

July 23, 1998

Spectrum Management Perspectives on Wireless

Robert J. Matheson

NTIA/ITS

Primary functions of spectrum management are to ensure that spectrum will be available for the most important radio services, that the spectrum will be used well, and that the radio services will create the maximum benefit to the nation's citizens. This paper applies those functions to the developing new wireless services.

Will there be adequate amounts of spectrum for all of the proposed new wireless services? The large growth in spectrum demand is matched by a similar large growth in spectrum capacity. Spectrum capacity—the ability of spectrum to carry communications—is very elastic and can be increased greatly by investment and technology. Many new technologies have been developed recently for squeezing more capacity from existing frequency bands, including digital compression, down-sizing of cells, use of directional antennas and adaptive antennas, etc. These techniques can increase the capacity of existing spectrum by a couple orders of magnitude.

Moreover, huge new frequency bands are becoming available at the upper edge of today's useful spectrum, paced mainly by the availability of suitable GaAs and Si-Ge microwave electronics. A decade ago, 1 GHz was viewed as the upper end for inexpensive consumer electronics. DBS satellite receivers at 12 GHz are becoming widespread today, and LMDS systems at 30 GHz are being developed for rapid introduction in the near future.

Higher frequency bands will be heavily used, partly because they have unique qualities that can be advantageously exploited. New wireless systems can overcome higher path loss at higher frequencies by using small cells and highly-directive/adaptive antennas. These techniques will also produce increased frequency reuse and improved multipath response. Such techniques are more effective at higher frequencies because of better performance from smaller antennas.

Different frequency bands have a variety of user rules—from the relatively total owner control of auctioned bands, to the traditional rigid service rules of licensed bands, to the anarchy of the ISM/Part15 bands. Some of these operating rules may be particularly suitable for particular functions, but the systems will need to fit the rules. For example, the ISM bands allow instant system operation without licenses, but the lack of protection from interference may require that each user be able to detect and avoid interfering signals.

Most of the new wireless systems will use the “digital convergence” to provide a wide number of services carried by “1”s and “0”s. This means that many different types of systems using many different technologies will be direct competitors of each other. This competition will be real and fierce; it is not clear yet how many competitors will succeed. With such competition between various services, there may be less need to regulate competition within each service.

Future wireless systems will be quite different from traditional systems. It will be very interesting and exciting to see what is developed and to learn how society will use it.