

Earth to Space: I Can't Hear You -- Selling Off Our Future To The Highest Bidder

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Abstract

Recently, two related U.S. policy shifts have placed in grave danger the future ability of private companies to explore and develop space, because they may not be able to communicate with the satellites, robots, and even humans, deployed on the High Frontier. This paper will examine those two policy changes – the reallocation of spectrum from government to private use, and the auctioning off of spectrum to the highest bidder -- and make some recommendations as to how the space community can work together to preserve spectrum for future space uses.

Introduction

Space activities have long been dominated by the activities of governments. Use of the radio portion of the electromagnetic spectrum (30 Hz to 300 GHz) also has dominated by government use. Long ago, both in the U.S. and abroad, the portion of the spectrum used for communications has been divided between government and private use, with the government reserving substantial portions of the spectrum for its own uses.¹ The Federal Communications Commission is charged with overseeing the use of that part of the spectrum reserved for use by private companies, while the National Telecommunication & Information Administration (NTIA), part of the Department of Commerce, is in charge of overseeing the government reserved spectrum. The FCC and NTIA work together to coordinating use of the spectrum which is shared between government and private use. The allocation of the electromagnetic spectrum between the various services is contained in Part 2 of the FCC Rules, an excerpt of which appears below.

Excerpt from 47 C.F.R. Part 2
Table of Frequency Allocations

International MHz		United States table		FCC use designations	
Region 1—allocation MHz	Region 2—allocation MHz	Government Allocation MHz	Non-Government Allocation MHz	Rule part(s)	Special-use frequencies
(1)	(2)	(4)	(8)	(6)	(7)
2290-2300 FIXED SPACE RESEARCH (space-to-Earth) (deep space only) MOBILE except aeronautical mobile	2290-2300 FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) (deep space only)	2290-2300 FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) (deep space only)	2290-2300 SPACE RESEARCH (space-to-Earth) (deep space only)		
2300-2400 FIXED MOBILE RADIOLOCATION Amateur	2300-2400 FIXED MOBILE RADIOLOCATION Amateur	2300-2310 RADIOLOCATION Fixed Amateur US323.02	2300-2310 Amateur US323	Amateur (87)	
2310-2380 FIXED MOBILE RADIOLOCATION Amateur	2310-2380 FIXED MOBILE RADIOLOCATION Amateur	2310-2380 Mobile RADIOLOCATION Fixed Amateur US328.02 0130	2310-2380 SPACE RESEARCH (space-to-Earth) (deep space only) FIXED MOBILE RADIOLOCATION Amateur US327.02 0130		Digital Audio Radio Services
2380-2390 FIXED MOBILE RADIOLOCATION Amateur	2380-2390 FIXED MOBILE RADIOLOCATION Amateur	2380-2390 MOBILE RADIOLOCATION Fixed Amateur US328.02 0130	2380-2390 MOBILE RADIOLOCATION Amateur US328		
2400-2402 RADIOLOCATION 661.152.02	2400-2402 RADIOLOCATION 661.152.02	2400-2402 RADIOLOCATION 661.152.02	2400-2402 RADIOLOCATION 661.152	Amateur (87)	

Allocating Spectrum In The Public Interest

In making these allocations between different uses of spectrum, much of the spectrum was set aside for future uses. Thus, even though the technology may not have existed in the late 1930s to efficiently utilize some parts of the spectrum for particular uses, nonetheless, that spectrum was set aside on the assumption that, in the future, the technology would develop to make use of these frequencies. In allocating spectrum for use in the private sector, the FCC is required under Section 301 of the Communications Act of 1934 to act consistent with "the public interest, convenience, and necessity."² In 1945, the FCC articulated a set of general principles it would henceforth follow in allocating spectrum:³

