

## 7 KEY FINDINGS AND RECOMMENDATIONS

Decisions must be made by the 2010–2015 time frame on the best way to sustain and improve the Nation’s domestic radar capabilities for weather surveillance and aircraft surveillance. The JAG/PARP has formulated a set of recommended next steps by which the FCMSSR, OFCM, and individual Federal agencies can prepare for an informed decision on whether a single network of multifunction phased array radar (MPAR) units should become the Nation’s next-generation technology for these surveillance applications. The recommendations are presented in section 7.2. Section 7.1 rehearses the key findings from chapters 2 through 6 on which the JAG bases its recommendations

### 7.1 Summary of Key Findings Supporting the Next Steps

The numbered paragraphs below summarize and draw conclusions from much more detailed discussions in chapters 2 through 6. The source section(s) are indicated in brackets at the end of the paragraph.

1. Building on the proven weather surveillance capabilities of the NEXRAD network, radar research is expanding the capability of phased array radar to sense more and more weather phenomena of substantial value for safety and National economic growth. Research has shown how radar can be used to detect precipitation type (hydrometeors) and quantify precipitation rate on the spatial and temporal scales necessary for advanced applications in quantitative precipitation forecasting and flash flood nowcasting. Wind and turbulence phenomena observable by new radar techniques can improve warning times for tornadoes and severe thunderstorms; for wind shear, wind gusts and shifts, and microbursts; and for the local spin-off effects of cyclonic storms interacting with terrain. These advanced radar observing capabilities, coupled with the improvements in NWP modeling that advanced radar data make possible, have application to downstream applications as diverse as fire weather and wildland fire management, debris flow prediction, spaceflight launch and recovery, and “ground truth” for calibrating and validating new generations of satellite-borne remote-observing instruments. Federal agencies whose mission areas already are or could be impacted by improved radar capabilities include NOAA/NWS, FAA, FHWA, NASA, Department of Agriculture (including the U.S. Forest Service), Department of the Interior (National Park Service, Bureau of Land Management, U.S.G.S.) Department of Homeland Security (FEMA, U.S. Fire Administration, U.S. Coast Guard), Department of Defense (Air Force, Navy, and Army for domestic and homeland defense operations), EPA, and others. **[sections 2.1 and 2.3]**
2. Radar surveillance of the National Airspace System will continue to be essential to detection, identification, tracking, and—if necessary—interdiction of non-cooperative aircraft. Radar surveillance can complement the planned cooperative

surveillance strategy, which depends on reception of signals from aircraft-borne transponders, by providing assured backup and transponder signal validation. Radar can also aid in detecting natural hazards to aviation not caused by atmospheric conditions alone, such as bird flocks and volcanic ash plumes. Federal agencies whose mission areas depend on these capabilities include the FAA, Department of Homeland Security, and Department of Defense. [sections 2.2 and 2.3].

3. Aging of the existing domestic radar networks for weather surveillance or aircraft surveillance will require substantial commitments of Federal resources to either maintain or replace the networks [section 3.1].
4. As many as seven of these aging, single-function conventional radar networks could in principle be replaced by a single network of MPAR units, with each unit capable of performing multiple functions. A shift in National strategy from multiple networks of mechanically rotating conventional radars to one MPAR network could not only provide all the capability of the existing systems, but also enable many of the new observing capabilities to support the full range of advances and downstream applications listed in points 1 and 2 above. [chapters 3 and 4]
5. However, before a decision is made between continuing with conventional single-function radars or an MPAR network, some specific technical issues need further testing and demonstration to ensure that the necessary MPAR technology is mature enough to proceed with this major shift in strategy. [chapter 4]
6. The JAG/PARP estimates that an MPAR network using today's technology is likely to be a cost-effective option. Technology trends provide opportunities for further cost reductions. In a preliminary study of required radar coverage, analysts from MIT's Lincoln Laboratory concluded that a network of about 334 MPAR units could replace the roughly 510 units in the seven aging, disparate networks—a 35 percent reduction in radar units. Preliminary analyses indicate that both the acquisition cost and the life-cycle cost of this MPAR network concept compare favorably with either continuing to repair, maintain, and replace the existing networks or replacing them with networks of newer, single-function conventional radars. However, these preliminary studies need to be refined and validated before a decision on National domestic radar strategy is made. [chapter 5]
7. The technical, cost, and programmatic risks associated with an MPAR network strategy can be reduced substantially by a modest R&D program, to be completed prior to the time that substantial resource commitments must be made to sustain current radar coverage and capability. This R&D program comprises three components, which merge toward the end of the program. (1) A technology development and test program will lead to construction of a prototype MPAR unit. (2) Proof of MPAR operational concepts will be conducted initially using the phased array radar of the National Weather Radar Testbed (NWRT), then with the MPAR prototype. (3) The provisional MPAR network concept will be refined using the NWRT, several research radars with appropriate transmission bands, and analysis of data from the legacy radar systems. [chapter 6]

## 7.2 Recommended Next Steps

On the basis of the preceding findings, the JAG/PARP recommends the following actions as next steps toward a coordinated, rational approach to deciding on the Nation's strategy for domestic radar capability for the next 30 years.

**Recommendation 1.** The FCMSSR should endorse the concept of an MPAR risk-reduction R&D program that substantially incorporates the objectives and the three components of the plan outlined in chapter 6.

**Recommendation 2.** The FCMSSR should consider organizational options to foster collaborative and joint R&D on the MPAR risk-reduction activities by establishing a joint entity, such as a Joint National Center for Advanced Radar Research and Development, to manage agencies' contributions to the risk-reduction program outlined in this report.

**Recommendation 3.** For the period prior to operational standup of a joint management entity, the FCMSSR should direct OFCM to form an interagency MPAR Working Group (WG/MPAR) within the OFCM infrastructure to coordinate and report on the R&D activities of participating agencies in implementing an MPAR risk-reduction program. Activities of the WG/MPAR should include, but not be limited to:

- Identification of agency contributions to the first phase of risk-reduction activities in each component prong of the program.
- Establish a cost basis for near-term agency contributions, sufficient to allow incorporation into Agency budget submissions.
- Explore options to foster interagency cooperation and collaboration on MPAR risk-reduction activities.
- Develop a set of specific program progress metrics against which annual progress toward risk-reduction goals and objectives can be assessed.
- Prepare and publish an annual statement of the next-year objectives and activities for the risk-reduction program. This annual statement should include a review of progress in the current year and connections to out-year activities and objectives, to show how each year's activities contribute toward achieving the overall risk-reduction goals. As guidance to the participating agencies, the report should include an estimate of budget resources needed for the next-year activities and a summary of prior-year funding by agency. Progress toward goals and objectives, using the program metrics, should be reported each year, with an analysis of areas of shortfall and of substantial progress.
- Identify opportunities for review of program plans and progress by appropriate boards or study committees of the National Academies' National Research Council (NRC).
- Prepare and publish an MPAR Education and Outreach Plan to build understanding of and garner support for a National surveillance radar strategy decision within all the potentially affected Federal agencies, Congress, State and

local governmental entities, the private sector, and the public. This plan should involve the academic community and the media and include dissemination of results from the NRC studies suggested above. A series of workshops, coordinated through NCAR, should be considered for engaging the academic research community.

**Recommendation 4.** The FCMSSR should direct that, in conjunction with the MPAR risk-reduction program, a cost-benefit analysis be undertaken to establish the cost-effectiveness of the MPAR option and competing domestic radar strategies. The basis for MPAR acquisition and life-cycle costs should include results from the technology development and test activities and the MPAR network refinement, as appropriate.