Pursuant to FCC ET Docket No. 02-135, the following comments on issues related to the Commission's spectrum policies are provided in response to the public notice issued June 6, 2002 by the FCC Spectrum Policy Task Force (DA 02-1311).

For reference, I am Professor of Electrical Engineering at the Massachusetts Institute of Technology and have been involved with government, non-profit, and commercial organizations that utilize spectrum for civilian and military purposes. I was also once Chair of the NAS Committee on Radio Frequencies (CORF).

I believe two questions central to the current inquiry are: a) how best to improve economic efficiency in spectrum allocation in volatile and competitive technological environments, and b) how to increase government revenues from fees.

Concerning economic efficiency:

1) Clearly the public-interest services must be adequately accommodated without direct economic (price) competition because tax revenues would obviously be difficult to divert into the many non-profit public-interest services that now exist. Adequate public and private charitable funds could never be found for this purpose. I believe the present system wherein the FCC and ITU allocate no-cost spectrum to specific public services works well and therefore it should simply be continued.

2) Continuation of present practices concerning public-service allocations requires continued adequate funding of the technical arm of the FCC and of related government bodies that advise on spectrum technical matters, monitor the spectrum environment, and enforce regulations. To economize on such expenses could cost the nation dearly in economic and other public-good outcomes resulting from poor spectrum policies and practices. The present technical spectrum-allocation studies and enforcement budget is a tiny fraction of the annual economic value of the U.S. spectrum, which arguably approximates tens-of-billions of dollars.

3) Others have suggested that transferring more of the frequency-management burden to the private sector might reduce costs, i.e., let the users in part regulate themselves within broad guidelines for each band, with the remedy for errors being at law. Although this arguably might work in the private sector within certain restricted spectral bands, it does not necessarily work for any adjacent bands that can be degraded by inadequate oversight of aggressive spectral neighbors. Remedies at law are likely to be tardy, inefficient, and prohibitively expensive for diffuse public-interest uses such as radio astronomy, weather satellites, public safety uses, and others that cannot always accommodate disruptions.

4) Several public-interest uses have international scope and therefore cannot be monetized efficiently or fairly. For example, environmental remote sensing from global satellites requires absolutely quiet bands that are often tied to scarce atomic or molecular resonances determined by nature. These satellites, costing billions of dollars in the aggregate (and of even greater value to the public), must operate globally to be effective

and therefore require international allocations without regional exceptions. For example, long-range weather forecasts over England require good data over the U.S., and the U.S. is dependent on good data obtained over Canada and Asia. One cannot have independent spectrum markets in different parts of the world and also have world allocations to public-interest uses without protecting the global spectral allocations needed for those uses.

5) Another enticing false economy in regulation involves type approvals divorced from quantity of production. For example, passive microwave weather sensors on satellites (and most other spectrum users) are sensitive to the product of the number of devices and their individual emission strengths. Often the number and local density of users (emitters) cannot be predicted accurately more than a few years into the future. I believe it is essential that those uses where the numbers of emitters could proliferate enormously must be licensed within restricted bands with strong limits on out-of-band emissions. Examples of potential problems include automobile radars with many GHz of bandwidth that cross many allocation bands, and local broadband spread-spectrum communications systems. Fortunately many such applications can be re-engineered to reduce problems if the allocations and licensing process is proactive and creative. Again, this is likely only if the FCC and other government technical frequency-allocation entities are adequately funded and staffed.

Concerning government revenues:

1) One consequence of continuing technological advances is that efficient uses of spectrum will evolve with time, together with the rules appropriate to those spectral allocations. Fairness, however, requires that owners of spectrum not be unduly subject to rule changes mid-ownership, or within the depreciation times of their committed assets. For these reasons, it seems most fair to recognize the reality of evolution by auctioning spectrum only for specified time periods, generally for a few nominal asset-depreciation times or perhaps 15-40 years. For cellular telephones or similar services, for example, it might be most appropriate to auction licenses (sell spectrum) perhaps 5-15 years (one or two depreciation times) prior to expiration of any existing lease. Rolling re-auctions in advance of lease expiration should permit any out-bid spectrum owners to exit profitably during their remaining years of lease life by planning their subsequent investments and by private negotiations with future allocation owners. The new owners would also have time to perfect their technology and finances before launch. Premature service launches have exacted an enormous price from financial markets in recent years--personal satellite communications services and HDTV are examples.

2) Another likely benefit of leasing rather than selling spectrum is that not only economic efficiency, but also long-term government revenues would be increased. Since technological progress and market conditions cannot be predicted more than a few years or decades ahead, any investors in spectrum should discount their expected returns for those risks and thus lower their bid price below true long-term value. I believe this long-term unrecognized value should remain a public good, which is an outcome achieved by leasing rather than selling. Economic efficiency would also be served by periodically

reintroducing open competition and perhaps reallocation into spectrum utilization, particularly as spectrum allocations shift back and forth between public service/military and commercial uses, as they have in the past.

3) Alternatively, and less attractively, the government might annually tax selected commercial frequency allocations for roughly the same reasons that local governments tax land. Users failing to keep up with taxes would sell out to more efficient users or surrender their property. The taxes could be proportional to the property valuation; the value of allocations would be proportional to nominal expected revenues, where the revenues expected for public service allocations would normally be zero. Abrupt changes in tax rates would have to be avoided if investor decisions are to be economically efficient. This approach does not provide the same government flexibility to direct future allocations that leasing does, however.

In conclusion, these issues are complex and timely, and the deliberations of your task force will hopefully help maintain and improve our national well being and competitiveness. I hope these various thoughts are helpful.