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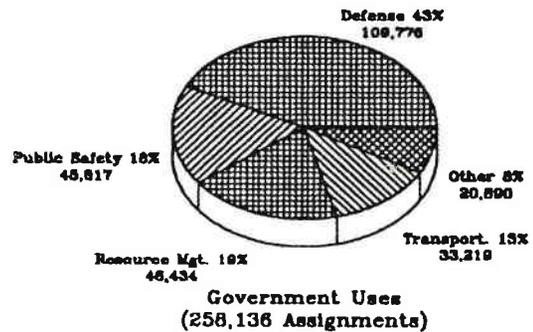
- 1) Whether the service proposed should be delivered over a wire, or with radio frequencies;
- 2) How many people would benefit from the proposed allocation;
- 3) Whether the public would accept that service;
- 4) Whether the technical characteristics of the that part of the spectrum allow for the use proposed;
- 5) Whether equipment had been developed which could utilize that spectrum for that purpose;
- 6) Whether other uses of the spectrum would allow the new use proposed, and if not, where the displaced users would have to go;
- 7) Whether the proposed service was the "most important" use suggested.

This paradigm served the public well for over 50 years. Especially in the last ten years, the public has seen an explosion of new services which have forever altered this planet. In all, commercial activities that rely on use of the radio spectrum generate over \$100 billion in annual revenues.⁴ As more and more uses were found for the electromagnetic spectrum, private users were forced to become more and more efficient in the way they used the spectrum, to squeeze as much as possible out of this finite resource. Technologies such as spread spectrum, Time Division Multiple Access (TDMA), and Code Division Multiple Access (CDMA), were developed to allow more users, and even different types of uses, to occupy the same bandwidth. The massive switch from analog transmission techniques to digital modes has allowed another order of magnitude leap in the efficiency of spectrum use.

Policy Shift I -- Stirring Up The Sleepy Backwater of Government Frequency Use

While new technologies were exploding on the private side of frequency use in the 1980's and 1990's, there came a realization that the demand for that spectrum was beginning to outstrip the total spectrum available, especially in the preferred range between 75 MHz and 3 GHz. The Government also realized that on a user per hertz basis, the government was far less efficient in its use of spectrum.⁵ The breakdown of government use of the spectrum is shown below.

Government Use of the Spectrum (0-300 GHz)



Faced with increasing spectrum demands from the private sector, Congress passed as part of the Omnibus Budget Reconciliation Act of 1993, a provision (Title VI), which directed NTIA and the FCC to review government spectrum use and directed the Secretary of Commerce to identify and transfer 200 megahertz (MHz) of spectrum below 5 GHz from government to private or shared use.⁶ This represents a fundamental shift in U.S. communications policy, and a much needed one.

Initially, government users claimed to NTIA that they were fully and efficiently utilizing their allocations of the spectrum. After further study, however, it became clear that it would be possible to gradually shift the 200 MHz called for by Congress. In February, 1994, NTIA issued its *Preliminary Spectrum Reallocation Report*, in which it identified 200 MHz of spectrum below 5 GHz that it determined could be converted to private or shared use. These bands were:

Table 1: Proposed Frequency Reallocation

Frequency (MHz)	Prior Government Use
1390-1400	Radio Astronomy
1427-1432	Fixed microwave
1670-1675	Radiosonde atmospheric testing
1710-1755	Fixed microwave
2300-2310	NASA Deep Space Network (adjacent)
2390-2400	No current government use
2402-2417	No current government use
3650-3700	Navy Radar
4635-4660	Tropospheric scatter microwave
4660-4685	No current government use

To understand the impact these reallocation of spectrum would have, the graphic below depicts the government allocations of spectrum, broken down by general service types (black bands indicated blocks of government allocations):

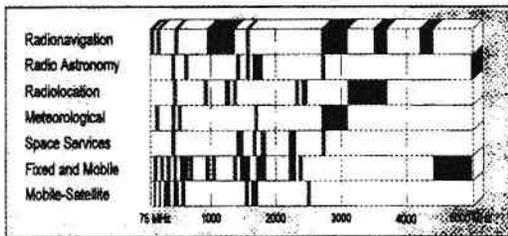


Figure 2-1. Radio Services in Frequency Bands Allocated to the Federal Government.

The stage thus was set for a significant shift of spectrum resources from government to private use. The next question would be – how should these frequencies be used, and who should get them? Most people assumed that when these frequencies were turned over for reallocation, the FCC would allocate them for similar, or at least compatible, uses. At the very least, observers assumed that the FCC would follow international conventions and allocation schemes. What no one anticipated, however, was the second major policy shift which was occurring at approximately the same time.

