NEW REGULATORY IDEAS AND CONCEPTS IN SPACE TELECOMMUNICATIONS+

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Introduction

Satellite communications is the space activity with the largest impact on society. International cooperation is required for satellite communications because the radio frequencies and earth orbits needed for this activity must be shared by many countries. The International Telecommunication Union (ITU) is the international institution responsible for coordinating global cooperation in the use of satellite frequencies and orbits.[1]

The ITU has developed methods of sharing satellite orbits and frequencies in a manner which are moderately efficient and equitable to countries lacking the current capability to launch satellites. It is hypothesized that the current methods can be improved with an ITU stock market on orbital slots. Under the proposed new method, "orbit/spectrum" shares currently in use would be distributed to all existing satellite system operators. Orbit/spectrum shares not yet in use would be sold by the ITU as a "privatization" action. The ITU would then serve as a clearing-house, or market, for the unrestricted purchase and sale of orbit/spectrum rights.

A fee on transactions, presumably brokered by securities firms as is done in other stock markets, would be established to cover the ITU's budget. This budget includes satellite communications development to aid emerging economies, and is now under downward pressure. New satellite systems would simply purchase at market prices those orbit/spectrum rights required for system implementation.[2] Owners of categories of rights, such as to frequency bands, could elect boards whose task would be to maximize value.

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1 International Telecommunication Union (ITU), Radio Regulations, art. XI (Geneva 1990).

2 The satellite systems may also be insured against certain losses. *See* Cassidy, *Current Status and Prospects for Space Insurance*, 19 J. SPACE L. 166 (1991).

Low earth orbit satellite systems present special additional issues which are addressed separately.

Defining the Stock

We should first ask ourselves "what is a satellite slot?" To be truly accurate would take a long answer, and one of the conclusions is that the term 'slot' itself is rather misleading. Basically, it is a property right in the frequency spectrum, which means it is a legally protected right to use radio waves over a geographic area, and the right to exclude others from technologically degrading the right, such as via radio interference. Perhaps the most unique aspect of a satellite slot is that the geographic area over which the frequency spectrum right extends is almost always at least nationwide, and sometimes global or semi-global. This is much greater than a television or cellular right, which never covers more than one city per license.

The term "slot" devolves from the assignment of satellites to specific orbital locations or orbits, in addition to their band of frequency spectrum. The orbital location limitations decrease the value of the frequency spectrum property right because the same frequencies can be used again, without technological harm, by different satellite systems at different orbital locations. The supply of slots is related to how many frequency bands current technology can transmit/receive from orbit, and how many satellite systems can re-use each frequency band for each portion of the earth's surface.

Slots usually get established in two steps. First, a country awards a satellite license to a prospective satellite operator.[3] Second, the country urges the International Telecommunication Union (ITU) to "recognize" the license by "registering" the satellite system as an official orbit/spectrum "assignment." Although this process takes years, the outcome gives the satellite operator international legal protection from interference with its slot. Since the dawn of the space age in the 1960's, "slot rights" have always been respected.

For example, one satellite slot designation is "100 degrees W.L., Ka-band, Fixed Satellite Service, United States." This designation belongs to the U.S. Government's ACTS satellite, scheduled for 1993 launch by NASA. There is a fairly ample supply of satellite slots under the coverage area of this designation because satellites may be technologically spaced 2 degrees apart at Ka-band for Fixed Satellite Service, and the United States can be "seen well" from orbital locations ranging from 70 to 130 degrees W.L. Hence, whatever value NASA's satellite slot has, there are about 30 more available (the difference between 130 and 70 degrees for U.S. coverage, divided by 2 degrees). The scarcity value would seem low.

As a second, contradictory example, consider the following satellite slot description: "101 degrees W.L., L-band, Land-Mobile Satellite Service,

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3 In the United States this is done through the Federal Communication Commission's satellite licensing process; see 47 C.F.R. § 25 (Oct. 1, 1990).

United States." This designation belongs to American Mobile Satellite Corporation's satellite, scheduled for 1995 launch.[4] It is intended to provide communications to vehicles employing near-omni user terminals. There may be a very limited supply of L-band slots under the coverage area of this designation because the Land Mobile Satellite Service user terminals cannot discriminate well among satellites by orbital location. Hence, only about two such satellite slots could be granted at L-band, per coverage area. The scarcity value is very high in this case, especially as compared to the previous example.

