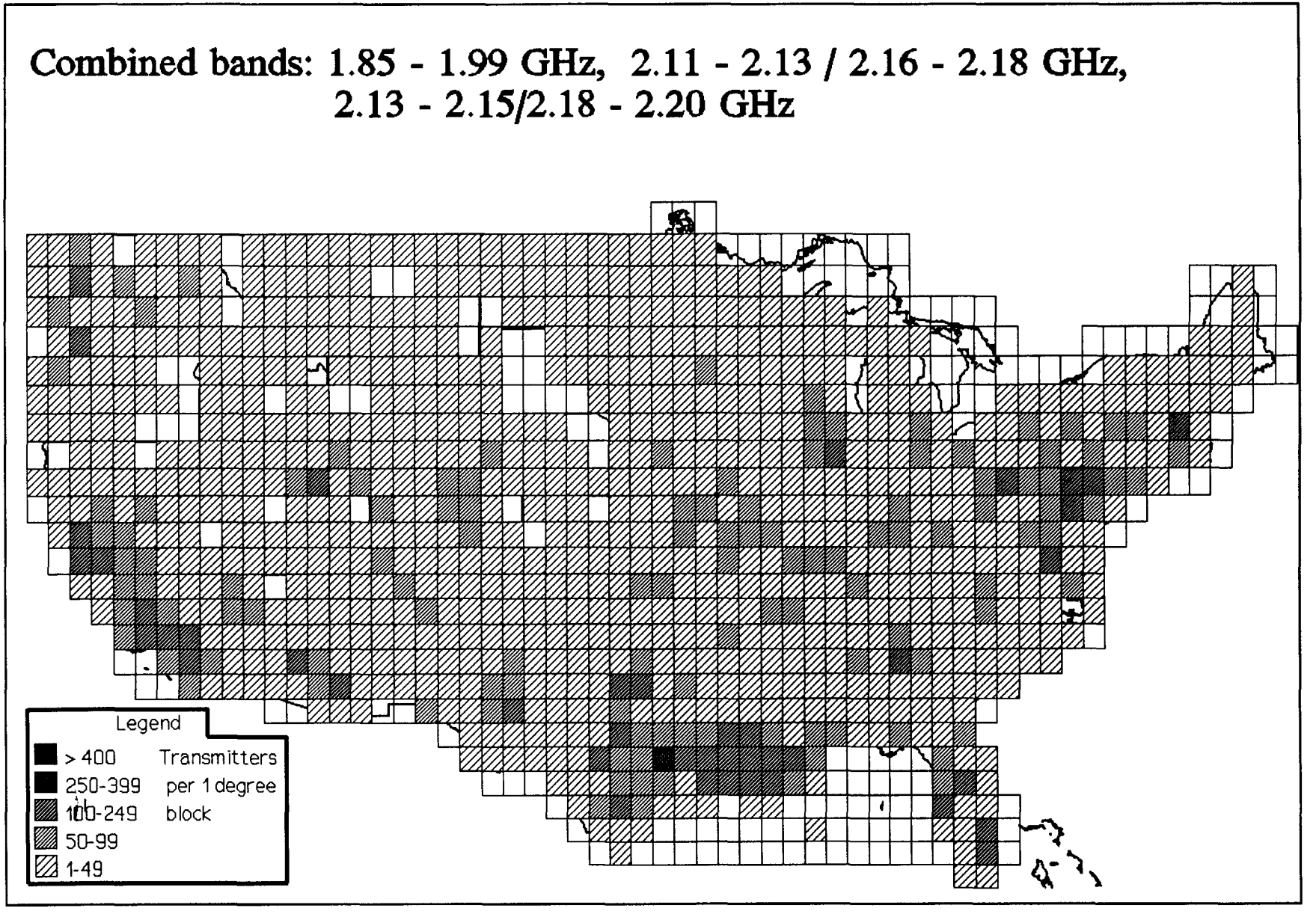
Figure 4


Combined bands: 1.85 - 1.99 GHz, 2.11 - 2.13 / 2.16 - 2.18 GHz,
2.13 - 2.15/2.18 - 2.20 GHz
Legend
> 400
250-399
100-249
50-99
1-49
Transmitters
per 1 degree
block

4.4.2 Distribution of 4 and 6 GHz Facilities. A grid analysis was also performed for the 4 and 6 GHz relocation bands. As was done for the 2 GHz band, the analysis divided the country into individual one degree zones, or blocks, and counted the number of transmitters contained in each one degree zone. Again, the density of 4 and 6 GHz microwave facilities is only moderate to light in the vast majority of the country. The heaviest concentrations of microwave facilities also vary by band and service.

The heaviest concentrations of transmitters are located in about 10% of the blocks in the country. The slope of the distribution curve for 4 GHz and 6 GHz is very similar to that for the 2 GHz, as shown below on Figure 5. Figure 6 shows the nationwide distribution of 4 and 6 GHz facilities in the one degree zones.

The zones with the most 4 GHz common carrier facilities occur in and near Philadelphia, PA, and around Cincinnati, OH, where major long haul switching centers are located. The zone with the most 6 GHz common carrier facilities is outside of Philadelphia, PA, where an AT&T central switching office is located. The maximum number of 6 GHz private microwave transmitters is located in San Francisco, CA, where there is a large concentration of petroleum, utilities, and local government facilities.

Figure 5

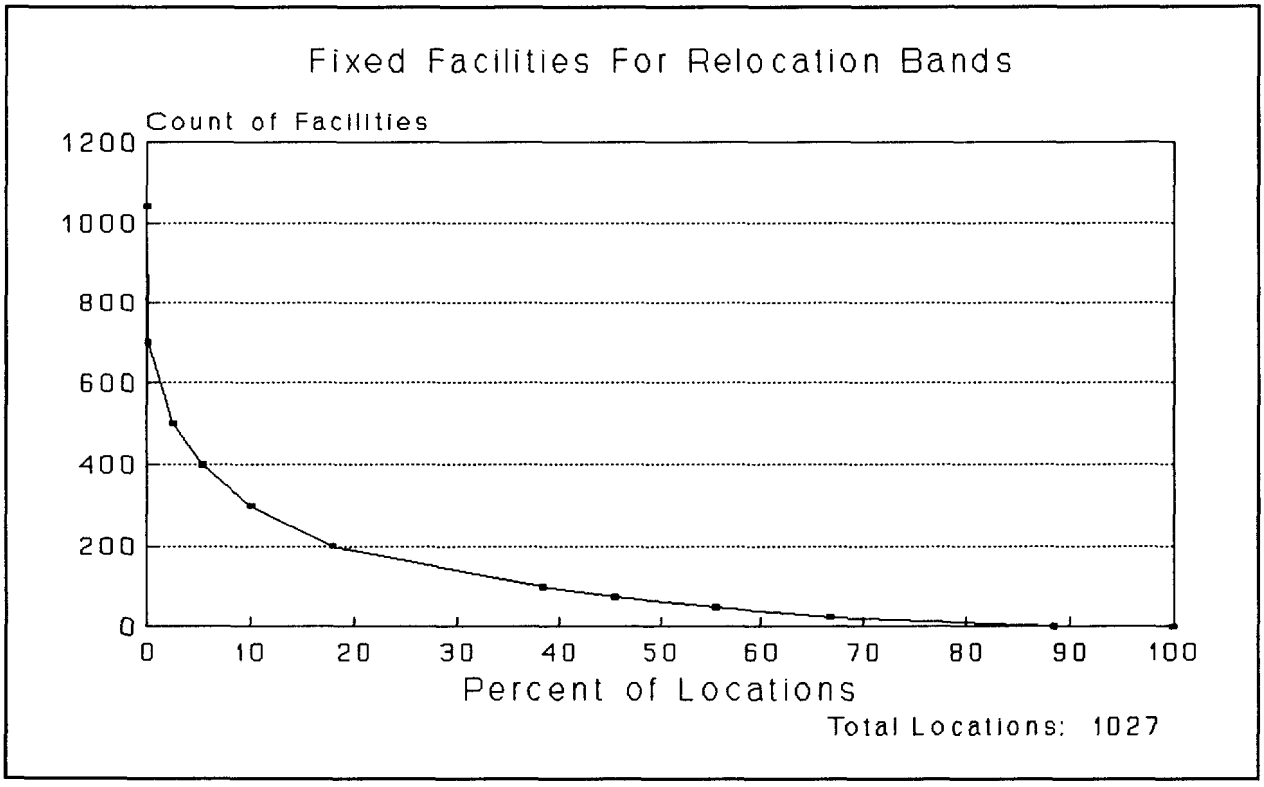
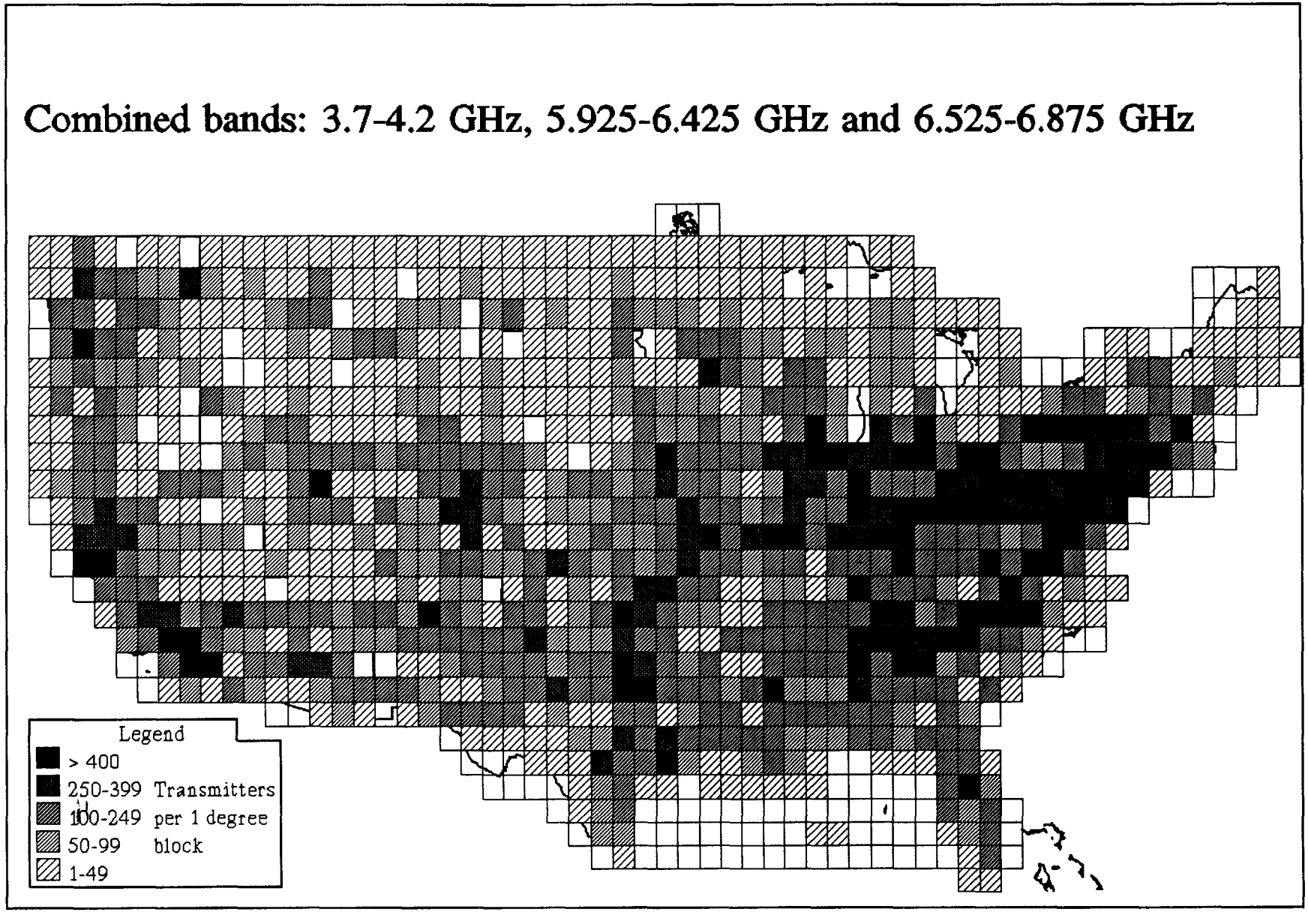


Figure 6


Combined bands: 3.7-4.2 GHz, 5.925-6.425 GHz and 6.525-6.875 GHz
Legend
> 400
250-399
100-249
50-99
1-49
Transmitters
per 1 degree
block

4.4.3 Relocation Band Capacity. As indicated above, the feasibility of relocating facilities from one band to another depends on the number and location of the facilities to be relocated and the capacity available in the new band at that location. One factor limiting the number of microwave facilities that can be constructed in a given area is interference among the facilities, which limits the reuse of frequencies. Another limiting factor is the plan by which frequencies are chosen and the resulting frequency patterns in an area. Except for minor differences in terrain and atmospheric conditions, there are no engineering reasons why the microwave facilities in one location cannot be duplicated in any other geographic location.[30] From our analysis, facility densities appear generally to reflect the service needs in a geographic area and not technical or interference limits. On this basis, it is reasonable to presume that the capacity in any one area can approach or possibly even surpass the number of facilities in the more heavily populated locations.