Policy Shift II – To The High Bidders Go the Spoils

At the same time NTIA was ordered to shift 200 MHz of spectrum to the private sector, Congress, NTIA, and the FCC were reevaluating how spectrum should be allocated. Traditionally, private entities making use of the electromagnetic spectrum did not have to pay directly for its use. Instead, as discussed above, the FCC determined the use of the spectrum which would best benefit the public. Indeed, prior to 1994, the FCC was precluded by statute from “charging” for spectrum. That all changed with the passage of Section 309(j) of the Communications Act in December of 1994.⁷

New Section 309(j) granted authority to the FCC to put up spectrum for competitive bidding (“auction”) when two or more applications were received for the same spectrum, or two or more parties sought reallocation of spectrum from one service to another, so long as the spectrum would be used to provide a “subscription” service (where an end-user would pay for the services provided). The first use of

spectrum auctions came with the new Personal Communications Services (“PCS”) – next generation digital cellular and data service. The Commission over the preceding several years had worked to clear out some 120 MHz of spectrum in the 2 GHz band, having already concluded that such a service was in the public interest under the old standard. The results of these auctions exceeded everyone’s expectations. Since the first round of auctions were held in 1994, some \$23 billion has been pledged by bidders.⁸

From Unexpected Windfall To Entitlement – Uncle Sam Gets Greedy

Policy makers and the FCC slapped each other on the backs, declared themselves brilliant, and assumed that if the first four auctions could generate almost \$25 billion for the federal coffers, then, it must follow, holding more auctions could only produce more money. In these days of tough budget battles, the idea of finding a whole new revenue source, literally from thin air, was intriguing, and some would argue, intoxicating. The 1997 Clinton Budget assumes that spectrum auctions will generate an additional \$37 billion over the next five years.⁹ \$14.8 billion of that was assumed to come from the recapture of spectrum after television stations switch to digital transmission modes beginning in 1998, with full digital conversion occurring by 2006.¹⁰ The original budget also specified that if there were any shortfall in the amount collected from the auctions, television broadcasters would be required to make up the difference – resulting in a potential \$9.2 million tax *per station* to feed the federal budget beast. In effect, the Federal government has created its own entitlement program, with the FCC appointed chief tax collector.

The Public Interest Now Equals -- \$\$\$

The governments greed did not end there, however. Seeing how much money was raised in the PCS auctions, Congress and the FCC began to look for other spectrum it could auction off. More specifically, the FCC looked at how it could reallocate spectrum it previously had given away, to a different service for which it could hold an auction. In an FCC “White Paper,” released in January, 1997, key FCC staff members set forth their positions as to the proper role of the FCC in making spectrum allocation decisions.

We believe the public interest is best served by ensuring that the American people receive the

maximum benefit from the spectrum resources. Therefore, the Commission's spectrum policy should advance the goals of ensuring that the full benefit of the spectrum recourse accrues to the public, and of achieving the beneficial uses of spectrum.¹¹

These FCC decision makers define "the public interest" as the amount of money which could be raised from auctioning the spectrum. "In general, the public derives the greatest benefit from spectrum to the extent that spectrum is used for services that the public values most highly and therefore is most willing to pay for." (Page 4).

In terms of finding spectrum which can be auctioned, the White Paper proposes to throw open vast portions of the spectrum to any use which will fetch the highest bid. "[W]here spectrum is currently governed by rules that do not permit it to be used to its full value, the Commission should act quickly and effectively to expand service flexibility so that this spectrum can be used more efficiently, thereby increasing the value of spectrum to licensees and the public." (Page 5.) This says what it means – if a particular use of the spectrum would result in higher auction fees, then the spectrum should be reallocated and the incumbent users moved.

Some might inquire as to the fate of the displaced users of the spectrum sold out from under them. The White Paper believes that in addition to the payments made to the Federal government in an auction, the new users will also compensate the incumbent users for the costs of relocating to a different part of the spectrum. (Page 9.) Indeed, this is what the FCC did with PCS, where displaced public safety and point-to-point microwave users were required to vacate the 2 GHz band for "higher ground."

