Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Establishment of an Interference Temperature	)	
Metric to Quantify and Manage Interference and	)	WT Docket No. 03-237
to Expand Available Unlicensed Operation in	)	
Certain Fixed, Mobile and Satellite Frequency	)	
Bands	)	
	)	

REPLY COMMENTS OF SPACE DATA CORPORATION

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Date: May 5, 2004

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Space Data Corporation ("Space Data") replies to comments filed in response to the Commission's Notice of Inquiry ("NOI") that examines the establishment of an interference temperature metric to quantify and manage interference.[1] Space Data supports the Commission's initiative to explore new and innovative ways to better use spectrum to benefit U.S. consumers.

A number of commenters acknowledged that the spectrum allocated to Commercial Mobile Radio Services ("CMRS") is among the most efficiently used spectrum in urban areas, but ignore the fact that most CMRS spectrum lies fallow in sparsely populated areas, primarily because wireless services cannot be economically provided in rural areas with towers. Space Data suggests that one solution to providing economically viable services in rural areas is to amend its licensing and service rules to permit stratospheric platform systems. Specifically, an

[1] *See Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands*, Notice of Inquiry and Notice of Proposed Rulemaking, 18 FCC Rcd 25309 (2003), *summarized in* 69 Fed. Reg. 2863 (Jan. 21, 2004).

Interference Noise Temperature metric could be introduced in future FCC allocations and assignments to encourage the introduction of more advanced wireless services to rural areas.

I. INTRODUCTION AND SUMMARY.

Space Data is a start-up company that has developed an innovative balloon-based telecommunications system to provide advanced messaging and other advanced wireless telecommunications services across the United States on a nationwide basis. Space Data initiated commercial service in April 2004 over a 39-county 52,268 square mile area in Western Texas and Southeastern New Mexico with a single stratospheric platform.[2] Space Data plans to deploy six additional stratospheric platforms this summer, which will cover all of Oklahoma, Texas and Louisiana.

Space Data is primarily focused upon extending wireless services to rural and other underserved areas, and was the first company to commit to provide service to tribal nations with limited telecommunications through the Commission's Tribal Land Bidding Credit program. Space Data's system utilizes inexpensive weather balloons to carry miniature radio repeaters (SkySites®) to an altitude of approximately 100,000 feet, far above that of commercial aircraft.[3] Space Data's balloon-borne system is one type of stratospheric high altitude communications platform. A constellation of seventy balloons can provide ubiquitous wireless coverage over the continental United States. Space Data is licensed to provide Narrowband PCS ("NPCS") services on eight paired nationwide channels, two paired Major Trading Area ("MTA") channels

[2] *See* Coverage Area, Space Data Corp., *available at* http://www.spacedata.net/coverage.htm. The population of the 39 counties in this service area is 958,454 people, and an average of 18 people per square mile.

[3] The Commission granted Space Data a waiver to operate its balloon-borne devices as terrestrial base stations. *See Petition for a Declaratory Ruling, a Clarification or, in the Alternative, a Waiver of Certain Narrowband Personal Communications Services (PCS) Rules as they Apply to a High-Altitude Balloon-Based Communications System,* 16 FCC Rcd 16421 (WTB 2001).

in all MTAs in the fifty states, and two additional MTA channels in regional areas. Space Data also has been named the high bidder for various NPCS licenses in Auctions 50 and 51 that will also accommodate its operations.[4]

Stratospheric platforms are rapidly developing in this country as well as in Europe and Japan. The commercial deployment of stratospheric platforms provides the Commission with a unique opportunity to meet its statutory mandate to promote the development and deployment of spectrum-based services in rural areas.[5] Space Data also believes the application of Interference Noise Temperature in allocating future spectrum could help the U.S. become a leader in the use of this important new technology. Space Data previously submitted comments in response to the Commission's inquiry regarding spectrum-based services in rural areas and proposed a novel licensing approach based on Interference Noise Temperature that, when combined with recent technical developments in the field of stratospheric platforms, offers the promise of advanced wireless services for the most remote areas of the country at a cost comparable to advanced services offered in urban areas.[6] Although the Commission decided not to address Space Data's

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[4] Space Data's stratospheric platforms are compatible with standard two-way paging user equipment. Its high altitude platform can serve standard wireless user equipment over a much larger range then would be possible in a terrestrial environment. For instance a standard ReFLEX telemetry modem that transmits at two watts can typically communicate with a terrestrial NPCS tower at a distance of 12 miles in flat terrain. Space Data's platform can communicate with the same modem over a distance of 225 miles.

[5] *See* 47 U.S.C. § 309(j)(3) (providing that the Commission "shall seek to promote… the development and rapid deployment of new technologies, products, and services for the benefit of the public, including those residing in rural areas, with administrative or judicial delays").

[6] Reply Comments of Space Data Corporation at 13 (Feb. 19, 2003) in *Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies To Provide Spectrum-Based Services,* Notice of Inquiry, 17 FCC Rcd 25554 (2002).

proposal, Space Data urges the Commission to reconsider its Interference Noise Temperature proposal here.[7]

The Commission should not retroactively change the licensing scheme for licenses already allocated using an Interference Noise Temperature metric. Any significant changes to such licenses would promote uncertainty in and otherwise negatively affect an otherwise stable wireless market. The Commission, however, should utilize Interference Noise Temperature when allocating future CMRS spectrum to permit stratospheric platform systems to be licensed on a wide area basis. Although CMRS spectrum is currently utilized very effectively in urban areas, such spectrum lies fallow in most rural and underserved areas of the country. It is not cost effective for traditional terrestrial wireless carriers to build out their networks to provide services to these areas.

Stratospheric platforms provide an innovative and cost effective way of deploying advanced wireless services to rural and underserved areas in that one platform can provide wireless services to large geographic areas. In order to be effective, such systems should be licensed on a wide area basis so that U.S. consumers can take advantage of their broad service areas. The Commission can allocate such licenses using Interference Noise Temperature. Specifically, certain spectrum can be licensed on a wide area basis to companies utilizing stratospheric technology that would be used with a low level of Interference Noise Temperature

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[7] *See Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies To Provide Spectrum-Based Services*, Notice of Proposed Rulemaking, 18 FCC Rcd 20802, 20829 n.108 (2003) ("Space Data argued that increasing antenna height may eliminate the need to increase handset power by eliminating the path loss effects (deep fading and clutter losses) present when a signal path is over land. Space Data asks the Commission to explore granting wide area licenses and allocating frequency usage based on an "Interference Temperature Limit." Although the Spectrum Policy Task Force raised the idea of an Interference Temperature Limit in its report, the Commission has not yet explored this idea. Therefore, we will not address Space Data's request here.")

that could provide ubiquitous wireless services to rural and underserved areas. That same spectrum also could be licensed for use in urban areas without creating undue interference between the two licensees' operations. Accordingly, Space Data urges the Commission to consider its proposal to allocate CMRS spectrum going forward using Interference Noise Temperature.

II. THE COMMISSION SHOULD APPLY INTERFERENCE NOISE TEMPERATURE TO FUTURE CMRS SPECTRUM BANDS TO PROMOTE MORE EFFICIENT USE OF SPECTRUM AND PROVIDE INNOVATIVE WIRELESS PLATFORMS THE OPPORTUNITY TO SERVE RURAL AND UNDERSERVED AREAS.

Several pending spectrum proceedings could double the approximate 190 MHz of spectrum now available for CMRS below 2.4 GHz within the next couple of years.[8] While the NOI appears focused on using an Interference Noise Temperature metric to gain more spectrum for unlicensed applications, Space Data believes Interference Noise Temperature can be better applied to allocating licensed spectrum. Unlicensed operations have more than 550 MHz of spectrum available below 6 GHz, including the recent allocation of an additional 255 MHz of unlicensed spectrum.[9] Unlicensed operators have almost three times the spectrum allocated to CMRS operators, and Space Data urges the Commission to assess the efficiency and success with which the unlicensed operators use this scarce resource before seeking more bandwidth for unlicensed operations. Instead, the Commission should use Interference Notice Temperature to allocate future spectrum for CMRS and to promote more efficient use of this spectrum in rural and underserved areas.

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[8] These proceedings include the MMDS/ IFTS Rebanding (up to 190 MHz), Spectrum Reclaimed from MSS (30 MHz), 3G Auction (90 MHz), and the 700 MHz auction (60 MHz) proceedings. *See* Legg Mason Walker, Inc., *After Nextel: A Catalogue for Wireless Carriers Shopping for Spectrum*, Apr. 8, 2004.

A. Existing CMRS Licenses Were Granted With The Expectation That The Licensee Had Full Use Of The Spectrum Down To The Noise Floor, And Changing This Expectation Would Be Detrimental Carriers and Customers.

The Commission should not apply a new licensing metric to CMRS operators that hold existing exclusive-use licenses. To do so would create uncertainty in an otherwise healthy and prosperous market that is generally using spectrum efficiently. Current exclusive-use licensees obtained and have used their spectrum based upon the assumption that they controlled all potential data bandwidth down to the noise floor (or even below the noise floor in the case of CDMA technology). Of the 43 commenters in this proceeding, all but four opposed the Interference Noise Temperature concept. Changing the rules after licensed operators have paid the government enormous sums for exclusive use of specific spectrum is not in the public interest, particularly when the industry is widely acknowledged to have made efficient use of the spectrum resources they control. There are new frequency allocations on the horizon, however, to which the Commission can apply the Interference Noise Temperature concept to gain efficiencies without the perils of retroactively applying it to existing licenses.

B. Although CMRS Spectrum Is Efficiently Used In Urban Areas, Most CMRS Spectrum Lies Fallow In Other Regions Of The Country.