It should be clear the the phrase "satellite slot" is a very general expression, and one must know details about it to assess its value, much the same as would be the case with the phrase "land parcel." This probably just enhances the business mystique of satellite slots since their value is not a commodity, but a consequence of numerous features requiring careful consideration. In short, it is a gamble requiring real skill.

Investor Skills

One of the investors' skills needed to evaluate the satellite slots of the 1990's is passing familiarity with the arcane concepts of "low earth orbit" satellites -- called LEOs for short -- and "spread spectrum" technology -- called Code Division Multiple Access for long. Instead of designating satellite slots by degrees W.L. as is done for geostationary satellites (all that we currently use for communications), LEOs are designated by orbital inclination and distance above the earth. For example, "0 degrees inclination, 1000 miles, 148 MHz, Mobile Satellite Service, Indonesia" designates a proposal to enable two-way paging via satellite in Indonesia using satellites in low earth orbit directly above the equator. This slot could be quite valuable because there may be only five (or less) frequencies such as 148 MHz scheduled to be available for LEO satellite service throughout the world. On the other hand, it may be less valuable if each LEO satellite system serves only a part of the world, such as Indonesia, thereby enabling other LEO satellite systems to use the same frequency to serve different portions of the world.

One other thing to be aware of in assessing slot value is whether more of the same kind of slot can be created via "spread spectrum." For example, the designation "100 degrees W.L., RDSS Band, Aeronautical Satellite Service, United States" was used for the Geostar System when the U.S. Government advised the world of its intention to claim this satellite slot. Since the Aeronautical Satellite Service requires near-omni antennas, it might first appear that this slot was very scarce. As with the Land Mobile Satellite Service discussed above, with near-omni antennas no other satellite slot could usually be assigned without fear of radio interference with the Geostar near-omni antennas. However, due to the technological magic of "spread spectrum" modulation -- used by the Geostar System --

4 American Mobile Satellite Corporation, FCC Gen. Dkt. No. 84-1234 (January 6, 1992) (final decision on remand).

several different satellite systems can use the same frequencies, in the same coverage area, all with near-omni antennas, and still avoid harmful levels of interference with each other.[5] So, the scarcity value of an RDSS slot is reduced by the number of other spread spectrum RDSS systems that can operate over the same coverage area, about 10 for North America. There is a negative though: each spread spectrum system carries much less information than it might otherwise carry with "normal" modulation.

To summarize this brief elaboration on the definition of a satellite slot, consider this checklist of factors:

- Frequency Band -- Defined uniquely or vaguely
- Orbital Location -- Geostationary Longitude, Medium Orbit or LEO Inclination/Altitude
- Coverage Area -- National, Semi-Global or Global
- Service Type -- Antennas require how much satellite spacing
- Modulation -- Spread Spectrum or "Normal" (i.e. TDMA or FDMA)

By this author's count, there are approximately 600 slots nominally available. The exact number is a function of upcoming frequency allocation conferences, ever-changing technological implementation factors, and market penetration considerations.

The Potential for a Satellite Slot Market

The satellite market is impeded by the lack of freely tradeable satellite slot interests, such as stocks and bonds. It is not realistic to expect most sources of capital to become experts on the myriad details of the various satellite businesses. Hence, much business development capital is blocked from the capital-starved satellite industry. If a satellite slot market did exist, capital would flow much more easily into the satellite industry. The result would be a greater practical utilization of satellite slots to the ultimate benefit of all consumers.[6]

A satellite slot market could be created by the International Telecommunication Union defining a set of roughly 600 slots. Avoidance of interference between slots, when this issue arises, would be settled with standard frequency coordination procedures. Slot rights could be broken down into small enough fractional pieces so that many individuals or small companies and countries could afford to purchase interests. The majority of holders of slot rights could elect a Board of Directors which would in turn make decisions on the rental or sales price for the slot. Some slot boards would appoint managers to find the most valuable use for the slots, and thereby maximize the payoff to the holders of slot rights.