Spectrum capacity measures can be derived from our distribution data. For each of the relocation bands, the study estimated the achievable capacity, or the number of facilities that can operate, in a one degree zone. These capacity or "benchmark" estimates were based on an examination of the zones with the highest number of transmitters. The benchmark selection was based on the assumption that if there are several blocks throughout the country where the same or higher transmitter populations are achieved then this number or benchmark should be achievable in any location.[31]

Using these benchmarks, the study estimated the available excess capacity that is achievable in each of the one degree zones nationwide. The available excess capacity for each of the relocation bands in a given zone is the difference between the benchmark and the number of existing facilities operating in that band. If a block contains more facilities than the benchmark for the band, it is assumed that there is no capacity available in the block for that band. The benchmarks chosen were: 400 for the 4 and 6 GHz common carrier bands and 250 for the 6 GHz private microwave band. The total benchmark capacity for a single block is the sum of all three capacities, or 1050 transmitters.

Using these benchmarks, an examination of the one degree zones indicates that there is excess capacity in all locations. In order to determine if the capacity of each block is sufficient to accommodate the relocation of the 2 GHz operations, the number of 2 GHz transmitters in each block were compared to the estimated available capacity for each block. Based on these comparisons, it appears that the 4 and 6 GHz bands are capable of fully accommodating the relocation of the 2 GHz transmitters.[32] In fact in most one degree zones, the 4 and 6 GHz

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[30] In a nationwide study, the advantages and disadvantages of terrain, atmospheric conditions, and physical structures generally balance out. As revealed by our density studies, some of the heaviest concentrations of transmitters are located not only in large cities but also outside of smaller cities such as, Bakersfield, CA, Harrisburg, PA, and New Brunswick, NJ.

[31] The study did not use the maximum number of transmitters operating in a one degree zone as a benchmark for any of the three relocation bands.

[32] As expected, there are several blocks that approach the benchmark capacities. The areas where the available excess capacity approaches the benchmark capacity located near Philadelphia, PA, Cincinnati, OH, and San Francisco, CA.

bands appear to be able to support a significant number of additional facilities even after consideration of the 2 GHz facilities. The results of this analysis are presented in Appendix A.

4.4.4 Top 50 MSA Capacity. Although the one degree zone analysis demonstrates enough capacity to relocate all of the migrating 2 GHz facilities nationwide, it does not consider the larger areas of dense concentrations that tend to occur in major metropolitan areas. To take this factor into account, the study next examined available capacity over larger metropolitan areas. Generally, the majority of the population and fixed microwave facilities in a metropolitan area can be encompassed within a two degree square block. A two degree block is approximately 120 miles on a side.

A two degree block capacity analysis, similar to the one degree analysis was conducted for the top 50 Metropolitan Statistical Areas (MSAs). For each of the relocation bands, the achievable or benchmark capacity was estimated. Benchmark capacities were estimated using the same method employed in the one degree analysis. The benchmarks for this analysis were chosen to be 1100 for the 4 GHz common carrier band, 1100 for the 6 GHz common carrier and 500 for the 6 GHz private.[33] These benchmarks are representative of the number of transmitters in several two degree blocks nationwide.

As in the one degree analysis, the available excess capacity for individual blocks in each band is assumed to be the benchmark less the number of existing transmitters in the block.[34] The available excess capacities were examined for each band and direct comparisons were made with the number of facilities to be relocated from 2 GHz. Table 4 shows the relocation capacities for the 50 major metropolitan areas.

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[33] It should be noted that the benchmarks chosen for the two degree analysis are not simply the one degree benchmarks multiplied by four. The two degree blocks with the highest number of transmitters generally have only about twice the number of transmitters than the one degree with the highest number of transmitters, even though the area involved is four times as great. For example, the two degree zone around New York City contains about 2300 transmitters in the 4 and 6 GHz bands, whereas a one degree zone in New York City contains approximately 1000 transmitters.

[34] In cases where the number of existing transmitters in a band exceeded the benchmark for that band, the capacity for that block was assumed to be zero. For example, in the Philadelphia area the available capacity for the 6 GHz Common Carrier band was assumed to have no available capacity for accommodating 2 GHz transmitters.

Table 4: Top 50 Metropolitan Statistical Areas
(Per 1990 Census)

Bench Marks

3700 MHz: 1100
5925 MHz: 1100
6525 MHz: 500

Rank	Location	2 GHz	3700 MHz		5925 MHz		6525 MHz		Remaining
		TXs	TXs	Cap	TXs	Cap	TXs	Cap	Capacity
1	New York, NY (CMSA)	263	948	152	1127	0	260	240	129
2	Los Angeles, CA (CMSA)	660	466	634	847	253	562	0	227
3	Chicago, IL (CMSA)	320	851	249	690	410	227	273	612
4	San Francisco, CA (CMSA)	543	488	612	543	557	441	59	685
5	Philadelphia, PA (CMSA)	314	944	156	1603	0	287	213	55
6	Detroit, MI (CMSA)	173	536	564	480	620	166	334	1345
7	Boston, MA (CMSA)	255	228	872	451	649	115	385	1651
8	Washington, DC (MSA)	327	955	145	842	258	278	222	298
9	Dallas-Fort Worth, TX (CMSA)	373	660	440	917	183	278	222	472
10	Houston, TX (CMSA)	581	261	839	343	757	409	91	1106
11	Miami-Ft.Lauderdale, FL (CMSA)	300	75	1025	189	911	102	398	2034
12	Atlanta, GA (MSA)	325	1029	71	629	471	163	337	554
13	Cleveland, OH (CMSA)	144	292	808	613	487	183	317	1468
14	Seattle-Tocoma, WA (CMSA)	276	259	841	278	822	163	337	1724
15	San Diego, CA (MSA)	165	201	899	186	914	138	362	2010
16	Minneapolis-St. Paul, MN (CMSA)	174	439	661	355	745	57	443	1675
17	St. Louis, MO (MSA)	182	619	481	525	575	143	357	1231
18	Baltimore, MD (MSA)	386	1095	5	1241	0	290	210	-171
19	Pittsburgh-Beaver Valley, PA (CMSA)	264	815	285	929	171	266	234	426
20	Phoenix, AZ (MSA)	238	244	856	332	768	136	364	1750
21	Tampa-St. Petersburg-Clearwater, FL (MSA)	241	169	931	357	743	101	399	1832
22	Denver-Boulder, CO (CMSA)	318	574	526	462	638	149	351	1197
23	Cincinnati, OH (CMSA)	175	998	102	733	367	159	341	635
24	Milwaukee-Racine, WI (CMSA)	196	285	815	275	825	101	399	1843

Rank	Location	2 GHz	3700 MHz		5925 MHz		6525 MHz		Remaining
		TXs	TXs	Cap	TXs	Cap	TXs	Cap	Capacity
25	Kansas City (MO-KS), MO (MSA)	229	263	837	518	582	151	349	1539
26	Sacramento, CA (MSA)	531	787	313	734	366	352	148	296
27	Portland-Vancouver, OR (CMSA)	195	430	670	338	762	132	368	1605
28	Norfolk-Virginia Beach-Newport News, VA (CMSA)	154	70	1030	190	910	48	452	2238
29	Columbus, OH (MSA)	42	497	603	685	415	186	314	1290
30	San Antonio, TX (MSA)	358	335	765	234	866	112	388	1661
31	Indianapolis, IN (MSA)	105	608	492	671	429	168	332	1148
32	New Orleans, LA (MSA)	471	116	984	223	877	255	245	1635
33	Buffalo-Niagara Falls, NY (CMSA)	113	310	790	313	787	14	486	1950
34	Charlotte-Gastonia-Rock Hill, NC (CMSA)	208	676	424	418	682	162	338	1236
35	Providence-Pawtucket-Fall River, RI (CMSA)	237	244	856	424	676	97	403	1698
36	Hartford-New Britain-Middletown, CT (CMSA)	218	505	595	476	624	135	365	1366
37	Orlando, FL (MSA)	290	330	770	449	651	84	416	1547
38	Salt Lake City-Ogden, UT (CMSA)	252	307	793	503	597	175	325	1463
39	Rochester, NY (MSA)	94	328	772	360	740	21	479	1897
40	Nashville-Davidson, TN (MSA)	148	575	525	345	755	42	458	1590
41	Memphis, TN (CMSA)	224	319	781	474	626	45	455	1638
42	Oklahoma City, OK (MSA)	103	449	651	616	484	218	282	1314
43	Louisville, KY (MSA)	152	628	472	570	530	183	317	1167
44	Dayton-Springfield, OH (MSA)	129	830	270	573	527	137	363	1031
45	Greensboro-Winston-Salem-High Point, NC (MSA)	214	551	549	327	773	101	399	1507
46	Birmingham, AL (MSA)	173	587	513	307	793	123	377	1510
47	Jacksonville, FL (MSA)	180	366	734	189	911	36	464	1929
48	Albany-Schenectady-Troy, NY (MSA)	198	380	720	499	601	64	436	1559
49	Richmond-Petersburg, VA (MSA)	242	671	429	464	636	78	422	1245
50	West Palm Beach-Boca Raton-Delray Beach, FL (MSA)	296	123	977	243	857	86	414	1952

From this analysis, it again appears that the lower three fixed microwave relocation bands, 3.7-4.2 GHz, 5.925-6.425 GHz and 6.525-6.875 GHz, generally offer sufficient capacity to accommodate all 2 GHz facilities in the major metropolitan areas. In most cases, the analysis indicates that there are large amounts of remaining capacity in the major cities. Relocation of 2 GHz facilities to the 4 and 6 GHz bands appears questionable in only three cases, New York, Philadelphia, and Baltimore. While the study shows that New York and Philadelphia could be expected to have some remaining capacity after relocating the 2 GHz facilities, their remaining capacity margins are relatively slim. Baltimore, however, appears to have a shortage of capacity for relocation. Further examination indicates that the shortage for Baltimore is the result of its proximity to Philadelphia and Washington, D.C. In addition, an examination of the individual facilities operating in the Baltimore region indicates that almost one-half of the 2 GHz links currently operating in the region are relatively short, less than ten miles. These shorter path length operations could readily be accommodated on higher frequencies or on alternative media. Accordingly, the study concludes that reaccommodation could be achieved within the Baltimore area.

4.5 Summary of Findings. Based on the one degree and major city analyses, the study concludes that it is technically feasible to relocate the existing 2 GHz fixed microwave operations to higher frequency bands. From this approximate analysis, it appears that there is generally sufficient capacity in the 4 GHz and 6 GHz bands to accommodate the existing 2 GHz FS facilities nationwide. Additional relocation capacity appears to be available in the 10 GHz, 12 GHz, and 18 GHz fixed microwave bands for short and medium path lengths. In conclusion, this study supports the establishment of several emerging technologies bands by relocating the existing 2 GHz FS operations to alternative media or to spectrum above 3 GHz.

5.0 Alternative Media

While relocating current 2 GHz operations to higher frequency bands is one possible solution, the use of alternative media, such as fiber optics and satellites, may offer a more attractive means of maintaining some of the important services that 2 GHz facilities now provide. The use of alternative media such as fiber optics and satellites, may provide significant cost, reliability and capacity benefits over fixed microwave operations. These alternative media are examined as a substitute for existing 1.85-2.20 GHz operations.