The majority of CMRS spectrum lies fallow in most of the country because carriers often conclude that it is prohibitively expensive to build out their wireless networks in areas with low population density. There is a trend of gradually decreasing wireless coverage in rural areas is noted by a white paper presented by American Roamer, which produces the coverage maps used by many wireless carriers each year. American Rover, a company with long experience studying coverage, observed:

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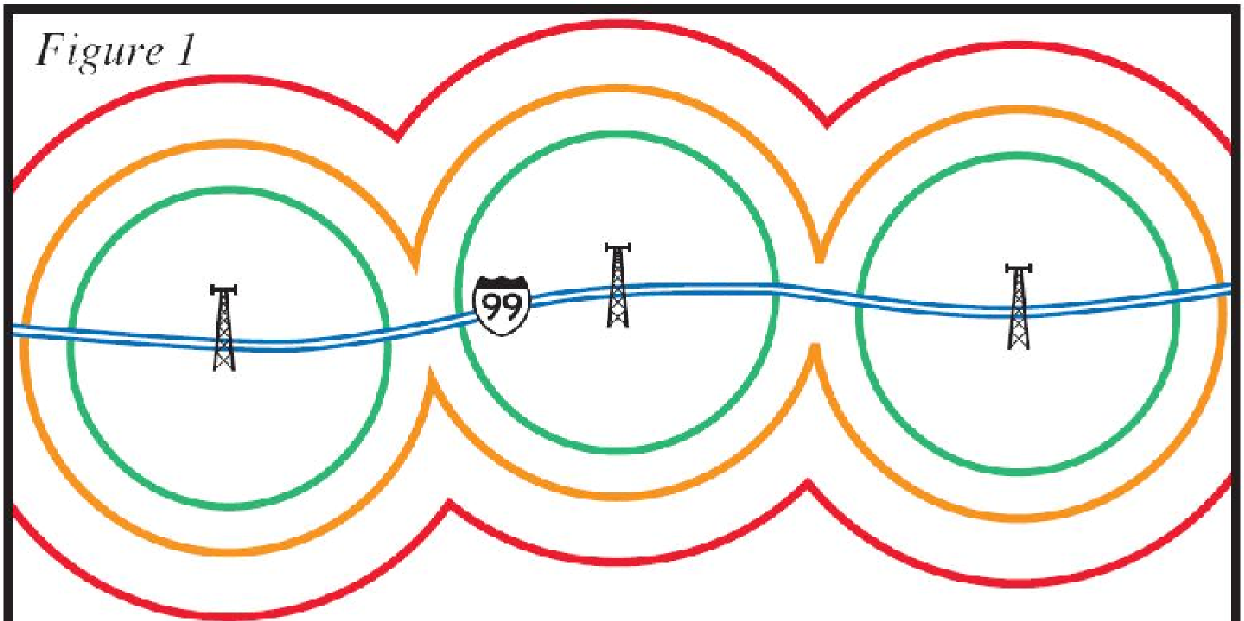
[9] *See Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz band*, 18 FCC Rcd 24484 (2003).

With the introduction of digital technology, many advantages have been realized by both subscribers and carriers. For example, subscribers have longer battery life and a host of new features; carriers have greater spectral efficiency and reap the benefits of higher market penetration with more services to sell. While the number of active cell sites continues to rise, usable coverage has actually decreased in some areas (see Figure 1). A portion of customers upgrading from an analog phone to a digital handset saw their signal strength decline. Rural sites tended to overlap one another just enough to perform a call hand-off. Any reduction in the coverage pattern generated by each site creates spotty coverage. Overlaying digital onto existing analog sites in these areas can produce exactly this type of effect. So the addition of more sites in rural areas is often necessary to provide the same coverage pattern.[10]

Figure 1



This diagram is a simplified representation of how coverage area can shrink along a rural highway as technology advances.

The 3-watt analog signal (red) was the first introduced. Handheld phones at six tenths of a watt (orange) offered less coverage.

Without the addition of new cell sites, the new digital phones (green) can cause no-service areas where the network was originally engineered for higher wattage phones.

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[10] American Roamer White Paper, *Coverage Maps and the Consumer Code for Wireless Service*, at 1 (Sept. 30, 2003), *available at* http://americanroamer.com/download/AR_CoverageCodeWhitePaper.pdf.

This shrinking of coverage in rural areas would be acceptable if carriers committed to building the additional sites needed to provide the coverage pattern previously offered. As Figure 2 demonstrates, however, it is often simply not cost effective even for the largest of carriers to build additional sites. In Figure 2 roaming coverage designates where only analog 3W coverage is available. Unfortunately, analog 3W user equipment is becoming more scarce as urban markets convert to digital equipment. The requirement that cellular companies provide service in accordance with a compatibility standard for analog systems (known as Advanced Mobile Phone Service or "AMPS") is due to sunset in 2007 and will also negatively impact rural coverage.

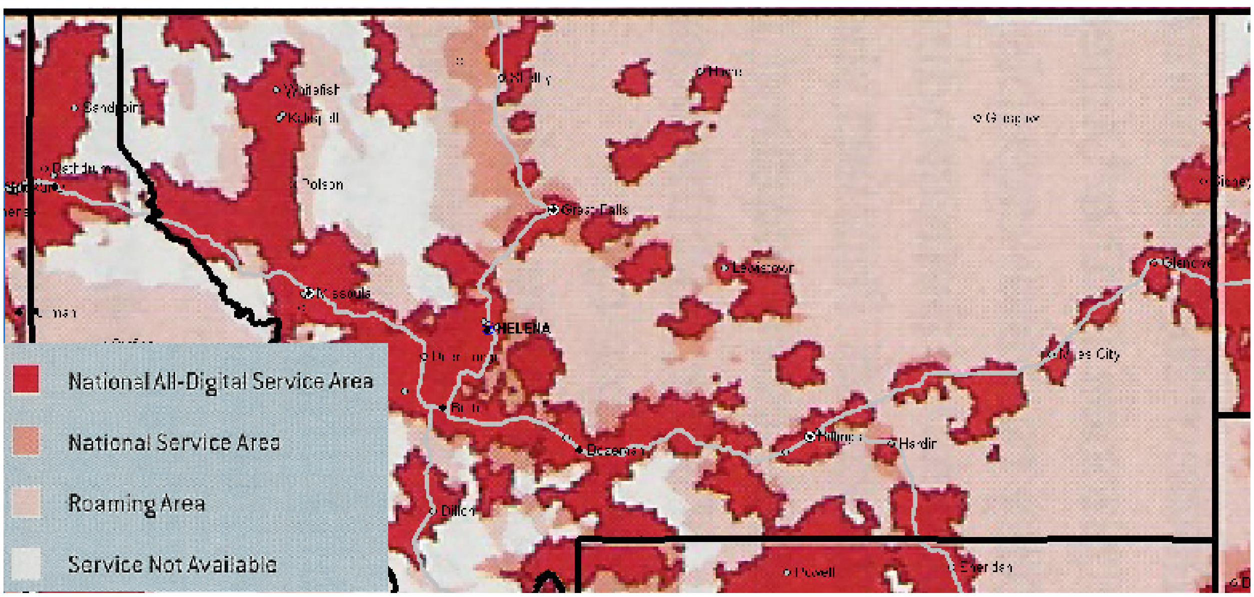

Figure 2: Real world example of loss of coverage along Interstate Highway 94 in Eastern Montana for Verizon customers as wireless technology progressed from analog to digital in order to meet capacity demands of urban subscribers.[11]

The population densities are so much higher in urban areas compared to rural areas that the wireless technologies are driven by urban capacity demands in environments with very tight

[11] *Can They Hear You NOW? A Mobile User's Guide to U.S. Cellular Coverage*, Mobile PC Magazine, Feb. 2004, at 111.

site spacing. The lack of continuity between the spacing of sites in urban and rural areas is best demonstrated by the coverage map of a broadband PCS ("BPCS") operator shown in Figure 3.

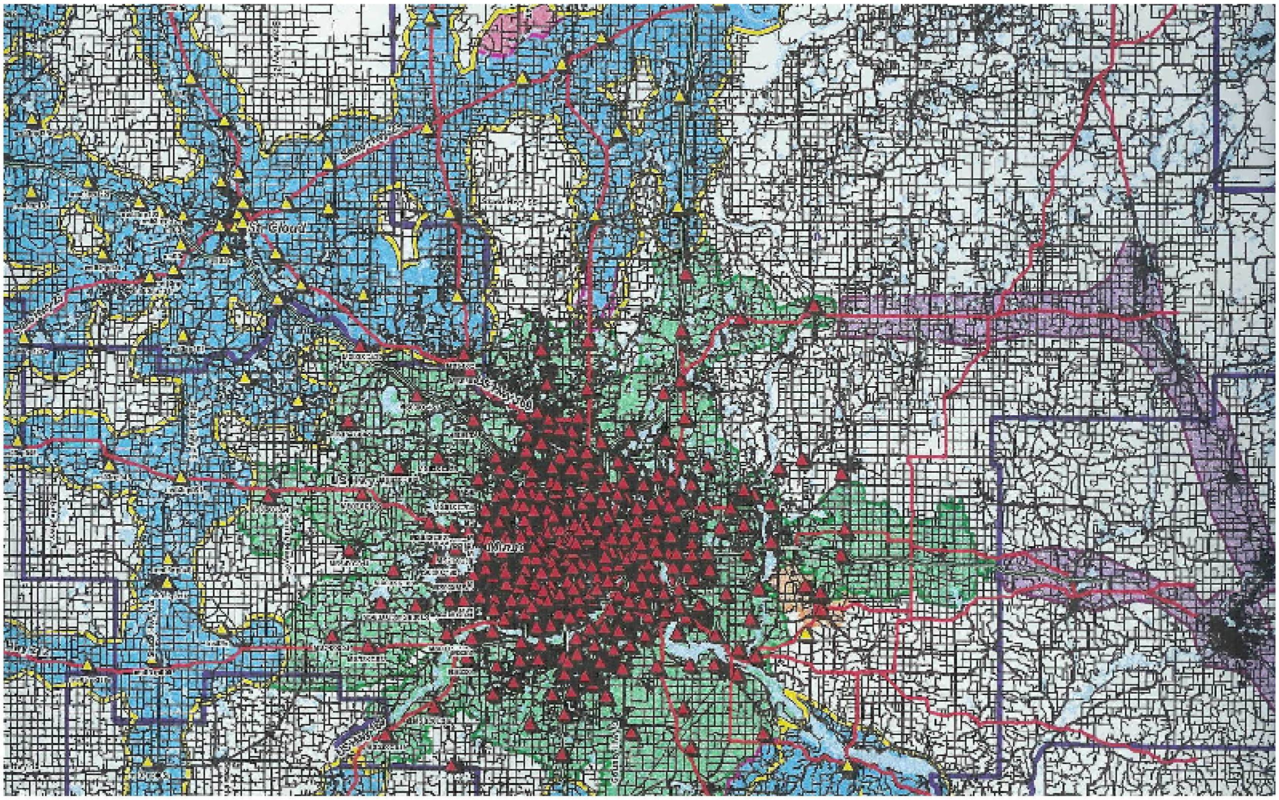

Figure 3: Real world illustration of the disparity of site density in urban areas versus rural areas for a BPCS operator. The red triangles denote urban sites which are spaced less than a mile apart, whereas the rural yellow sites are spaced about 10 miles apart with antennas directing coverage to highways. The fine black line grid provides scale and are approximately one mile grids of the township roads in rural areas.

