E-Auctioning by The U.S. Federal Communications Commission

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INTRODUCTION

Market economies rest on a foundation of the private ownership of resources. Certain resources, however, have been managed outside of the market mechanism, even in the United States' decidedly pro-free-market economy. The management of radio frequencies, or spectrum, is a prime example of government control of a valuable resource. Spectrum management is practiced by governments around the globe, and the experience of the U.S. Federal Communications Commission (FCC) provides a valuable illustration of how management of this resource may be improved through the use of electronic resources.

BACKGROUND

The portion of the electromagnetic spectrum consisting of the frequencies ranging from 3 kilohertz (KHz) to 300 gigahertz (GHz), commonly known as radio frequencies, represents a natural resource that may be exploited through technological means. When considered in the context of other naturally occurring resources, radio frequencies are unique. On a geographic basis, radio frequencies are limited but are uniformly distributed. As long as the strength of the radio signal is controlled, the same amount of radio frequency is available per square mile in the U.S., Uganda, or any other nation. Each nation must live with what is available within its borders; the import and export of radio frequencies is not possible. While the resource is limited, it is continuously renewable—each frequency becomes available again at each new moment in time.

In addition to the geographically limited nature of the resource, various portions of the radio-frequency spectrum have properties that affect their usefulness. As the frequency of a radio wave increases, the wavelength decreases. Smaller wavelengths have a higher likelihood of being deflected by physical objects such as buildings, foliage, or even water droplets in the atmosphere in the form of rain, snow, or fog. Longer wavelengths easily can penetrate objects. These differences in the physical properties of spectrum make certain frequency ranges more useful (and more valuable) than others. The differences in the quality of spectrum place further impetus for management of the resource. By matching the performance needs of a technology with a spectrum range, the resource can be used more effectively. For example, broadcast radio, which may encounter significant environmental barriers associated with mobile receiving units (in automobiles) or stationary receiving units (inside dwellings) benefits from the use of relatively longer wavelengths associated with the AM and FM frequency bands. On the other hand, satellite-to-earth transmission can rely on a fixed ground station antenna that can be oriented skyward to avoid physical barriers such as walls and trees and, thus, can perform well with relatively shorter wavelengths associated with higher frequencies.

Concerns regarding interference between competing users of spectrum have been the prime motivation for strict control of most of radio-frequency resources (Noam, 1998). Analog technologies, which were associated with early radio-frequency applications, suffered functional degradation if they were not guaranteed the exclusive use of a specific radio frequency. Thus, management of radio frequencies by the FCC and other governmental bodies around the globe traditionally are based on an approach that systematically organizes the spectrum resource into logical groupings and then assigns exclusive rights to use the spectrum to certain individuals or organizations.

U.S. POLICY AND SPECTRUM MANAGEMENT

In order ro facilitate the management of spectrum in the U.S., the entire range of radio frequencies is divided into bands or blocks that are associated with specific applications or technologies, such as broadcast television or cellular telephones. These divisions are known as allocations. Within the allocation of radio frequency, the bands face further subdivision, known as allotments. Allotments are associated with a specific geographic area; for example, a specific frequency to be used as a television channel in a specific metropolitan area or a frequency to be used by cellular telephone companies in a rural area. With these divisions, the spectrum then may be assigned,

or licensed. The grant of a license gives the user the ability to provide the specified service in the geographic area and may impose additional conditions on the use of the radio frequencies, including the type of technology (analog vs. digital) and the strength of the signal.

Assigning Spectrum in the U.S.

While economists have advocated private property rights for spectrum for years (Coase, 1965), U.S. law prohibits private ownership of spectrum (Shelanski & Huber, 1998). Thus, administrative means were traditionally used to manage the resource (FCC, 1997b). Applications that had the most significant potential to suffer from interference degradation, such as broadcast radio and television, required significant capital investments, which led to relatively little competition for the required spectrum resource. In geographic areas where the economics of the market was substantial enough to lead to higher demand for the resource, comparative hearings were used to determine which of the competing entities would be eligible to receive an exclusive license. In a comparative hearing, the competing interests (typically a broadcast radio or television station) would present their cases before an administrative law judge, who ultimately decide whether the public interest would be better served by one or the other of the competing interests.

Impact of Cellular Technology

With technological change, significant difficulties emerged with the then-existing approach to spectrum management. While radiotelephones were commercialized in the 1950s, the development of analog cellular telephone technology during the 1970s offered the potential for a much broader dissemination of wireless telephony. By carefully limiting signal strength, a limited amount of spectrum could be reused in multiple adjacent cell sites. While the previous radiotelephone service might enable 40 to 50 simultaneous calls in a metropolitan area, the new cellular technology potentially enabled thousands of simultaneous calls, which generated the possibility of a much larger subscriber base (Rappaport, 2002). The new technology required that spectrum be licensed to companies that essentially would resell use of the radio frequency to the public, which the FCC deemed Commercial Mobile Radio Service (CMRS). Underlying the distribution of spectrum for the initial cellular telephone technology was a policy of duopoly. In each geographic area, only two licenses would be granted, with one offered first to the local telephone company serving the geographic area and the second available to other businesses. The limited availability of licenses combined with the commercial potential of the new service led to high levels of demand for available licenses. As a result, the FCC was confronted with a new problem with the allocation of spectrum resources. Multiple competing interests were interested in the limited number of licenses, with 200 applicants vying for the first 30 licenses made available (FCC, 1997b). Comparative hearings were the only means by which the FCC could settle the issue of which of the limited number of licenses should go to whom. Complicating the comparative hearing process was the similarity of the applicants. As a result, the administrative process was faced with numerous situations that, for all practical purposes, were ties between competing interests. The inefficiency of the comparative hearing process led to significant delays in the distribution of the initial cellular licenses.

Following the problems associated with the distribution of spectrum licenses through comparative hearing, the FCC sought authority for an alternative mechanism—lotteries. Given the prevalence of ties in the qualifications of those seeking licenses, the theory of the FCC lottery scheme was based on random selection from a qualified pool of interested parties. With the winner picked randomly, ties would be broken, and the speed of distribution would be promoted. However, the process of qualifying lottery participants also introduced delays, with the first prequalifications taking about two years. To remedy this situation, the FCC sought further authority from the U.S. Congress to eliminate the need for prequalification. With prequalification eliminated, lottery participants quickly obtained licenses, but now another set of problems emerged. As the public became aware of the value of the resource that was being given away through the lottery process, large numbers of individuals sought to participate in the lotteries. Given the pre-Internet period, the paperwork required by the FCC to participate in a lottery presented a hurdle for those uninitiated in the operations of U.S. federal government agencies. Thus, third-party businesses, which came to be known as license mills, emerged. The license mills would process and submit the necessary paperwork for participation in a lottery. This rent-seeking activity resulted in hundreds of millions of dollars of revenue for the license mills (Hazlett & Michaels, 1993).

While the rent-seeking activity associated with the license mills was socially wasteful, further problems emerged after the licenses were awarded. Licenses were awarded relatively quickly; however, the licenses were not put to immediate use. Rather, a secondary market for licenses emerged, resulting in windfall profits for license holders. Delays once again were introduced into the process of distributing licenses while lottery winners sought the highest bidder for their licenses.

The problems associated with the distribution of spectrum licenses led the FCC to approach Congress again to