5.1 Fiber Optics. All major FS groups in the 1.85-2.20 GHz band employ fiber optics to some degree. The current trend is toward more extensive use of fiber and fiber is gaining ground over the use of point-to-point microwave facilities in many applications. Many common carrier service providers are engaged in large-scale replacement of existing microwave routes with fiber optics.[35]

In tutorials and briefings before the FCC, representatives of FS groups describe the advantages of fiber for many applications.[36] Fiber optics permits the rapid transport of large amounts of data from one location to another. Fiber data transmission rates range from 1.544 Mbps to 1610.496 Mbps and can support from as little as 24 to as much as 2500 voice grade circuits. Once installed, fiber optic links are very rugged, almost maintenance free. Fiber links have excellent reliability and are not affected by weather.[37] All of the services that are now provided over fixed microwave operations can be provided through fiber links. This includes, for example, real time control of electric utility, pipeline systems and other systems that require high speed interactive communications.[38]

Over 5.5 million miles of fiber had been deployed by the end of 1990, and deployment has been increasing by 30% annually. The cost of installing fiber is decreasing with the development of improved tools and technical expertise.[39] Based on a cost of $40,000 per mile, fiber could

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[35] For example, a number of long distance carriers, including AT&T, GTE Sprint and MCI employ extensive fiber networks.

[36] "The Role of Public Utility Fiber Optic Systems in the Telecommunications Network", an FCC tutorial presented by a panel of industry members representing: South Carolina Electric and Gas, Ohio Edison, and Wisconsin Public Service, April 3, 1990; The results of an informal survey conducted for this study show that all major FS groups in the 18.5-2.20 GHz band have employed fiber optics.

[37] Several electric utilities indicate that fiber has proven very reliable and durable. They further state that fiber is compatible with electric power distribution systems because of its immunity to electromagnetic, radio-frequency, and lighting interference. The fiber is often installed as part of the overhead static-line (ground wire) which is exposed to the elements and lighting strikes. Representatives from Georgia Power, for example, report that their fiber system has survived three rather severe lighting seasons, including direct strikes on the static wire, with no outages.

[38] " The Role of Public Utility Optic Systems in the Telecommunications Network," an FCC tutorial presented by a panel of industry members.

[39] John Burgess, "Wire War: Putting America on Line." The Washington Post, October 22, 1989, at p. C3.

replace a 7 mile two way microwave facility for approximately the same total cost ($300,000)[40]. In addition, the excess capacity which is available with fiber can be sold or shared to offset installation costs. This could make the actual cost of fiber installation and use more reasonable. Some private FS operators that have installed fiber have formed cooperative companies to sell excess communications capacity to common carriers and other private users. We recognize, however, that for many existing operations, fixed microwave continues to offer a significant cost savings over the deployment of fiber for long distances, especially when right-of way problems exist or the fiber route is through rocky or rough terrain.

The fiber optic cable must be buried or strung on overhead poles. One of the major concerns and costs with fiber is the availability of rights-of-way. While this may be a problem for some business and public safety users, many fixed microwave users such as railroads, electric utilities, wireline telephone common carriers, and petroleum pipeline operators have right-of-way access through their existing operations. These users can replace many of their existing microwave facilities with fiber optic links at relatively low cost.

5.2 Satellite Technology. Satellite technology offers another alternative for fixed users that require communications between many locations or locations that are relatively far apart. Satellites offer a reliable substitute for long haul fixed microwave systems and are suitable for voice, data and video communications.[41] The recent development of low-cost, very small aperture terminal (VSAT) systems have made satellite operations a more competitive substitute for terrestrial communications facilities.[42] Satellite communications currently are being used as an alternative to fixed microwave in a number of applications. For example, satellite links are being used for communications between land and oil platforms in the Gulf of Mexico.

The installation cost of a satellite link can be relatively inexpensive for long distance communications links in comparison to fiber and multiple-hop fixed microwave systems[43]. However, the operation would also have to include the cost of transponder time. Other licensees such as banks and retailers are using satellite communications to link remote locations to corporate headquarters. These satellite facilities are used primarily for routine data and voice traffic.

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[40] Actual cost estimates per mile are as follows: static-line $15,000 to $40,000; overhead and pole $40,000; and underground or buried $32,000 and up depending on soil. (Virginia Power and Alcoa Fujihura)

[41] The echo and delays associated with satellite communications may make this alternative less desirable for some applications, such as real-time control. Low earth orbit satellites (LEOs), which may be introduced in the near future, offer the potential to provide space communications without echo and delay problems.

[42] Very Small Aperture Terminal (VSAT) satellite systems are well suited for wide area, data communications applications. These systems provide typical data rates of 56 to 224 kbps and can be designed to provide higher rates such as 1.54 Mbps, based on the user need. According to Hughes Network Systems, transponder cost for a VSAT would be about $50,000 a month for 10 MHz.

[43] Cost of two VSAT site installations range from $30,000 to $40,000. While the cost of each microwave link is about $150,000.

6.0 Economic Feasibility

In examining the economic feasibility of relocating the existing 2 GHz users, the study sought to develop estimates of the general level of the expenses that would be incurred in converting a typical 2 GHz microwave link to 4 or 6 GHz operation. These estimates were used to approximate the cost of converting 2 GHz existing fixed microwave facilities to higher band operation at some stage during their useful life. The estimates are intended to indicate only the scale of such expenses and, accordingly, do not attempt to determine the actual costs associated with specific conversions.

6.1 Methodology. Typical microwave communications systems provide service between two locations and, depending on the distance, may require intermediate sites to relay communications between the end locations. Although the overall system is often composed of several facilities, in a chain of sites, the basic type of equipment required at each facility is the same. The approach used in this analysis was to estimate the typical costs for converting a single 2 GHz facility to 4 or 6 GHz operation and then to multiply this figure by the number of such facilities to be converted to determine overall cost estimates.

The study first developed estimates of the value that would be lost due to premature replacement of 2 GHz equipment. To construct these estimates, the study staff obtained estimates of the cost of 2 GHz equipment replacement. These cost estimates reflect typical expenses that would be incurred by existing users at the end of an equipment life cycle. The next step was to determine the expected lifetime of the 2 GHz equipment and the average age of that equipment. The value of the 2 GHz equipment to be replaced was then reduced to reflect the portion of its useful life still remaining. This amount represents a cost to the licensee over-and-above the normal equipment replacement costs. The study next estimated the cost of converting an existing 2 GHz facility to operation on a frequency above 3 GHz. This cost was added to the value of the remaining 2 GHz equipment to arrive the net cost for converting a typical facility. This estimate was used to develop aggregate estimates of the economic impact of relocation on existing 2 GHz operations.

6.2 Cost of 2 GHz equipment to be replaced. To convert a 2 GHz facility to operation on a higher frequency, only the basic microwave communications equipment, i.e., the radio terminal equipment, which includes the transmitter or receiver, the antenna, and the necessary feed lines, would need to be replaced.[44] Other equipment used in 2 GHz operation, for example, towers, back up power equipment, alarm systems, and monitoring and control equipment could generally be retained.[45] The study found that the useful life of the "frequency

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[44] Our analysis is based on replacing existing 2 GHz facilities with facilities at the higher frequency bands that have similar communications capabilities. We recognize that many systems are upgraded at replacement. For example, increasing the system capacity or conversion to digital modulation may require all new microwave equipment. These upgrades generally will increase the cost of equipment and were not considered in the analysis.

[45] As discussed below, in some cases conversion may also require upgrade of the tower structure.

sensitive" equipment that would need to be replaced is typically 15 years.[46] These items are routinely replaced at the end of their useful life. Information obtained from licensees and manufacturers indicated that $125,000 to $150,000 is a reasonable estimate for the average cost of replacing these items for 2 GHz operation.[47]

Since there has not been any significant recent growth in the installation of private fixed microwave facilities, it is reasonable to assume that the age of this equipment generally is evenly distributed over the typical 15 year life cycle.[48] The study therefore assumed that the average age of this equipment is 7.5 years. On the other hand, the study found that there has been significant recent growth in new common carrier 2 GHz microwave facilities. Cellular licensees are using this band for intra system links within their systems. This recent growth skews the age distribution of the common carrier 2 GHz facilities, so that half of the equipment used in this service is under three years old. The study therefore estimated the average age of the common carrier facilities to be only 5 years old. Using these estimates of equipment age, the study estimated that if 2 GHz private and common carrier licensees were to convert immediately to higher band operation, the amount of the lost value of the 2 GHz equipment replaced would be $62,500 and $83,000 per facility, respectively. These estimates are based on the lower, $125,000 estimate of the cost of frequency sensitive 2 GHz equipment. Of course, if licensees were allowed to reach the end of the equipment life cycle before converting, there would be no losses associated with the existing 2 GHz equipment.

6.3 Cost of conversion to frequency bands above 3 GHz. As indicated above, conversion of a 2 GHz facility to a higher frequency would require replacement of the facility's frequency sensitive equipment. The cost of transmitters, receivers and replacement antennas of the same level of operation on frequencies above 3 GHz is similar to the cost of 2 GHz radio terminal equipment, e.g., $125,000 to $150,000. The new 4 or 6 GHz frequency to be used would also have to be coordinated with other frequencies used in the area. The cost of frequency coordination will vary across individual facilities depending on the complexity of the case. The cost of these studies ranges from $300 to $3,500.[49]

In some situations, for example congested areas, a new microwave facility may need to use a larger antenna or a high performance antenna to meet interference criteria or to address other factors. Further, in some cases it may be necessary to upgrade the antennas of existing

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[46] The study did find a few instances where the frequency sensitive equipment of fixed private microwave facilities was as much as 20 years old. Information concerning equipment costs was provided by Nebraska Public Power District, Harris Farinon, Andrew Corporation and Telelocator, Inc.

[47] This estimate was based on information obtained in informal contacts with representatives of the Utilities Telecommunication Council, Associations of American Railroads, Telocator, Inc. and other microwave users and suppliers.

[48] This assessment is based on discussions with private fixed microwave users.

[49] This information was provided by Rockwell International and Comsearch. These are firms that perform frequency coordination studies for the industry.

microwave systems in or near the path of the new facility.[50] These costs associated with upgrading the antennas of existing facilities in a band generally are the responsibility of the licensee of the new facility. High performance antennas are more expensive than standard microwave antennas. The price range of a 3 meter high performance antenna for operation in the 4 to 6 GHz band can range from about $3,000 to more than $30,000, depending on size and performance characteristics.[51] By comparison, a standard 1 to 2 meter 2 GHz antenna can cost as little as $900 to $2000, depending on size and performance. The majority of the existing high performance antennas currently used in the 4 to 6 GHz band are the more expensive types, so that $15,000 appears to be a reasonable estimate for the price differential in cases where a high performance antenna is needed. High performance antennas are generally heavier than most 2 GHz antennas and may require new support structures or reinforcement of existing structures to support the increased loading. The cost of such structural improvements could be expected to range from $1000 to $20,000, depending on the extent of changes needed.[52] The study estimated that the average costs per facility of frequency coordination, antenna upgrades, improvements to antenna structures and other relocation costs would be approximately $25,000.

6.4 Total Impact of Relocating 2 GHz facilities. From Table 1, above, there are approximately 23,000 private and 7,000 common carrier fixed microwave facilities currently operating at 2 GHz. If the Commission were to allow these facilities to operate at 2 GHz until the end of the equipment life cycle, the cost of converting the average facility to operation above 3 GHz would be the $25,000 for frequency coordination and related antenna expenses. If all 30,000 facilities were allowed to convert in this manner, the total cost would be $750 million. If the Commission were to require immediate relocation, each private and common carrier facility so converted would incur an additional $62,500 or $83,000 expense for the lost value of the existing 2 GHz equipment. If all 23,000 private and 7,000 common carrier 2 GHz operations converted immediately, the total cost would be approximately $2.75 billion.

6.5 Other considerations. The study shows that for purposes of providing spectrum for emerging technologies, it is feasible to relocate 2 GHz licensees to higher portions of the spectrum. The study did not investigate, however, the extent to which there may be unused channels in the 2 GHz band. Several parties have argued that there is a considerable amount

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[50] It is not clear how many of the converted facilities and existing facilities in or near their paths would require high performance antennas.

[51] See, for example, 1991 Andrew Antenna Catalog.

[52] The cost of mounting heavier antennas would vary from site to site, depending on the weight of the new antenna and the ability of the existing supporting structure to accommodate the increased weight. The most common towers in the 2 GHz band are free standing structures that are less than 200 feet in height. The standard method for reinforcing such towers is merely to replace the cross braces. Information obtained from site managers in New Orleans, San Francisco and Los Angeles indicates that the cost of replacing cross braces can range from $5000 to $20,000. If the tower can not be strengthened it would require replacement. Other 2 GHz antennas currently may be mounted on more simple structures such as a freestanding pole. To mount a heavier antenna in these cases it may be necessary to replace the freestanding pole with a stronger structure such as a three-legged stand.

of unused 2 GHz spectrum in most major markets and not all 2 GHz facilities would be required to relocate to permit the operation of some emerging technologies, such as personal communications.[53] While the study did not attempted to measure available spectrum in the major markets, it is plain that there is much less use of the spectrum in areas outside of the major markets. The study shows that approximately half of all the 2 GHz microwave links are licensed in areas outside the top 50 MSAs. At least in these areas, it is unlikely that any significant amount of relocation need occur. Thus, even if it were decided to require immediate relocation of those 2 GHz facilities that would have to relocate eventually, the estimated cost would be reduced to approximately $ 1 billion, and, if the Commission were to permit relocation to occur at the end of the equipment life cycle, then the costs could be reduced further to approximately several hundred million dollars.