While Figures 2 and 3 represent real world data, a simple simulation provides a more descriptive overview of the amount of CMRS spectrum that lies fallow in rural areas on a national basis. Assume that a BPCS carrier holds 30 MHz of spectrum on a nationwide basis. The relevant question is in what percent of the landmass of the continental U.S. is this hypothetical carrier actually utilizing all 30 MHz of spectrum available to it? Table 1 shows the key parameters that must be assumed to simulate an answer to this question.

Table 1: Assumptions for Capacity Simulation

Protocol	CDMA
Designed Blocking Level	2%
Erlangs per Subscriber in the Busy Hour	0.025
Traffic Channels per RF channel	16
Total Subscribers	28 million
Penetration in each market	10% of population
Spectrum Available	10 MHz
Channel Bandwidth	1.25 MHz pair
RF Channels Available	4
Reuse factor	1
Coverage Radius	5 miles

For the sake of simplicity, this simulation assumes that the hypothetical carrier's subscriber penetration is exactly 10% in all markets and thus population density from census numbers is a perfect indicator of subscriber density. If the carrier uses the lowest capacity sites with omni-directional antennas the number of traffic channels per site would be 4 x 16 = 64. At a 2% blocking 64 traffic channels equals 52.5 Erlangs of offered capacity per site. At the assumed 0.025 Erlangs per subscriber, this works out to 2100 subscribers per site, or 21,000 people per site because the carrier is assumed to have a 10% market penetration in all markets. The hex area of a site with a 5 mile radius is 65 square miles. Thus, the maximum population density this hypothetical network can support with 10 MHz of spectrum is 21,000 / 65 = 323 people per square mile. If the population density is higher than this amount, the carrier would have to invest in more equipment to sectorize the sites or split the sites into smaller sites or obtain additional spectrum.

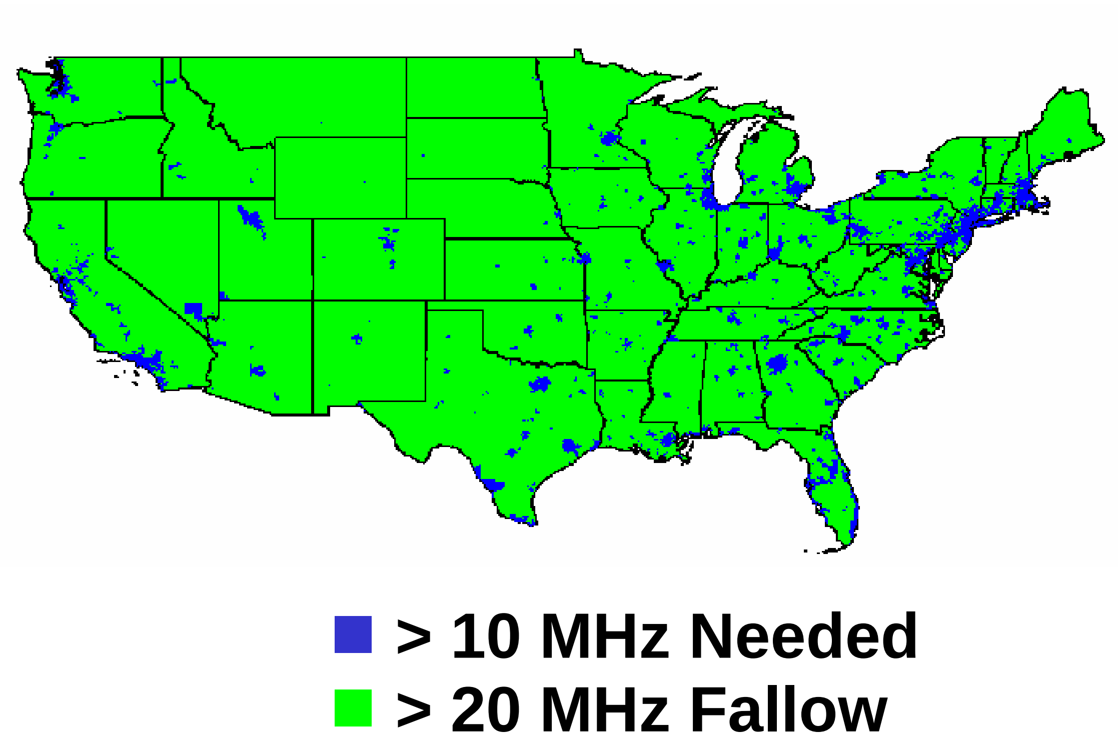

Figure 4: If a CDMA carrier with 30 MHz of spectrum uses the lowest capacity site configuration (omni direction sites) it allows 66% of its spectrum lay fallow in 95% of the landmass if the carrier has a 10% subscriber penetration in all markets.

Thus, in this example a carrier with 10 MHz of spectrum becomes capacity limited only at a population density of 323 people per square mile. Significantly less than 5% of the continental U.S. has a population density of more than 323 people per square mile based on a census block resolution. The areas in blue in Figure 4 represent where the population density is greater than 323 people per square mile. Thus, if the hypothetical carrier holds a 30 MHz license nationwide, 20 MHz of the carrier's spectrum lies fallow in over 95% of the continental U.S.[12]

[12] This is a conservative analysis because CDMA carriers often have more than 16 traffic channels per RF channel. A greater number of traffic channels would simply increase the capacity per site, which would increase the population density cut off before more than 10 MHz (*Footnote continues*)

The issue the Commission must address is how this valuable, fallow CMRS spectrum can be used to deliver state of the art wireless services to rural and underserved areas. The problem is not a shortage of spectrum, but is rather a shortage of sites with adequate line-of-sight that can serve rural areas.[13] This shortage could be eliminated by building more towers as coverage areas shrink due to advancements to address capacity demands in urban areas. In rural markets, however, there is simply not enough potential customer base to justify the cost of building additional towers.

C. High Altitude Platform Technologies Are A Rapidly Developing Innovation That Can Provide Cost Effective Wireless Services To Rural And Underserved Areas.

Increasing the height of base station antennas presents a viable solution for increasing coverage in rural and underserved areas. As an antenna is raised, its line-of-sight increases to a larger area without the path loss effects (deep fading and clutter losses) present when a signal path travels over land. Increasing the transmission power of a base station, however, is not a viable solution for increasing wireless coverage in rural areas. If the power of a base station increased, the power of wireless handsets also would necessarily increase in order to link with the base station. Non-standard handsets would then have to be used in rural areas, and would likely cost significantly more than their urban counterparts. Figure 5 shows that increasing the line-of-sight in rural areas by simply making towers taller quickly runs into regulatory and physical limitations.

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of spectrum would be needed. Thus, even a smaller percentage of U.S. would require more than 10 MHz of spectrum.

[13] Line-of-sight refers to the shortage of locations to put antennas in rural area that are high enough to provide ubiquitous wireless coverage.

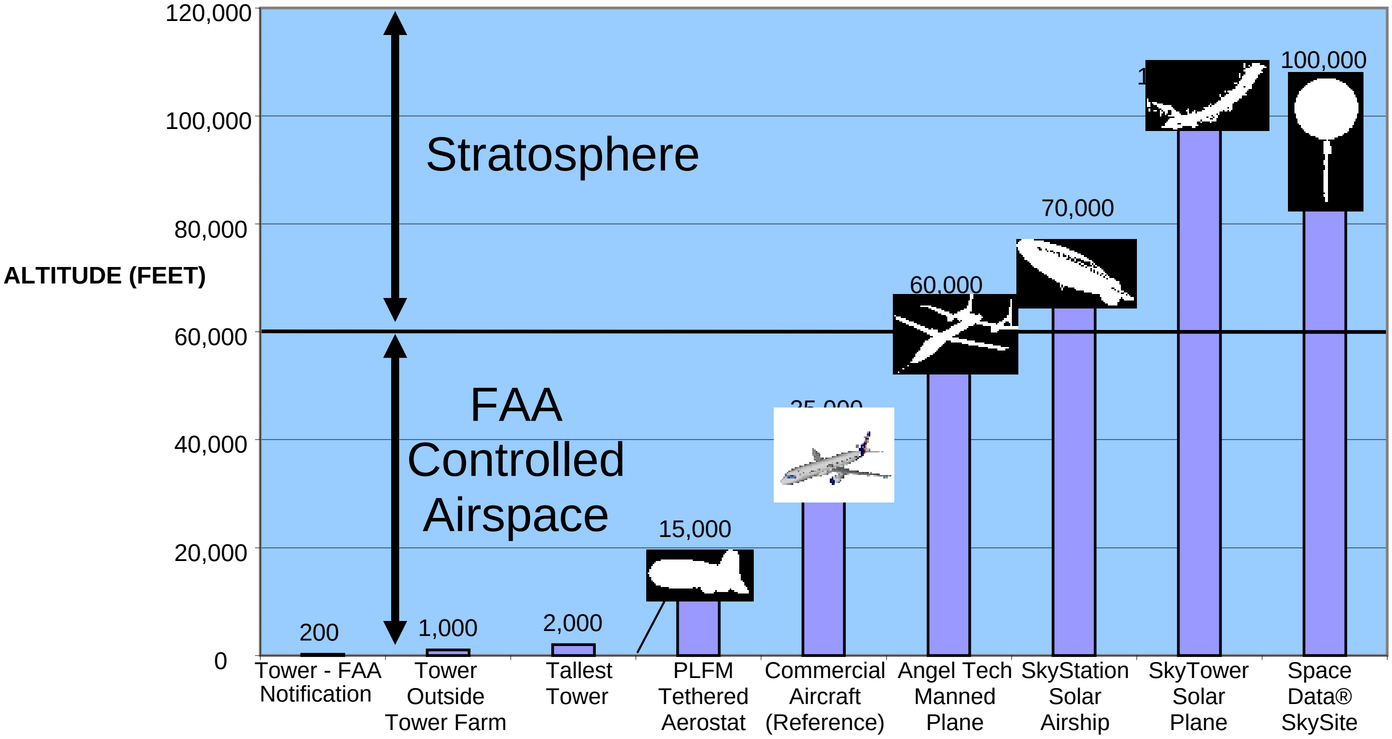

Figure 5: Comparison of base station antenna height for various wireless antenna platforms.[14]

