluated. When the identified antenna height above average terrain variations for the station have been evaluated, the process **1900** ends in block **1922**.

[**0256**] Referring to FIG. **7**, the program **3414** determines if the station scenario is feasible in block **712**, and if the station scenario does not meet the applicable communications and/or regulatory laws spacing requirements between field strength contours of stations, the scenario is not feasible. Because it may be possible to make changes to one or more of the stations in conflict with the scenario station to resolve the conflict, the process moves to block **714**, where the program **3414** evaluates accommodation scenarios. FIG. **20** is a flow chart illustrating a process **2000** to analyze accommodation station scenarios, according to an embodiment of the invention. The process **2000** analyzes accommodation scenarios to generate accommodation solutions for infeasible target station scenarios. The process **2000** further scores, sorts, and presents scored accommodation scenarios.

[**0257**] For example, one embodiment of the invention electronically or via data analysis analyzes one or more alternative operational parameters associated with a communication broadcast and electronically or via data analysis determines whether the alternative operational parameters conflict with at least one other communication broadcast. The embodiment can further determine whether the operational parameters of the other communication broadcast can be varied to remove the conflict.

[**0258**] In an embodiment, the process **2000** considers simple and complex accommodation scenarios. In an embodiment, simple accommodation scenarios comprise changing one of the location, channel, or class of the accommodation station. In an embodiment, complex accommodation scenarios comprise varying, in any combination, the location, channel, frequency, or class of the accommodation station **104**. In an embodiment, the changes are based at least in part on the FCC Rules section 73.215.

[**0259**] In another embodiment, if the accommodation scenario is not feasible because it creates secondary conflicts with other stations, the process **2000** evaluates additional accommodation scenarios to resolve the secondary conflict. In an embodiment, the process **2000** can evaluate accommodation scenarios to resolve conflicts with other accommodation scenarios. The process **2000** can continue until the program **3414** has exhausted all possible locations having all possible channel and/or frequency changes and all possible class changes for each accommodation station **104** that is identified as having a conflict with the previously determined accommodation station **104**. By considering secondary accommodation station scenarios to resolve conflicts with primary accommodation scenarios, where the primary accommodation station **104** conflicts with the target station, the program **3414** cascades or daisy chains accommodation station scenarios. In an embodiment, the user determines the maximum acceptable number of cascading accommodation stations **104**.

[**0260**] In block **2010**, the program **3414** identifies an accommodation station **104**. Accommodation stations **104** are the stations conflicting with the station scenario. In block **2012**, the program **3414** evaluates changing the location of the accommodation station **104**. FIG. **21** describes the process of evaluating location changes for the accommodation station **104**. In block **2014**, the program **3414** evaluates changing the channel of the accommodation station **104**. FIG. **16** describes the process of evaluating channel and/or frequency changes for the accommodation station **104**. In block **2016**, the program **3414** evaluates changing the class of the accommodation station **104**. FIG. **17** describes the process of class changes for the accommodation station **104**.

[**0261**] In block **2018**, the program **3414** evaluates changing the location and class of the accommodation station **104**. FIG. **22** describes the process of evaluating location and class changes for the accommodation station **104**. In block **2020**, the program **3414** evaluates changing the location, channel, and/or frequency of the accommodation station **104**. FIG. **23** describes the process of evaluating location, channel, and/or frequency changes for the accommodation station **104**. In block **2022**, the program **3414** evaluates changing the class, channel, and/or frequency of the accommodation station **104**. FIG. **24** describes the process of evaluating class, channel, and/or frequency changes for the accommodation station **104**. In block **2024**, the program **3414** evaluates changing the location, class, channel, and/or frequency of the accommodation station **104**. FIG. **25** describes the process of evaluating location, class, channel, and/or frequency changes for the accommodation station **104**.

