Slicing the Geostationary Pie

Property Rights in Orbit

Molly K. Macauley and Paul R. Portney

THERE MAY BE NO free lunch, but dessert is on the house at the Federal Communications Commission (FCC). For the second time in twelve months, the commission is about to give away a large number of shares of an outer-space resource that has become a mouth-watering delicacy to the telecommunications industry. But deciding who gets pieces of the pie is not easy. It requires the commission to assess and compare the technological sophistication, financial viability, and commitment to the "public interest" of all applicants—which, this time around, total twenty-one telecommunications providers and would-be providers. Nor is it really a "free" giveaway, even though users do not pay for the resource. In fact, the FCC's generosity may soon force every American business and household having a telephone, TV, radio, or computer modem to pay needlessly high rates for services.

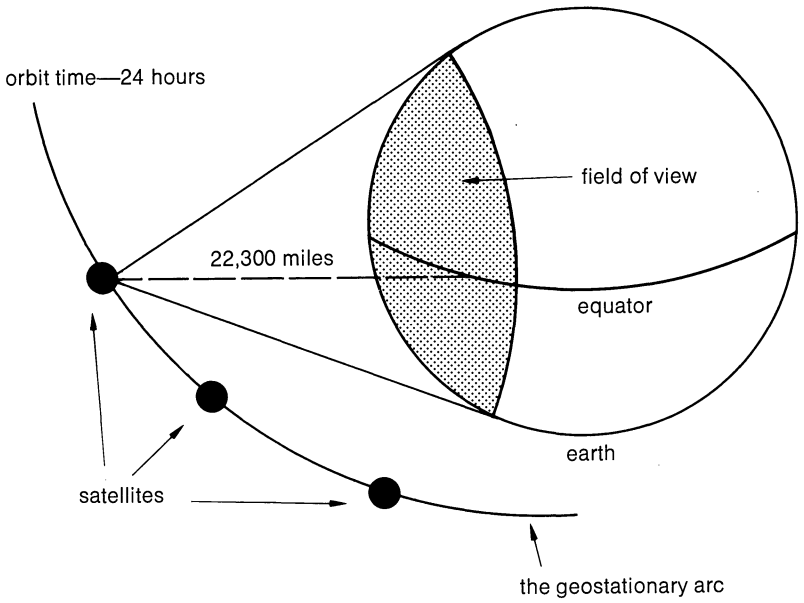
If the FCC were willing to organize a market for this extraterrestrial resource, it could overcome both difficulties. A market would be much easier to administer than the current system of bureaucratic allocation and would ensure that the price of most communications services fairly reflects their costs. So far, however, the commissioners have yet to endorse the sale rather than the rationing of their wares.

Molly K. Macauley is a fellow and Paul R. Portney is a senior fellow at Resources for the Future, Washington, D.C.

The Pie in the Sky

The commission's five-star confection is the "geostationary arc," a precise orbit in space where most communications satellites prefer to locate. The arc is a tire-like ring positioned around the equator about 22,300 miles from earth (see diagram). When a satellite occupies such an orbit, its velocity not only perfectly offsets the earth's gravitational pull, but also exactly matches the twenty-four-hour rotation of the earth. The orbiting satellite thus appears from earth to be stationary. This in turn allows earth stations (the large transmitting and receiving "dishes" that dot the landscape) to aim their antennae only once, at the always-in-view geostationary satellite. Because of the curvature of the earth, a single satellite can keep only a portion of the earth's surface in view—which means that earth stations as far apart as Maine and Alaska, but not further, can communicate with each other.

A satellite in any other orbit, by contrast, is not always in the view of the same two sta-



tions because it disappears below the horizon much of the time. In order to maintain continuous communications in this latter case, numerous satellites would be required (up to one hundred according to some estimates) along with complex earth stations having movable antennae that track the path of the satellites across the sky. Such a system would be extremely costly. Consequently, the most common alternative to geostationary satellites is terrestrial microwave facilities. For long-distance telephone communications, these consist of a network of transmitters, amplifiers, and relay stations spaced every 30 miles along the earth's surface. If the distances involved are greater than about 900 miles, using this sort of system for telephone transmission is more expensive than using a satellite in the arc. In fact, a nationwide long-distance telephone network using several geostationary satellites able to "see" the entire United States could save its owners as much as $500 million a year compared to a spider's web of terrestrial microwaves across the continent.