The rural market needs a "Goldilocks Tower" that is not too tall and not too short. Satellites are "too tall" because they require special user equipment. Terrestrial towers are "too short" because even the highest tower cannot cover enough subscribers to pay for itself in many rural areas. Different types of stratospheric platforms, however, which are two to three times higher than commercial aircraft, are being developed that allow a base station antenna to be hundreds of times higher than terrestrial towers. These "Goldilocks Towers" have the ability to

[14] A tower above 200 feet must be specially lit and the FAA notified to avoid being a hazard to aircraft. A tower above 1000 feet must be located in a tower farm, which effectively limits its use for ubiquitous mobile wireless coverage. Towers (or buildings for that matter) cannot extend above 2000 feet due to limitations in building materials.

cover very large geographic areas with broad antennas.[15] Figure 6 demonstrates that stratospheric platforms provide a fairly even power level across the ground, even though the terrain of the ground may not be flat, because stratospheric transmitters are at least 15 miles from the ground. This is in contrast to terrestrial towers, which emit a very high power to users close to the tower. Terrestrial transmitter power levels typically decay at the inverse forth power of the distance from the tower.

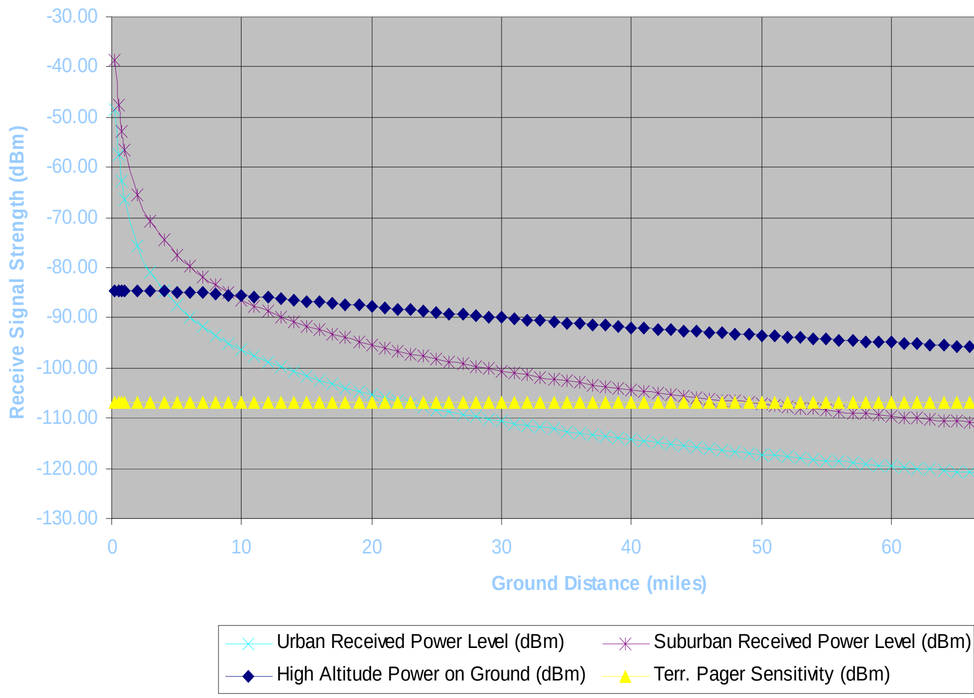

Figure 6: The signal level of stratospheric platforms provide a very uniform power level at the ground since the closest user is 15 miles away, and the antenna pattern can be used to create a uniform power density at ground level throughout the footprint.[16]

[15] Stratospheric platforms can take several forms, including tethered blimps, high-altitude manned airplanes, high-altitude unmanned airships, unmanned solar airplanes and Space Data's weather balloons with miniature wireless repeaters. Some can maintain a position over one spot on earth and some drift with the wind like Space Data's. Space Data relies on continual launches to fill its constellation so that as one platform drifts out of range another drifts into range. A redundant constellation such as Space Data's provides high service reliability and an on-board Global Positioning System receiver provides tight control of transmissions, protocol timing, and power near service area borders.

[16] Theodore S. Rappaport, P.E., Ph.D., et al., *Interference Analysis for Balloon-borne Repeaters in the Narrowband Personal Communications Service* (May 21, 2001) (Filed in DA No. 01-970).

In addition to Space Data, several other companies are pursuing stratospheric platforms, including SkyStation International, AeroVironment, Inc. (www.skytowerglobal.com), Angel Technologies Corporation (www.angeltechnologies.com), Techsphere Systems International, LLC (www.techspheresystems.com), and Lockheed-Martin/ Stratcom.[17] Abroad, Japan is developing the SkyNet airship and the European Union is funding the development of the Heliplat high altitude airplane and the Capanina airship (http://www.capanina.org/).[18]

D. Providing The Latest Wireless Technologies To Rural Areas And Underserved Areas Requires Wide Area Licenses.

The primary advantage of stratospheric platforms for wireless services – the wide coverage area achieved from a single platform – becomes a barrier when applied to the highly fragmented geographic licensing of CMRS spectrum in the U.S. The Commission's past spectrum allocation policies have resulted in the geographic fragmentation of CMRS spectrum into 734 Cellular Market Areas ("CMAs"), 493 Basic Trading Areas ("BTAs"), or 51 MTAs. This, coupled with Commission's policy of allowing each licensee to choose its own technology, can create significant geographic fragmentation of wireless technologies on any given frequency block. This presents a potential problem for stratospheric platforms that have coverage footprints that may cover several CMAs or BTAs. Figures 7, 8, 9 and 10 show the technology fragmentation in the U.S. for each CMRS frequency block as of a year ago.[19]

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[17] The Missile Defense Agency awarded Lockheed-Martin a $40 million contract to design a solar powered airship for homeland defense purposes. The next phase of this High Altitude Airship program is a $50 million phase to build a prototype to be delivered in 2006. *See* Global Security Org., *High Altitude Airship (HAA), available at* http://www.globalsecurity.org/intell/systems/haa.htm.

[18] *See* Dept. of Electronics, Communications Research Group, *Communications from High Altitude Platforms, available at* http://www.elec.york.ac.uk/comms/haps.html.

[19] This Data is from the Wireless Industry Search and Retrieve Database (WISARD™) published by American Roamer as of April 2003.

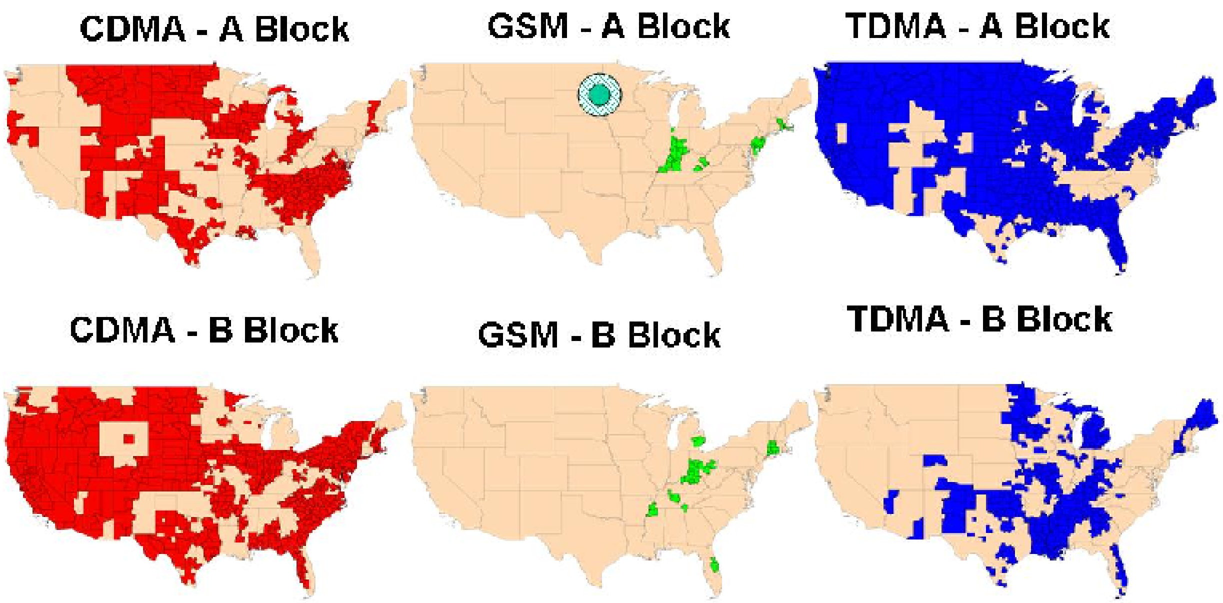


Figure 7: Deployed wireless technology for cellular frequency block A and block B.