5 For details, *see* MARTIN ROTHBLATT, RADIODETERMINATION SATELLITE SERVICES AND STANDARDS (Artech House 1987).

6 U.S. DEPARTMENT OF COMMERCE, NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, U.S. SPECTRUM MANAGEMENT POLICY; AGENDA FOR THE FUTURE 97-125 (1991).

The ITU could reserve for itself valuable jobs akin to those performed by the New York Stock Exchange today. These tasks would include serving as a clearinghouse for the sales of slot rights and arbitrating many disputes. Fees charged by the ITU for providing a slot market could be cloaked in the mantle of a value tax, thereby both supporting the ITU and providing it with a source of funds for pursuing global telecommunications development.

Although it is very difficult to envision the ITU or its member States embracing a satellite slot market, there is now a rare opportunity for such a bold move to be accomplished. The ITU has consented to looking into a major revision of its structure and has formed an important High Level Committee consisting of telecom experts from around the world to perform this task. The changes are expected to be accomplished by the mid-1990's. With the world's gradual recognition of the intrinsic benefits of business over bureaucracy, and of commerce over command decisions, perhaps now is the time to forge a satellite slot market as a new model for global resource development in the new millenium.

Special Considerations Unique to Low Earth Orbit Satellites

Much attention in the space community has recently focused on low earth orbit satellite communications systems as an alternative to the geostationary paradigm. Advantages attributed to low earth orbit systems include reduced launch expense, greater modularity, much less expensive user terminals, global service capability, and improved system characteristics for mobile communications.[7] These new low earth orbit systems also raise unique institutional and regulatory issues. It is not clear, for example, whether low earth orbit satellite systems require separate frequency allocations or can share in other satellite service spectrums. It is also not clear how equitable access to low earth orbit frequencies can be accommodated since each system has global coverage, making problematic the current regime of sharing orbit/spectrum by national geography.

The First Commercial Low Earth Orbit System

In early 1987, Geostar Corporation inaugurated the first commercial low earth orbit satellite communications service. Known as "System 1", Geostar equipped some 400 trucks and boats with palm-size transmitters capable of operating at a VHF band. Transmissions were relayed via two VHF payloads carried on the polar-orbiting NOAA satellite. The Geostar System 1 was so successful that two stolen trucks were recovered via the inherent position tracking capabilities of low earth orbit satellites.[8]

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7 Notice of Proposed Rulemaking, ET Docket No. 91-280, October 18, 1991 (FCC's proposed authorization of low earth orbit satellites).

8 ENCYCLOPEDIA BRITTANICA, *Yearbook of Science* (1988).

Geostar's System 1 presented unique legal questions because the VHF frequencies it used were reserved primarily for meteorological purposes. Nevertheless, authority was granted to Geostar for truck-tracking by the U.S. Department of Commerce to show the potential of such technology.

Eventually, Geostar transferred all of its users to its System 2, which was based on geostationary satellites operating at much higher frequencies. The geostationary satellites offered more continuous service and much higher data throughout capacity. Nevertheless, the commercial feasibility of low earth orbit communications satellites had been proven.

The Second Batch of Low Earth Orbit Systems

During 1990, within a few months of each other, four U.S. companies submitted proposals to the U.S. Federal Communications Commission (FCC) to receive and expand upon the Geostar System 1 concept. The first two companies, Orbital Communications (a subsidiary of rocket pioneer Orbital Sciences) and StarSys, Inc. (a subsidiary of a group of French banks and scientific industries) proposed expensive, $200 million constellations of sophisticated but small satellites. The other two companies, Leosat Corporation and VITA Corporation, proposed low-cost lightsats costing only $1 million each to build and launch. The FCC has now proposed to license all of these systems in new VHF frequencies, taken from governmental users, sometime in mid-1992.

The market focus of the second batch of low earth orbit satellite systems is to provide brief, two-way, alphanumeric communications anywhere in the world to low-cost (less than $100) user terminals. The user terminals can be inexpensive because they need output only 2 or 3 watts of power to reach the low earth satellites, compared to 20-40 watts needed to reach high orbit satellites. Also, by using the VHF band, it is possible to access the satellite via a standard car or truck FM radio antenna.

