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February 20, 2001

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington DC 20554

Re: ET Docket No. 00-258
Notice of Proposed Rule Making and Order, FCC 00-455
Amendment of Part 2 of the Commission's Rules to Allocate Spectrum below 3 GHz for Mobile and Fixed services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems.

Dear Ms. Salas:

The Jet Propulsion Laboratory of the California Institute of Technology would like to file the attached comments with the Federal Communication Commission regarding Third Generation Wireless Systems as contained in ET Docket No. 00-258.

Respectfully submitted,

Gael F. Squibb
Director for Telecommunications and Mission Operations
Jet Propulsion Laboratory

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	ET Docket No. 00-258
Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems	)	
	)	
Petition for Rulemaking of the Cellular Telecommunications Industry Association Concerning Implementation of WRC-2000: Review of Spectrum and Regulatory Requirements for IMT-2000	)	RM-9920
	)	
Amendment of the U.S. Table of Frequency Allocations to Designate the 2500-2520/2670-2690 MHz Frequency Bands for the Mobile-Satellite Service	)	RM-9911

COMMENTS OF THE JET PROPULSION LABORATORY

1. INTRODUCTION

In the Notice of Proposed Rule Making (NPRM) contained in FCC 00-455, the Commission proposes, among other things, to make the 2110-2150 MHz band available to advanced mobile and fixed services and seeks comment on this proposal.

Currently, in the United States, these bands are used primarily for non-Federal Government Fixed and Mobile services licensed under either the Fixed Microwave Service in Part 101 of the

Commission's Rules or the Public Mobile Services under Part 22 of the Rules. However, as noted in Paragraph 53 of the current NPRM, a portion of the 2110-2150 MHz band is also allocated via US252 to the Space Research service on a primary basis[1] and is used by the Deep Space Network (DSN) at Goldstone, California for uplink transmissions to interplanetary spacecraft. Internationally the band segment is allocated in all three ITU regions to Fixed, Mobile, and Space Research (deep space) (Earth-to-space) services and is also used by the DSN tracking stations near Madrid, Spain and Canberra, Australia.

The Jet Propulsion Laboratory (JPL) of the California Institute of Technology is concerned that implementation of IMT-2000 wireless services in the 2110-2120 MHz band would result in interference to IMT-2000 receivers. Interference calculations performed by JPL and submitted to the Commission in this document indicate that the Goldstone DSN facility would require a protected operating zone in southern California of approximately 200 km in radius.

1 A historical note: At a full Commission meeting on February 15, 1961, the Commission considered and approved a February 11, 1961 request from the Director of Telecommunications, Executive Office of the President (EOP), to reallocate the 2110-2120 MHz band so as to permit its use on a primary basis by JPL for Space Research/Deep Space Network communications. Subsequently, the Commission approved the request enabling use of the band at Goldstone with transmitter power up to 100KW, later increased to 400KW. The Commission also specified in Secretary Waple's letter of February 15, 1961 to the Director of Telecommunication/EOP, Mr. F.C.Alexander, that interference protection will not be afforded non-Government licensees from the effects of Deep Space operations at Goldstone. Since that date operations at Goldstone have been effected, supporting Deep Space missions on a primary, co-equal basis, and without any RFI to non-Federal licensees.

2. JPL SPECTRUM USAGE IN THE 2110-2120 MHZ BAND

JPL manages the worldwide DSN and is the lead U.S. center for robotic exploration of the Solar system. The 2110-2120 MHz band provides critical tracking and command up-links from Earth to numerous interplanetary spacecraft. JPL has used this band in support of the National Civil Space Program for over 40 years. This band is currently used for the operation of such flight programs as Voyager 1 and 2, Galileo, Ulysses and Planet B. The band will support such future missions as Mars Express and Rosetta.

The DSN commands spacecraft in deep space over extreme distances, in some cases exceeding 20 Astronomical Units (1 AU is 150 million km, the average distance from the Earth to the Sun). To ensure command link integrity, the DSN tracking stations employ large dish antennas of 34 and 70-meter diameters and high power transmitters radiating up to 400 kW of power. Radiation from these high power transmitters will interfere with IMT-2000 receivers operating in the 2110-2120 MHz band in areas around Goldstone.

