

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of)
)
Spectrum Policy Task Force) ET Docket No. 02-135
)

REPLY COMMENTS OF VANU, INC.

Vanu, Inc. hereby files these Reply Comments in the above-captioned proceeding.

I. Summary

Software Defined Radio (SDR) can help the Federal Communications Commission (the Commission or the FCC) improve spectrum management by lowering secondary market transaction costs, accommodating sharing of spectrum, accelerating acceptance of efficient technologies, increasing the options available and lowering the cost of remedying interference, adapting to current conditions and uses to ensure the most efficient protocols are used at any given point in time and by obviating most of the need to harmonize spectrum internationally.

The Commission and public can benefit from SDR with comparatively little effort. First, the Commission should set forth a clear policy direction that includes flexible radio devices. Second, the Commission should eliminate rules that needlessly constrain technology choices wherever possible. Third, the Commission should eliminate rules that mandate spectrum be used only for particular uses wherever possible. Fourth, the Commission should eliminate regulations that create disincentives for certain licensees to offer their spectrum on the secondary spectrum market. These steps will lead to significant investment in SDR technology and to investment in SDR-based networks, which in turn will lead to rapid improvement in our ability to use spectrum efficiently for the reasons noted above. Failure to take these steps lead to unnecessary uncertainty surrounding regulatory acceptance of SDR and will act as a disincentive to invest in SDR.

II. Introduction

A. About Vanu, Inc.

Vanu was formed in 1998 to explore the feasibility of building software radios using object oriented computer languages running on mainstream processors. This approach to software radio was initially investigated by the founders of Vanu in the SpectrumWare Project at Massachusetts Institute of Technology, which began in 1995. Project participants recognized that the rapid rate of improvement in microprocessor speed would soon bring the implementation of complex signal processing software systems into the realm of software. We believe this paradigm shift in the implementation of wireless communications systems will enable more efficient spectrum use, interoperation between historically incompatible radio systems, and much faster acceptance and adoption of advances in digital communications.

B. The Need for a Re-Examination of Spectrum Policy

The Commission and many other observers have identified certain trends affecting the wireless communications. In particular, trends relating to the demand for spectrum indicate increasing competition among uses for spectrum in the future, while increased demand has also led to, and will continue to lead to, increasingly congested spectrum. These trends are the reason this proceeding was initiated.

Partially offsetting the trends toward greater demand for, and congestion of spectrum, is technological progress in wireless protocols. This progress has allowed the introduction of new technologies that are more efficient with respect to how much spectrum and how much time are used to transmit a given amount of information. Although we can expect more efficiency gains in the future (especially those relating to more sophisticated and dynamic signal processing), they will be insufficient to meet the increase in demand for spectrum. The Commission should be looking to Software Defined Radio to enable significant additional latitude in meeting the challenges associated with increased demand for spectrum.

We believe the Commission and the general public will be able to reap the rewards associated with the benefits of software radio by simply removing regulatory barriers to the adoption of software radio. The ensuing investment in software radio technology will quickly bring software radio technology into mainstream markets.

III. Software Defined Radio and Spectrum Policy

Software defined radio enables radio equipment to reach previously unattainable levels of flexibility. Previously, the cost associated with this flexibility was high. However, the rapid price/performance improvements associated with Moore's law have made the benefits of software radio described in the following paragraphs available at low cost in the near term for many markets.¹ In other markets, SDR underperforms with regard to certain attributes required in such markets. Once again, Moore's law and the price performance improvements of other components employed in many SDR systems show every indication that they will continue. We expect that SDR will be able to address all significant radio markets within the next five years and will offer important competitive advantages over other implementation techniques, including those set forth in the following paragraphs.²

Low Costs for Secondary Spectrum Market Transactions

The flexibility enabled by SDR eliminates a major barrier to the successful establishment of secondary markets in spectrum by lowering the transaction costs associated with such market. Without this flexibility, networks could only be modified to take advantage of many market opportunities at very high expense and over long periods of time. The costs associated with such modifications in the absence of SDR would be sufficiently high that it would reduce the utility of secondary markets in all cases and eliminate the benefits in a large number of cases. Further, the timeliness with which such modifications could be made influences both the time within which the transaction costs can be recouped and the minimum window necessary for a spectrum trade to be

¹ Comments of Steve Stroh at page 3, Comments of IEEE 802.11 AMSC at page 17.

² Although several commenters stated they believe SDR is not ready to address spectrum policy matters (Nokia comments at page 1, Motorola comments at page 23 and New York State Office for Technology comments at page 11) we disagree.

economically rational. By lowering the transaction costs and time associated with temporary usage of available spectrum, SDR will lead to a more efficient allocation of resources.

Ability to take Advantage of Under-Utilized Spectrum

The discussion above with respect to the cost and timeliness with which changes to equipment may be brought about also applies to the model under which Commission regulations permit devices that dynamically sense spectrum utilization and use spectrum so long as they do not collide with another user.³ The flexibility to take advantage of such opportunities quickly and at low cost is a predicate to such regulations being beneficial. SDR devices capable of meeting this challenge are a reality today. To date SDR appears to be the only technology well suited to addressing this need, especially where the potential range of signal processing tasks to be performed is large or uncertain.