[**0262**] After evaluating changes in location, class, channel, and/or frequency, alone or in combination, for the accommodation station **104**, the program **3414**, in block **2026**, determines if there are additional accommodation stations **104** to study. If there are additional accommodation stations **104**, the program **3414** returns to block **2010**, where the steps **2010-2024** are repeated for another accommodation station **104**. The program **3414** repeats steps **2010-2024** until the accommodation stations **104** that have been identified for the target station **100** have been evaluated. When the identified accommodation stations **104** for the target station **100** have been evaluated, the process **2000** ends in block **2028**.

[**0263**] FIG. **21** is a flow chart illustrating a process **2100** to evaluate possible changes of the accommodation station location, according to an embodiment of the invention. In

block **2110**, the program **3414** identifies a new location for the accommodation station **104**. In block **2112**, the program **3414** determines if the accommodation station scenario is feasible. FIG. **8** describes the process of determining whether the scenario is feasible.

[**0264**] If the scenario is feasible, the program **3414** scores the scenario in block **2116**. FIG. **14** describes the scoring process. In block **2118**, the program **3414** identifies a new community of license for the accommodation station **104**, if needed. FIG. **15** describes the process of identifying a new community of license.

[**0265**] In block **2120**, the program **3414** identifies a replacement station if needed. FIG. **33** describes the process of identifying a replacement station. An accommodation station **104** may need to have part or all of its previous coverage area replaced by a replacement station. In other embodiments, regulations can require a replacement station to continue service to the community. For example, the FCC requires a new community of license station if the accommodation station **104** is the only station licensed to provide service to the community of license and it is relocated outside of the community of license. In further embodiments, for business reasons, the owner of the accommodation station **104** may desire a replacement station that covers a user-defined target market or area. In an embodiment, replacement stations comprise FM and/or AM radio stations.

[**0266**] If the scenario in block **2112** is not feasible, the program **3414** analyzes accommodation scenarios in block **2114**. FIG. **20** describes the process of analyzing accommodation scenarios.

[**0267**] After evaluating the change in the accommodation station location, the program **3414**, in block **2122**, determines if there are additional locations to study. If there are additional locations, the program **3414** returns to block **2110**, where the steps **2110-2120** are repeated for the identified accommodation station **104** at another location. The program **3414** repeats steps **2110-2120** until the locations that have been identified for the accommodation station **104** have been evaluated. When the identified locations for the accommodation station **104** have been evaluated, the process **2100** ends in block **2124**.

[**0268**] FIG. **22** is a flow chart illustrating a process **2200** to evaluate changes of the accommodation station location and class, according to an embodiment of the invention. In block **2210**, the program **3414** identifies a new accommodation station location. In block **2212**, the program **3414** evaluates class changes for the accommodation station at the new location. FIG. **17** describes the process of evaluating class changes.

[**0269**] In block **2214**, the program **3414** determines if there are additional locations. If there are more locations at which to evaluate the accommodation station **104**, the process **2200** moves to block **2210**, where the steps **2210-2214** are repeated for the accommodation station **104** at another location. The program **3414** repeats steps **2210-2214** until the identified locations have been evaluated. When the identified locations for the accommodation station **104** have been evaluated, the process **2200** ends in block **2216**.

[**0270**] FIG. **23** is a flow chart illustrating a process **2300** to evaluate changes of the accommodation station location, channel and/or frequency, according to an embodiment of the invention. In block **2310**, the program **3414** identifies a new accommodation station location. In block **2312**, the program **3414** evaluates channel and/or frequency changes for the accommodation station **104** at the new location. FIG. **16** describes the process of evaluating channel and/or frequency changes.

[**0271**] In block **2314**, the program **3414** determines if there are additional locations. If there are more locations at which to evaluate the accommodation station **104**, the process **2300** moves to block **2310**, where the steps **2310-2314** are repeated for the accommodation station **104** at another location. The program **3414** repeats steps **2310-2314** until the locations have been evaluated. When the identified locations for the accommodation station **104** have been evaluated, the process **2300** ends in block **2316**.