3. POTENTIAL RADIO FREQUENCY INTERFERENCE

Considering the very high transmit powers used at Goldstone for uplink transmissions, it is expected that IMT-2000 mobile receivers would experience service disruption in the 2110-2120 MHz band when attempting to operate in areas surrounding the Goldstone site and during uplink transmissions. The severity and duration of such disruption would depend upon the frequency channel assigned to the mobile unit, time and power of transmission at Goldstone, orientation of the transmitting antenna, distance and terrain between Goldstone and the mobile unit, and weather in the area.

In order to assess the geographic extent of this interference potential, JPL has developed a set of

interference contours based upon characteristics of anticipated IMT-2000 receivers, the DSN antennas and high power transmitter, the terrain around Goldstone, and upon ITU propagation models. The latter is as provided in document ITU-R IS.847-1: *"Determination of the coordination area of an Earth station operating with a geostationary space station and using the same frequency band as a system in the terrestrial service."*

Calculation of Potential Interference

Based on the ITU propagation models, transmissions from Goldstone can propagate by three mechanisms in addition to simple line-of-sight propagation. They include diffraction over the spherical Earth and mountaintops, ducting, and rain scattering. Diffraction and ducting happen when signals propagate nearly parallel to the horizon. This phenomenon generally corresponds to coupling through the side lobes of the transmitting antennas. Rain scattering may occur through main lobe coupling.

Using these models, interference power levels and required separation distances surrounding the DSN Goldstone transmitters have been calculated. The distances are those at which the radiation levels from DSN transmissions will exceed the IMT-2000 permissible interference levels for a given percentage of time. In calculating interference power, JPL has used the 70-meter DSN antenna with 400 kW (56 dBW) transmitting power, 62 dBi antenna gain for the main lobe, and -10 dBi gain for side lobes. For the IMT-2000 users, it is assumed that the receiving antenna is omni-directional with a 0 dBi gain. It is also assumed that the permissible interference level is –109 dBm based on UMTS mobile receiver specifications. The rain climatic zone used for the model is ITU region E, which includes Goldstone.

The model calculates for each propagating mechanism the received interference power as a function of distance and percentage of time that the level is exceeded. Of the three mechanisms, rain scattering causes the highest interference during the 1 % of time when the rain is heaviest. This propagation mechanism therefore defines the largest separation distance.

For example, the highest interference power that will be exceeded 1% of time at a receiver 200 km from Goldstone will be –62 dBm, assuming there is no mountain separating the two. This is 47 dB above the permissible interference level of –109 dBm.

Interference Contours Including the Effects of Mountains

A practical interference contour should protect the IMT-2000 users at least 99% of time. JPL therefore examined the interference distance for the worst-case 1% of time. JPL first estimated the interference power due to rain scattering, as it is the major contributor. JPL then estimated the attenuation of mountains using the ITU diffraction model and reduced the interference power accordingly.

For large mountains, which can intercept the path of direct rain cloud illumination, DSN transmission can still be scattered by a rain cloud to a mountaintop, and then diffracted from the mountaintop to the plain on the other side of the mountain. Along this path there is additional attenuation in the combination of propagation mechanisms above the attenuation by rain scattering alone. For large mountains the additional attenuation amounts to more than the 47 dB required for avoiding interference. As a result, for example, the Los Angeles basin is well shielded by the San Bernardino Mountains from the transmission at Goldstone.

Figure 1 presents a contour map showing interference distances (or required separation distances) in all directions around Goldstone. The white contour encloses an area within which a mobile receiver could receive emissions from the DSN site above the threshold of -109 dBm for more than 1% of time. The shades inside the contour represent relative levels of interference at various distances and terrain. In the directions without the shielding of large mountains, as in the deserts southeast and northeast of Goldstone, the interference may propagate further, beyond the white contour.