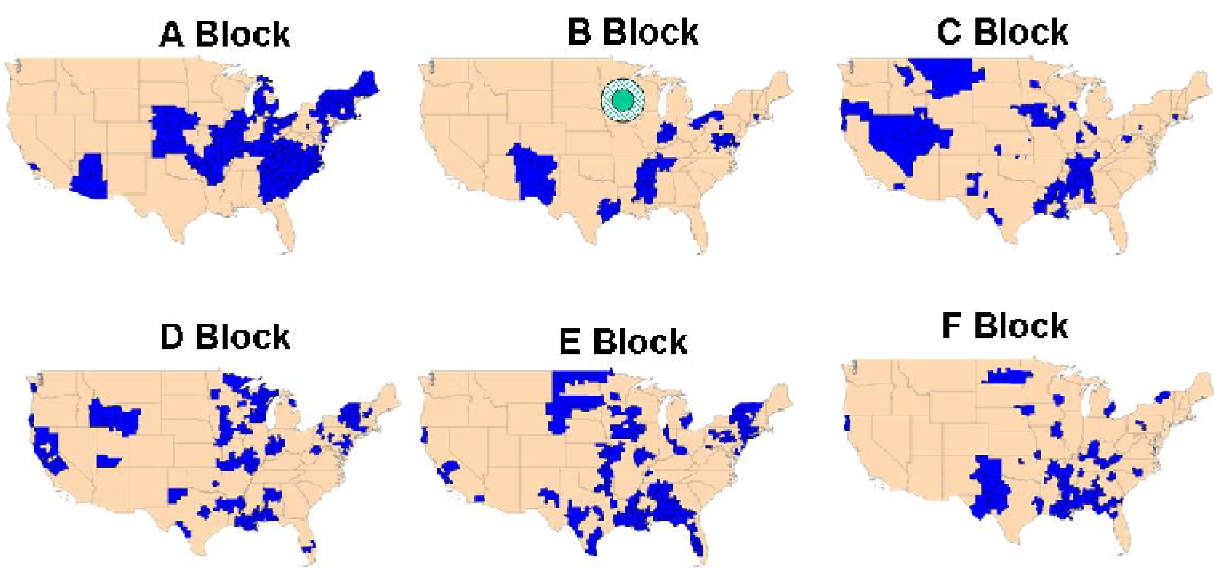


Figure 8: Market Areas where TDMA is deployed for BPCS frequency blocks.

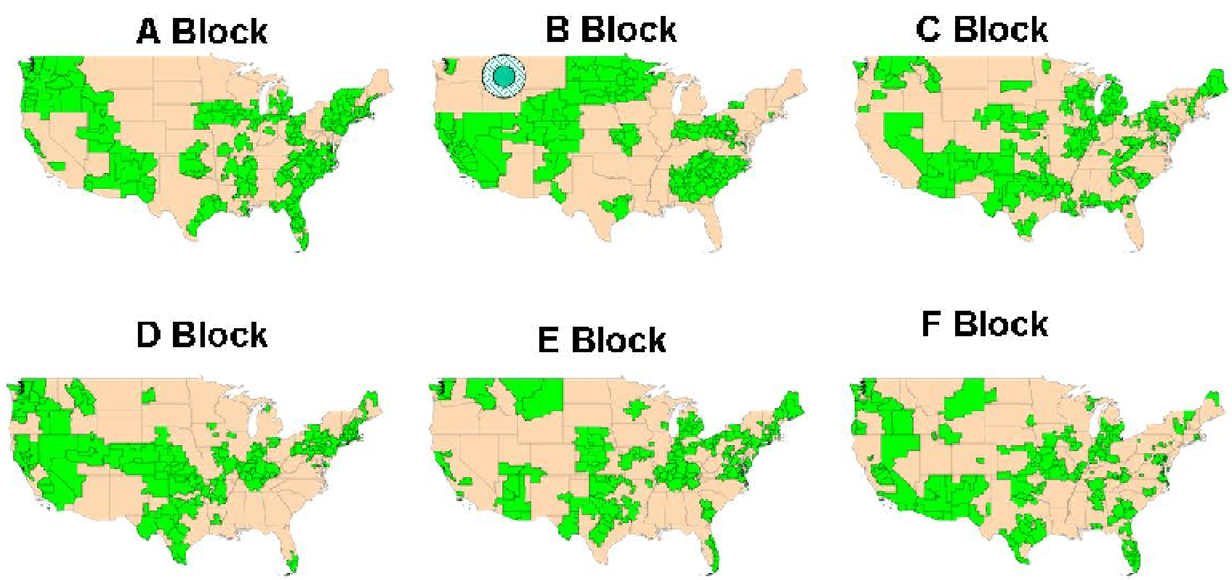


Figure 9: Market Areas where GSM is deployed for BPCS frequency blocks.

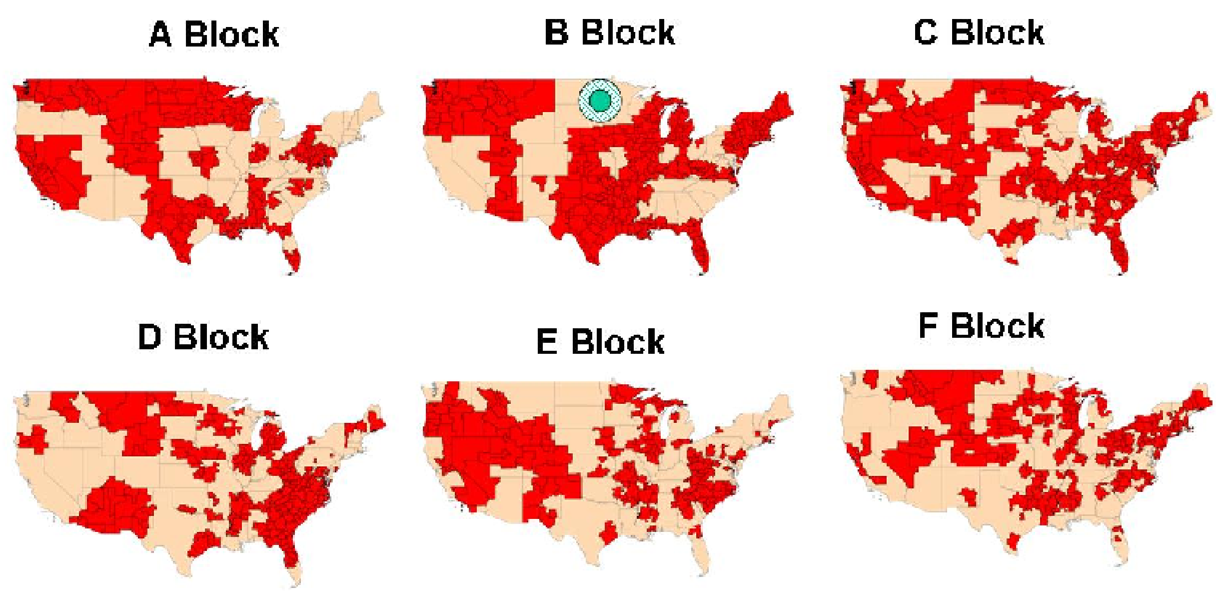


Figure 10: Market Areas where CDMA is deployed for BPCS frequency blocks.

In each of Figures 7 through 10, there is one map with a set of two concentric circles. This represents a notional size of coverage from one stratospheric platform. The center circle is the service area of the stratospheric platform which is nominally about 180 miles in diameter for wireless voice protocols. The outer circle is a notional representation of an interference zone around the service area such that if the interference zone overlaid a market area with an incompatible wireless standard compared to the wireless standard the stratospheric platform is transmitting, interference to ground-based operations may result.[20]

Figures 7 through 10 demonstrate that the geographic fragmentation of wireless technologies by frequency block in the U.S. can limit the regions where stratospheric platforms can be used to fill in rural coverage for standard user equipment. This problem largely does not exist in other countries because other countries typically license frequency blocks on a nationwide basis. The only U.S. licensed nationwide frequencies are in the NPCS band and in the 1670-1675 MHz band auctioned last year. For this reason Space Data's initial operations have been constrained to the NPCS band. Unless the Commission modifies the policy it has pursued in the past with CMRS licensing, geographic fragmentation may prevent the U.S. from utilizing stratospheric platform technologies for wireless services.

As discussed below, the Interference Noise Temperature concept provides a means whereby stratospheric platforms can fill in wireless coverage for rural and underserved areas using the spectrum that now lies fallow in 95% of the continental U.S. without limiting use of the spectrum in urban-core areas where all the available spectrum is needed to meet the demands of densely populated markets.

[20] These figures are not to scale as the scale would depend upon the wireless standards and also upon the antenna pattern used on the stratospheric platform. A large antenna, for instance, may be able to shape the pattern such that the signal level on the ground falls off rapidly outside the service area, thereby minimizing the size of the interference circle relative to the service circle.

E. An Interference Noise Temperature Approach Can Allow Licensing A Wide-Area Underlaid License For Rural Areas On A Co-Channel Basis With An Urban-Core-Only License.

To further advance the application of stratospheric platforms to rural markets, the Commission should explore granting wide area licenses with low interference rights to promote the provision of more efficient services to rural areas. The spectrum of these wide area licensed also could cover urban areas with high interference limits. Table 2 shows the proposed licensing scheme compared to current approaches to licensing a hypothetical 30 MHz frequency block. In the proposed approach, 30 MHz licenses could be assigned in each market area, 10 MHz of which would be co-channel in urban areas with a nationwide license operating with low noise floors. The nationwide license would keep transmissions to a low level suitable for providing rural coverage in environments with low noise floors (which would be too low to provide effective urban coverage). Figure 10, below, also is a notional map of spectrum use under this proposal.

Table 2: Proposed approach for licensing a 30 MHz block of spectrum

Market Area	**Current Licensing Approach**	**Proposed Licensing Approach**
493 BTAs	License 1: 30 MHz Block A in each BTA	License 1: 20 MHz Block A1 in each BTA plus 10 MHz Block A2 that is limited in high density areas only (i.e., where Population Density is > 500 ppl/sq. mi.)
Nationwide	None	License 2: 10 MHz Block A3 Nationwide