There are various factors that can affect these estimates. If, for some service, the Commission were to find it desirable to reserve some number of specific channels for nationwide use, then some licensees in smaller markets could be affected. This situation would tend to increase the estimate of relocation costs. On the other hand, movement by fixed microwave users to other communications media, such as optical fiber, would have the effect of decreasing the estimate.

The study also recognized that relocation costs could prove especially burdensome to local government licensees using the 2 GHz band. It may be desirable for the Commission to adopt a policy which would not require these users to relocate, but rather allow them to move at their option. The estimated total costs of relocation costs would decrease significantly if the local government licensees were not required to convert to operation above 3 GHz. In particular, the total costs of relocation if existing 2 GHz licensees either were allowed to convert at the end of an equipment life cycle or required to convert immediately would fall to $600 million and $2.15 billion respectively.

[53] "Report on Spectrum Sharing in the 1850-1990 MHz Band Between Personal Communications Services and Private Operational Fixed Microwave Service"; American Personal Communications, Inc; July 1991.

7.0 Conclusions

7.1 Findings. The study finds that it is feasible to make spectrum available for emerging telecommunications technologies. The study concludes that the most appropriate choice for the emerging technologies band is between 1.85 to 2.20 GHz. The analyses conducted indicate that 220 MHz of this 350 MHz band could be made available for the emerging technologies bands. This 220 MHz is presently used for common carrier and private fixed microwave operations. The study finds that these existing operations generally could be relocated to higher frequency bands, in particular, the 3.7 to 4.2 GHz, 5.925 to 6.425 GHz and 6.525 to 6.875 GHz bands. These relocation bands can support the operational requirements of the existing 2 GHz fixed users and have sufficient capacity to accommodate those operations without displacing the present occupants of the 4 and 6 GHz bands. The economic impact associated with the relocation of the existing 2 GHz facilities was examined and found not to be a barrier to establishing the emerging technologies bands.

In addition, the study concludes that other media, such as fiber optics and satellite technology, offer attractive alternatives to relocation of the 2 GHz facilities to higher frequency bands. Fiber optics, in particular, is a highly suitable option for many fixed microwave operations. It offers improved reliability and capacity over terrestrial microwave links.

The study also concludes that it may not be desirable to consider relocating the 2 GHz broadcast auxiliary services and multipoint distribution systems at this time. There does not appear to be capacity available in other bands to support the current operations in these services. However, the introduction of new technologies, such as new digital compression techniques, may make such capacity available in the near future and further study is necessary in this area.

APPENDIX A

This appendix lists the results obtained from the nationwide one degree zone analysis. The benchmark densities per zone for this analysis are 400 transmitters for the 3.7-4.2 GHz band, 400 transmitters for the 5.9-6.4 GHz band and 250 transmitters for the 6.5-6.8 GHz band. Data is listed for the 1027 one degree zones used to cover the Continental United States. Columns one and two (LAT, LON) list the latitude and longitude of the northwest corner of each zone. Columns three, four and five (3.7 GHz, 5.9 GHz and 6.5 GHz) list the number of transmitters that are located in the zone for each band. Columns six, seven and eight (CAP3, CAP5 and CAP6) list the expected excess capacities calculated for each band by subtracting the number of transmitters in each zone from the benchmarks for each band. A zero in one these columns indicates that the number of transmitters in the zone is greater than the benchmark for that band and no additional capacity was available in that band. The sum of the capacities for the three bands is listed in column nine (TOTCAP). Column ten (2 GHz) lists the number of 2 GHz transmitters in a zone that would require relocation. The total number of 2 GHz transmitters in each zone are subtracted from the total capacity in the zone and the remaining capacity is listed in the last column (REMCAP).

LAT	LON	3.7 GHz	5.9 GHz	6.5 GHz	CAP3	CAP5	CAP6	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
50	96	0	0	0	400	400	250	1050	0	1050
50	95	0	0	0	400	400	250	1050	0	1050
50	94	0	0	0	400	400	250	1050	0	1050
49	125	0	9	1	400	391	249	1040	8	1032
49	124	13	7	0	387	393	250	1030	6	1024
49	123	31	80	11	369	320	239	928	78	850
49	122	0	0	10	400	400	240	1040	13	1027
49	121	0	0	0	400	400	250	1050	0	1050
49	120	0	4	4	400	396	246	1042	12	1030
49	119	0	3	1	400	397	249	1046	5	1041
49	118	0	0	1	400	400	249	1049	20	1029
49	117	0	4	19	400	396	231	1027	22	1005
49	116	0	12	10	400	388	240	1028	1	1027
49	115	0	28	6	400	372	244	1016	12	1004
49	114	0	23	0	400	377	250	1027	9	1018
49	113	12	19	0	388	381	250	1019	19	1000
49	112	8	14	0	392	386	250	1028	23	1005
49	111	0	0	2	400	400	248	1048	12	1036
49	110	4	10	8	396	390	242	1028	6	1022
49	109	0	12	4	400	388	246	1034	2	1032
49	108	0	10	4	400	390	246	1036	5	1031
49	107	0	9	4	400	391	246	1037	8	1029
49	106	0	2	4	400	398	246	1044	4	1040
49	105	0	8	2	400	392	248	1040	10	1030
49	104	9	17	6	391	383	244	1018	5	1013
49	103	0	10	8	400	390	244	1034	6	1028
49	102	0	34	6	400	366	244	1010	25	985
49	101	0	10	4	400	390	246	1036	4	1032
49	100	0	1	5	400	399	245	1044	5	1039
49	99	0	11	4	400	389	246	1035	10	1025
49	98	22	12	5	378	388	245	1011	3	1008
49	97	0	9	4	400	391	246	1037	9	1028
49	96	0	12	3	400	388	247	1035	6	1029
49	95	0	8	0	400	392	250	1042	7	1035
49	94	2	8	1	398	392	249	1039	15	1024
49	93	10	9	0	390	391	250	1031	0	1031
49	92	5	0	0	395	400	250	1045	0	1045
49	91	10	0	0	390	400	250	1040	0	1040
49	90	33	2	0	367	398	250	1015	0	1015
49	89	17	4	0	383	396	250	1029	0	1029
49	88	3	0	0	397	400	250	1047	0	1047
49	87	0	0	0	400	400	250	1050	0	1050
49	86	11	0	0	389	400	250	1039	0	1039
49	85	6	0	0	394	400	250	1044	0	1044
48	125	0	3	1	400	397	249	1046	10	1036
48	124	18	14	4	382	386	246	1014	16	998
48	123	128	131	88	272	269	162	703	151	552
48	122	109	89	43	291	311	207	809	38	771
48	121	26	81	29	374	319	221	914	62	852
48	120	26	23	11	374	377	239	990	28	962
48	119	26	25	6	374	375	244	993	11	982
48	118	104	106	40	296	294	210	800	57	743
48	117	22	45	8	378	355	244	977	27	950
48	116	22	3	6	378	397	244	1019	0	1019
48	115	21	28	15	379	372	235	986	7	979
48	114	0	18	8	400	382	242	1024	9	1015
48	113	6	5	4	394	395	246	1035	4	1031
48	112	52	52	8	348	348	242	938	5	933
48	111	0	2	2	400	398	248	1046	6	1040
48	110	0	4	2	400	396	248	1044	2	1042
48	109	0	6	0	400	394	250	1044	1	1043
48	108	0	0	0	400	400	250	1050	0	1050
48	107	0	3	0	400	397	250	1047	4	1043
48	106	0	4	0	400	396	250	1046	5	1041
48	105	21	43	4	379	357	246	982	13	969

LAT	LON	3.7 GHz	5.9 GHz	6.5 GHz	CAP3	CAP5	CAP6	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
48	104	6	2	0	394	398	250	1042	6	1036
48	103	12	6	0	388	392	250	1030	10	1020
48	102	8	8	11	392	392	239	1023	19	1004
48	101	6	5	1	394	395	249	1038	6	1032
48	100	26	16	4	374	384	246	1004	6	998
48	99	0	0	2	400	400	248	1048	4	1044
48	98	39	21	16	361	379	234	974	5	969
48	97	0	6	6	400	394	244	1038	4	1034
48	96	0	2	0	400	398	250	1048	6	1042
48	95	0	18	0	400	382	250	1032	4	1028
48	94	0	28	0	400	372	250	1022	15	1007
48	93	0	34	3	400	366	247	1013	38	975
48	92	6	24	1	392	376	249	1017	14	1003
48	91	8	8	0	392	392	250	1034	4	1030
48	90	0	0	0	400	400	250	1050	0	1050
48	89	0	11	1	400	389	249	1038	0	1038
48	88	0	0	0	400	400	250	1050	0	1050
48	87	0	0	0	400	400	250	1050	0	1050
48	86	0	0	0	400	400	250	1050	0	1050
48	85	3	0	0	397	400	250	1047	0	1047
48	71	0	0	0	400	400	250	1050	0	1050
48	70	0	0	0	400	400	250	1050	0	1050
48	69	0	0	0	400	400	250	1050	3	1047
48	68	0	2	0	400	398	250	1048	0	1048
47	125	0	0	0	400	400	250	1050	3	1047
47	124	57	64	14	343	316	236	895	70	825
47	123	97	61	33	303	339	217	859	38	821
47	122	22	2	0	378	398	250	1026	9	1017
47	121	120	104	19	280	296	231	807	41	766
47	120	23	109	60	377	291	190	858	53	805
47	119	24	53	18	376	347	232	955	19	936
47	118	0	34	14	400	366	236	1002	33	969
47	117	0	10	3	400	390	247	1037	19	1018
47	116	0	6	0	400	394	250	1044	0	1044
47	115	0	10	2	400	390	248	1038	6	1032
47	114	43	34	6	357	366	244	967	4	963
47	113	93	62	16	307	338	234	879	31	848
47	112	96	33	5	304	367	245	916	7	909
47	111	0	0	0	400	400	250	1050	4	1046
47	110	0	6	0	400	394	250	1044	11	1033
47	109	0	9	0	400	391	250	1041	16	1025
47	108	44	8	4	356	392	246	994	6	988
47	107	44	13	4	356	387	246	989	3	986
47	106	44	14	4	356	386	246	988	7	981
47	105	0	0	0	400	400	250	1050	0	1050
47	104	48	0	4	352	400	246	998	0	998
47	103	91	23	6	309	377	244	930	3	927
47	102	24	14	6	376	386	244	1006	10	996
47	101	53	31	6	347	369	244	960	24	936
47	100	26	16	4	374	384	246	1004	8	996
47	99	28	17	4	374	383	246	1003	2	1001
47	98	127	70	7	273	330	243	846	7	839
47	97	59	22	14	341	378	236	955	13	942
47	96	53	6	2	347	394	248	989	17	972
47	95	47	16	8	353	384	242	979	24	955
47	94	0	13	0	400	387	250	1037	11	1026
47	93	56	37	6	344	363	245	952	32	920
47	92	0	11	3	400	389	247	1036	4	1032
47	91	0	8	1	400	392	249	1041	19	1022
47	90	0	12	0	400	388	250	1038	3	1035
47	89	0	17	9	400	383	241	1024	6	1018
47	88	9	22	16	391	378	234	1003	4	999
47	87	0	13	0	400	387	250	1037	0	1037
47	86	44	3	16	356	397	232	985	4	981
47	85	10	8	37	390	392	213	995	0	995