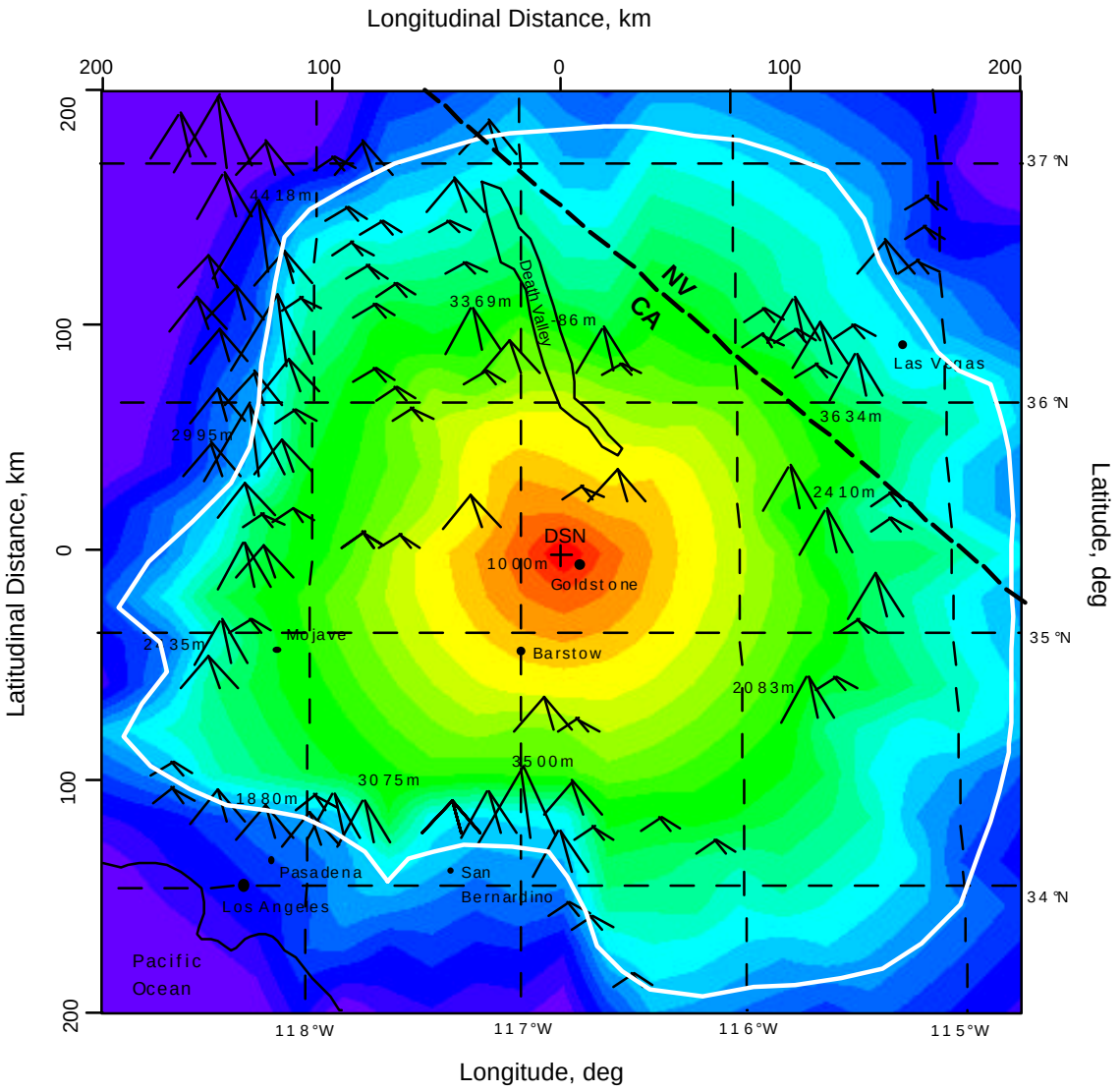

Figure 1. Interference Zones Surrounding DSN station at Goldstone.

For geographic reference, Figure 2 presents the -109 dBm contour map showing cities and highways.

Figure 2. Cities and Highways in the Interference Zone of Goldstone Station

4. SUMMARY

It is expected that interference would occur in the 2110-2120 MHz band to IMT-2000 receivers in the region of southern California and part of Nevada surrounding the JPL facility at Goldstone. The interference contour associated with Goldstone is largely determined by mountains, with a radius of roughly 200-km. Mobile receivers using the 2110-2120 MHz band outside the contour could expect little or no interruption. Probabilities for interference outside the contour are less than 1 % and are lower in areas shielded by large mountains. Receivers in areas not protected by large mountains could expect some interference even outside the contour, as in the deserts southeast and northeast of Goldstone.

It would be very difficult for mobile users inside the contour to time-share the same frequencies with Goldstone transmissions. The Goldstone site operates 24 hours a day, 7 days a week, with transmissions occurring on a daily basis and lasting, on average, 8 hours or longer. These transmission periods, while normally scheduled, can at times be unpredictable because of unplanned spacecraft events.

It is recommended that the 2110-2120 MHz band not be used by 3G or IMT-2000 systems inside the interference contour. Frequencies outside of this band are likely to be adequate to serve the low population density in the areas surrounding Goldstone.

Submitted By:

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