[**0272**] FIG. **24** is a flow chart illustrating a process **2400** to evaluate changes of the accommodation station class, channel, and/or frequency, according to an embodiment of the invention. In block **2410**, the program **3414** identifies a new accommodation station channel and/or frequency. In block **2412**, the program **3414** evaluates class changes for the accommodation station **104** having the new channel and/or frequency. FIG. **17** describes the process of evaluating class changes.

[**0273**] In block **2414**, the program **3414** determines if there are additional channel and/or frequency changes. If there are more channels and/or frequencies at which to evaluate the accommodation station **104**, the process **2200** moves to block **2410**, where the steps **2410-2414** are repeated for the accommodation station **104** at another channel and/or frequency. The program **3414** repeats steps **2410-2414** until the identified channel and/or frequency changes have been evaluated. When the identified channel and/or frequency changes for the accommodation station **104** have been evaluated, the process **2400** ends in block **2416**.

[**0274**] FIG. **25** is a flow chart illustrating a process to evaluate changes of the accommodation station location, class, channel, and/or frequency, according to an embodiment of the invention. In block **2510**, the program **3414** identifies a new accommodation station location. In block **2512**, the program **3414** evaluates class, channel, and/or frequency changes for the accommodation station **104** at the new location. FIG. **24** describes the process of evaluating class, channel, and/or frequency changes.

[**0275**] In block **2514**, the program **3414** determines if there are additional locations. If there are more locations at which to evaluate the accommodation station **104**, the process **2500** moves to block **2510**, where the steps **2510-2514** are repeated for the accommodation station **104** at another location. The program **3414** repeats steps **2510-2514** until the identified locations have been evaluated. When the identified locations for the accommodation station **104** have been evaluated, the process **2500** ends in block **2516**.

[**0276**] To facilitate the search for a new location for the accommodation station **104**, the search can be restricted to areas that are more likely to produce results efficiently. In an embodiment, the program **3414** considers locations within a user-defined area of arbitrary shape and size surrounding the accommodation station **104**. In another embodiment, the search area can be divided into any user-defined polygon or set of polygons.

[0277] In yet another embodiment, the program **3414** considers locations that are no farther than a user-defined maximum distance from the accommodation station **104**. In this embodiment, the search forms a portion of a circle around the accommodation station **104**.

[0278] The search area in any of the above search embodiments can be further divided into sectors of feasibility as cones or as polygons and each of these cones or polygons is searched for new potential locations for the accommodation station **104**. The number of cones is user-defined. The search within each cone terminates when a user-specified distance is reached, or when a new violation of the regulations is encountered. In the FM radio example, the search distance from the accommodation station **104** terminates when the FCC Rules sections 73.207 and 73.215 are violated. In other words, the spacing requirements between the possible accommodation station **104** and yet another station are not met.

[0279] FIG. **26** is a graphical representation of a single accommodation station location change illustrating possible new locations for an accommodation station **2610**. As illustrated in FIG. **26**, the accommodation station **2610** conflicts with a target station **2612**. In order to create a feasible scenario for the target station **2612**, the program **3414** evaluates the accommodation station **2610** at various new locations to determine if moving the accommodation station **2610** to a new location resolves the conflict with the target station **2612**.

[0280] The program **3414** determines which locations to search by determining the bearing **2614** of the accommodation station **2610** from the target station **2612**. Next, the program **3414** determines a boundary **2616** passing through the accommodation station **2610** and perpendicular to the bearing **2614**. In an embodiment, the user specifies a radius of distance d **2618** from the accommodation station **2610** and the program **3414** searches an area **2620** defined by the radius d **2618** from the accommodation station and the boundary **2616** for station locations. The program **3414** considers station locations, as specified in FIG. **4**, for example, within the area **2618**. In an embodiment, station locations comprise the locations of real, hypothetical, and mutually exclusive towers, repeaters, translators, antennas, self-supporting structures, guide towers, building rooftop locations, locations suitable for a broadcast antenna, and the like.