LAT	LON	3.7 GHz	5.9 GHz	8.5 GHz	CAP3	CAP5	CAP6	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
47	84	21	0	0	379	400	250	1029	0	1029
47	83	18	0	0	382	400	250	1032	0	1032
47	82	23	0	0	377	400	250	1027	0	1027
47	81	13	0	0	387	400	250	1037	0	1037
47	71	0	0	0	400	400	250	1050	0	1050
47	70	0	0	0	400	400	250	1050	0	1050
47	69	0	18	1	400	382	249	1031	5	1026
47	68	0	8	1	400	392	249	1041	0	1041
46	125	0	0	0	400	400	250	1050	0	1050
46	124	56	78	5	344	322	245	911	24	887
46	123	203	125	82	197	275	168	640	105	535
46	122	137	73	13	263	327	237	827	24	803
46	121	99	48	22	301	352	228	881	30	851
46	120	11	17	13	389	383	237	1009	8	1001
46	119	9	43	19	391	357	231	979	12	967
46	118	0	34	0	400	366	250	1016	6	1010
46	117	0	6	0	400	394	250	1044	12	1032
46	116	0	0	0	400	400	250	1050	3	1047
46	115	0	6	0	400	394	250	1044	9	1035
46	114	0	5	0	400	395	250	1045	6	1039
46	113	30	55	2	370	345	248	963	11	952
46	112	26	12	3	374	388	247	1009	5	1004
46	111	24	34	9	376	366	241	983	2	981
46	110	48	80	7	352	320	243	915	4	911
46	109	55	42	9	345	358	241	944	14	930
46	108	48	4	0	352	396	250	998	22	976
46	107	0	7	0	400	393	250	1043	7	1036
46	106	0	7	0	400	393	250	1043	8	1035
46	105	0	0	0	400	400	250	1050	0	1050
46	104	32	4	0	368	396	250	1014	3	1011
46	103	0	0	0	400	400	250	1050	1	1049
46	102	0	6	1	400	394	249	1043	0	1043
46	101	0	8	2	400	392	248	1040	4	1036
46	100	12	6	3	388	394	247	1029	8	1021
46	99	2	4	2	398	396	248	1042	12	1030
46	98	68	48	4	332	352	246	930	19	911
46	97	0	0	0	400	400	250	1050	10	1040
46	96	11	17	11	389	383	239	1011	15	996
46	95	98	36	10	304	364	240	908	39	869
46	94	107	38	20	293	362	230	885	38	847
46	93	109	35	5	291	365	245	901	30	871
46	92	49	37	5	351	363	245	959	11	948
46	91	48	22	7	352	378	243	973	9	964
46	90	10	23	13	390	377	237	1004	2	1002
46	89	33	16	10	367	384	240	991	5	986
46	88	46	10	13	354	390	237	981	6	975
46	87	22	0	0	378	400	250	1028	4	1024
46	86	60	0	0	340	400	250	990	3	987
46	85	44	34	11	356	366	239	961	13	948
46	84	4	9	1	396	391	249	1036	3	1033
46	83	0	0	0	400	400	250	1050	0	1050
46	82	0	0	0	400	400	250	1050	0	1050
46	81	16	0	0	384	400	250	1034	0	1034
46	80	8	0	0	392	400	250	1042	0	1042
46	76	0	0	0	400	400	250	1050	0	1050
46	75	4	0	1	396	400	249	1045	1	1044
46	74	3	10	0	397	390	250	1037	0	1037
46	73	0	0	0	400	400	250	1050	0	1050
46	72	0	0	0	400	400	250	1050	0	1050
46	71	0	8	0	400	392	250	1042	4	1038
46	70	0	2	0	400	398	250	1048	2	1046
46	69	0	13	6	400	387	244	1031	9	1022
46	68	0	6	0	400	394	250	1044	0	1044
46	67	5	0	0	395	400	250	1045	0	1045
45	125	0	10	0	400	390	250	1040	16	1024

LAT	LON	3.7 GHz	5.9 GHz	8.5 GHz	CAP3	CAP5	CAP6	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
45	124	24	39	33	376	361	217	954	53	901
45	123	71	78	7	329	322	243	894	19	875
45	122	49	36	3	351	362	247	960	20	940
45	121	64	20	7	336	380	243	959	12	947
45	120	45	3	2	355	397	248	1000	10	990
45	119	24	6	6	376	394	244	1014	1	1013
45	118	29	22	16	371	378	234	983	1	982
45	117	0	15	11	400	385	239	1024	29	995
45	116	0	0	0	400	400	250	1050	13	1037
45	115	0	0	0	400	400	250	1050	14	1036
45	114	20	7	0	380	393	250	1023	9	1014
45	113	10	28	0	390	372	250	1012	5	1007
45	112	0	6	0	400	394	250	1044	0	1044
45	111	0	0	0	400	400	250	1050	11	1039
45	110	0	19	1	400	381	249	1030	7	1023
45	109	0	34	2	400	366	248	1014	12	1002
45	108	0	31	2	400	369	248	1017	17	1000
45	107	48	10	1	352	390	249	991	27	964
45	106	0	3	0	400	397	250	1047	23	1024
45	105	0	10	0	400	390	250	1040	8	1032
45	104	32	28	5	368	372	245	965	5	960
45	103	35	11	0	365	389	250	1004	0	1004
45	102	0	4	3	400	396	247	1043	0	1043
45	101	6	9	5	394	391	245	1030	6	1024
45	100	0	22	2	400	378	248	1026	10	1016
45	99	0	5	2	400	395	248	1043	16	1027
45	98	47	33	6	353	367	244	964	21	943
45	97	0	1	2	400	399	248	1047	21	1026
45	96	12	34	1	388	366	249	1003	21	982
45	95	0	28	4	400	372	246	1018	19	999
45	94	127	141	15	273	259	235	767	55	712
45	93	74	126	20	326	272	230	828	43	785
45	92	7	60	23	393	340	227	960	11	949
45	91	0	15	12	400	385	238	1023	8	1015
45	90	132	59	11	268	341	239	848	15	833
45	89	65	67	15	335	313	235	883	41	842
45	88	0	14	6	400	386	242	1028	21	1007
45	87	0	4	0	400	396	250	1046	0	1046
45	86	45	12	0	355	388	250	993	12	981
45	85	21	36	0	379	364	250	993	11	982
45	84	0	10	0	400	390	250	1040	0	1040
45	83	0	0	0	400	400	250	1050	0	1050
45	82	0	0	0	400	400	250	1050	0	1050
45	81	15	1	0	385	399	250	1034	0	1034
45	80	51	10	0	349	390	250	989	0	989
45	79	0	0	0	400	400	250	1050	0	1050
45	78	0	0	0	400	400	250	1050	0	1050
45	77	0	0	0	400	400	250	1050	0	1050
45	76	8	34	2	392	366	248	1006	0	1006
45	75	16	6	4	384	394	246	1024	10	1014
45	74	31	61	8	369	339	242	950	18	932
45	73	40	31	29	360	369	221	950	7	943
45	72	0	31	13	400	369	237	1006	9	997
45	71	0	31	11	400	369	239	1008	17	991
45	70	10	47	24	390	353	226	969	14	955
45	69	19	18	3	381	382	247	1010	18	994
45	68	6	0	0	394	400	250	1044	0	1044
45	67	0	0	0	400	400	250	1050	0	1050
44	125	0	44	1	400	356	249	1005	19	986
44	124	51	62	15	349	338	235	922	34	888
44	123	0	18	2	400	382	248	1030	4	1026
44	122	68	42	10	334	358	240	932	12	920
44	121	20	32	5	380	368	245	993	9	984
44	120	0	4	4	400	396	246	1042	7	1035
44	119	0	10	2	400	390	248	1038	6	1032

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
44	118	0	0	0	400	400	250	1050	1	1049
44	117	72	48	10	328	352	240	920	37	883
44	116	24	42	4	376	358	246	980	14	966
44	115	0	5	0	400	395	250	1045	16	1029
44	114	0	3	0	400	397	250	1047	0	1047
44	113	20	61	9	380	339	241	960	22	938
44	112	0	4	1	400	396	249	1045	26	1019
44	111	0	15	0	400	385	250	1035	1	1034
44	110	0	3	0	400	397	250	1047	0	1047
44	109	0	43	4	400	357	246	1003	16	987
44	108	1	67	7	399	333	243	975	10	965
44	107	72	12	2	328	388	248	964	2	962
44	106	0	6	2	400	394	248	1042	23	1019
44	105	0	7	0	400	393	250	1043	2	1041
44	104	36	13	1	364	387	249	1000	3	997
44	103	0	4	0	400	396	250	1046	1	1045
44	102	0	8	0	400	392	250	1042	0	1042
44	101	0	16	3	400	384	247	1031	0	1031
44	100	0	28	0	400	372	250	1022	0	1022
44	99	0	8	1	400	392	249	1041	22	1019
44	98	32	27	4	368	373	246	987	15	972
44	97	51	114	7	349	286	243	878	8	870
44	96	0	66	6	400	334	244	978	10	968
44	95	0	67	0	400	333	250	983	24	959
44	94	61	27	9	339	373	241	953	23	930
44	93	0	7	0	400	393	250	1043	13	1030
44	92	22	23	14	378	377	236	991	37	954
44	91	44	100	6	356	300	244	900	14	886
44	90	84	96	11	316	304	239	859	36	823
44	89	104	80	34	296	320	216	832	66	766
44	88	21	27	9	379	373	241	983	36	957
44	87	0	1	0	400	399	250	1049	0	1049
44	86	74	10	2	326	390	248	964	10	954
44	85	26	11	0	374	389	250	1013	5	1008
44	84	53	96	6	347	304	244	895	11	884
44	83	0	0	1	400	400	249	1049	0	1049
44	82	30	0	0	370	400	250	1020	0	1020
44	81	24	0	0	376	400	250	1026	0	1026
44	80	15	8	0	385	392	250	1027	13	1014
44	79	26	4	0	374	396	250	1020	9	1011
44	78	30	27	3	370	373	247	990	31	959
44	77	91	81	22	309	319	228	856	33	823
44	76	102	72	15	298	328	235	861	39	822
44	75	8	20	0	392	380	250	1022	13	1009
44	74	0	63	4	400	337	246	983	26	957
44	73	84	53	24	316	347	226	889	10	879
44	72	12	45	17	388	355	233	976	24	952
44	71	37	75	23	363	325	227	915	47	868
44	70	12	4	5	388	396	245	1029	3	1026
44	69	0	0	0	400	400	250	1050	1	1049
43	125	0	24	2	400	376	248	1024	11	1013
43	124	26	13	5	374	387	245	1006	28	978
43	123	71	60	13	329	340	237	906	28	878
43	122	114	83	25	286	317	225	828	32	796
43	121	20	35	2	380	365	248	993	7	986
43	120	0	0	1	400	400	249	1049	0	1049
43	119	0	8	0	400	392	250	1042	0	1042
43	118	0	0	0	400	400	250	1050	1	1049
43	117	0	0	0	400	400	250	1050	6	1044
43	116	24	17	2	376	383	248	1007	2	1005
43	115	23	35	19	377	365	231	973	22	951
43	114	66	89	9	334	311	241	886	11	875
43	113	87	86	27	313	314	223	850	33	817
43	112	0	30	9	400	370	241	1011	22	989
43	111	0	34	5	400	366	245	1011	28	983

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
43	110	0	16	2	400	384	248	1032	2	1030
43	109	0	8	2	400	392	248	1040	6	1034
43	108	1	32	3	399	368	247	1014	8	1006
43	107	49	57	10	351	343	240	934	30	904
43	106	72	62	20	328	338	230	896	37	859
43	105	0	21	23	400	379	227	1006	41	965
43	104	40	8	7	360	392	243	995	7	988
43	103	32	3	6	368	397	244	1009	14	995
43	102	0	0	0	400	400	250	1050	2	1048
43	101	0	6	0	400	394	250	1044	4	1040
43	100	0	6	0	400	394	250	1044	0	1044
43	99	0	14	0	400	386	250	1036	0	1036
43	98	0	16	0	400	384	250	1034	7	1027
43	97	25	101	4	375	299	246	920	35	885
43	96	47	26	8	353	374	242	969	18	951
43	95	0	16	50	400	384	200	984	28	956
43	94	65	42	18	335	358	232	925	20	905
43	93	56	8	17	344	392	233	969	13	956
43	92	24	30	18	376	370	232	978	23	955
43	91	2	35	9	398	365	241	1004	29	975
43	90	48	65	12	352	315	238	905	9	896
43	89	172	192	45	228	208	205	641	50	591
43	88	26	8	22	374	392	228	994	55	939
43	87	0	0	1	400	400	249	1049	6	1043
43	86	160	96	5	240	302	245	787	31	756
43	85	126	84	8	274	316	242	832	22	810
43	84	254	219	73	146	181	177	504	68	436
43	83	36	14	7	364	386	243	993	17	976
43	82	30	0	0	370	400	250	1020	0	1020
43	81	2	3	3	398	397	247	1042	5	1037
43	80	50	61	8	350	339	242	931	17	914
43	79	219	224	8	181	176	242	599	59	540
43	78	115	167	14	285	233	236	754	47	707
43	77	157	259	11	243	141	239	623	63	560
43	76	182	208	0	218	192	250	660	49	611
43	75	105	193	8	295	207	242	744	71	673
43	74	156	200	20	244	200	230	674	91	583
43	73	35	94	51	365	306	199	870	31	839
43	72	169	273	75	211	127	175	513	108	405
43	71	0	7	7	400	393	243	1036	20	1016
43	70	0	0	0	400	400	250	1050	0	1050
42	125	0	20	1	400	380	249	1029	0	1029
42	124	0	37	3	400	363	247	1010	0	1010
42	123	46	67	14	354	333	236	923	25	898
42	122	70	46	7	330	354	243	927	25	902
42	121	0	4	3	400	396	247	1043	6	1037
42	120	0	0	5	400	400	245	1045	0	1045
42	119	0	0	0	400	400	250	1050	3	1047
42	118	0	14	3	400	386	247	1033	17	1016
42	117	0	0	0	400	400	250	1050	5	1045
42	116	22	36	2	378	364	248	990	4	986
42	115	22	104	2	378	296	248	922	26	896
42	114	0	72	0	400	328	250	978	2	976
42	113	52	156	36	348	244	214	806	21	785
42	112	26	85	24	374	315	226	915	29	886
42	111	51	108	53	349	292	197	838	76	762
42	110	52	131	39	348	269	221	838	45	793
42	109	26	51	7	374	349	243	966	13	953
42	108	57	75	8	343	325	242	910	35	875
42	107	52	89	8	348	311	242	901	14	887
42	106	26	113	10	374	287	240	901	20	881
42	105	89	71	24	311	329	226	866	30	836
42	104	38	42	35	362	358	215	935	57	878
42	103	56	61	19	344	339	231	914	29	885
42	102	61	25	10	339	375	240	954	31	923

