

(As Prepared for Delivery)

# **Spectrum Management in the New Millennium**

Remarks by

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I am very pleased to be able to participate in this Fourth Annual International Symposium on Advance Radio Technologies as both a moderator and a speaker. I last spoke at this event in September 2000 when I was still at the Federal Communications Commission as Chief of the Office of Engineering and Technology. I have been away from the Commission for a little over one year now and, during the intervening period, I have been reflecting on that experience – especially as it relates to the issue of spectrum management.

As some of you may know, I also served as Chief of the Office of Plans and Policy at the FCC back in the mid-1970s and, subsequently, as Assistant Secretary of Commerce and Administrator of the National Telecommunications and Information Administration. In those positions, I observed first hand the battles over spectrum that were going on at that time. But, between the mid-1970s and now, the demand for radio spectrum -- particularly in the range from 300MHz to 3GHz – has increased in intensity. There is tremendous pressure for added spectrum to support competition, economic growth and -- especially after the events of last September 11<sup>th</sup> -- the safety of life and property, homeland security and the national defense. Pressure on spectrum has always been there but it was much more visible and contentious during my recent stint than it was before. The battles over spectrum have gotten even tougher. Part of the reason for this is that the economic value of the spectrum resource has been made explicit -- became visible to even the general public -- because of the spectrum auctions. I am a firm believer in spectrum auctions. But one of their unintended consequences is that they have intensified the pressure, as more people understand the true economic value of the resource.

Now as everyone in this audience knows, spectrum management -- the management of the spectrum resource -- involves two fundamental steps: allocating spectrum -- essentially zoning it -- for particular purposes and then assigning it to particular licensees. There is actually another step in between and that is developing the service rules – including the technical rules that apply to the new allocation. Auctions are an excellent way of assigning spectrum -- of deciding among mutually exclusive applicants for scarce assignments once the technical rules have been established. However, and this is very important to understand, they really don't solve the allocation problem. In fact, if anything -- because the auctions have so dramatically revealed the value of spectrum and because of the intensifying demand for the resource -- the allocation battles have gotten that much tougher.

But the point I want to make is not that spectrum has gotten more valuable -- that's old news. Rather the immediate point I want to make is that the battles over spectrum allocations have become more politicized. If you want to have any hope of getting spectrum allocated for a new service these days, you have to hire a whole troop of lobbyists and wage a full-blown lobbying campaign on both Capitol Hill and the Executive Branch as well as at the Commission. We pay a terrible penalty for this politicization. I can personally give you examples of how investors -- sophisticated investors -- have given up on promising new wireless businesses because the allocation process seemed so long, expensive, and ultimately unpredictable.

As we move further into the new millenium, what can we do in general to relieve some of the pressure on the spectrum resource? As I see it, there are four basic techniques for freeing up spectrum to accommodate new services and the growth of existing services: (1) reallocating spectrum from one service or purpose to another, (2) increasing the technical efficiency with which individual systems use the spectrum resource just as we have improved the fuel efficiency of motor vehicles to reduce our dependency on fossil fuels, (3) increasing the amount of sharing among users of the scarce resource and (4) extending the upper-most range of the useable spectrum through improvements in devices and systems.

I would like to talk briefly about the first technique – reallocation – and then spend some time on the issue of increased sharing because it – that is, sharing -- is associated with some of the most contentious spectrum issues that are now being debated in our Nation's Capitol. Reallocation from a lower value use to a higher value use has traditionally been utilized as a way of providing spectrum for new services or the expansion of existing services. Over the past decade or so, the Commission has increasingly relied upon marketplace forces for the reallocation of spectrum by – among other things – giving existing licensees much greater flexibility in terms of the services that they can provide and the technologies that they can employ. This facilitates changes in services offered -- what we refer to as voluntary reallocation. Voluntary reallocation has the advantage of not only permitting the use of spectrum to be shifted in accordance with marketplace forces, but also allowing the shift to occur more quickly by avoiding the need for a long regulatory proceeding.