[0281] In an embodiment, the program **3414** searches for stations along the radius d **2616** until the station location becomes infeasible with respect to other stations or until the program **3414** reaches the distance d. The program **3414** saves the feasible stations as possible accommodation station locations.

[0282] To accommodate a scenario target station **100**, in some embodiments, it is possible that more than one accommodation station **104** be relocated to comply with applicable communications and/or regulatory laws. In one embodiment, the program **3414** can simultaneously relocate the stations in parallel, or in another embodiment, the program **3414** can relocate the stations sequentially. In another embodiment, any combination of parallel and sequential moves can be applied to accommodate a target station **100** and one or more accommodation stations **104**.

[0283] FIG. **27** is a graphical representation of multiple accommodation station location changes, according to an embodiment of the invention. As illustrated in FIG. **27**, the program **3414** has cascaded two accommodation stations. A first accommodation station **2710** (Station **2**) conflicts with a target station **2712**. By moving the accommodation station **2710** to a new location **2714**, the interference between the accommodation station **2710** (Station **2**) and the target station **2712** is resolved, but the target scenario is not feasible due to a conflict between the accommodation station **2710** (Station **2**) and a second accommodation station **2716** (Station **3**). The program **3414** searches for a new location for the accommodation station **2716** within an area **2718**.

[0284] FIG. **28** is a screen shot illustrating a table of **2800** possible target stations **100**, according to an embodiment of the invention. The table has one entry for each station **100** that was studied for the defined market or area **102**. Each row of the table **2800** shows the best scenario for each of the existing stations **100** that the program **3414** evaluated. In this example, the table **2800** comprises a call column **2810**, a class column **2812**, a city column **2814**, an in market population column **2816**, a percentage of the market increase column **2818**, a total percentage of the market column **2820**, and a composite score column **2822**. The call column **2810** displays the call letters of the existing facility and the class column **2812** displays the class of the existing facility. The city column **2814** displays the community of license and the state for the facility.

[0285] The in market population column **2816** displays the total population and/or demographics within the market that is covered by the best scenario. The percentage of the market increase column **2818** displays the increase of market coverage between the best scenario and the existing facility as a percentage. The total percentage of the market column **2820** displays the amount of the market that is covered by the best scenario as a percentage of population and/or demographics. The composite score column displays the composite score of the best scenario for the station. The composite score is a combination of the implementation score, based on applicable communications and/or regulatory laws, and the population improvement score, based on market coverage improvement.

[0286] FIG. **29** is a screen shot illustrating a table of scenarios **2900** for the target station **100**, according to an embodiment of the invention. The title bar area of the table **2900** displays the call letters, channel, and class of the existing facility. In this example, the table shows 16 scenarios that the program **3414** evaluated for station KKHQ-FM, which is the first target station **100** listed in FIG. **28**. The table comprises a number column **2910**, which is used for reference, a channel column **2912**, which displays the channel number for a given scenario, and a class column **2914**, which displays the class for the given scenario.

[0287] The table **2900** further comprises the community of license field strength column **2916**, the tower column **2918**, and the overlaps column **2920**. The community of license field strength column **2916** displays the field strength in dBu at the community of license coordinates given the scenario's parameters. The tower column **2918** displays the difference between the actual tower height listed in the database **3416**, such as, for example, the ASR database or the FM/TV database, and the height used for calculating the scenario. A negative number indicates the tower height is less than the scenario height. The overlaps column **2920** displays the

number of field strength contour overlaps in the scenario, or in other words, the number of accommodation stations **104**.

[**0288**] The table **2900** further comprises an in market population column **2922**, an existing facility percentage column **2924**, a scenario percentage column **2926**, and a difference percentage column **2928**. The in market population column **2922** displays the total population and/or demographics coverage of the scenario in the market. The existing facility percentage column **2924** displays the existing facility percentage of the market coverage, the scenario percentage column **2926** displays the scenario percentage of market coverage, and the difference percentage column **2928** displays the difference between the scenario and existing facility market coverages.