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
42	101	23	12	6	377	388	244	1009	15	994
42	100	0	0	0	400	400	250	1050	9	1041
42	99	23	16	0	377	384	250	1011	1	1010
42	98	46	33	6	354	367	244	965	14	951
42	97	105	122	9	295	278	241	814	45	769
42	96	256	157	40	144	243	210	597	57	540
42	95	53	74	20	347	326	230	903	19	884
42	94	106	99	34	294	301	216	811	28	783
42	93	72	77	18	328	323	232	883	17	866
42	92	112	79	53	288	321	197	808	30	778
42	91	147	147	39	253	253	211	717	47	670
42	90	142	145	45	258	255	205	718	17	701
42	89	366	212	94	34	188	156	376	55	323
42	88	343	365	102	57	35	148	240	181	59
42	87	191	143	44	209	257	206	672	40	632
42	86	125	125	34	275	275	216	766	34	732
42	85	247	155	28	153	245	222	620	19	601
42	84	183	280	73	217	140	177	534	88	486
42	83	106	83	34	294	317	216	827	20	807
42	82	110	245	98	290	155	152	597	96	501
42	81	85	140	26	315	260	224	799	36	763
42	80	16	73	14	382	327	236	945	16	929
42	79	36	52	6	364	348	244	956	13	943
42	78	14	37	16	386	363	234	983	80	903
42	77	48	95	0	352	305	250	907	46	861
42	76	98	218	1	302	182	249	733	80	653
42	75	311	328	11	89	72	239	400	45	355
42	74	221	233	18	179	167	232	578	41	537
42	73	157	98	43	243	302	207	752	45	707
42	72	27	84	11	373	316	239	928	89	839
42	71	0	51	5	400	349	245	994	22	972
42	70	0	0	0	400	400	250	1050	0	1050
41	125	18	2	7	382	398	243	1023	13	1010
41	124	12	30	8	388	370	242	1000	16	984
41	123	113	75	35	287	325	215	827	45	782
41	122	65	81	19	335	319	231	885	44	841
41	121	0	24	12	400	376	238	1014	11	1003
41	120	0	0	2	400	400	248	1048	4	1044
41	119	22	77	2	378	323	248	949	15	934
41	118	44	55	1	356	345	249	950	15	935
41	117	44	61	3	356	339	247	942	43	899
41	116	22	49	6	378	351	244	973	26	947
41	115	22	3	2	378	397	248	1023	10	1013
41	114	22	2	2	378	398	248	1024	3	1021
41	113	61	79	22	339	321	228	888	66	822
41	112	194	169	78	206	231	172	609	109	500
41	111	0	12	2	400	388	248	1036	28	1008
41	110	0	10	15	400	390	235	1025	51	974
41	109	0	1	2	400	399	248	1047	9	1038
41	108	0	21	3	400	379	247	1026	33	993
41	107	48	52	8	354	348	242	944	33	911
41	106	63	32	20	337	368	230	935	57	878
41	105	132	97	27	268	303	223	794	60	734
41	104	76	103	29	324	297	221	842	43	799
41	103	72	26	14	328	374	236	938	20	918
41	102	3	17	4	397	383	246	1026	2	1024
41	101	23	47	4	377	353	246	976	28	948
41	100	35	52	14	365	348	236	949	31	918
41	99	39	74	10	361	326	240	927	31	896
41	98	39	53	0	361	347	250	958	20	938
41	97	26	84	21	374	336	229	939	47	892
41	96	142	140	7	258	260	243	761	39	722
41	95	70	64	19	330	336	231	897	10	887
41	94	52	52	16	348	348	234	930	15	915
41	93	26	30	8	374	370	244	988	52	936

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
41	92	2	9	19	398	391	231	1020	22	998
41	91	0	28	32	400	372	218	990	22	968
41	90	201	146	29	199	254	221	674	10	664
41	89	129	148	44	271	252	206	729	11	718
41	88	86	96	15	314	304	235	853	18	835
41	87	196	207	25	204	193	225	622	36	586
41	86	46	88	22	354	312	228	894	15	879
41	85	113	28	16	287	372	234	893	6	887
41	84	37	105	38	363	295	212	870	5	865
41	83	88	205	40	334	195	210	739	7	732
41	82	125	232	42	275	168	208	651	26	625
41	81	242	244	95	158	156	155	469	61	408
41	80	318	361	79	82	39	171	292	124	168
41	79	110	240	35	290	160	215	665	73	592
41	78	110	202	28	290	198	222	710	50	660
41	77	172	371	28	228	29	222	479	134	345
41	76	357	613	73	43	0	177	220	140	80
41	75	411	432	150	0	0	100	100	77	23
41	74	95	161	69	305	239	181	725	97	628
41	73	20	0	2	380	400	248	1028	29	999
41	72	0	0	0	400	400	250	1050	0	1050
41	71	0	0	0	400	400	250	1050	0	1050
40	125	0	0	0	400	400	250	1050	0	1050
40	124	24	8	7	376	392	243	1011	25	986
40	123	62	79	5	338	321	245	904	15	889
40	122	193	78	45	207	322	206	734	65	669
40	121	24	64	26	376	316	224	916	47	869
40	120	47	127	36	353	273	214	840	66	774
40	119	22	14	0	378	386	250	1014	13	1001
40	118	0	2	1	400	398	249	1047	3	1044
40	117	0	0	0	400	400	250	1050	4	1046
40	116	0	5	3	400	395	247	1042	5	1037
40	115	48	30	14	352	370	236	958	10	948
40	114	18	10	2	382	390	248	1020	0	1020
40	113	93	39	17	307	361	233	901	13	888
40	112	38	88	16	362	312	234	908	18	890
40	111	74	37	29	326	363	221	910	23	887
40	110	0	24	1	400	376	249	1025	1	1024
40	109	23	65	16	377	335	234	946	67	879
40	108	3	65	19	397	335	231	963	19	944
40	107	15	44	14	385	356	236	977	29	948
40	106	168	77	47	232	323	203	758	91	667
40	105	148	199	41	252	201	209	662	82	580
40	104	51	64	3	349	336	247	932	14	918
40	103	0	51	5	400	349	245	994	0	994
40	102	12	34	0	388	366	250	1004	9	995
40	101	12	60	0	388	340	250	978	16	962
40	100	0	44	10	400	356	240	996	7	989
40	99	12	38	0	388	362	250	1000	0	1000
40	98	112	80	10	268	320	240	848	7	841
40	97	26	101	15	374	299	235	908	14	894
40	96	8	132	26	392	268	224	864	29	855
40	95	99	176	50	301	222	200	723	80	643
40	94	38	50	23	362	350	227	939	52	887
40	93	0	83	22	400	317	228	945	27	918
40	92	2	33	26	398	367	224	989	59	930
40	91	80	44	28	320	356	222	898	8	890
40	90	146	160	41	254	240	209	703	23	680
40	89	55	86	56	345	314	194	853	37	816
40	88	67	105	41	333	295	209	837	17	820
40	87	244	217	91	156	183	159	498	34	464
40	86	172	176	24	228	224	226	678	30	648
40	85	401	264	56	0	136	194	330	91	239
40	84	195	214	44	205	186	206	597	13	584
40	83	175	175	66	225	225	184	634	17	617

LAT	LON	3.7 GHz	5.9 GHz	6.5 GHz	CAP3	CAP5	CAP6	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
40	82	133	165	21	267	235	229	731	29	702
40	81	138	164	82	262	236	168	666	53	613
40	80	159	178	35	241	222	215	678	37	641
40	79	150	125	31	250	275	219	744	23	721
40	78	250	280	57	150	140	193	483	64	419
40	77	236	326	104	164	74	146	384	136	248
40	76	155	345	34	245	55	216	516	69	447
40	75	36	202	49	364	198	201	763	37	726
40	74	0	0	0	400	400	250	1050	0	1050
39	124	5	10	6	395	390	244	1029	7	1022
39	123	146	134	97	252	266	153	671	154	517
39	122	219	122	58	181	278	192	651	90	561
39	121	147	145	26	253	255	224	732	92	640
39	120	20	48	9	380	352	241	973	12	961
39	119	28	23	6	372	377	244	993	19	974
39	118	42	30	5	358	370	245	973	26	947
39	117	28	20	2	372	380	248	1000	1	999
39	116	28	20	4	372	380	246	998	2	996
39	115	0	0	0	400	400	250	1050	4	1046
39	114	14	7	10	386	393	240	1019	9	1010
39	113	47	16	14	353	384	236	973	16	957
39	112	0	0	5	400	400	245	1045	10	1035
39	111	24	4	2	376	396	248	1020	3	1017
39	110	72	19	5	328	381	245	954	20	934
39	109	17	16	4	383	384	246	1013	10	1003
39	108	31	48	7	369	352	243	964	13	951
39	107	25	63	7	375	337	243	955	18	937
39	106	0	2	2	400	398	248	1046	20	1026
39	105	191	120	35	209	280	215	704	75	629
39	104	30	12	0	370	388	250	1008	10	998
39	103	80	44	0	320	356	250	926	13	913
39	102	0	0	4	400	400	246	1046	0	1046
39	101	24	14	6	376	386	244	1006	6	1000
39	100	52	10	4	348	390	246	984	10	974
39	99	52	68	8	348	332	242	922	11	911
39	98	0	72	22	400	328	228	956	26	930
39	97	14	34	20	386	366	230	982	30	952
39	96	33	64	17	367	336	233	936	25	911
39	95	78	156	52	322	244	198	764	81	683
39	94	119	116	21	281	284	229	794	37	757
39	93	76	124	19	324	276	231	831	76	755
39	92	110	155	14	290	245	236	771	52	719
39	91	206	192	60	194	208	190	592	90	502
39	90	256	210	35	144	190	215	549	31	518
39	89	51	88	25	349	312	225	886	25	861
39	88	173	116	26	227	284	224	735	28	707
39	87	171	123	24	229	277	226	732	13	719
39	86	226	228	74	174	172	176	522	80	442
39	85	289	191	53	111	209	197	517	56	461
39	84	24	60	31	376	340	219	935	34	901
39	83	50	80	64	350	320	186	856	67	789
39	82	56	113	60	344	287	190	821	33	788
39	81	63	39	11	337	361	239	937	7	930
39	80	48	6	17	352	394	233	979	10	969
39	79	140	52	25	260	348	225	833	76	757
39	78	247	171	60	153	229	190	572	98	474
39	77	237	151	56	163	249	194	606	41	565
39	76	22	82	22	378	318	228	924	21	903
39	75	0	5	0	400	395	250	1045	0	1045
38	124	0	0	0	400	400	250	1050	0	1050
38	123	150	174	184	250	226	66	542	222	320
38	122	182	305	147	218	95	103	416	163	253
38	121	30	98	16	370	302	232	904	66	838
38	120	30	43	5	370	357	245	972	57	915
38	119	0	43	21	400	357	229	986	38	948

