MANAGEMENT OF THE FREQUENCY SPECTRUM*

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The most striking feature of the history of domestic and international frequency spectrum management has been the general failure to recognize the fundamental nature of the problem. The wellspring of the confusion has been the belief that interference is a technical problem peculiar to the use of frequency spectrum. In fact, interference is simply a manifestation of scarcity. It is not possible for all those who would like to use the spectrum to do so without affecting the amount of the resource available to others. The analogy to other resources, land, labor, and capital, is so obvious as not to require elaboration.

Any effort to improve frequency management must be built on a recognition that frequency spectrum is an economic resource in no significant way different from the mass of other resources available to society. By the same token, the central function of any frequency management system must be to resolve the conflict among competing potential uses for the resource. From the standpoint of social action, the central question is what institutional framework should be promulgated to resolve this conflict.

While this paper is directed primarily to discussing alternative systems for managing frequency spectrum, the choice of such a system is not the important barrier to improvement in the existing situation. The real barrier to progress is the problem of provoking political action. Frequency spectrum is managed today in much the same manner as the commons were on feudal estates in the Middle Ages; while we may not be able to prescribe the optimal management system, we can improve substantially on that state of affairs.

Frequency spectrum is the only resource of any consequence for which:

(1) All use rights are defined by government and then given away;

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(2) Recipients of rights are not permitted to sell all or any portion of their rights, hence, no rights holder has any incentive to economize on the use thereof or transfer his rights to someone who values them more highly;

(3) The total amount of the resource available is subdivided, with each piece alloted to specific services (*e.g.*, land mobile) and no transfer permitted among services;

(4) Significant portions of the resource are allocated to specific services, but the number of individuals who can use the resource is unlimited, *i.e.*, within certain service categories spectrum is treated as a free good;

(5) Because the government completely controls use rights, government agencies get first consideration in their distribution—again, at no cost;

(6) Potential current users have no incentive to take into account future value, *i.e.*, of withholding use today in favor of more valuable possible future uses.

There is no resource for which the misuse, in economic terms, is more dramatic. Frank H. Knight summarized the dilemma very nicely when he said,

> . . . the problem of social action, from the economic standpoint, is chiefly that of getting people—those in control of social policy, which in a democracy ultimately means the electorate—to act in accord with principles which when stated in simple and set terms are trite even to the man in the street.[1]

I. Reforming The Present System

The basic policy choice we have with respect to institutional frameworks is between piece-meal improvements in the existing system and abandonment of it in favor of a market system. The crucial factor that distinguishes these two alternatives is whether the rights which individuals acquire can be bought and sold. The introduction of a market system has been discussed in various papers, especially in the work of Professor Ronald Coase.[2]

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1. Knight, *Socialism: The Nature of the Problem,* in Freedom and Reform 130 (F. Knight ed. 1957).

2. Coase, *The Federal Communications Commission,* 2 J. Law & Econ. 1 (1959).

There has been less systematic analysis of more modest changes to the existing framework.

A. *The Criterion Problem*

A modified version of the present system which does not use prices as a means of allocating frequencies, must immediately face the criterion problem.

Neither Congress nor any of the frequency management authorities have ever seriously addressed this question. They have never given serious explicit consideration to what criterion or criteria ought to be used in deciding how frequencies will be allocated or assigned. They do, of course, consciously take into account questions of the technological appropriateness of various portions of the spectrum for different uses. But such considerations by themselves do not constitute a criterion on the basis of which the conflict can be resolved.

An examination of the literature reveals two answers commonly advanced to the question of what it is the central frequency management authority is trying to do or should be trying to do. The goal cited most frequently is to minimize interference. An alternative goal often proposed is maximizing utilization of the frequencies. Statements of this type illustrate the perils involved in viewing the problem as a technical one. Aside from the fact that these goals are in direct conflict, taken literally neither seems very attractive. The way to minimize interference is to prohibit all but one individual from radiating. The way to maximize utilization is to let every one radiate. The most generous interpretation one can give to such proposals is to say that they are not meant to be taken literally. If they cannot be taken literally, however, they have no real meaning, and we are left with the question of what criterion the frequency management authority should employ in making decisions.

The balance of this article accepts as given the notion that we want to use frequency spectrum efficiently: that is, market value will be accepted as the important criterion in deciding how the spectrum ought to be used. This is a normative judgment, and a variety of rationales for sacrificing efficiency to other goals have been proposed. These include the hackneyed allegation that radio communications is an industry in which there is a special public interest, an argument that has always seemed to be at least as applicable to printing presses as to the frequency spectrum.

B. *Market Simulation by Government Authority*

Conceptually, at least, one reform that might be introduced would be to induce the government agencies responsible for spectrum utilization de-

cisions to make those decisions on the basis of the market value of frequencies. The Federal Communications Commission and the Interdepartmental Radio Advisory Committee could move in this direction without legislation, but it seems unlikely that they will do so, at least without strong pressures from the Executive and Congress.