Adaptation to Optimize for Current Conditions

SDR-based equipment will also be able to adapt to conditions and uses in order to make the most efficient use of available spectrum. For example, while many radio systems can alter some aspects of their signal processing to adapt to current conditions, most radio systems today are statically designed to handle poor operating conditions. This means the systems will work reliably, but at the cost of sub-optimal resource utilization when conditions do not require extremely robust signal processing. SDR will permit devices to alter the signal processing they are performing in order to get the best performance for the current conditions. For example, under poor signal to noise conditions, aggressive forward error correction may be called for. As conditions improve, the error correction could be modified in order to get improved data rates. Without the flexibility to make these changes quickly and inexpensively, the benefits of adaptation for the current operating environment could not be realized.

³ Comments of Gerald R. Faulhaber and David J. Farber at page 12, Comments of Personal Telecommunications Technologies, Inc. at page 2, Comments of The New America Foundation, et al. At page 37, Comments of David Reed at page 9, Comments of The Dandin Group at page 5 and Comments of Jon M. Peha at page 3.

Adaptation to Optimize for End User Applications

Similar arguments to those made in the preceding paragraph apply to adaptation for the current use. Increasingly, customers use a single device or network to fulfill a variety of requirements. An example might be a mobile user of a cellular or PCS network who, at one moment may be talking to another party via the public switched telephone network and at the next might be responding to an e-mail that originated on the Internet. These uses have different requirements relating to bandwidth and latency, among other things. A device that can employ substantially different wireless protocols to fulfill different needs will allow network operators to use their spectrum resources much more efficiently.

Facilitation of Spectrum Management

SDR will lower the cost of future industry and Commission initiated spectrum management initiatives. The flexibility of SDR will allow wireless network operators to inexpensively undertake initiatives to improve their spectrum utilization. For example, a migration from wideband to narrowband voice networks could be accomplished much more quickly and at lower cost using software defined radio. Similarly, migration from a less spectrally efficient protocol can be accomplished more quickly and at lower cost if the radio network is composed of SDR devices. The acceleration of adoption of more spectrally efficient radio standards will be a desirable outcome associated with this capability.

Reduced Cost and Additional Strategies for Mitigation of Harmful Interference

SDR will at times be helpful in addressing harmful interference issues as quickly and efficiently as possible.⁴ One example might include the recent interference issues experienced by various public safety agencies in connection with nearby networks operating using a cellular architecture. Under these circumstances, SDR would lower the cost and decrease the time associated with moving users within or between bands. In addition, SDR would enable additional measures, such as improving filtering, to address

⁴ Comments of Hypres, Inc. at page 5 and Comments of Old Colorado City Communications Company at page 2.

interference. In the recent case relating to public safety, a part of the solution might have been to improve receiver filtering. While it may seem a little untraditional to have the party experiencing harmful interference take steps to remedy the situation, there can be no doubt that having a broader array of tools that will lower the overall costs of mitigating the harmful effects of this situation benefits everyone.

International Coordination Simplified

Finally, SDR will give the Commission and industry a new tool in handling international coordination issues.⁵ The need to harmonize spectrum allocations internationally will be supplanted with the need to ensure the right radio communications protocols are implemented by radios that are transported to area in which different regulatory requirements are applicable. We feel the technical complexity of this issue is minor compared to the political issues presented by efforts to achieve international harmony.

IV. SDR and the Regulatory Landscape

The Commission should seek to foster investment in SDR (the technology as a whole and the introduction of the technology into networks when the time is appropriate). The best way to ensure this happens is to 1) ensure the Commission's existing rules do not stand in the way of investment in SDR and 2) create a clear policy direction that incorporates flexible wireless equipment in order to encourage industry investment in SDR.

The Commission should eliminate wherever possible rules that require that a particular technology must be used to deliver services. This will free licensees to adopt technologies that best meet their needs.

The Commission should eliminate wherever possible rules that limit the uses to which a spectrum license may be put. The equities associated with removal of restrictions that result in a windfall to a licensee fall beyond the scope of our response.

⁵ Comments of Steve Stroh at page 3.

The Commission should encourage the creation of secondary markets by fine-tuning the rules permitting secondary transactions in spectrum. Changes to those rules should include protection against the inference that a transaction suggests the licensee does not need the spectrum and protection against forfeiture on the part of the licensee in the event its transferee of rights in the secondary transaction commits some transgression despite the due diligence of the licensee.

Finally, the Commission should foster investment in SDR systems by establishing a clear policy direction embracing more flexible radio devices. This will allow many of the benefits described above to be realized without further action on the part of the Commission.

V. Conclusion

SDR promises to benefit the Commission and the public by enabling improved spectrum management capabilities. We believe these capabilities will be realized by permitting the market to allocate resources toward this important technology. We also believe the Commission can accelerate the realization of these benefits by removing regulatory impediments to investment in SDR discussed above. Many of these impediments are largely the result of historical regulatory regimes and are no longer relevant or necessary. The removal of these impediments will accelerate the deployment of SDR and result in the benefits described above. If the Commission takes additional steps to establish a clear policy direction regarding spectrum allocation and usage, the removal of uncertainty will set the backdrop for substantial investment in technologies that will make better use of spectrum resources, including SDR.