LAT	LON	3.7 GHz	5.9 GHz	6.5 GHz	CAP3	CAP5	CAP6	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
38	118	0	1	7	400	399	243	1042	8	1034
38	117	0	3	2	400	397	248	1045	8	1037
38	116	0	6	0	400	394	250	1044	12	1032
38	115	0	0	2	400	400	248	1048	17	1031
38	114	24	18	15	376	382	235	993	21	972
38	113	6	14	2	394	386	248	1028	19	1009
38	112	0	0	2	400	400	248	1048	12	1036
38	111	0	0	3	400	400	247	1047	9	1038
38	110	0	4	6	400	396	244	1040	18	1022
38	109	77	21	8	323	379	242	944	52	892
38	108	48	23	1	352	377	249	978	21	957
38	107	72	6	0	328	394	250	972	7	965
38	106	76	28	1	324	372	249	945	8	937
38	105	96	46	0	304	354	250	908	17	891
38	104	66	7	0	334	393	250	977	13	964
38	103	67	8	0	333	392	250	975	24	951
38	102	120	28	12	280	372	238	890	32	858
38	101	175	65	15	225	315	235	775	34	741
38	100	77	24	8	323	376	242	941	14	927
38	99	44	33	8	356	367	242	965	10	955
38	98	42	66	28	358	334	222	914	17	897
38	97	26	44	0	374	356	250	980	11	969
38	96	75	38	13	325	362	237	924	17	907
38	95	159	115	25	241	285	225	751	46	705
38	94	111	88	30	289	312	220	821	36	785
38	93	116	60	4	284	340	246	870	58	812
38	92	44	4	9	356	396	241	993	21	972
38	91	48	36	22	352	364	228	944	26	918
38	90	51	75	31	349	325	219	893	74	819
38	89	0	8	32	400	392	218	1010	55	955
38	88	55	51	60	345	349	190	884	93	791
38	87	40	76	40	360	324	210	894	38	856
38	86	75	41	31	325	359	219	903	31	872
38	85	202	95	53	198	305	197	700	37	663
38	84	83	63	20	317	337	230	884	44	840
38	83	56	61	36	342	339	214	895	31	864
38	82	48	70	28	352	330	222	904	39	865
38	81	149	87	25	251	313	225	789	33	756
38	80	104	115	30	296	285	220	801	44	757
38	79	189	127	14	211	273	236	720	26	694
38	78	240	158	31	160	242	219	621	124	497
38	77	10	65	15	390	315	235	940	42	898
38	76	0	5	0	400	395	250	1045	10	1035
37	123	0	0	0	400	400	250	1050	4	1046
37	122	44	71	26	356	329	224	909	47	862
37	121	53	77	19	347	323	231	901	61	840
37	120	53	137	26	347	263	224	834	83	751
37	119	0	27	13	400	373	237	1010	41	969
37	118	0	0	3	400	400	247	1047	6	1041
37	117	0	11	2	400	389	248	1037	4	1033
37	116	9	23	16	391	377	234	1002	60	942
37	115	16	2	20	384	398	230	1012	21	991
37	114	0	0	0	400	400	250	1050	0	1050
37	113	0	5	1	400	395	249	1044	7	1037
37	112	0	23	4	400	377	246	1023	16	1007
37	111	0	2	2	400	398	248	1046	42	1004
37	110	0	6	11	400	394	239	1033	12	1021
37	109	2	8	19	398	392	231	1021	42	979
37	108	13	33	5	387	367	245	999	60	939
37	107	0	14	2	400	386	248	1034	27	1007
37	106	52	24	0	348	376	250	974	9	965
37	105	48	48	0	352	352	250	954	2	952
37	104	0	0	0	400	400	250	1050	16	1034
37	103	0	4	3	400	396	247	1043	15	1028
37	102	48	56	14	352	344	236	932	6	926

LAT	LON	3.7 GHz	5.9 GHz	8.5 GHz	CAP3	CAP5	CAP8	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
37	101	0	0	13	400	400	237	1037	6	1031
37	100	24	30	27	376	370	223	969	12	957
37	99	0	15	22	400	385	228	1013	4	1009
37	98	69	80	31	331	340	219	890	16	874
37	97	127	155	37	273	245	213	731	61	670
37	96	139	129	49	261	271	201	733	84	649
37	95	40	38	27	360	362	223	945	49	896
37	94	44	43	14	356	357	236	949	40	909
37	93	22	2	0	378	398	250	1026	29	997
37	92	0	7	2	400	393	248	1041	47	994
37	91	40	22	16	360	378	234	972	20	952
37	90	30	30	8	370	370	242	982	28	954
37	89	8	14	12	392	386	238	1016	16	1000
37	88	36	18	10	364	382	240	986	31	955
37	87	240	106	13	160	294	237	691	84	607
37	86	120	22	6	280	378	244	902	11	891
37	85	124	40	16	276	360	232	868	16	852
37	84	53	53	8	347	347	242	936	45	891
37	83	17	53	10	363	347	240	970	33	937
37	82	0	45	3	400	355	247	1002	30	972
37	81	77	50	13	323	350	237	910	79	831
37	80	225	90	36	175	310	214	699	47	652
37	79	66	62	11	334	338	239	911	13	898
37	78	0	7	13	400	393	237	1030	11	1019
37	77	15	44	24	385	356	226	967	81	886
37	76	0	2	0	400	398	250	1048	8	1040
36	122	0	13	5	400	387	245	1032	8	1024
36	121	84	98	26	316	304	222	842	64	778
36	120	94	164	45	306	236	205	747	146	601
36	119	91	120	47	309	280	203	792	61	731
36	118	16	39	21	384	361	229	974	18	956
36	117	76	34	2	324	366	248	938	9	929
36	116	204	59	15	196	341	235	772	80	692
36	115	73	32	21	327	368	229	924	70	854
36	114	74	31	11	326	369	239	934	22	912
36	113	98	39	13	302	361	237	900	16	884
36	112	50	63	16	350	337	234	921	22	899
36	111	25	20	9	375	380	241	996	9	987
36	110	50	36	14	350	364	236	950	11	939
36	109	50	37	21	350	363	229	942	38	904
36	108	26	25	15	374	375	235	984	37	947
36	107	195	170	44	205	230	206	641	80	561
36	106	99	81	12	301	319	238	858	37	821
36	105	49	35	5	351	365	245	961	8	953
36	104	25	18	3	375	382	247	1004	5	999
36	103	62	50	2	338	350	248	936	2	934
36	102	76	68	56	322	332	194	848	34	814
36	101	0	10	14	400	390	236	1026	8	1018
36	100	24	20	9	376	380	241	997	9	988
36	99	48	53	19	352	347	231	930	11	919
36	98	220	292	81	180	108	169	457	32	425
36	97	125	153	30	275	247	220	742	38	704
36	96	54	79	19	346	321	231	898	37	861
36	95	43	27	13	357	373	237	967	45	922
36	94	46	28	0	354	372	250	976	28	948
36	93	0	44	2	400	356	248	1004	45	959
36	92	16	12	10	384	388	240	1012	25	987
36	91	99	89	10	301	311	240	852	85	767
36	90	28	106	18	372	294	232	898	76	822
36	89	84	99	10	306	301	240	847	16	831
36	88	90	90	8	310	310	242	862	12	850
36	87	137	89	6	263	311	244	818	16	802
36	86	233	92	21	167	308	229	704	21	683
36	85	146	108	38	254	292	212	758	18	740
36	84	31	45	13	369	355	237	961	22	939

LAT	LON	3.7 GHz	5.9 GHz	8.5 GHz	CAP3	CAP5	CAP8	TOTCAP	2 GHz	REMCAP
1	2	3	4	5	6	7	8	9	10	11
36	83	84	51	.37	336	349	213	898	18	880
36	82	158	65	36	242	335	214	791	44	747
36	81	200	164	79	200	236	171	607	59	548
36	80	196	152	21	204	248	229	681	22	659
36	79	134	123	38	266	277	212	755	49	706
36	78	18	39	21	382	361	229	972	17	955
36	77	0	0	3	400	400	247	1047	0	1047
36	76	0	17	0	400	383	250	1033	2	1031
35	121	23	21	20	377	379	230	986	59	927
35	120	62	93	71	338	307	179	824	123	701
35	119	181	333	255	219	67	0	286	237	49
35	118	279	288	135	121	114	115	350	185	165
35	117	60	87	30	340	313	220	873	36	837
35	116	30	32	8	370	368	242	980	23	957
35	115	0	49	6	400	351	244	995	22	973
35	114	0	8	2	400	392	248	1040	12	1028
35	113	59	31	25	341	369	225	935	21	914
35	112	0	36	0	400	364	250	1014	9	1005
35	111	25	23	8	375	377	242	994	12	982
35	110	30	44	16	370	356	234	960	20	940
35	109	25	40	3	375	360	247	982	18	964
35	108	45	78	0	355	322	250	927	19	908
35	107	64	63	8	336	337	242	915	25	890
35	106	52	80	9	348	320	241	909	11	898
35	105	29	73	4	371	327	246	944	3	941
35	104	29	67	4	371	333	246	950	18	932
35	103	58	68	15	342	332	235	909	22	887
35	102	181	125	0	219	275	250	744	9	735
35	101	48	43	0	352	357	250	959	2	957
35	100	24	17	16	376	383	234	993	3	990
35	99	0	45	30	400	355	220	975	15	960
35	98	132	134	62	268	266	188	722	12	710
35	97	44	71	34	356	329	216	901	17	884
35	96	123	44	7	277	356	243	876	15	861
35	95	23	10	4	377	390	246	1013	9	1004
35	94	24	18	0	376	382	250	1008	18	990
35	93	70	154	13	330	246	237	813	63	750
35	92	83	138	8	317	262	242	821	24	797
35	91	80	158	11	320	242	239	801	34	767
35	90	114	125	7	286	275	243	804	23	781
35	89	44	55	12	356	345	238	939	8	931
35	88	60	27	15	340	373	235	948	8	940
35	87	107	126	19	293	274	231	798	11	787
35	86	161	84	39	239	316	211	766	46	720
35	85	304	94	18	96	306	232	634	53	581
35	84	226	103	15	174	297	235	706	46	660
35	83	233	213	39	167	187	211	565	31	534
35	82	206	131	68	194	269	182	645	27	618
35	81	112	83	7	288	317	243	848	25	823
35	80	29	71	2	371	329	246	946	24	924
35	79	0	49	10	400	351	240	991	30	961
35	78	0	47	1	400	353	249	1002	26	976
35	77	0	0	0	400	400	250	1050	4	1046
35	76	0	0	0	400	400	250	1050	0	1050
34	121	0	0	0	400	400	250	1050	0	1050
34	120	0	0	0	400	400	250	1050	0	1050
34	119	12	49	60	388	351	190	929	91	838
34	118	133	207	138	267	193	112	572	161	411
34	117	139	271	39	261	129	211	601	96	505
34	116	0	22	19	400	378	231	1009	46	963
34	115	68	70	14	332	330	236	898	34	864
34	114	54	88	13	346	312	237	895	20	875
34	113	133	172	57	267	228	193	688	111	577
34	112	110	78	71	290	322	179	791	83	708
34	111	44	50	21	356	350	229	935	15	920