The one advantage of this suggestion is its salability. General dissatisfaction with the present state of affairs, combined with the pressure from economic quarters to have frequencies sold, has persuaded some that "economic factors are important;" and while they are not prepared to accept a market system, they are quite willing to accept the market criterion.

One fundamental difficulty with this suggestion is pointed up by recent discussions and recommendations for the creation of a research agency to undertake economic studies of the spectrum. If the FCC is to assign frequencies in accord with potential price, it must know how much prospective users would be willing to bid for rights. In practice, it is virtually impossible to elicit that information without actually forcing the competing claimants to incur the relevant costs. Otherwise, it takes little imagination to visualize the exaggerated nature of the claims that would be made by competitors for rights to use the frequencies, and of the painful task the judges would have in deciding whose claim was valid. On the other hand, that kind of a contest in exaggeration is probably no worse than what happens under current procedures.

Another fundamental difficulty with the proposal that spectrum authorities adopt market value as a criterion, is the problem of what to do about rights that have already been granted. Much has been said about the government never giving away this great natural heritage, but the fact is that individuals and businesses have been given rights to use spectrum—rights which are valuable, and which they would not forego lightly. If we now institute a system of allocation according to willingness to pay, there is no doubt that the list of those possessing rights would be substantially revised. Is it reasonable to suppose that any frequency authority would take rights away from a large number of those who now have them to reassign them to other individuals who value them more highly? Given the history of the FCC's inability to reclaim rights, an adjustment of that magnitude is hard to imagine.

The problem is magnified for frequency allocations. Effective use of the market value criterion would imply wholesale changes in the frequency allocation tables. Is it reasonable to suppose that any frequency authority would take entire frequency allocations or significant portions thereof away from one service and give them to another?

One of the most serious implications of this inflexibility is the hopeless outlook for inducing present rights holders to economize on spectrum. Technologically, there are many ways other resources can be substituted for frequency spectrum in producing a given signal output, and many others could be and would be developed if the possessors of rights could capture the gains that would ensue from economizing on frequency utilization. Moreover, systems which don't use spectrum, *e.g.,* commercial broadcasting by wire or coaxial cable, can be substituted for those that do. Unless frequency authorities are willing to ruthlessly apply the market criteria, such measures for economizing on frequency will not even be considered much less put into effect, and the development of technology for further economizing will be stifled.

A second interesting possibility for reform of the current management system revolves about the way use rights are defined. In order to control interference, the FCC now generally specifies the rights of individual users in terms of production inputs, like the size and shape of the antenna, power level at the transmitter, etc. This means of control has two disadvantages: first, it makes it difficult for the user to make input substitutions, *e.g.,* of transmitter power for antenna size; secondly, it results in different levels of interference as a function of time of day, day of the year, sun spot cycle, etc.

Basically, the interference problem is one of energy levels on the same frequencies at the same time, in the same geographic area. Despite the fact that many engineers and physical scientists protest, it seems clear that we could improve the use of frequency spectrum by defining rights in terms of energy level along geographic contours. Instead of specifying the physical inputs users can employ, it is suggested that it would be desirable to specify energy levels they are permitted to impose at various geographic points. From an interference standpoint there is no reason why we should be concerned about how those energy levels are created.

Our knowledge of the relationship between inputs and the power levels that result at various geographic points is uncertain, so that rights would have to be defined in probabilistic terms, *e.g.,* power levels cannot exceed a specified amount more than one percent of the time at specific geographic points, but that problem exists whether we define rights in terms of inputs or in terms of outputs. The latter practice overcomes the two disadvantages mentioned above. Spectrum users would be enabled to make alterations to their physical plants whenever they found it economic to do so, without consulting the FCC. In addition, spectrum users would be held responsible for changing their operations as a function of time of day, month of year,

sun spot cycle, etc., so that they stay within the transmitted power levels which they have the right to create. It is also reasonable to conjecture that defining rights in this way would encourage the development of a more effective system of detection and enforcement of rights than currently exists. Finally, it is worth noting that the inauguration of this reform is independent of whether market value is accepted as the criterion for distributing use rights.

The third modification of present practice which appears attractive is that of limiting the number of rights in those portions of the spectrum where such limitations do not now exist. Currently certain segments of the frequency spectrum are set aside for use by specific services, and any qualified user engaged in that service is authorized to operate thereon. From an economic standpoint, this practice is a perfect parallel to the problem of the good road and the bad road raised by A. C. Pigou in 1920 in "The Economics of Welfare." Individual users will not take into account the interference (congestion) costs which they impose on others when they use the spectrum. As Professor Knight pointed out in 1924 in his article, "Fallacies in the Interpretation of Social Cost," the crux of this problem lies in the character of the rights individuals have in the resource.[3] (In Pigou's example, the road was not owned.) If we are not to have a market for frequencies, the solution lies in the FCC's limiting the number of assignments in these segments of the spectrum just as it does for broadcasting. Here again, however, the criterion problem arises. If there are to be a limited number of such assignments, how is the FCC to decide how many there ought to be, and to whom they will be granted?

