Response to Gerald R. Faulhaber's Commentary

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We appreciate Professor Gerry Faulhaber's thoughtful commentary on our article "The Spectrum Opportunity: Sharing as the Solution to the Wireless Crunch." It throws into sharper relief some of the main points we advanced.

Faulhaber is too good an economist and engineer to dismiss spectrum sharing out of hand, as opponents often do in public policy debates in Washington, DC. Instead, he points out that some existing spectrum-sharing efforts, such as unlicensed use of TV white spaces, have been only modestly successful to date, failing to meet the overheated projections of their boosters. And he chastises the Obama administration for not going far enough to free up federal spectrum for wireless broadband. We find little to disagree with on either score.

In fact, we are in agreement with Faulhaber on a litany of points: More spectrum capacity is needed; clearing is unlikely to get us there quickly in the current political environment; receiver standards should be adopted; spectrum holders should have incentives for maximizing efficient usage; and government itself imposes many of the barriers to wireless innovation. The fact we share so much common ground with an expert who favors spectrum property rights is an indication of just how far off base the policy rhetoric on spectrum has become.

So where do we and Faulhaber actually disagree? In the framing of the discussion.

Contrary to Faulhaber's suggestion, our advocacy of greater spectrum sharing is not just a more appealing name for an old position. The goal of our article is to recast the debate. It is a mistake to view spectrum allocation as a stark binary choice between no sharing (property rights) and all sharing (unlicensed "commons"). Instead, there is a matrix of greater and lesser sharing along various dimensions.

Faulhaber believes "it is perhaps more useful" to distinguish the sharing in the PCAST report (PCAST, 2012) from the sharing in our article (which expresses support for, among other things, the PCAST report). We believe otherwise, for the reasons we set forth in the original discussion. PCAST advanced arguments primarily about federal spectrum, but the underlying principles are not limited to that

domain. They are relevant whenever there is a gap between the potential and the reality of spectrum utilization.

Limiting the conception of sharing to dedicated unlicensed bands, such as those supporting WiFi, inadvertently devalues opportunities to incorporate sharing alongside limited exclusive rights. Integrated WiFi offloading of data traffic from licensed cellular networks and the hierarchical regime proposed by PCAST are two examples that demonstrate that sharing and exclusivity may be synergistic. Faulhaber himself makes this very point when he says, "[t]here is nothing about 'exclusive use' or commercial ownership that precludes sharing." Indeed.

Here is the real nub of the issue. Does leaving the degree of sharing entirely up to those with exclusive ownership rights maximize the capacity and value of the spectrum? We offered several arguments why it might not. Just as Faulhaber is skeptical that federal agencies will look beyond their own needs, we are skeptical that private spectrum licensees will be willing or able to maximize overall utilization of the spectrum.

Faulhaber says that exclusive licensees already share, because they let their customers buy devices and service plans in their frequencies. This stretches the term to the point of meaninglessness. Perhaps in some abstract sense the owner of an office building "shares" her property with her tenants, but no one actually describes the relationship that way. That would be like saying that Apple shares its inventory of iPhones with its users. What Faulhaber is really arguing is that unchained commercial agreements would produce the ideal configuration of spectrum access.

There is something to Faulhaber's argument. As the late, great Ronald Coase taught us, in the absence of transaction costs, market arrangements will determine entitlements efficiently, regardless of the initial legal rules (Coase, 1959). However, Coase did not stop there. A distinctive feature of the real world, he noted, is that there are, in fact, transaction costs. Often, those costs determine the best approach.

Even if legal impediments were magically eliminated, the transactions Faulhaber desires are costly in at least two ways: They require companies to anticipate and optimize across an unknowable space of possible spectrum uses by others, and they deprecate business models that cannot support up-front payments for access. For simple transfers such as reallocating broadcast frequencies to cellular carriers, the property rights model works well. The certainty it gives to rights holders will make it the most efficient approach in some cases. But as the potential arrangements become more complex, the number of required transactions becomes a significant and growing cost. As we explained in the article, sharing reduces the need for such commercial transactions, either through coexistence or express cooperation between systems.