Of course, simply reallocating spectrum from one use to another on either a voluntary or involuntary basis does not increase the total, aggregate amount of spectrum available. Thus, as spectrum use intensifies, it is becoming increasingly difficult to find a new home for licensees/users displaced as a result of involuntary reallocations. Long-term reallocation works when there are large blocks of under-utilized spectrum, but those are no longer easy to find. While there may well be some remaining outright reallocations that are economically and socially beneficial, we can not count on them for solving the spectrum scarcity problem in the long term. That means we will have to put more reliance on the remaining three techniques.

But allowing licensees even greater flexibility to facilitate voluntary reallocation can have unintended consequences. For example -- and this is something that I became increasingly concerned with in my recent time at the Commission -- giving licensees greater flexibility means that you may be allowing them to develop and deploy what I refer to as "fragile" systems -- systems without adequate margins against interference. Why would someone do that? To save money of course. For example, in a satellite system, where each dB of added link margin costs a substantial amount of money, you tend to want to cut the margin to the absolute minimum. That's okay -- commendable even -- if you don't make it so fragile -- so susceptible to small changes in the interference environment -- that you unduly restrict or constrain your spectrum neighbors. In other words, if you make your system too fragile, too susceptible to interference -- you shift the cost of protecting the spectrum resource to your neighbors. This is what

economists refer to as a negative externality. It means that your spectrum neighbors -- often new entrants -- have to employ much tighter filters or operate at much lower powers or leave excessive amounts of guard bands to protect you. In the extreme this may prevent new uses -- sharing -- entirely and deny significant economic and other benefits to society.

Even if the system is initially deployed with adequate noise or interference margins there is an incentive for the licensee to "use up" the margin by, for example, extending service beyond what was originally intended. In a satellite system, this might mean providing in-building rather than just street-level coverage or a terrestrial broadcast system extending its geographic reach beyond its original contour. By using up existing margins in this way, the licensee can eliminate any opportunity for sharing while increasing potential profitability, shifting costs to other users of the resource, and eliminating a potential new source of competition. Given the increased value of the spectrum resource, this is a perfectly rational economic response.

If you believe this may be happening -- or could happen -- what is the answer? In the old days, with more rigid allocations and detailed service rules, rather complete system design information was filed with the Commission and subject to review. Now the Commission typically limits its concerns to the interference licensees cause others. And it does so in the most general sort of way -- controlling out of band emission limits for example -- to give licensees the most flexibility in designing their systems in response to market place demands and changes. Since the Commission generally does not concern itself with interference susceptibility, this leads to the possibility of under-designed or fragile systems as I just described.

Let me step back once again and try to look at this from a broader standpoint. The issue is sharing and how the government -- the FCC -- can encourage or facilitate more sharing of the spectrum resource in order to accommodate additional demand. Broadly speaking, there are two ways of achieving increased sharing: (1) forced sharing, where the government through an additional allocation in already encumbered spectrum mandates sharing and (2) voluntary sharing where the incumbent agrees to sharing in return for some financial consideration -- some payment -- from the new entrant. (Note that in the latter case -- voluntary sharing -- I am not talking about voluntary reallocation where one use is replaced entirely by another. Here I am talking about over-lapping allocations where true sharing is achieved by technical or other means.)

The difficulty with forced sharing is that it is so contentious and takes so long. In these sharing battles where the economic stakes are now so high, we have both sides relying upon competing and often very complex engineering studies -- studies that often directly contradict each other. As a former colleague of mine has so eloquently pointed out, in the engineering and scientific fields we rely upon the publication of engineering and scientific results in peer reviewed journals as a way of getting to the truth. In these battles over increased sharing, there is generally no peer review. You have to rely upon the expertise in the agency -- and on Capital Hill for that matter now that Congress is so much more involved -- to sort out the studies. Too often the needed technical expertise is

too thinly spread or, in the case of Congress, essentially non-existent. These difficulties are compounded when the existing or incumbent systems are very fragile – very susceptible to interference – as I described a few moments ago. In short, in this day and age of high-priced and high-powered Washington lawyers and lobbyists, forced reallocations seem like a prescription for continued paralysis.