The above is by no means a complete catalogue or adequate discussion of steps that might be taken to patch up the existing frequency management system. It is a sketchy outline of the steps which appear to promise the most in increased effectiveness, but even if all of those steps were taken, it is doubtful that they would significantly improve spectrum utilization.

II. A Market System for Frequencies

It is neither necessary nor appropriate to discuss in detail how a market system for frequencies would operate: the one big difference between it and what we have now is simply that individual frequency rights would be transferable in whole or in part, and in terms of the three dimensions of bandwidth, geographic location, and time. Taking that single step of conferring the right to sell spectrum would go far toward correcting the

3. Knight, *Fallacies in the Interpretation of Social Cost,* in The Ethics of Competition 217 (2d ed. 1936).

deficiencies enumerated in the early pages of this article. The resultant system might not be optimal, but it would certainly be a significant improvement over either the present system or the present system modified as outlined above.

There is, however, enormous resistance to that change. Aside from the vested interests, which one would expect to be opposed to a market system, many are suspicious of the idea largely because it seems to them to be a radical change. In truth, as Professor Coase has pointed out, this "novel theory" was novel with Adam Smith.[4]

From a political action standpoint, making existing rights transferable has the advantage that present holders thereof would tend to favor the change since the effect will be to increase the value of their rights. Making rights transferable, however, would not correct all the deficiencies mentioned above. For example, it would not correct the "congestion" problem in those portions of the spectrum where assignments are now essentially unlimited, and rights would still be defined in terms of inputs rather than outputs. However, these problems could be resolved in the context of a market system at least as well or better than outside that context. In those portions of the spectrum that are overused (congested) some users would buy out others, reducing the level of interference. Professor Coase has presented substantial evidence to support the view that, left alone, the courts will develop reasonable definitions of rights. In particular they would in the end define rights in terms of outputs, if that definition proves to be the most efficient. Most important of all, of course, making rights transferable would provide incentives to owners of those rights to use them economically.

The objections which have been advanced to using prices to allocate frequencies generally do not dispute these advantages. The exception to this is the question sometimes raised of whether the extent of monopoly in broadcasting and the communications industries would thereby be increased. Fear that a single firm might buy up all of the frequency spectrum is the extreme expression of this question. There is no reason to believe that a market for frequencies would be any more susceptible to monopoly. It is doubtful that AT&T, NBC, ABC and CBS will be the major sponsors of legislation designed to create a market for frequencies. In any case, we have anti-trust laws specifically designed to handle the problem of monopoly, and there is no reason why frequency monopoly problems can't be handled under those laws just as is the case for other resources.

A second source of objection to using prices stems from the urge to pro-

4. Coase, *supra* note 2, at 18.

tect and subsidize activities which particular individuals or groups regard as important. In the case of the frequency spectrum, the most sacred of all cows is perhaps the hydrogen line. If you would like to make yourself *persona non grata* among your physical science friends, just suggest that you think those who wish to use the hydrogen line for research should pay for it.

The next most sacred cow is the amateur bands, followed closely by the forest service, the fire departments, police departments, *et al.* The vehemence with which the various protagonists defend the view that these agencies or services ought to have frequencies free is impressive, to say the least, and they are not disturbed from their position by the point that police departments are not given cars or radios—fire departments are not given fire engines or radios—the forest service is not given fire-fighting equipment—amateurs must buy their radios and antennae. Even the radio telescopes that are given to the physicists must first be bought by the government. In truth, there is no reason why the agencies shouldn't be forced to take into account the opportunity costs of frequency spectrum just as they are forced to take into account other costs.

The last objection to the use of markets for frequencies has serious social implications outside the realm of economics. There are many who argue that the government should retain control of frequency spectrum in order to control the quality of broadcasting, both TV and radio. One can sympathize with those who judge the character of our television as a vast wasteland. On the other hand, one despairs of looking to the Federal Communications Commission, which created this wasteland, or to any other government agency, as the instrumentality for converting it to a garden. More importantly, there is a potential for censorship implied by using government control over frequencies as a lever for enforcing higher standards on broadcasters.

The allegations about the quality of TV and the character of the TV industry apply *a fortiori* to the newspaper industry. There are more TV stations broadcasting in New York City than there are newspapers, and more competition as a result. Moreover, newspaper content, including advertisements (to say nothing of magazines and books) is at least as lurid and inane on the average as what appears on television. Would anyone seriously suggest that printing presses or newsprint should be controlled by the government in order to control the quality of newspapers?

Conclusion

Of the two courses of action open to us for improving the utilization of frequency spectrum, the one which promises significant improvements is

the introduction of a market system. On the other hand, it seems highly improbable that the political support necessary for such a reform will be forthcoming in the near future. Short of that action, there are steps that could be taken to improve the existing framework, but these cannot be realized easily either, and even if they are, significant improvements in spectrum utilization are not likely to ensue. In brief, we should not be optimistic that much can be done to undo the mistakes we have made in the past.