In essence, sharing means giving up some control, and not just in return for a corresponding payment. The control implicit in spectrum licenses has both positive and negative impacts. On the negative side, it may create incentives for the deployment of poor-quality receivers (as in the LightSquared/GPS case); it may place licensees in the position to foreclose potential competition; or it

may lead them to disregard small-scale or innovative systems that are unlikely to create a significant revenue stream for the licensee. Many potential sharing arrangements address these limitations. Unlicensed allocations are one way; PCAST's three-tier access hierarchy is another.

Faulhaber argues that "[i]f people don't want to share, they are not going to share." This leaves out the essential contextualizing question: Compared to what? If the options were sharing or clearing, federal users would likely prefer sharing as the outcome that preserved the greatest residual control. The opponents of the PCAST report we cited in our article seem to think that if sharing is off the table, clearing will somehow become more palatable to these agencies. Their logic escapes us.

We heartily agree with Faulhaber that, in a perfect world, many aspects of spectrum policy could be improved dramatically. Conceptualizing alternatives such as a spectrum "base closing commission" is a valuable function that academic work in this area can provide. We hope Faulhaber expands on this intriguing idea in future publications. Our article operates on a considerably messier level. Taking the world as it is, we ask what realistic steps could free up more capacity more quickly.

Cold, hard realities make it difficult for anyone in these debates to point to compelling empirical evidence. Faulhaber is correct that the absence of flexible-use provisions in broadcast licenses bars wireless broadband providers from acquiring that spectrum through secondary market transactions. When discussing TV white spaces, however, he ignores the fact that the FCC imposed extremely stringent power limits to mollify broadcasters, even though advocates argued those might kill the commercial viability of the new systems. This is an oft-repeated pattern in many industries in which innovative new ideas are hindered by powerful legacy incumbents. Would there be a more vibrant TV white spaces market today in the counterfactual case? We can make arguments, but we can't know.

Faulhaber bemoans the absence from Radio Shack of "whizzy gadgets" using spectrum sharing, which he was promised in an old article in *The Economist.* He might start at the smart phone aisle, because the recent explosion of mobile data activity depended on offloading most of the traffic via unlicensed connections. In the next aisle, he might observe how WiFi access points implemented technologies such as orthogonal frequency division multiplexing and adaptive beam forming years before they made their way into licensed cellular systems (Thanki, 2013).

Is there sometimes excessive hype about the speed with which wireless technologies will move from the lab to deployment? Certainly, as Faulhaber correctly observes, while some forms of spectrum sharing can easily be implemented today, others—including full-scale cognitive radios—may not be ready for years. We never suggested otherwise. The question is what real-world decision makers should do given real-world conditions. Every possible method of freeing up spectrum capacity involves uncertainties and delays. Clearing, as we discussed, can involve years to relocate incumbent systems, years to conduct an auction, and years for the purchaser to build out networks, even if the initial resistance from federal users is overcome.

To reiterate, we do not claim that spectrum sharing is a panacea, or the right answer in every situation. Faulhaber's cautionary language on that score is both important and welcome. We argue, as did

PCAST, that some form of sharing should be the default in future efforts to allocate or reallocate spectrum. Is sharing sometimes hard? Yes. But so are all the realistic alternatives; in fact, more so.

Emphasizing sharing will encourage commercialization of research that, today, stays in the lab because it has no opportunity to come to market. As we described in our article, the current emphasis on exclusive licenses and auctions creates blind spots and directs resources toward solutions that mimic the centralized business models of today's cellular operators. Perceived market needs have a way of changing what is commercially possible. For example, there has been a renaissance in mesh networking development following the Arab Spring, when governments monitored or shut down Internet access to counter popular uprisings (Open Technology Institute, 2013).

At the end of the day, our argument is not with careful experts such as Faulhaber. He is correct that the academic debate about the ideal approaches to spectrum allocation is unresolved, and quite right to urge moderation of expectations when it comes to spectrum. But that cuts both ways. Those who persist in seeing the spectrum world in binary terms, such as the congressman we cited who advocated "having it" instead of "sharing it," need to adjust their expectations as well. Too much emphasis on having it will turn the United States into a spectrum have-not.

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