[**0289**] The table **2900** further comprises an existing facility population column **2930**, which displays the total population and/or demographics coverage of the existing facility, a scenario population column **2932**, which displays the total population and/or demographics coverage of the scenario facility, and a difference population column **2934**, which displays the difference between the scenario coverage and the existing facility coverage. The table **2900** further comprises an implementation score column **2936**, a population score column **2938**, and composite score column **2940**.

[**0290**] FIG. **30** is a screen shot illustrating an allocation table **3000** listing allocation study information for the specific scenario, according to an embodiment of the invention. The title bar of table **300** comprises the call letters, original channel and class, and scenario number. In this example, the table **3000** displays the allocation study for KKHQ-FM scenario **14**, which is the first scenario listed in table **2900**. Each row in the allocation table **3000** contains a station with which the scenario station configuration has an allocation relationship. A text box **3010** at the bottom of the screen shot shows a summary of the scenario configuration and changes made to the existing facility in the scenario.

[**0291**] The table **3000** comprises a call column **3012**, which displays the call letters of the station, a channel column **3014**, which displays the station channel number, and a community of license column **3016**, which displays the community of license and state for the station.

[**0292**] The table **3000** further comprises an azimuth column **3018**, which displays the azimuth from the reference station in degrees, and a distance column **3020** which displays the distance between the stations. Column **3022** displays the spacing margin for the separation and channel/class relationship between the two stations. This is the difference between the required separation and the actual separation. If it is negative, then the configuration fails to meet the required spacing. In an embodiment, the spacing margin is displayed in km and is based on FCC Rules. In this example, the negative spacing margin value in row **1** corresponds to the one overlap for station KKHQ-FM scenario **14**, as displayed in table **2900**, row **1**, column **2920**.

[**0293**] The table **3000** further comprises an in contour column **3024**, and an out contour column **3026**. The in contour column **3024** displays the direct line distance between the protected field strength contour of the reference station and the interfering field strength contour of the station in the table. If it is less than zero, it indicates that the station in the table is causing field strength contour overlap to the reference station. In an embodiment, this value is not calculated if the spacing requirement is met. The out contour column **3026** displays the direct line distance between the interfering field strength contour of the reference station and the protected field strength contour of the station in the table. If it is less than zero, it indicates that the reference station is causing field strength contour overlap to the station in the table. In an embodiment, this value is not calculated if the spacing requirement is met.

[**0294**] FIG. **31** is a screen shot illustrating a table of scenarios **3100** for target station KXXI, according to an embodiment of the invention. The candidate station for reengineering is station KXXI near Albuquerque, NM. As shown in the table **3100**, the program **3414** identified **28** target scenarios for KXXI. Of the **28** scenario, **12** are not viable because they would result in a reduction in population and/or demographics covered by the target station. Of the remaining **16** scenarios, **5** of them, scenario numbers **5**, **7**, **24**, **21**, and **20**, do not have any identified conflicts. Therefore, these scenarios need only be scored.

[**0295**] The other **11** scenarios have one or two conflicts with other stations. The program **3414** evaluates possible changes to the conflicted or accommodation stations **104** in order to make the **11** conflicted scenarios feasible for target station KXXI.

[**0296**] In scenario **4**, for example, the program **3414** moves station KXXI to a new tower location without changing the channel, the frequency or the class of the original station (FIG. **7**). Next, the program **3414** evaluates the feasibility of scenario **4** (FIG. **8**) and determines that moving the location of KXXI results in conflicts with two stations, KZRR, a class C station on channel **231**, and KKOB-FM, a class C station on channel **227**. The new location of KXXI can potentially be made feasible by changing the accommodation stations' channel, frequency, class, or location.

