Lifting Aviation Off the Ground

The multi-agency Joint Planning and Development Office is planning the Next Generation Air Transportation System.

Visions of a new world of aviation provide a backdrop for MITRE employees supporting the Next Generation Air Transportation System project. From back left: E. J. Spear, Bob Humbertson, Mimi Hailegiorghis, Katie Bolczak, and Jerry Friedman.

TODAY'S NATIONAL AIRSPACE SYSTEM relies on a fixed structure tied to more than 5,000 ground-based navigation aids. In its place, the authors of a new model—the Next Generation Air Transportation System—envision a world where travelers and shippers set their own arrival and departure times, pilots assume some tasks now handled by controllers, and precision landings occur without control towers or radar. In promoting the new model, Secretary of Transportation Norman Mineta said it heralds "an exciting future where even the sky may not be the limit."

Birth of the "next generation"

The genesis of the air transportation system transformation was the 2003 Vision 100—Century of Aviation Reauthorization Act. A major impetus for the measure was economics, especially the need to accommodate an expected tripling of demand in the next 20 years, including unmanned vehicles, and increases in single-engine planes and small jets. The primary goals of the next generation system are to improve the level of safety, security, efficiency, quality, and affordability of the National Airspace System and aviation services.

The Act created the Joint Planning and Development Office (JPDO), a partnership of seven agencies, plus the private sector, as the hub of activity (see "The Cast of the JPDO"). Amr ElSawy, senior vice president and general manager of the Center for Advanced Aviation System Development (CAASD), describes it as "a brand new operating model for government. The idea is to have technical alignment, programmatic alignment, and budgetary alignment toward a single mission. I think that is both unprecedented and difficult to do."

MITRE as chief engineer

At the very center is MITRE, serving in the role of the JPDO chief engineer. Jerry Friedman, a CAASD director, holds the title and leads the effort, but ElSawy says the function is really "beyond a sole individual's capacity—it includes the capabilities of the entire company."

Friedman is a nine-year veteran of similar privileged roles, most recently as chief architect for the Air Force. He describes the task of planning the Next Generation Air Transportation System as "unprecedented not only in its scale, but also because it crosses the boundaries of the core mission areas of so many agencies. There really are few if any pathfinders."

Given this complexity, he says, the expectation of our sponsors is that we will fully leverage across all of MITRE. "Whenever I mention that somebody from the Air Force Center or the Washington Command, Control, and Communications Center is working on this, or that we're consulting with somebody from the Center for Enterprise Modernization, that's exactly what our customers want to hear," says Friedman. "That's why they want MITRE."

DEMONSTRATING THE FUTURE

Security operations stand to gain significant advantage from shared situational awareness. In today's aviation environment, the time it takes to share information about a suspicious aircraft—off-course, transponder turned off, or veering into restricted airspace—often precludes any option but interception, a costly proposition (close to $40,000/hour) for a frequent event.

Showing the impact of shared situational awareness was the focus of a multi-agency, multi-million-dollar, multi-company, multi-system demonstration staged last fall. The Network-Enabled Operations demo linked equipment in 11 laboratories in eight states, different types of control displays—including personal digital assistants (PDAs)—and several agencies.

The first operator to spot the fictitious aircraft straying from its pre-set path could send messages instantly to interested operators in other operating centers and then transmit cueing information for display on other radar systems. They could share a passenger list for checking against the terrorist watch list. In one scenario, the suspicious action stemmed from an avionics problem, which was confirmed by the air marshal using his PDA. No action needed.

The JPDO is structured around four technical divisions: enterprise architecture, systems engineering and integration, portfolio management, and evaluation and analysis. As chief engineer, Friedman's role is to "integrate across these technical functions within the JPDO," he says.

Architecting as organic process

Enterprise architecture takes a unique form on this project. "It's tens of thousands of individual acquisitions, not a large federal acquisition," says Andy Anderegg, who headed the JPDO architecture division while on intergovernmental loan to the Federal Aviation Administration (FAA). (He returned to CAASD this January.) Anderegg looks at it as more like an organism than something built from a master plan. Explaining that it's more of a process, he says: "We're interested in the verb—*architecting*, not architecture."

Another aspect unique to the JPDO is that policy is an element of the architecture, as overseen by a senior policy committee—composed of secretary-level executives from each agency. If putting a desired technology into place would require policy changes, the JPDO staff can call on this panel. It has been crucial as a vehicle for taking policy issues right to the top, according to Anderegg.