The usefulness of a slot in the geostationary arc is therefore obvious, and satellites occupying such slots are already providing us with a large and growing variety of services. Live television transmission via satellite began two decades ago, with the Tokyo summer Olympic games, and by now most live TV coverage is routinely beamed by satellite, as are popular cable network programs and radio broadcasts. Cloud-cover pictures on the evening news come from government-owned and -operated satellites located in the arc just off the east and west coasts. Moreover, 1985 will mark the twentieth anniversary of the use of satellites in telephony, a use likely to intensify given the vigorous competition developing in long-distance services. Finally, the arc is now home to satellites beaming newspaper copy and other text to regional printing offices. It is estimated that the services provided by satellites in the arc will gross as much as $10 billion in worldwide sales by 1990.

But the arc can accommodate only a finite number of satellites. At any given time, that number is limited both by current telecommunications technology and (as we shall see) by the mechanism the government uses to apportion them. Of the more than 200 satellites currently and soon to be stationed in the arc, about 60 percent will be parked in less than one-third of its length, along those parts either viewable by the United States or situated over the Atlantic Ocean so as to link the United States and Europe. Some seventy applications for slots above the United States (including ten renew-

als) have been pending before the FCC since November 1983. Under present ground rules, these demands would more than exhaust the capacity of this part of the arc. With crowding becoming so serious a problem, the FCC opened a rulemaking six months ago to study and perhaps revise the ground rules and related policies.

Slicing the Pie

A hierarchy of authorities determines who gets which slices of the arc. First, the United Nations' International Telecommunications Union (ITU)—through global, regional, and even bilateral meetings—divvies up the worldwide arc. Since slots in the arc with a view of the United States are also ideal locations for both Canada and the nations of Central and South America, competition for them through the ITU is especially keen. As for U.S. use of the arc, the Commerce Department's National Telecommunications and Information Administration (NTIA) coordinates allocations for defense, weather, and other U.S. government purposes, while the FCC has the task of making allocations to U.S. domestic commercial users.

Actually, under current practice, the FCC must do more than just allot a fixed number of slots to applicants. It must also decide *how many* slots to allow in the stretch of the arc of interest to commercial users. This question arises because Mother Nature and the FCC's response to her whims impose constraints on the allowable spacing between satellites. For one thing, geostationary satellites tend to wander somewhat in their orbits due to solar and lunar perturbations. To reduce the chances of a collision, the FCC requires satellites to maintain a separation of one-tenth of a degree, or about forty-seven miles. That may be overly conservative. Even if satellites were spaced more closely, the chances of a collision would be infinitesimally small.

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The binding constraint, however, is a second one—interference. If satellites were situated only 47 miles apart in the arc, they could not communicate at the same time on the same frequency without interfering with each other's signals. This interference problem might not be very serious if satellites could use many different frequencies, but the FCC has allocated only a small chunk of the frequency spectrum for satellite use (see *Regulation*, May/June 1983). Because of this frequency crowding, the FCC has had to rely on wide spacing. In August 1983, after it had been flooded with slot requests, the FCC cut its previous minimum spacing in half to 800 miles, where it stands today. By freeing up more spectrum for their use, the commission could reduce the spacing between satellites and thereby increase the number of arc slots.

Once it has decided on slot-widths, how then does the FCC choose among commercial applicants for these valuable pieces of galactic real estate? How does it decide between an application for expanded service from a well-established satellite company and one for unique services from an entrepreneurial newcomer? It does so in much the same way that it allocates the electromagnetic spectrum to conventional radio and TV broadcasters or that the Interstate Commerce Commission awards new routes to truckers: through an administrative process known as "allocation under a public interest standard." And as in the case of traditional trucking regulation, the competing applicants can file long briefs explaining why their rivals should not get the slots. The decision process customarily takes little heed of either the value of a slot to competitors or the economic benefits to consumers.