[**0297**] The program **3414** next evaluates potential accommodation scenarios for KZRR and KKOB-FM (FIG. **20**). In a first accommodation scenario, the program **3414** changes the class of KZRR and KKOB-FM to class C**3**, evaluates the feasibility of the accommodation scenario, and determines that the accommodation class changes make scenario **4** feasible.

[**0298**] In a second accommodation scenario, the program **3414** changes the channel of KZRR to **233** to remove the conflict between KXXI and KZRR. The program **3414** evaluates the accommodation scenario and determines that it is not a feasible accommodation because changing the channel of KZRR creates new conflicts between KZRR and other stations in the area. However, it may be yet possible to cascade additional accommodation changes to resolve the conflict between KZRR and the other stations in the area.

[**0299**] In a third accommodation scenario, the program **3414** changes the location of KZRR and KKOB-FM, evaluates the feasibility of the accommodation scenario, and determines that the accommodation location changes make the new location of KXXI in scenario **4** feasible.

[**0300**] In an embodiment, a computer-based software application or firmware/hardware based application and/or program performs calculations to analyze, manage, and/or vary location, power, class, antenna height, format channel

and/or frequency of points of communication in the communication spectrum. FIG. **34** is a schematic of a communication spectrum improvement system **3400**, according to an embodiment of the invention. The communication spectrum improvement system **3400** comprises the computer **3410**, and memory **3412** comprising the communication spectrum program **3414** and database information **3416**. In an embodiment, the database information **3416** comprises at least one of a terrain database, a demographic database, a location database, a station database, an FCC database, a tower database, and the like. The communication spectrum improvement system **3400** interfaces with users through user input/output devices. In an embodiment, the user enters information through a keyboard **3418** and receives output from the communication spectrum improvement system **3400** through a monitor **3418** and/or a printer **3420**. In other embodiments, other user input/output devices can be used

[**0301**] The application or program **3414** executes on one or more computers **3410** and comprises program **3414** logic. In an embodiment, the application **3414** executes on a Windows based platform. In an embodiment, the term "channels" comprises transmission points, "virtual" repeaters, "virtual" boosters, and/or "virtual" translators. In an embodiment, the communication spectrum ranges from approximately 3 kHz to approximately 300 GHz.

[**0302**] The computers **3410** comprise, by way of example, processors, program logic, or other substrate configurations representing data and instructions, which operate as described herein. In other embodiments, the processors **3410** can comprise controller circuitry, processor circuitry, processors, general-purpose single-chip or multi-chip microprocessors, digital signal processors, embedded microprocessors, microcontrollers and the like.

[**0303**] In one embodiment, the program logic **3414** may advantageously be implemented as one or more modules. The modules may advantageously be configured to execute on one or more processors. The modules may comprise, but are not limited to, any of the following: software or hardware components such as software object-oriented software components, class components and task components, processes methods, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, or variables.

[**0304**] The term "output" describes any type of results generated by the program **3414** including conclusion or analysis information after calculations have been completed. The output can include, but is not limited to, information displayed on the computer monitor **3420**, information input into a database and/or spreadsheet program, information printed out from the printer **3422** as a report and/or readable by any machine and/or computer that can then take the information and perform further analysis, and/or other information outputs generated by the program **3414**.

[**0305**] While certain embodiments of the inventions have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel methods and systems described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions, and changes in the form of the methods and systems described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A computerized method of evaluating a radio transmitter, the method comprising:

analyzing potential changes in a signal coverage of a target area associated with alternative locations of a radio transmitter, alternative classes of the radio transmitter, alternative frequencies of the radio transmitter, and/or alternative channels of the radio transmitter;

determining whether the alternative locations, alternative classes, alternative frequencies and/or alternative channels create a need to obtain a replacement radio transmitter to service portions of the target area; and

identifying one or more existing radio transmitters that could function as the replacement radio transmitter.