Concerning reserving spectrum for future use, there again, according to the FCC White Paper, the market should decide. Rather than setting aside spectrum for future use, such as commercial space to earth communications, these FCC staffers believe that the spectrum should be put to immediate use if there are users out there willing to pay for the spectrum.

The Commission also should be wary of unnecessarily reserving spectrum for future use. In most instances, the public is probably

better served if spectrum is made available for use and that use is allowed to change as technological and market developments warrant, rather than if spectrum is withheld from use indefinitely. The Commission should therefore make available for assignment any remaining large blocks of unassigned spectrum, and it should move quickly to reallocate spectrum to private sector use as it continues to receive authority over spectrum formerly reserved for the Federal Government. (Page 9.)

This might not be so bad for spectrum that can't reasonably be expected to be utilized in the next ten years or so (the average FCC license term). There is no provision for recapturing the spectrum for its original intended use, however. Instead, the White Paper calls for establishing something very close to perpetual property rights in exchange for auction payments.

Although the Commission awards license for fixed terms, due to the high renewal expectancy these licenses in many ways resemble *de facto* licenses in perpetuity. This policy encourages efficient investments in assets tied to a specific license because license holders retain the benefits of those investments. (Page 21).

This, in and of itself, is a radical departure from prior FCC precedent which has held firm that FCC licenses convey no rights in the underlying frequencies and the FCC could revoke the "privilege" of operating on a particular frequency at any time. It appears that the FCC is willing to reverse this precedent in the face of the almighty dollar. If that is the case, then once a frequency is taken away from a future reserved use, there is little possibility that it might be returned to its originally intended purpose – a purpose that met the old public interest standard, but can't possibly compete with the new public interest standard of lots and lots of money. The term "eating your seed corn" should leap into the reader's mind about now.

Let Them Eat Grants

Not to be criticized for being overly cold hearted, the White Paper noted that there are some public interest uses of the spectrum which must be undertaken no matter what the cost. Police departments must be able to dispatch officers, and fire departments must be able to communicate with their

fire trucks. Gas companies must be able to monitor their pipelines for leaks. None of these entities could possibly afford the going rate of \$150 million a MHz which resulted from the previous rounds of bidding. The White Paper's solution? Have Congress provide cash subsidies to such entities so they can either bid for the frequencies on par with commercial users, or buy their needed communications services from commercial vendors.

To ensure that the public gets the maximum benefit from the spectrum, in considering the reservation of spectrum for any service the Commission should balance the value of spectrum in that service against its value for other uses. In general, explicit financial subsidies are preferable to set-asides because they are more narrowly targeted and their costs can be more easily evaluated. (Page 15)

Thus, according to the White Paper, every police and fire department would be required to lobby Congress for a cash subsidy to buy spectrum to continue doing exactly what it has done for years and years. Their thinking is that part of the money put into this bottomless pot by auction bidders can simply be funneled to needy users. Unfortunately, no one apparently informed these FCC policy makers about the "government multiplier," the well-known fact that for every dollar that goes into the government and then comes back out into the economy, well over half of it is eaten away by the bureaucratic process.

Presumably, space users would be in the same situation as police and fire departments. They would be required to convince Congress that it should provide money to allow them to purchase either spectrum or commercial services to provide the command and control telemetry critical to operating a spacecraft, let alone the necessary bandwidth to bring back video or other data-intensive transmissions. At \$150 million per MHz of spectrum, how many missions could afford to be flown? Probably close to zero.

This Is All A Joke, Right?

About now, the reader is probably questioning either the sanity or the sobriety of the authors of the FCC White Paper. Indeed, within a few days of the issuance of the White Paper, the FCC Commissioners and even the authors were backpedaling as quickly as they could, claiming that the issues presented in the

White Paper were merely for discussion purposes, and didn't necessarily reflect official FCC policy. Top FCC officials even acknowledged that the White Paper's presumption that all of the electromagnetic spectrum could be used for any service was not based on sound engineering principles, and that the FCC would not deliberately allocate spectrum for uses that were not technically feasible.