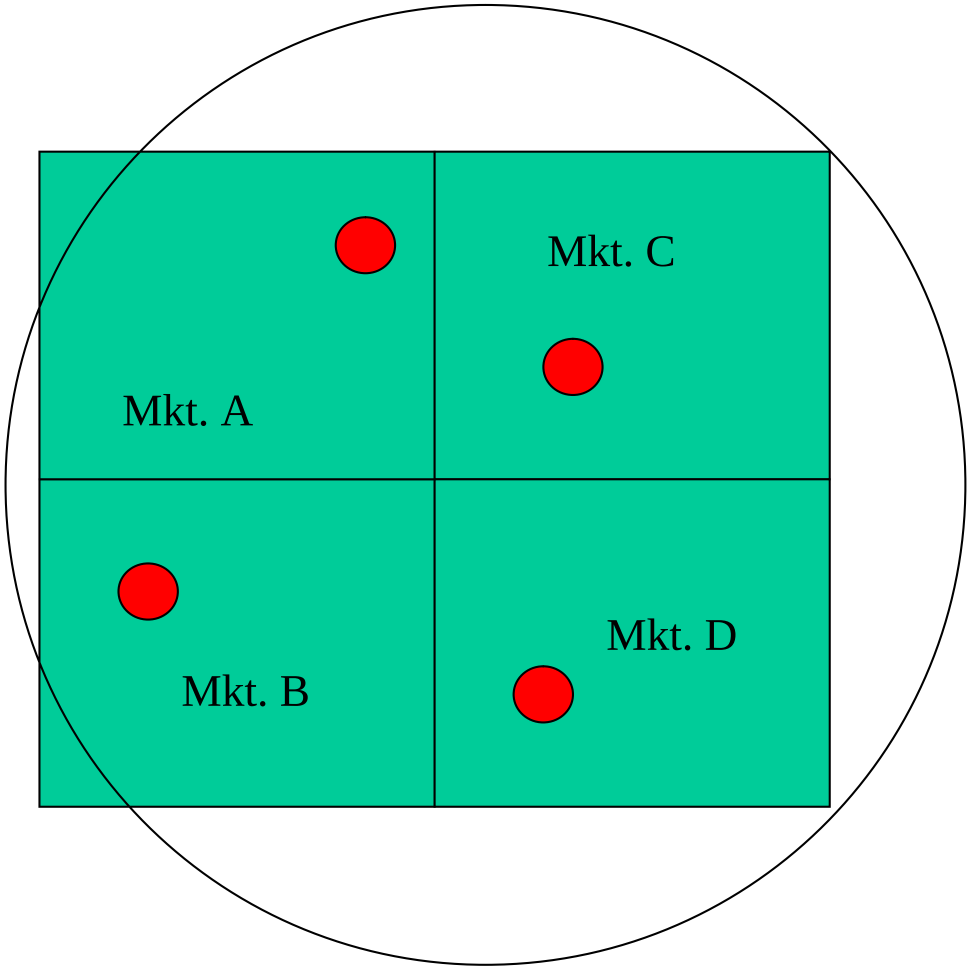
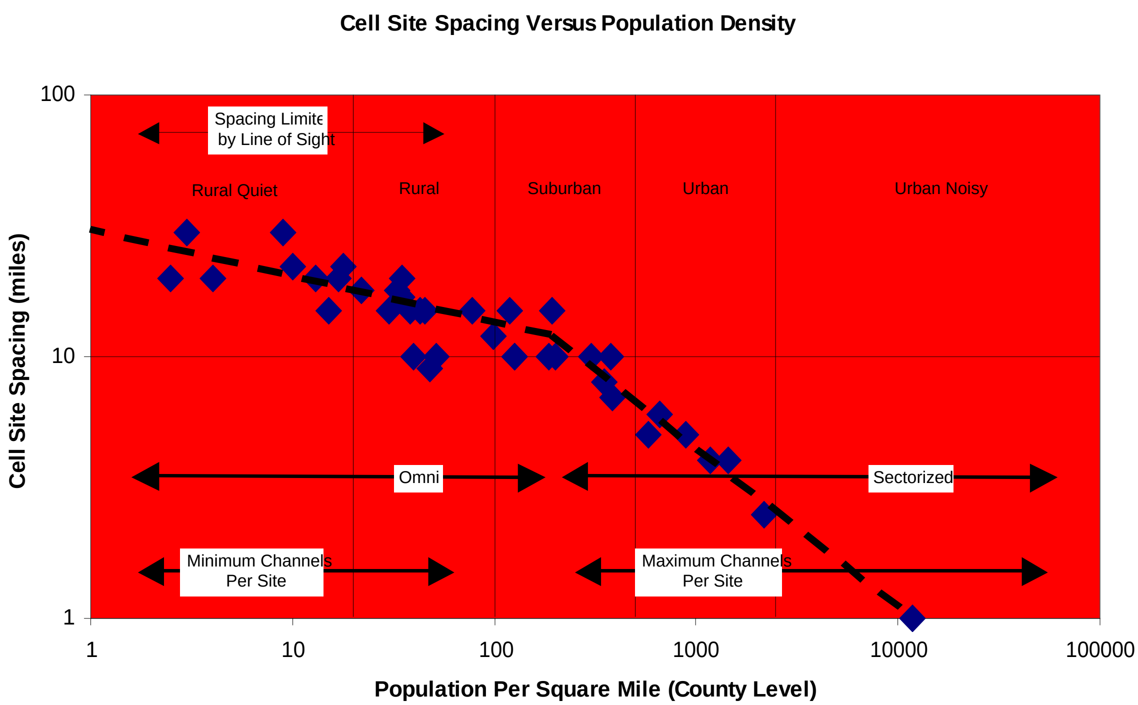


Figure 11: Notional map of proposed spectrum licensing scheme.

Figure 11 shows a scenario where there are four different geographic markets: A, B, C and D. Under the current policy, 30 MHz of spectrum would simply be licensed to one operator in each of the four markets. Under the proposed scheme, 30 MHz would be assigned in each BTA, 10 MHz of which would share co-channel frequencies with a nationwide licensee in urban markets. A 10 MHz license would be assigned on a nationwide basis that would share co-channel frequencies in urban areas with the 30 MHz licensee. The licensee of the nationwide 10 MHz license would operate at a low Interference Temperature and would be able to provide service to rural and underserved areas. This 30 MHz license is functionally equivalent to current market licensing practices (*i.e.* the license holder has limited transmit power in their market area, cannot exceed a certain power level on the ground at the edges of their market area, and can exploit the full bandwidth potential of the 20 MHz down to the noise floor or below), except in urban areas where 10 MHz of it would be co-channel to the nationwide license. The 10 MHz nationwide operator will provide the wide area coverage depicted by the large transparent circle in Figure 10. This operator is limited to the power level that can be present on the ground, *i.e.*, it is set to a level that provides adequate service to subscribers in quiet rural areas with low noise floors and small buildings. The small red circles represent urban areas where population density is high and where the 10 MHz of spectrum licensed to the 30 MHz operator that is co-channel to the nationwide licensee. The urban-core-only licensee must also agree to implement tight power control on the 10 MHz return channel from all handsets. Without this control, the wide area licensee will suffer interference from the handset emissions emanating from the urban core. The requirement for tight power control on the subscriber equipment transmissions does not limit technology because all proposed 3G wireless standards already implement very tight power control of subscriber equipment in order to maximize capacity in the interference limited environment of an urban core and also to improve battery life of the subscriber equipment. Several commenters pointed out that today's CDMA networks adjust the power of the subscriber unit in 1 dB increments at rates of 800 times per second. Power control in proposed 3G wireless networks is even tighter than that used in today's CDMA networks.

This proposed licensing scheme does not create interference between the wide area licensee and the urban core licensee because the signal required to provide service to users in a rural environment is much lower than in an urban environment. First, adjacent and co-channel interference are much lower in rural areas because the noise floor is low. Second, the link margin required to penetrate typical rural structures such as two-story, wood frame houses is at least 10 dB less than the link margin required to penetrate urban structures such as concrete and steel, multi-story buildings. Figure 12 presents data on the noise floor in various population density regimes that was illustrated in the original petition in the AirCell proceeding.[21] AirCell, working with its rural cellular partners, listed cell site spacing based on county-level population density as shown below. AirCell then split the country into five regions based on population density and reported a received ambient noise plus interference floor for each region.



Market Type	Population Density Range (ppl/ sq. mi.)	Percent of Population	Percent of U.S. Area	Received Ambient Noise + Interference Floor
Rural Quiet	0 - 20	3.7	49	-120 dBm
Rural	20 - 100	18.5	35	-118 dBm
Suburban	100 - 500	30	13	-115 dBm
Urban	500 - 2500	35.2	2.8	-107 dBm
Urban Noisy	2500 & up	12.6	0.2	-100 dBm

Figure 12: Typical noise floors in various population density regimes.

[21] AirC*ell, Inc. Petition, Pursuant to Section 7 of the Act for a Waiver Of the Airborne Cellular Rule, Or In the Alternative, For a Declaratory Ruling*, at 46 and App. A, at 25 (filed Oct. 9,
(*Footnote continues*)

Cingular and BellSouth commented that the noise floors AirCell presented were outdated and that noise floors had generally declined since AirCell's 1997 waiver request.[22] They appeared to prefer the numbers reported by V-COMM, L.L.C., which reported -127 dBm in rural environments.[23] The key parameter for the current analysis is not the absolute noise floor level, but the difference between "rural quiet" noise floors and "urban noisy" noise floors. According to AirCell's study, this difference is 20 dB. According to the V-COMM cellular study, the dense urban noise floor was -118 dBm and the rural noise floor was -127 dBm, for a difference of 9 dB. According to the V-COMM PCS study, the urban noise floor was -116 dBm and the rural noise floor was -128 dBm, for a difference of 12 dB. However, there seems to be a substantial difference between AirCell's and V-COMM's definition of rural quiet. AirCell defines rural quiet as population densities of 0-20 people per square mile, whereas V-COMM's considers sites in Lehigh County, Pennsylvania as rural sites even though the 2000 census lists Lehigh county as having an average population density of 900.3 people per square mile. Lehigh county is only 347 square miles, therefore it is only about 18 miles across. Thus interference from a cell site anywhere in the county is likely present to some degree at the sites V-COMM considers rural. In fact, V-COMM uses Lehigh College as a rural site when intuitively any college would have population densities much greater than 0-20 people per square mile. V-COMM's other rural site is Bucks county, which has a population density of 984 people per square mile. AirCell's data shows that the noise floor difference between urban noisy and areas with 500-2500 people per square mile is 7 dB, which compares to V-COMM's 9 dB.