This creates a nightmarish regulatory dilemma. What criteria best measure the "public interest"? In a succession of rulings, the FCC has imposed a number of standards on applicants. These have ranged from requiring "prompt and efficient utilization of orbital locations," through prohibiting excess capacity and specifying particular technical requirements, to insisting that contestants for slots demonstrate "financial viability." No one doubts that these and other criteria have something to do with the public interest. Unfortunately, as in the case of transportation regulation, each criterion generates a different rank-

ing of applicants. So the final selection from among competing applicants cannot but appear arbitrary.

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A major problem is that the FCC's allocation procedure encourages firms to apply for slots merely on speculation they can use them. In both the 1983 and current rounds of slot allocations, the commission imposed a cut-off date for submitting slot applications—a practice that naturally tends to create a land-rush mentality among applicants. And since applicants pay nothing for a slot (save for the cost of preparing an application), they lose nothing if they receive one they fail to use. Consumers, of course, *do* lose if there are viable current uses for a claimed but unoccupied slot. At least one industry participant has expressed for the record what must be common talk in the locker room—that many of the seventy-odd applications are filed on behalf of systems that could never obtain sufficient financing to be built.

Consider how the FCC, faced with a deluge of applicants, goes about determining financial viability. As some applicants have pointed out, it is hard to secure firm financial commitments when prospects for success are unsure and subject to time-consuming deliberations at the FCC. Sympathetic to this bind, the FCC has in the past issued conditional satellite construction permits that give applicants a slot provided they adhere to a schedule on financing, construction, and so forth. However, monitoring applicants' progress step by step imposes added administrative costs on the FCC's already overburdened staff. And the process can also open up Pandora's box for traditional regulators at the FCC. In one recent case a conditional applicant, in a creative effort to secure financial commitments from an experienced incumbent in the arc, promised to swap some of its satellite capacity in exchange. Other firms in the industry promptly accused the conditional applicant of "trafficking" in permits—one of the worst sins in the regulatory syllabus.

Such entrepreneurship or, if you prefer, trafficking is a sure sign that a market is bubbling not far beneath the surface. It is worth spelling out what such a market in arc slots would imply.

How the Arc Could be Marketed

In this area of economic regulation, unlike many others, there is no question that government must play a basic role. If the government were to permit a market without first defining property rights in the arc and creating a mechanism to enforce them, it is unlikely that the arc would be allocated efficiently. Users could launch and operate new satellites without having to pay for their interference with other users (which would be a sort of pollution "externality"). Sooner or later, not only would there be too many users, but each of them would have reason to increase its transmission volume in an attempt to drown out its neighbors. Such an outcome could hardly be deemed efficient by any economic standard.

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After its initial definition of noninterfering slot boundaries, the FCC could ensure a vigorous market for subsequent arc use in one of two ways. It could either simply parcel out arc slots that would not interfere with each other and then sell or rent each of them to private users. Or it could auction off or rent out smaller units of arc, such as individual degrees, letting individual companies assemble as many degrees as they wished to form a slot. The alternatives are like those a developer faces in dividing and selling a large tract of land, where each subdeveloper must somehow be deterred from spoiling the land purchased by other subdevelopers (say, by blocking the view). The first solution is to "internalize" these undesirable effects—that is, sell indivisible tracts large enough so that nothing one owner does could possibly affect another. The second solution is

to allow any configuration of purchases and to rely on special contracts or zoning rules to prevent negative spill-over effects. The FCC could implement the latter solution by technically defining a maximum level of interference allowable at the boundaries of any individual user's position of arc. Companies could then assemble slots of any size subject only to this rule.

These principles are hardly unusual. The government already limits commercial and other access to so-called common property resources such as underground aquifers and grazing lands, and it already collects revenues from the sale or lease of minerals, timber, and oil and gas (both offshore and on). If objections should arise as to the legitimacy of the government's claim to "own" the geostationary arc in the first place, initial arc slots could continue to be given for free as they are now or, for that matter, they could be distributed by lottery. The important point is that a secondary market be allowed to form so that present and prospective slot occupants would begin to confront the true opportunity costs of their actions. Such a market would, of course, be subject to the interference constraints discussed above.