Each of the four possible system operators in the second batch of VHF low earth orbit firms has a unique market segment in mind. Leosat Corporation has focused on the Intelligent Vehicle Highway System,[9] whereas Orbital Communications has focused on handheld messaging terminals. StarSys highlights its environmental data collection capabilities while Vita emphasizes its ability to deliver electronic mail to researchers in Third World countries.

The second batch of low earth orbit satellite communications companies appear likely to be approved because they present few

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9 The Intelligent Vehicle Highway System is a concept for automated traffic control and collision avoidance on a country's highways by using computer, communications, navigation and radar technology. *See* Sheldrick, "*Driving While Automated: Planning Smart Highways for Tomorrow's Smart Cars,*" 263 SCI. AM. 86 (1990).

regulatory problems. Each of the companies plan to cooperate with national authorities for selling service to users within each country.

Third Wave of Low Earth Orbit Satellites

During late 1990 and through mid-1991, a third wave of super-sophisticated low earth orbit proposals was announced. Led by a Motorola proposal called "Iridium", and followed by an Inmarsat concept called "Project 21", these satellite systems would all cost in excess of $1 billion, and would go far beyond the limited capability of Geostar's System 1.

The third wave of proposals all were designed to operate near the microwave frequency band and to provide normal cellular-phone type telecom service anywhere in the world. The third wave concepts involved many dozens of satellites, and global consortia rivalling traditional international organizations in size and scope.

The third wave of low earth orbit satellite proposals raise unique institutional and regulatory issues because they provide a central telecom service (voice communications), as compared to the more peripheral importance of position tracking services, or alphanumeric data messaging -- the traditional uses of low earth orbit satellites. A further concern is that there is not enough orbit/spectrum to accommodate all of the third wave proposals.

Notwithstanding the need to create appropriate regulatory and institutional structures for the advanced low earth orbit systems, it appears to be fairly certain that there are no major legal roadblocks. The experience of the world with global satellite communication has been quite positive.[10] The advanced technology of third wave low earth orbit satellites simply reduces the size of a satellite earth station until it is no larger than a cellular telephone. While telecom authorities may be reluctant to permit satellite cellphones to bypass their national networks, as a practical matter, there would be no way to enforce any kind of restriction for long.

Differences From Geostationary Satellites

Low earth orbit satellites do not remain stationary over a single portion of the earth's surface; geostationary satellites do. The single difference makes it impractical for low earth orbit satellites to be "domestic-service" only, and hence presupposes an internationally coordinated legal regime.

The international legal regime for low earth satellites can be limited to technical regulation, or could require the active approval of each country being radiated. The latter case applies to most other international satellite systems. It is suggested that low earth orbit satellites be

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10 *See, e.g.,* Samara, *Space Law and the Development of International Business: Implementing a Satellite Sound Broadcasting Service,* 33 PROC. COLLOQ. L. OUTER SPACE 74 (1991).

considered approved for worldwide use so long as they meet a set of internationally agreed-upon technical criteria. If active approval of many countries were required, low earth satellite systems may be blocked.[11]

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11 *See, e.g.*, WARC-92 Doc. 97-E, Proposal of the Federal Republic of Nigeria for the work of the Conference, 5 Feb. 1992:

> There is considerable doubt as to whether LEO and GEO systems can operate co-channel. Most non-GEO systems in operation today share by band segmentation (e.g. GPS and GLONASS). If multiple LEO systems cannot share co-channel then the first LEO system to occupy a frequency band will preclude any other administration's LEO system. This situation may be contrary to the principle of equitable access.
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> Article 11 is based upon quantitative sharing of criteria for GEO systems. Such criteria do not yet exist for LEO systems. Thus, Article 11 cannot yet logically apply to bands open to LEO systems.
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> Article 14 provides an approach to identify a frequency band for a new satellite service, but not permit the band to be used in derogation of the rights of other administrations with plans to implement the new satellite service. Once coordination of subsequent satellite systems can be assured, it will be possible to assure the coordination of multiple LEO systems in an MSS band. Implementation of such systems should be subject to Article 14.