



Highlights of [GAO-04-666](#), a report to congressional requesters

Why GAO Did This Study

Recent advances in technologies that rely on the use of the radio-frequency spectrum have turned science fiction of the past into reality. Cellular telephones, wireless computer networks, global positioning system receivers, and other spectrum-dependent technologies are quickly becoming as common to everyday life as radios and televisions. Further, these technologies have become critical to a variety of government missions, including homeland security and strategic warfare.

However, with the increased demand, the radio-frequency spectrum—a resource that once seemed unlimited—has become crowded and, in the future, may no longer be able to accommodate all users' needs. As a result, there has been a growing debate among spectrum policy leaders about how to use spectrum more efficiently. To help inform these debates, GAO was asked to look at agencies' investments in spectrum efficient technologies and how the nation's spectrum management system may affect the development and adoption of these technologies.

What GAO Recommends

GAO is making six recommendations intended to facilitate greater investment by federal agencies in spectrum efficient technologies. Overall, the agencies indicated their commitment to promoting greater flexibility and more efficient use of radio spectrum.

www.gao.gov/cgi-bin/getrpt?GAO-04-666.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Katherine V. Schinas at (202) 512-4841 or schinasik@gao.gov.

SPECTRUM MANAGEMENT

Better Knowledge Needed to Take Advantage of Technologies That May Improve Spectrum Efficiency

What GAO Found

The nine federal agencies that GAO reviewed—which are among the largest users and investors in technologies and systems impacting spectrum use—have made some investments in technologies that provide improved spectrum efficiency. However, these investments have tended to occur when agencies needed to make greater use of available spectrum to meet a mission requirement—not by an underlying, systematic consideration of spectrum efficiency. For example, as a result of growing spectrum constraints, the Department of Defense (DOD), the Federal Aviation Administration, and the National Aeronautics and Space Administration began investing in technologies that would increase the throughput of information while using smaller segments of their available spectrum. However, agencies also consider other factors—including cost and technical and operational concerns—that may dissuade them from investing in spectrum efficient technologies. For example, DOD may need to use more spectrum to meet an operational requirement to field a jam-proof and accurate radar for military aircraft.

The current structure and management of spectrum use in the United States does not encourage the development and use of some spectrum efficient technologies. Because the spectrum allocation framework largely compartmentalizes spectrum by types of services (such as aeronautical radio navigation) and users (federal, nonfederal, and shared), the capability of emerging technologies designed to use spectrum in different ways is often diminished. For example, software-defined cognitive radios—radios that adapt their use of the spectrum to the real-time conditions of their operating environments—could be used to sense unused frequencies, or “white spaces,” and automatically make use of those frequencies. It may also be possible to use software-defined cognitive radios to exploit “gray spaces” in the spectrum—areas where emissions exist yet could still accommodate additional users without creating a level of interference that is unacceptable to incumbent users—to increase spectrum efficiency. Currently, however, the spectrum allocation system may not provide the freedom needed for these technologies to operate across existing spectrum designations, and defining new rules requires knowledge about spectrum that spectrum leaders do not have. At the same time, there are few federal regulatory requirements and incentives to use spectrum more efficiently. While the National Telecommunications and Information Administration (NTIA) is responsible for managing the federal government's use of spectrum and ensuring spectrum efficiency, NTIA primarily relies on individual agencies to ensure that the systems they develop are as spectrum efficient as possible. Agencies' guidance and policies, however, do not require systematic consideration of spectrum efficiency in their acquisitions. The lack of economic consequence associated with the manner in which spectrum is used has also provided little incentive to agencies to pursue opportunities proactively to develop and use technologies that would improve spectrum efficiency governmentwide.