An appropriately designed arc market would provide a number of other important advantages. Slots would tend to be allocated to their most efficient uses, since bids for sale and resale would reflect each firm's best-informed estimate of the consumer demand for its services. Such an approach would put to the real test—the market test—the financial viability of firms, and an ideal laboratory would be substituted for bureaucratic speculation. Creating a market could also end the land rush each time new slots go up for grabs, since new users could gain access (at a price) to the arc at any time. Incentives to stake out "free claims" would disappear.

Still more important are the benefits that would accrue over the longer haul. As noted, certain locations in the arc—especially those that have a full view of the United States—are much more desirable than others. Pricing would inevitably reflect the locational value of these sought-after slots, much as urban land values rise from block to block as one nears a downtown area. This would in turn spur innovation to take advantage of scarce locations. Just as the pressure of real estate prices gives rise to skyscrapers in terrestrial central business districts, so the most valuable arc slots might become home to multi-antennaed, high-capacity space telecommunications platforms designed to economize on arc. Some of these large platforms ("earthscrapers"!), designed to be arc-chintzy, are already on engineers' drawing boards. An arc market would hasten their development and manufacture.

Innovation in the mitigation of interference would also be encouraged. Just as the other inputs to signal reception have price tags—from the smoothness of the dish (surface imperfections cause "noise") to the sophistication of the electronics—so too should signal inaccuracy. The higher the rent for an arc slot, the more diligently designers would seek to eliminate noise. A company skilled in interference mitigation might find room to "squeeze" into a slot that was heretofore believed unusable because of potential interference. In fact, an arc market would also spur innovation in terrestrial technologies. The FCC's current practice of dispensing valuable arc locations free of charge has implicitly undercut innovation in fiber optics and terrestrial microwave communications systems, both of which must pay for their rights of way. An arc market would correct this inequity and stimulate innovation in earth-bound telecommunications.

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What disadvantages might attend the creation of a market for arc? Perhaps the most daunting problem would be the transition from the current system of allocation. Existing satellite companies would hardly be eager to pay for what they now enjoy free of charge, and potential new entrants are geared up for administrative rationing rather than market bidding. Other regulatory areas, however, offer encouraging precedents for change. The airlines have had little trouble figuring out, and prospering from, experimental marketing of airport landing slots. Likewise, industrial firms caught on

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ternal Revenue Service must now attempt to determine, first, what constitutes racial discrimination, and second, what institutions besides schools and what evils besides racial discrimination should fall within the scope of the public policy rule. Further, the service must decide what are the ripple effects of an exemption denial: do students lose the tax exclusion of their scholarships, faculty the exclusion of their fellowships, and parents the exemption for student dependents? And how should the service measure the taxable "income" of a school that does not pursue profit? Stephan warns that the sanction may result in disastrous consequences for heavily endowed schools guilty of minor acts of discrimination, but impose few costs on hard-core segregated schools that rely for support principally on tuition rather than donations.

There is nothing sacred about tax law, the author says, and no intrinsic reason why revenue collection should be the only purpose that taxation serves. But in a society where an ever-growing public sector requires ever-increasing taxation for its support, the scope of a public policy rule can only become wider and wider, in both range of application and devastating impact on targets.

> *Bob Jones* reflects a simplistic belief that the government, when confronted with something bad (whether illegal or immoral is unimportant), must attack the offending act with every resource at its disposal. The conviction that withholding any potential means of attacking a problem demonstrates a lack of commitment to its solution suffers from two flaws. First, it ignores the possibility that some agencies of government may have comparative advantages as prosecutors of particular policy violations. Second, it ignores the fact that the failure to mold a penalty system to match the policy it enforces has both moral and welfare costs. *Bob Jones* illustrates each of these flaws.

Thus, if only implicitly for the time being, the Court's opinion invites the Treasury and the courts to develop a public policy overlay for every tax rule whose role in defining the base of taxation is not immediately apparent. This, Stephan says, is what makes the case important and the outcome regrettable.

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quickly and recouped sizable benefits when the Environmental Protection Agency adopted its bubble, offset, and emissions banking programs. Once restraints on arc were lifted, it is a safe bet that a healthy market would soon emerge.