2. The method of claim 1, wherein the radio transmitter at an original location, an original class, an original frequency, and original channel is associated with an original community of license.

3. The method of claim 2, wherein identifying one or more existing radio transmitters that could function as the replacement radio transmitter comprises:

identifying the existing radio transmitter having a field strength contour that covers at least a portion of the original community of license;

determining whether the field strength contour of the existing radio transmitter exceeds a threshold; and

determining that the existing radio transmitter could function as the replacement radio transmitter when the field strength contour exceeds the threshold.

4. The method of claim 3, wherein the field strength contour is a 70 dBu field strength contour.

5. The method of claim 3, wherein determining whether the field strength contour exceeds the threshold comprises determining whether the field strength contour covers more than a first user-defined percentage of an area of the original community of license and more than a second user-defined percentage of a population and/or demographic of the original community of license.

6. The method of claim 5 wherein the first and second user-defined percentages are 85%.

7. The method of claim 3, further comprising determining that the existing radio transmitter could not function as the replacement radio transmitter when the field strength contour is less than the threshold.

8. An apparatus that evaluates a radio transmitter, the apparatus comprising:

one or more processors configured to analyze potential changes in a signal coverage of a target area associated with alternative locations of a radio transmitter, alternative classes of the radio transmitter, alternative frequencies of the radio transmitter, and/or alternative channels of the radio transmitter;

one or more processors configured to determine whether the alternative locations, alternative classes, alternative frequencies and/or alternative channels create a need to obtain a replacement radio transmitter to service portions of the target area; and

one or more processors configured to identify one or more existing radio transmitters that could function as the replacement transmitter.

9. The apparatus of claim 8, wherein the radio transmitter at an original location, an original class, an original frequency, and original channel is associated with an original community of license.

10. The apparatus of claim 9, wherein identifying one or more existing radio transmitters that could function as the replacement radio transmitter comprises:

one or more processors configured to identify the existing radio transmitter having a field strength contour that covers at least a portion of the original community of license;

one or more processors configured to determine whether the field strength contour of the existing radio transmitter exceeds a threshold; and

one or more processors configured to determine that the existing radio transmitter could function as the replacement radio transmitter when the field strength contour exceeds the threshold.

11. The apparatus of claim 10, wherein the field strength contour is a 70 dBu field strength contour.

12. The apparatus of claim 10, wherein when the field strength contour exceeds the threshold comprises when the field strength contour covers more than a first user-defined percentage of an area of the original community of license and more than a second user-defined percentage of a population and/or demographic of the original community of license.

13. The apparatus of claim 12, wherein the first and second user-defined percentages are 85%.

14. The apparatus of claim 9, further comprising one or more processors configured to determine that the existing radio transmitter could not function as the replacement radio transmitter when the field strength contour is less than the threshold.

15. A computerized method of evaluating a transmitter, the method comprising:

analyzing potential changes in one or more alternative operational parameters of a transmitter;

determining whether the alternative operational parameters create a need to obtain a replacement transmitter; and

identifying one or more existing transmitters that could function as the replacement transmitter.

16. The method of claim 15, wherein identifying one or more existing transmitters that could function as the replacement transmitter comprises:

identifying the existing transmitter having a field strength contour that covers at least a portion of an original community of license;

determining whether the field strength contour of the existing transmitter exceeds a threshold; and

determining that the existing transmitter could function as the replacement transmitter when the field strength contour exceeds the threshold.

17. The method of claim 16, wherein the field strength contour is a 70 dBu field strength contour.

18. The method of claim 16, wherein determining whether the field strength contour exceeds the threshold comprises determining whether the field strength contour covers more than a first user-defined percentage of an area of the original community of license and more than a second user-defined percentage of a population and/or demographic of the original community of license.

19. The method of claim 16 wherein the first and second user-defined percentages are 85%.

20. The method of claim 16, further comprising determining that the existing transmitter could not function as the replacement transmitter when the field strength contour is less than the threshold.

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