The communications community exhaled deeply, assuming that it had dodged a bullet, and that rationality still counted for something. They exhaled too soon.

The New Wireless Communications Service – Let It All Hang Out

Barely a month after the release of the White Paper, and only weeks after fierce backpedaling, the FCC released an Order establishing a new Wireless Communications Service, or "WCS."¹² Under the Telecommunications Act of 1996, the FCC was required to establish this service, as well as hold the auction for the spectrum by April 15, 1997. Faced with a very tight schedule, the FCC figuratively threw up its hands and said that licensees could use the newly allocated 30 MHz of spectrum for whatever services they could figure out how to make work in this part of the spectrum. In essence, the FCC fully adopted the recommendations made in the White Paper.

The FCC established virtually no technical guidelines, and the only power limitations placed on the use of these frequencies is that at the edge of each market (defined as a metropolitan area), there must be significant roll-off of the power levels so as not to interfere with adjacent market activities. Within the market area itself, however, licensees are allowed to "pump up the power" to deliver their desired service.

And the spectrum chosen for this grand experiment in technological twister? Remember the frequencies NTIA handed over to the FCC to reallocate in 1994? Those would be the ones. Only it gets worse. The FCC took the 2305-2320 spectrum from the NASA DSN, and added to it 15 additional MHz in the 2345-2360 Band. The other user of these bands which might be of interest to readers just happens to be flight test and vehicle launch range safety frequencies. Amateur radio also uses these frequencies. The FCC has said that they can stay on a secondary basis, which means that they must not cause interference to WCS

operations, and must tolerate any interference they may receive.

We also proposed to permit continued flight test and vehicle launch use of the 2310-2320 and 2345-2360 MHz bands on a secondary basis. We are adopting these proposals. The effect of this action is that amateurs and aeronautical telemetry operations will be able to continue to use these bands so long as these operations do not interfere with WCS service. (Par. 36).

What is most unsettling about the WCS decision is the FCC's decision to reject the ITU's condition that aeronautical telemetry have priority over terrestrial uses, contained in International Footnote S5.394 to Part 2. Thus, while under international law these frequencies are to be allocated such that aeronautical telemetry has priority, only in the United States, the new terrestrial WCS will have priority over these other uses.

In one swoop, therefore, the FCC potentially has crippled the Deep Space Network and put rocket launches at risk. How can the space community use these frequencies when they don't even know what uses will be made of these frequencies by the new WCS users, or their technical parameters, or even the power used by WCS operators. While no one can say that WCS will preclude use of these frequencies for their traditional space uses, the next vehicle launch using the 2345-2360 band better hope no one decides to order a pizza 60 seconds into the flight.

St. Louis For A Buck – The Auction Bloom May Be Off The Rose

The picture painted above is indeed bleak. Nevertheless, the space community may find solace, and possibly a solution, in what happened next to WCS. As promised, the FCC auctioned off this spectrum in April. The Commission anticipated that it would receive \$1.8 billion from auctioning of this spectrum – a steal at \$60 million a MHz. That amount had already been penciled into next year's Federal budget. A funny thing happened on the way to the bank, however. Virtually no one showed up for the auction. Closed almost as soon as the bidding opened, only \$13.6 million was ultimately bid for all the markets in the United States (a paltry \$450,000 a MHz). Major markets such as St. Louis and

Minneapolis were sold for \$1. San Francisco sold for \$6. The FCC argued that the poor showing of the WCS auction was caused by Congress' demand that the auction occur by April 15, 1997. The FCC concluded that the time frame was just too short to allow bidders to put together the financing necessary to drive bidding over a billion dollars.

The poor showing of the WCS auction has also been mirrored by substantial defaults by PCS licensees. In July, 1996, the FCC was forced to re-auction PCS Block C licenses in such markets as Minneapolis-St. Paul, Denver, Seattle, Phoenix and Portland, because the original winning bidder had defaulted on its payments.¹³ Pocket Communications, which bid a total of \$1.4 billion in the PCS auctions, filed for bankruptcy protection on April 1, 1997, calling into question its ability to make further payments into the U.S. Treasury.¹⁴ Numerous other PCS bidders have been unable to make the required progress payments to the government.