One solution to the problem of under-designed systems would be to subject new or changed systems to some sort of Commission administered design review. But design reviews would inevitably slow things down in an era where product cycles are becoming even shorter and systems are continually modified. Perhaps a better way, and I am serious in proposing this, is to establish clear standards for interference susceptibility on an allocation-by-allocation basis. In other words, in addition to out-of-band emission limits on the transmit side, licensees would have to design the receive side of their systems to tolerate some minimum level of interference. Licensees would be on notice that their systems have to exhibit some minimum degree of robustness. This might speed up the processing of spectrum sharing proposals because all the new entrant would have to show is that he or she would not raise the interference level above a specified amount.

The other way of encouraging increased sharing is, as I mentioned a few moments ago, voluntary sharing where the incumbent agrees to sharing in return for some financial consideration – some payment either in cash or in-kind from the new entrant. To its credit -- in my opinion – in recent years, the FCC has moved in the direction of allowing existing licenses much greater flexibility in transferring their spectrum to other providers -- e.g., through disaggregation and partitioning in cellular and PCS -- and in what services they can offer. This means that spectrum can – as I have described before -- be reallocated from one purpose to another in response to marketplace forces without going through a politicized -- and therefore lengthy and costly – formal reallocation process. But what I just described is, strictly speaking, reallocation rather than sharing. Thus, while I was at the Commission, I was a big proponent of secondary markets wherein licensees would be giving increased flexibility to lease excess or unused spectrum to other parties. In this voluntary reallocation approach, licensees would have the incentive to share because they would profit by doing so.

Once again stepping back and trying to see the big picture, what I am describing here with voluntary reallocation is moving spectrum closer to a system based upon property rights where the rights to use spectrum would be treated just like any other commodity. Stated another way, the traditional ways of managing spectrum treated the spectrum as a commons owned by all and in which government regulations were needed to prevent over-consumption – the tragedy of the commons if you will. We chose to allocate and regulate its use just like in a centrally managed economy such as in the former Soviet Union. The difficulty – nay the near impossibility -- of centrally managing an increasingly scarce resource is precisely the reason the Commission has moved in the direction of relying upon marketplace forces in the management of spectrum. Through the use of secondary markets, for example, an incumbent cellular licensee would have the incentive to share his or her spectrum with a another company wanting to, say, provide

wireless meter reading. He would have the incentive because he or she would gain revenue by making mutually acceptable arrangements for non-interfering sharing.

But, exactly what rights are you buying when you get spectrum through an auction at the Commission or you purchase a license from an existing user? When people pay for spectrum, they argue – just as the people do who got spectrum for free – that they are entitled to protection against interference from people with which they have not entered into a voluntary sharing agreement. That leads me back to the notion that we need to establish clear standards for interference susceptibility on an allocation-by-allocation basis. As I indicated before, licensees would be on notice that their systems have to exhibit some minimum degree of robustness to interference from outside their system. This would, potentially at least, mean that ultra-wideband and similar systems could move forward as long as they could show that they do not increase the interference level above the threshold.

I need to wrap up, but what I am suggesting in broad terms is that as spectrum gets increasingly congested and valuable we may need to look very hard at regulating minimum interference susceptibility. This is true whether – and this is important – we continue to move in the direction of using marketplace forces for the allocation of spectrum or we return to the more traditional centrally managed approach. If we would have had such a regulatory scheme in place in the past few years, I think it could have expedited the regulatory processes associated with a number of very contentious sharing proposals. If nothing else, I hope I have stimulated you to think in broader terms about the spectrum management challenges that we face in this country as we move further into the new millenium.

Thank you very much.