The transition might be more politically acceptable if, like radio and television broadcasters, satellite firms continued to receive their slots free of charge, but could sell them after that. This would, of course, confer substantial rents on the firms that get free slots—rents that would accrue to the public if the government were to claim ownership of the arc sectors allocated to it through the ITU. One solution to this problem would be to require every firm to buy its slot whenever it replaced its existing satellite. This method would also soften somewhat the financial shock to incumbent slot holders who would incur huge unexpected costs if they suddenly had to compete in an auction for the slots they were already using. And since the life of a typical satellite is about seven years, the transition to a market system would not take long to complete.

Another fear might be that firms or consortia might succeed in monopolizing slots (just as some have worried that marketable air pollution permits could be "cornered" in particular regions). As an aside, note that this problem is not unique to market processes—for FCC decisions have themselves tended to distribute more new slots to incumbents than to newcomers. Under a market scheme, judicious application of antitrust laws should be sufficient to guard against undue market power in the arc. Ultimately, of course, the threat of monopoly will be curbed by the increasing competitiveness of alternative technologies, such as fiber optics and terrestrial microwave.

Finally, there is the argument that pricing the arc will make telecommunications services more costly. This is not necessarily so. Much of the current demand for slots is no doubt due to their zero price—that is, there may be fewer serious bidders once they must put their money where their applications are. In addition, pricing the arc might call forth the kinds of technical innovations that have resulted in constantly falling prices for hand calculators, per-

sonal computers, and a host of other products or services. And if—once a market is working—prices *do* increase, they will be reflecting the true social costs of telecommunications services.

Pie à la Monde?

FCC allocation, as mentioned earlier, is only a final level in the overall administration of the worldwide arc. If a strong case exists for marketing the geostationary arc to U.S. users, perhaps there is an equally strong case for marketing it to international users.

To be sure, persuading the United Nations' ITU to adopt or allow a market approach would be no easy matter. For one thing, some equatorial nations have long argued that if the arc belongs to anyone, it belongs to them by virtue of their locations. More fundamentally, the Outer Space Treaty of 1967, drafted under the auspices of the ITU, implies that the geostationary arc is not really private property at all and cannot "belong" to a nation, much less to a firm: it is another of that growing collection of places and things claimed as "the province of all mankind." In recent years, the multilateral negotiations over the arc have become increasingly politicized along the rancorous lines of the Law of the Sea discussions. There is an important difference between the seas and the arc, however, that augurs well for a global arc market. Although ocean resources (in theory) are not renewable, the geostationary orbit is forever pristine. It cannot be depleted or degraded by the use of satellites. Once their lifetimes end, they can simply be boosted out of the arc.

Next summer in Geneva the ITU will convene the Space World Administrative Radio Conference to allocate additional degrees of arc among competing nations. Suppose the ITU were persuaded to make its initial allocation of the arc to all member countries via political negotiations, as intended, but then to make the resulting slots rentable (though inalienable). This should meet the demand of equatorial and less developed countries that they start on an equal political footing with the technologically advanced nations and that their national rights not be "sold away" (even by themselves). And with a market in arc rental permitted, a less-developed country would be able to lease its slot to any country or firm having the technology to use it, perhaps for the seven or so years that the satellite would be functional. Lessor nations could then, if they wished, use the rental income to develop their own telecommunications network, and could later occupy their slots with their own (or purchased) satellites. Alternatively, they could continue to lease out arc space so long as it was economically advantageous to them to do so.

In our view, organizing such an international market is far preferable to recent proposals that the United States tilt its system of sugar import quotas toward certain equatorial countries in exchange for arc access. The economic advantages of the market alternative are self-evident (who can calculate how sweet the arc is? why further distort agricultural markets?).

Recently the United States has been eager to promote the virtues of competitive markets, especially to nonaligned and developing countries. The FCC now has a golden opportunity to foster the spirit of deregulation both at home and abroad. Surely the commission would like to settle its policy on arc disposal before next summer's international conference, if only to arm our delegation with proof that we are willing to abide by our own principles. Indeed, a U.S. domestic market for arc would have substantial demonstration value to the ITU and just might help pave the way for a global experiment along the same lines. If actions speak louder than words, some FCC action on the arc would well serve pie *à la monde.* ■

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