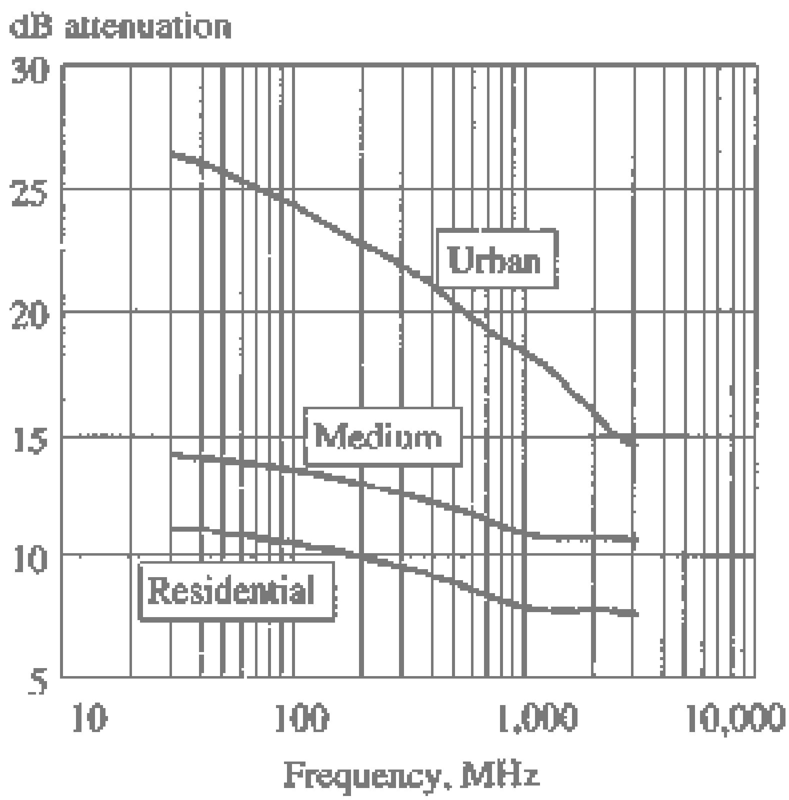
1997).

[22] Cingular and BellSouth Joint Comments at 16 n.39.

[23] *See id.*

Data taken in the Phoenix, Arizona area shows a noise floor of –111 dBm in the PCS band in downtown Phoenix and -124 dBm in the suburbs compared to –142 dBm in the PCS band in Tortilla Flat, Arizona where there are 6 full time residents, no wireless services and no land-line phone service. There may be some differences between how each data set was taken, but comparing urban noisy to rural quiet seems to give a difference in noise floor of 18-31 dB.[24]

Another difference in the signal level required to provide wireless service in rural versus urban areas deals with building penetration margins. Figure 13 shows the penetration margin difference between urban buildings and rural/ suburban buildings. At 1 GHz, urban buildings have an average attenuation of 18 dB whereas residential buildings only have an average attenuation of 7 dB, for a difference of 11 dB.



[24] *See* Exhibit A for Space Data's analysis of these amounts.

Figure 13: Building attenuation differences between urban and rural (residential).[25]

Accordingly, the sum of the noise floor difference and the building difference indicate that communication in a rural quiet area can be done at a level up to 31 dB lower than communication in a typical noisy urban setting. Assuming the urban noise floor is at -111 dBm, adding a signal only 20 dB lower at -130 dBm from the proposed wide area licensee only raises the noise floor in the urban area by 0.04 dB.[26] Verizon reports that a 0.33 dB increase in noise from current levels would reduce current CDMA capacity by 5% and a 1 dB raise in the noise floor would reduce capacity by 16%.[27] Therefore, it appears that a 0.04 dB raise in the noise floor would likely reduce capacity by only a fraction of a percent in the urban core. If the wide area licensee raised the noise floor in the urban core by 0.33 dB, there would be a loss of capacity in the urban core for the whole 30 MHz block of 1.67% because the wide area licensee is only licensed a third (10 MHz) of the spectrum. This reduction in capacity would likely be worth the social benefit of providing ubiquitous wireless coverage to rural and underserved areas. The wide area licensee would therefore be able to transmit up to -121 dB, which would be more than an ample signal to serve rural areas.[28]

Under the proposal above, the same frequency can be allocated based on Interference Temperature as advocated by the recent white paper issued by the Commission's Spectrum Policy Task Force.[29] The figure below illustrates Space Data's suggested licensing scheme

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[25] *See* Kazimierz Siwiak, *Radiowave Propagation and Antennas for Personal Communications* 209-10 (2nd Ed., Apr. 1998).

[26] 10 * LOG (10^(-110 / 10) + 10^(-130/10)) = -109.957 dBm.

[27] Verizon Comments at 15.

[28] -109.67 dB = 10 LOG (10^(-110/10) + 10^(x/10)) solving for x yields X= -121.02 dBm.

[29] Spectrum Policy Task Force, Federal Communications Comm'n, *Report of the Interference Protection Working Group*, at 19, Fig. 3 (Nov. 15, 2002).

based upon Interference Temperature. As previously mentioned, two licenses could be granted for the same set of frequencies. License A would be restricted to urban areas with population densities higher than 500 people per square mile. This license allows high Interference Temperature to overcome the urban environment, but requires user equipment be under dynamic power control. License B would be unlimited geographically, but is limited to a low Interference Temperature only suitable for providing service to rural areas where noise plus interference is low and the margin to penetrate buildings is modest. The suburban areas are used as a buffer zone to protect the rural regions from interference from the urban networks.

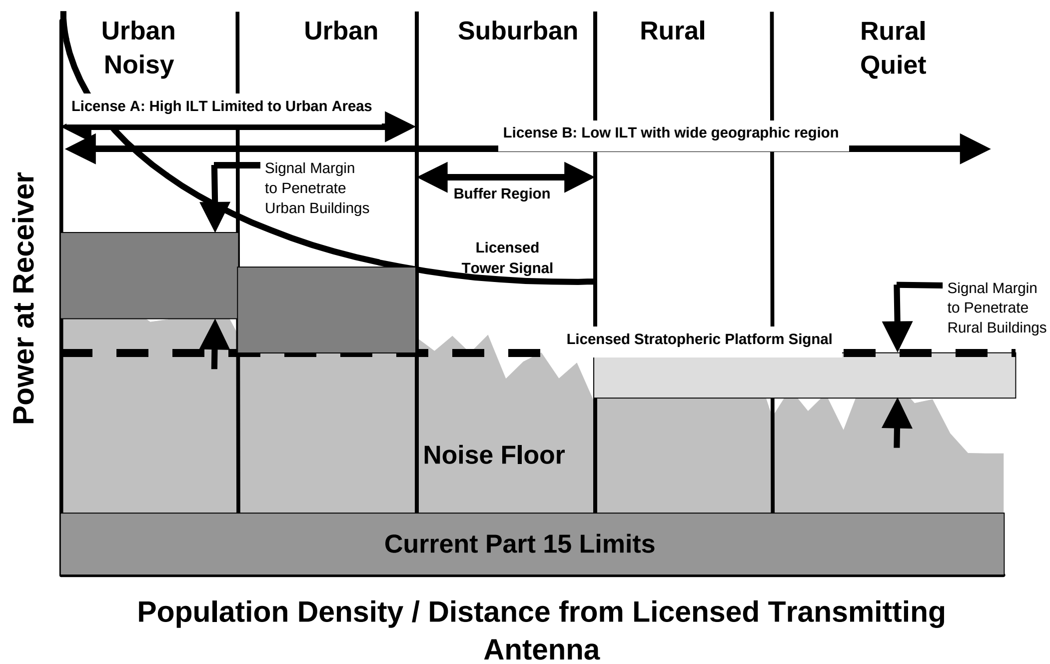
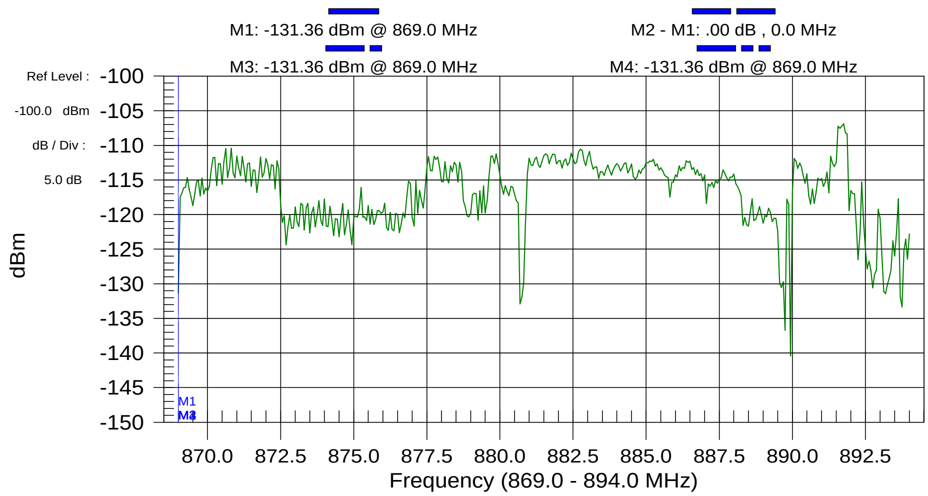
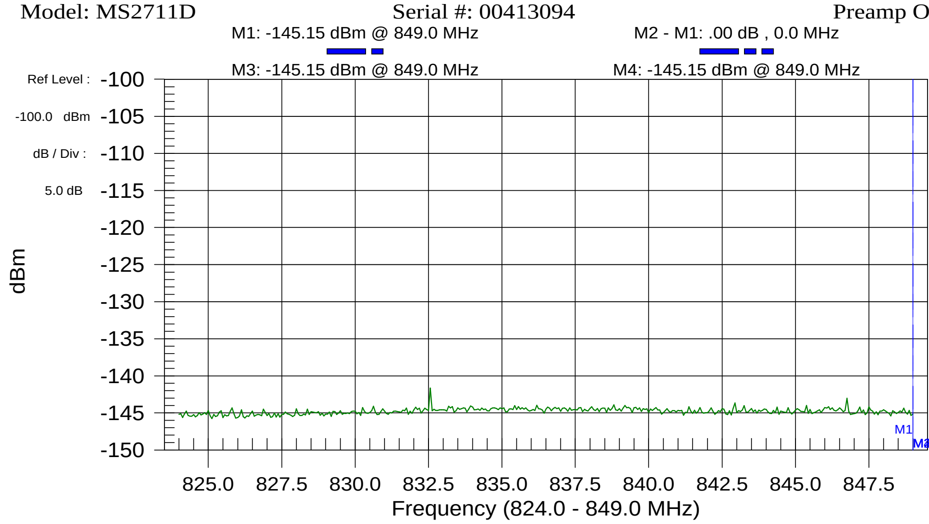


Figure 14: Proposed licensing scheme as related to the Interference Noise Temperature concept.

As long as handsets in the urban core environment using the return frequency are practicing active power control, they would only put out enough power to reach its nearby antenna. The urban carrier, of course, would want to minimize the power of the handsets because the urban environment is interference limited. Additionally, the urban carrier would effectively block the return signals of the urban handsets from significantly interfering with the return signals from rural users. To test this proposition, Space Data used a calibrated Anritsu SpectrumMaster spectrum analyzer to measure the noise floor from an airplane at 26,000 feet over the Atlantic Ocean 60 miles south of Manhattan. Figure 15 shows the cellular spectrum forward and return blocks. Figure 16 shows the BPCS spectrum Block B forward and return channels for a CDMA operator in the New York MTA.