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
34	110	0	0	0	400	400	250	1050	2	1048
34	109	0	0	0	400	400	250	1050	41	1009
34	108	26	0	0	374	400	250	1024	3	1021
34	107	29	10	0	371	390	250	1011	2	1009
34	106	8	37	7	392	363	243	998	13	985
34	105	50	50	14	350	350	236	936	15	921
34	104	72	91	17	328	309	233	870	30	840
34	103	16	72	17	384	328	233	945	60	885
34	102	68	127	2	332	273	248	853	30	823
34	101	48	21	5	352	379	245	976	24	952
34	100	92	14	8	308	386	242	936	19	917
34	99	94	56	34	306	344	216	866	21	845
34	98	201	226	35	199	174	215	588	32	556
34	97	143	109	33	257	291	217	765	68	697
34	96	54	58	20	346	342	230	918	13	905
34	95	0	49	15	400	351	235	986	28	958
34	94	0	143	13	400	257	237	894	24	870
34	93	0	31	14	400	369	236	1005	33	972
34	92	0	16	0	400	384	250	1034	29	1005
34	91	46	45	17	354	355	233	942	28	914
34	90	73	42	8	327	358	244	929	7	922
34	89	86	67	5	314	333	245	892	12	880
34	88	98	43	24	302	357	226	885	34	851
34	87	245	99	58	155	301	194	650	96	554
34	86	140	51	19	260	349	231	840	19	821
34	85	241	203	88	159	197	162	518	171	347
34	84	224	202	14	176	198	236	610	54	556
34	83	51	31	14	349	369	236	954	27	927
34	82	95	71	35	305	329	215	849	42	807
34	81	0	26	17	400	375	233	1008	29	979
34	80	0	30	31	400	370	219	989	43	946
34	79	2	6	12	398	394	238	1030	14	1016
34	78	0	0	0	400	400	250	1050	2	1048
33	120	0	0	0	400	400	250	1050	0	1050
33	119	0	2	0	400	398	250	1048	0	1048
33	118	25	15	39	375	385	211	971	59	912
33	117	3	13	32	397	387	218	1002	24	978
33	116	40	78	11	360	322	239	921	39	882
33	115	11	47	13	389	353	237	979	38	941
33	114	8	22	0	392	378	250	1020	3	1017
33	113	0	28	2	400	372	248	1020	18	1002
33	112	1	78	19	399	322	231	952	56	896
33	111	72	90	68	328	310	182	820	103	717
33	110	41	80	23	359	320	227	906	41	865
33	109	42	102	12	358	298	238	894	48	846
33	108	114	68	22	286	332	228	846	24	822
33	107	36	33	6	364	367	244	975	41	934
33	106	18	18	6	382	382	242	1006	31	975
33	105	0	9	5	400	391	245	1036	36	1000
33	104	0	24	34	400	376	216	992	90	902
33	103	60	75	35	340	325	215	880	75	805
33	102	48	102	15	352	298	235	885	32	853
33	101	142	120	8	258	280	242	780	45	735
33	100	44	125	9	356	275	241	872	44	828
33	99	22	97	18	378	303	232	913	29	884
33	98	195	207	77	205	193	173	571	146	425
33	97	141	331	117	259	69	133	461	140	321
33	96	40	172	23	360	228	227	815	27	788
33	95	50	139	28	350	261	222	833	63	770
33	94	81	68	32	319	332	218	869	39	830
33	93	24	40	31	376	360	219	955	42	913
33	92	75	20	20	325	380	230	935	38	897
33	91	280	120	35	120	280	215	615	39	576
33	90	56	0	4	344	400	246	990	26	964
33	89	37	29	13	363	371	237	971	10	961

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
33	88	3	60	23	397	340	227	964	16	948
33	87	147	129	22	253	271	228	752	47	705
33	86	68	53	27	332	347	223	902	35	867
33	85	24	77	28	376	323	222	921	34	887
33	84	77	79	31	323	321	219	863	37	826
33	83	59	94	16	341	306	234	881	16	865
33	82	0	25	11	400	375	239	1014	49	965
33	81	27	63	13	373	337	237	947	48	899
33	80	5	9	0	395	391	250	1036	14	1022
32	114	0	0	0	400	400	250	1050	0	1050
32	113	0	0	0	400	400	250	1050	1	1049
32	112	0	16	3	400	384	247	1031	12	1019
32	111	0	51	8	400	349	242	991	24	967
32	110	0	4	2	400	396	248	1044	11	1033
32	109	0	0	0	400	400	250	1050	0	1050
32	108	0	10	0	400	390	250	1040	0	1040
32	107	36	44	19	364	356	231	951	65	886
32	106	52	50	10	348	350	240	938	28	910
32	105	52	53	8	348	347	242	937	33	904
32	104	52	48	16	348	352	234	934	56	878
32	103	37	72	41	363	328	209	900	118	782
32	102	0	6	24	400	394	226	1020	31	989
32	101	42	44	12	358	356	238	952	10	942
32	100	0	43	4	400	357	246	1003	7	996
32	99	0	8	8	400	392	242	1034	13	1021
32	98	49	86	46	351	312	204	867	60	807
32	97	72	80	37	328	320	213	861	24	837
32	96	0	19	22	400	381	228	1009	23	986
32	95	18	12	23	382	388	227	997	19	978
32	94	67	17	17	333	383	233	949	18	931
32	93	89	19	32	311	381	218	910	40	870
32	92	26	8	10	374	392	240	1006	14	992
32	91	46	69	13	354	331	237	922	33	889
32	90	21	72	14	379	328	236	943	22	921
32	89	63	18	24	337	382	226	945	14	931
32	88	67	116	20	333	284	230	847	26	821
32	87	70	60	14	330	340	236	906	23	883
32	86	17	71	17	383	329	233	945	21	924
32	85	38	28	17	362	372	233	967	17	950
32	84	5	11	22	395	389	228	1012	11	1001
32	83	75	68	17	325	332	233	890	26	864
32	82	0	85	0	400	315	250	965	18	947
32	81	0	0	0	400	400	250	1050	0	1050
31	108	0	0	0	400	400	250	1050	0	1050
31	105	0	0	6	400	400	244	1044	7	1037
31	104	0	18	2	400	382	248	1030	19	1011
31	103	0	8	4	400	392	246	1038	44	994
31	102	0	0	2	400	400	248	1048	33	1015
31	101	0	1	12	400	399	238	1037	22	1015
31	100	42	8	14	358	392	236	986	36	950
31	99	21	22	19	379	378	231	988	42	946
31	98	102	97	60	298	303	190	791	151	640
31	97	43	100	53	357	300	197	854	74	780
31	96	59	132	66	341	268	194	783	60	713
31	95	60	69	82	340	331	168	839	88	751
31	94	30	57	74	370	343	176	889	74	815
31	93	48	71	98	352	329	152	833	125	708
31	92	70	75	95	330	325	155	810	106	704
31	91	48	74	69	352	326	181	859	93	766
31	90	37	35	27	363	365	223	951	24	927
31	89	22	39	11	378	361	239	978	51	927
31	88	36	40	6	364	360	244	968	92	876
31	87	83	28	0	317	372	250	939	42	897
31	86	135	18	0	265	382	250	897	40	857
31	85	73	14	10	327	386	240	953	56	897

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
31	84	98	38	14	302	362	236	900	9	891
31	83	186	12	12	214	388	236	840	18	822
31	82	75	94	22	325	308	228	859	85	774
30	105	0	1	0	400	399	250	1049	7	1042
30	104	0	0	0	400	400	250	1050	8	1042
30	103	0	0	0	400	400	250	1050	5	1045
30	102	0	0	6	400	400	244	1044	7	1037
30	101	0	10	11	400	390	239	1029	10	1019
30	100	14	22	11	388	378	239	1003	33	970
30	99	150	103	40	250	297	210	757	111	646
30	98	95	26	19	305	374	231	910	51	859
30	97	82	26	38	338	374	212	924	57	867
30	96	109	139	238	291	261	12	564	286	278
30	95	9	25	31	391	375	219	985	116	869
30	94	0	13	33	400	387	217	1004	113	891
30	93	0	3	15	400	397	235	1032	125	907
30	92	4	7	46	396	393	204	993	132	861
30	91	31	96	97	369	304	153	826	168	658
30	90	0	22	49	400	378	201	979	158	821
30	89	0	0	4	400	400	246	1046	61	985
30	88	0	0	0	400	400	250	1050	0	1050
30	87	0	0	0	400	400	250	1050	0	1050
30	86	24	5	1	378	395	249	1020	1	1019
30	85	24	6	4	376	394	246	1016	1	1015
30	84	14	0	0	386	400	250	1036	1	1035
30	83	83	44	10	317	356	240	913	58	855
30	82	109	46	1	291	354	249	894	35	859
30	81	0	9	0	400	391	250	1041	3	1038
29	104	0	0	0	400	400	250	1050	0	1050
29	103	0	0	0	400	400	250	1050	0	1050
29	102	0	0	0	400	400	250	1050	0	1050
29	101	0	0	0	400	400	250	1050	2	1048
29	100	8	23	0	392	377	250	1019	14	1005
29	99	36	37	9	364	363	241	968	19	949
29	98	65	43	53	335	357	197	889	63	826
29	97	0	13	29	400	387	221	1008	79	929
29	96	1	3	9	399	397	241	1037	52	985
29	95	0	0	0	400	400	250	1050	29	1021
29	94	0	0	5	400	400	245	1045	123	922
29	93	0	0	8	400	400	242	1042	205	837
29	92	0	13	17	400	387	233	1020	237	783
29	91	0	2	14	400	398	236	1034	134	900
29	90	0	0	7	400	400	243	1043	56	987
29	89	0	0	2	400	400	248	1048	2	1046
29	88	0	0	0	400	400	250	1050	0	1050
29	87	0	0	0	400	400	250	1050	0	1050
29	86	0	0	0	400	400	250	1050	0	1050
29	85	0	0	0	400	400	250	1050	0	1050
29	84	0	0	0	400	400	250	1050	0	1050
29	83	41	90	39	359	310	211	880	72	808
29	82	157	178	45	243	222	205	670	150	520
29	81	37	35	0	363	365	250	978	23	955
28	101	0	0	0	400	400	250	1050	0	1050
28	100	18	7	4	382	393	246	1021	20	1001
28	99	36	0	28	364	400	222	986	55	931
28	98	35	62	48	365	338	202	905	105	800
28	97	0	0	0	400	400	250	1050	56	994
28	96	0	0	0	400	400	250	1050	4	1046
28	95	0	0	0	400	400	250	1050	18	1032
28	94	0	0	0	400	400	250	1050	28	1022
28	93	0	0	0	400	400	250	1050	0	1050
28	92	0	0	1	400	400	249	1049	4	1045
28	91	0	0	0	400	400	250	1050	3	1047
28	90	0	0	0	400	400	250	1050	0	1050
28	89	0	0	0	400	400	250	1050	0	1050

LAT 1	LON 2	3.7 GHz 3	5.9 GHz 4	6.5 GHz 5	CAP3 6	CAP5 7	CAP6 8	TOTCAP 9	2 GHz 10	REMCAP 11
28	88	0	0	0	400	400	250	1050	0	1050
28	87	0	0	0	400	400	250	1050	0	1050
28	86	0	0	0	400	400	250	1050	0	1050
28	85	0	0	0	400	400	250	1050	0	1050
28	84	0	0	0	400	400	250	1050	0	1050
28	83	85	120	36	335	280	214	829	123	706
28	82	5	42	12	395	358	238	991	10	981
28	81	54	83	0	346	317	250	913	28	885
28	80	0	0	0	400	400	250	1050	0	1050
27	100	0	0	0	400	400	250	1050	1	1049
27	99	36	19	7	364	381	243	988	44	944
27	98	31	48	3	369	354	247	970	33	937
27	97	0	0	0	400	400	250	1050	2	1048
27	96	0	0	0	400	400	250	1050	0	1050
27	95	0	0	0	400	400	250	1050	0	1050
27	94	0	0	0	400	400	250	1050	0	1050
27	93	0	0	0	400	400	250	1050	0	1050
27	92	0	0	0	400	400	250	1050	0	1050
27	91	0	0	0	400	400	250	1050	0	1050
27	90	0	0	0	400	400	250	1050	0	1050
27	89	0	3	0	400	397	250	1047	5	1042
27	88	0	0	2	400	400	248	1048	0	1048
27	87	0	0	0	400	400	250	1050	0	1050
27	86	0	0	0	400	400	250	1050	0	1050
27	85	0	0	0	400	400	250	1050	0	1050
27	84	0	0	0	400	400	250	1050	0	1050
27	83	0	23	1	400	377	249	1028	10	1018
27	82	4	50	9	396	350	241	987	23	964
27	81	72	113	30	328	287	220	835	176	659
27	80	0	0	0	400	400	250	1050	0	1050
26	99	0	0	0	400	400	250	1050	0	1050
26	98	0	6	0	400	394	250	1044	4	1040
26	97	0	0	0	400	400	250	1050	0	1050
26	96	0	0	0	400	400	250	1050	0	1050
26	95	0	0	0	400	400	250	1050	0	1050
26	94	0	0	0	400	400	250	1050	0	1050
26	93	0	0	0	400	400	250	1050	0	1050
26	92	0	0	0	400	400	250	1050	0	1050
26	91	0	0	0	400	400	250	1050	0	1050
26	90	0	0	0	400	400	250	1050	0	1050
26	89	0	0	0	400	400	250	1050	0	1050
26	88	0	0	0	400	400	250	1050	0	1050
26	87	0	0	0	400	400	250	1050	0	1050
26	86	0	0	0	400	400	250	1050	0	1050
26	85	0	0	0	400	400	250	1050	0	1050
26	84	0	0	0	400	400	250	1050	0	1050
26	83	0	0	0	400	400	250	1050	0	1050
26	82	0	7	0	400	393	250	1043	5	1038
26	81	21	76	72	379	324	178	881	134	747
26	80	0	0	0	400	400	250	1050	0	1050
25	82	0	0	6	400	400	244	1044	8	1036
25	81	0	0	4	400	400	246	1046	2	1044