Lift-off strategies

Eight broad strategies define the roadmap for transforming air transportation, and each has an integrated product team—an interagency group guided by one agency—to do the hard work of setting the stage for change.

Two strategies—agile air traffic management and situational awareness—will combine to literally take aviation off the ground. Today's air traffic is managed by ground-based air traffic controllers responsible for certain geographic segments, and they successively hand off control of an aircraft as it moves across the sky.

The geographic system works locally, but it has trouble coping with disruptions that originate miles away. Technology now makes it possible to guide a plane from a distance without an air traffic control facility on the ground just below. But making that happen means changing procedures for the whole way the system works, and that's the job of the agile air traffic management team.

An even more radical shift—from ground-based control to self-management—will come from extending situational awareness to pilots in the cockpit. As soon as they get information directly, with the attendant improvements in timeliness and quality, pilots will be able to take over much of the responsibility from air traffic controllers, instead of relying on ground-based, two-party exchanges involving multiple relays.

The benefits to civil aviation of adopting this network-centric concept include tighter, more efficient collaboration among parts of the air traffic control system and aviation customers, as well as faster response to potential security threats (see "Demonstrating the Future").

Multidimensional challenges

The challenges facing the JPDO are multidimensional. "I think we will eventually solve the tough technical challenges, but the cultural, organizational, and economic challenges will be the most difficult ones to address," says Friedman. They include developing solutions that span government organizations, making sure the solutions are compatible globally, and creating solutions that the private sector—which ultimately finances at least 90 percent of aviation investment—is able and willing to fund.

"It really needs to be part of our mindset when we craft solutions, that they have to be seen as affordable by the constituents," says Friedman. The need for a business case to substantiate private sector investment is behind some of the innovative work at the JPDO in architecting and simulation. "We're coupling the architecture that we're developing with high fidelity models so we can model the projected air transportation system to assess benefits and costs," he says.

Immediate impact

But people won't wait until 2025; they're looking for impact now, Friedman emphasizes. So besides looking far ahead, the JPDO has identified six near-term opportunities that are "transformational in nature and are oriented toward achieving the vision," he says.

One such opportunity is ADS-B (automatic dependent surveillance broadcast), a satellite-based tracking system that lets aircraft communicate their locations directly to each other, or transmit data to ground controllers without radar. To help meet the goal sooner, the FAA is accelerating its national deployment of ADS-B. Other steps include synchronizing and accelerating the weather research of several government organizations and providing Internet-enabled information sharing.

At a June 2005 conference called Airport 2025, Secretary Mineta emphasized near-term results: "We don't have to wait until 2025 to see changes. By focusing current investments on next generation systems, we are making an operational difference today."

—Shari Dwyer

THE CAST OF THE JPDO

The JPDO's agency partners, with the strategy areas they lead:

Department of Transportation
(Federal Aviation Administration)
- airport infrastructure
- safety
- environmental protection
- global harmonization

Department of Homeland Security
- security

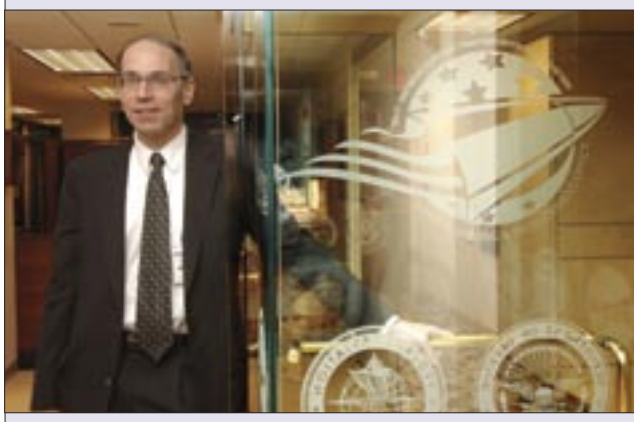
National Aeronautics and Space Administration
- agile air traffic system

Department of Defense
- shared situational awareness

Department of Commerce
(National Oceanic and Atmospheric Administration)
- reducing weather impacts

White House Office of Science and Technology Policy

In addition, the **NGATS (Next Generation Air Transportation System) Institute** is a vehicle for private sector involvement.



Logos of partner agencies remind Chief Engineer Jerry Friedman of the extraordinary collaboration underway at the JPDO's Washington headquarters.