CF: 881.5 MHz SPAN: 25.00 MHz Attenuation: 0 dB
RBW: 100 Hz VBW: 100 Hz Detection: RMS Average
MaxHold: ON
Std: GSM 900-UL Channel: 982
Min Sweep Time: 1.00 Milli Sec
Date: 04/24/2004 Time: 15:37:17
Model: MS2711D Serial #: 00413094 Preamp ON



CF: 836.5 MHz SPAN: 25.00 MHz Attenuation: 0 dB
RBW: 100 Hz VBW: 100 Hz Detection: RMS Average
MaxHold: ON
Min Sweep Time: 1.00 Milli Sec
Date: 04/24/2004 Time: 15:38:45
Model: MS2711D Serial #: 00413094 Preamp ON

Figure 15: Spectrum Analyzer Scan of the Cellular Band from an Airplane 60 miles Southeast of Manhattan. The top plot shows the forward channel and clearly shows the CDMA operator in the B-side frequencies. The bottom plot shows the return channel. Note there is no increase in the noise floor from B-side subscriber transmissions because of the tight power control the CDMA carrier implements on subscriber equipment.

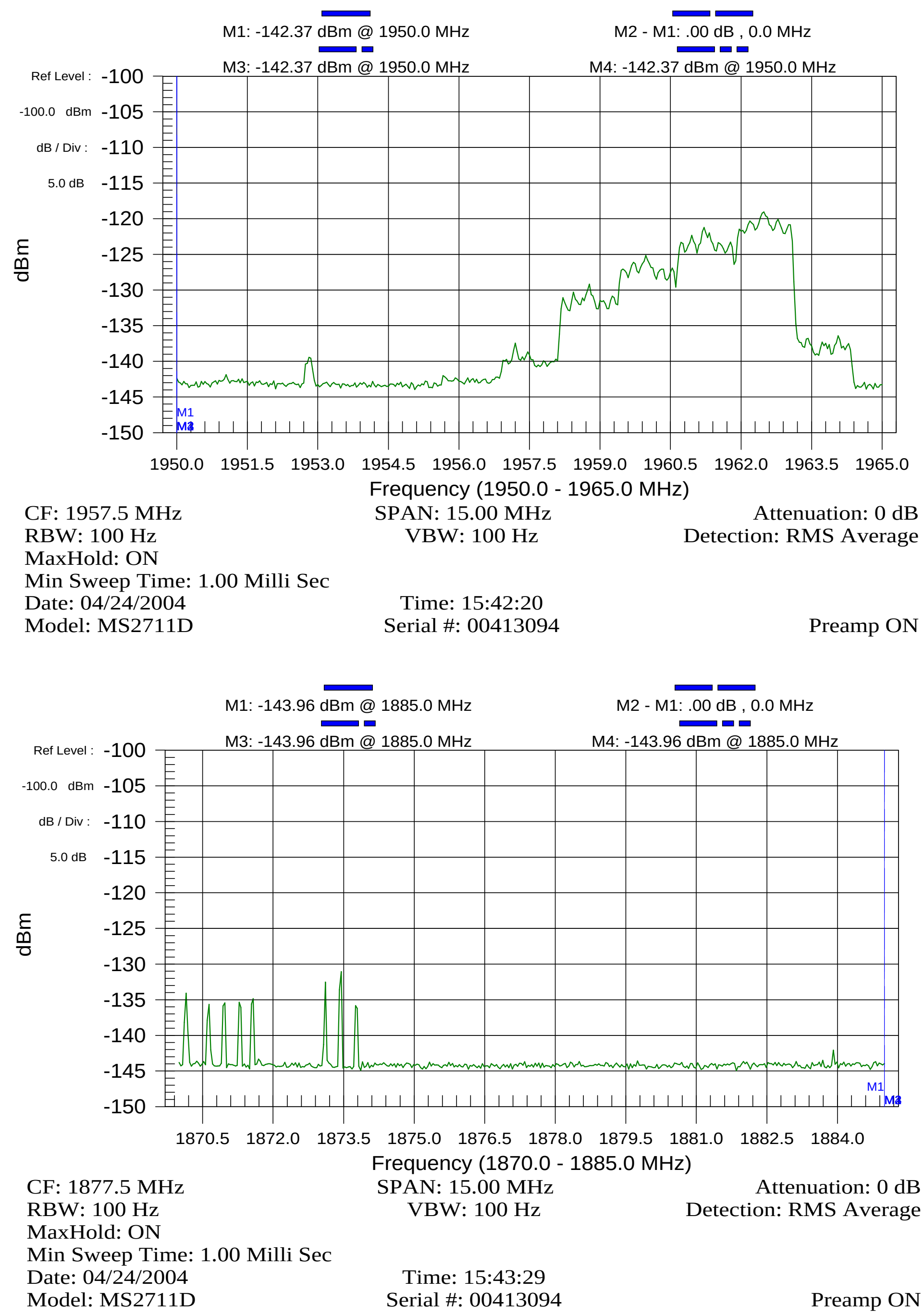


Figure 16: Spectrum Analyzer Scan of the BPCS B Block from an Airplane at 26,000 feet 60 miles Southeast of Manhattan. The top plot shows the 6 forward CDMA channels and clearly shows the CDMA operator in the B block. The bottom plot shows the return channel. Note there is no rise in the noise floor from B Block subscriber transmissions because of the tight power control the CDMA carrier implements on subscriber equipment.

F. Auction Economics Of The Proposed Wide-Area-Underlay/ Urban-Core-Only Licensing Scheme.

Space Data's spectrum assignment proposal, as described above, would maximize the value of the licenses at issue and would benefit U.S. consumers. Under Space Data's proposal, the Commission can auction a nationwide license that it could not otherwise have auctioned without resorting to an Interference Noise Temperature approach. Specifically, the Commission could auction the 30 MHz and 20 MHz licenses on an MTA, BTA or other basis throughout the United States, 10 MHz of which would be assigned on a restricted urban market basis. The Commission then also would auction the 10 MHz the nationwide low Interference Temperature license that would share co-channel frequencies with the 10 MHz urban frequencies. Overall, the license would likely be more valuable due to its nationwide coverage than geographically fragmented licenses that cover only small portions of rural areas and would be a more efficient use of spectrum. The public would benefit not only from the additional monies flowing from the auction, but also from the services provided by the carrier utilizing the nationwide license.

III. THE INTERFERENCE NOISE TEMPERATURE MEASUREMENT GRID COULD BE EFFECTIVELY IMPLEMENTED WITH HIGH ALTITUDE PLATFORMS.

The NOI also encourages commenters to identify other approaches to monitoring Interference Noise Temperature. Space Data suggests that stratospheric platforms may be an ideal platform with which to monitor Interference Noise Temperature. Several commenters argued that an Interference Noise Temperature approach could be problematic because terrestrial monitoring methods would be difficult given that signal paths would often be obstructed by buildings or the geographic landscape.[30] This is much less of a problem if stratospheric platforms monitor Interference Noise Temperature because the platforms have superior line-of-

[30] *See, e.g.*, V-COMM Comments at 47; Sprint Comments at Attachment A, at 13, 14.

sight to wide areas due to their extreme height. Stratospheric platforms also have significant advantages over LEO and GEO satellites because stratospheric platforms have a 34 dB range advantage over LEO satellites and a 66 dB range advantage over GEO satellites. Because stratospheric antennas are much closer to the ground that satellites, it is likely that stratospheric platforms could monitor Interference Noise Temperature with a much better spatial resolution than the spatial resolution provided by a satellite. Also, since stratospheric platforms are located at a high altitude, they also would serve as ideal platforms for broadcasting the Interference Noise Temperature reports to devices needing such information.

IV. CONCLUSION.

A quarter century after the introduction of cellular communications in this country, there are large populations in rural areas do not enjoy the advances in wireless so widely used in urban areas. As Luxon noted, President Bush has recently championed aggressive broadband policy goals to provide broadband access to all Americans by 2006.[31] There are several rural areas of the U.S. where this will simply not be possible without a wireless component.

It was thought in the 1990s that satellites could solve the rural access problem, but they have not. In 1999 the Commission noted that:

> AMSC has also installed public satellite payphones in isolated communities in Arizona so business owners, residents and tourists can communicate with urban centers. The satellite phone represents the only choice today for Tortilla Flat residents and passing tourists who may need to make an emergency phone call. For years, the six permanent residents of Tortilla Flat, Arizona, had to travel 40 minutes to reach the nearest town in order to make a phone call. Today, they and the many tourists that pass through Tortilla Flat can use a public satellite payphone that was installed by International Connectors and Cable Corporation (ICC) and AMSC. The satellite payphone allows Tortilla Flat residents to better manage their restaurant and gift shop and, more importantly, to have

[31] Luxon Comments at 2.

> access to 911 emergency help. The satellite phone booth costs $5,000, and the price for a phone call starts at $1.00-$1.50 per minute.[32]

The satellite payphone hailed by the Commission in Tortilla Flat in 1999 is no longer there. Rather, there is only a hole in the wall where it once existed, and the residents of Tortilla Flat (a town less than 38 miles from the center of the fifth largest city in the country) must still travel 40 minutes to reach the nearest town to make a call. The United States will not be able to deliver on the promise of broadband access to all Americans or provide wireless services to rural and underserved areas without major technological innovations and the regulatory flexibility to implement them. Space Data has been active in identifying and deploying innovative ways to bring modern wireless services to rural America. Accordingly, Space Data respectfully asks the Commission to consider the ideas presented in its reply comments before making new spectrum-based licensing commitments based upon an Interference Noise Temperature metric.

Respectfully submitted,

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May 5, 2004

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[32] *See Extending Wireless Services to Tribal Lands*, Notice of Proposed Rulemaking, 14 FCC Rcd 13679, 13686 and n.37 (1999).

CERTIFICATE OF SERVICE

I, Theresa L. Rollins, hereby certify that a copy of the foregoing **REPLY COMMENTS** has been served this 5th day of May 2004 via electronic mail on the following:

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