In short, there is a real question as to whether Congress' dream of finding a new revenue source will pan out, and it is becoming clearer that the FCC's policy of "let the market sort it out" may not be the best policy after all.

Don't Just Sit There, Communicate – While You Still Can

These are scary times for those within the space community who work every day toward settling the High Frontier. It truly would be a shame if while solving the tough issues such as Cheap Access To Space, private enterprise lost the rights to use the radio spectrum to communicate to and from space. Or worse yet from the perspective of those who advocate less government and more private enterprise, future space entrepreneurs may have to turn back to NASA and ask to rent time on their communications systems because all the other available bandwidth is now being used to order and deliver pizzas via wireless Internet hookups.

What then should the space community do? Below is a "shopping list" of activities that could aid in the preservation of frequencies for private space use:

- 1) Space advocacy groups such as the National Space Society and the Space Frontier Foundation should be made aware of these

critical frequency issues and should include them in their advocacy agendas;

- 2) An Ad Hoc Space Communications Users Group (SCUG), should be formed to monitor allocation proceedings and provide information to other members of the space community where it appears that the FCC may be depriving the space community of future frequencies;
- 3) SCUG members should aggressively argue to the FCC at every available opportunity that auctioning off space-related frequencies makes for bad public policy because of the international ramifications; and
- 4) SCUG should lobby Congress to limit the FCC's ability to auction off space-related frequencies where use of such frequencies would be for both domestic and international use.

Conclusion – There's Always Two Tin Cans And a Really Long Piece of String

The collective eyes of the space community must occasionally look up at the horizon as the path to space development is trod, to make sure that a governmental policy decision does not impact our ability to go. Future use of the radio frequency spectrum is one such issue that cannot be ignored. For if we do, we may find a time, in the not too distant future, where we will be forced to rely on an older form of technology to relay messages to and from space – two tin cans and a string.



¹ See 47 C.F.R. Part 2 (table of allocations of all frequencies broken down by government, private, and shared use).

² 47 U.S.C. Sec. 301 (1934).

³ *Allocation of Frequencies to the Various Classes of Non-Governmental Services in the Radio Spectrum from 10 Kilocycles to 30,000,000 Kilocycles*, Docket No. 6651, Report of Proposed Allocation from 25,000 Kilocycles to 30,000,000 Kilocycles at 18-20 (released January 15, 1945).

⁴ *Preliminary Spectrum Reallocation Report*, NTIA Special Publication 94-27 (February, 1994).

⁵ See *U.S. Spectrum Management Policy: Agenda For The Future*, NTIA Special Publication 91-23 (February, 1991).

⁶ *Omnibus Budget Reconciliation Act of 1993*, Pub. L. No. 103-66, 107 Stat. 312 (August 10, 1993).

⁷ Pub. L. No. 103-465, 108 Stat. 4809 (December 12, 1994).

⁸ "Latest License Auction Disappoints FCC – Total Comes Up Short of Expectations in Bargain-Basement Bidding," *Washington Post*, April 26, 1997, p. D-1.

⁹ "FCC Spectrum Policy Skewed," *Wireless World*, March 24, 1997, p. 35.

¹⁰ "NAB Scrambles To Counter New Fee Threat," *Broadcasting & Cable*, April 28, 1997, p. 4.

¹¹ R. Rosston & J. Steinberg, "Using Market-Based Spectrum Policy to Promote the Public Interest." FCC White Paper, January, 1997.

¹² *Amendment of The Commission's Rules to Establish Part 27, the Wireless Communications Service ("WCS")*, FCC 97-50, GN Docket #96-228, released February 19, 1997.

¹³ *FCC Public Notice*, DA 96-889, released June 3, 1996.

¹⁴ Pocket Communication's Press Release announcing that it had filed for Chapter 11 bankruptcy protection can be found at <http://www.pocketcomm.com/corpnws/4-1-97.htm>.