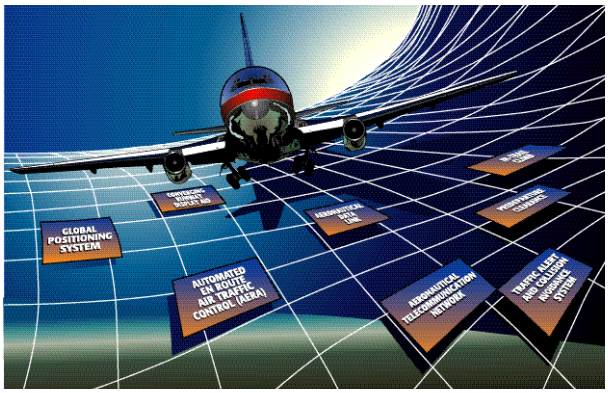
CAASD
CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT

Free Flight

Introduction

Through the 1990s, we have witnessed a transformation of the world economy. Ten years into this transformation, we are beginning to understand the real impact of the Information Age. Part of that impact is the global reach of aviation. Travel and air commerce are on the increase, while intense global competition is holding the line on prices. Because competition keeps prices low, the nation's and the world's users of national and international airspace must streamline their operations, cut costs, and become efficient as possible.

Free Flight is all about eliminating restrictions to give users of the National Airspace System (NAS) the ability to optimize their operations. For most, this means being able to determine their aircraft's route of flight and schedule with as few constraints as possible. However, absolute Free Flight is almost unattainable because there will always be a role for the Federal Aviation Administration's (FAA's) Air Traffic Management (ATM) activity to guarantee safety or to adjudicate in instances when demand for an airport or airspace resource exceeds capacity. Therefore, when there are constraints, Free Flight principles call for allowing users to decide, as much as possible, which actions to take to meet the constraints, rather than having those actions prescribed.



The MITRE Corporation's Center for Advanced Aviation System Development (CAASD) is committed to working with the aviation community and the FAA on the implementation of Free Flight. Moreover, as the FAA's federally funded research and development center (FFRDC), we are uniquely qualified to play a significant role in leading the Free Flight efforts. Our institutional knowledge of ATM spans decades. With our broad set of interdisciplinary skills, we understand the technological challenges facing the community as well as the requirements for implementing NAS improvements.

Near-Term Procedural Enhancements

In 1995, the RTCA Task Force Three Report on Free Flight highlighted the need to take advantage of improvements that rely on procedural changes while requiring no additional ATM technologies. These procedural enhancements provide "early wins" that include the increased use of area navigation (RNAV) routes, expansion of opportunities for direct routing between city pairs, increased collaborative decision-making, and the reduction of the 250 knot restriction in busy airspace.

CAASD has been a major force in the implementation of these enhancements, often providing key analysis and assessment capabilities giving the FAA and users confidence in the viability of such changes. For example, we have increased user access to Philadelphia, Newark, and JFK airports through the implementation of RNAV procedures, implemented collaborative routing decision support systems at Kansas City, Indianapolis Centers, and the Air Traffic Control System Command Center, and have facilitated the removal of the 250 knot airspeed restriction for departures at Houston International Airport.

MITRE

Free Flight Phase One

In parallel with the implementation of procedural enhancements, both government and industry personnel realized that a new way of doing business was needed to ensure that significant benefits could be gained from the introduction of technology into the NAS. As part of the FAA's NAS modernization effort, CAASD helped initiate the Free Flight Phase One (FFP1) Program, a government/industry initiative that brings a number of mature capabilities from the laboratories of leading institutions to the field. Rather than immediately jump to a national implementation plan, FFP1 follows an incremental, "spiral" approach to development that focuses on early fielding of capabilities in a limited number of facilities. The FFP1 systems include the CAASD-developed User Request Evaluation Tool (URET), the Surface Management Advisor (SMA), the Traffic Management Advisor (TMA), the passive Final Approach Spacing Tool (pFAST) and the implementation of Collaborative Decision-Making (CDM) capabilities. Many of these tools and capabilities are in daily use and their implementation to selected locations will be complete by 2002.

CAASD has been a major player in FFP1. Our URET conflict detection and resolution capability is based on over 20 years of research and enables controllers to work in a more strategic manner, allowing aircraft to fly off the traditional route system along user-preferred routes. CAASD is working with field personnel to help transition to operations using URET. In addition, we are working with the FFP1 program office to transfer the URET technology to Lockheed Martin, the FAA's URET contractor.

CAASD is also a major player in the fielding of CDM capabilities. The CAASD-developed Collaborative Routing and Coordination Tools (CRCT) prototype deployed to the Air Traffic Control System Command Center and at Kansas City and Indianapolis Air Route Traffic Control Centers will be used to define requirements for the Traffic Flow Management (TFM) decision support infrastructure. The use of CRCT will also reduce delays associated with severe weather during the busy summertime travel season. CAASD continues to develop new capabilities in response to existing and future NAS problems.

Introducing these capabilities in a successful manner requires that government and industry plan ahead for potential problems, identify key risks, and take measured action to mitigate potential and actual problems. CAASD's system view has helped us to lead the risk management process in FFP1 and thus minimize potential setbacks.

A key principle for FFP1 is that each introduced capability be tested for measurable benefits to the government and users. CAASD has worked closely with both government and industry to understand the current baseline of operations and services, to define meaningful metrics for measuring benefits, and to measure the specific metrics and benefits associated with the FFP1 capabilities.

Data Link and SafeFlight 21

A key step in Free Flight is the implementation of Controller-Pilot Data Link Communications (CPDLC). CPDLC provides a digital alternative to voice communications, which is workload-intensive and prone to misunderstandings and errors. With digital data communications for even simple messages such as Transfer of Communications, CPDLC should alter controller activities, enabling them to focus more on improved management and services. CPDLC is being built in an incremental, spiral fashion so that the entire aviation community can build on past successes. Build 1 will introduce four basic services in the Miami area in mid-2002; Build 1A expands these services a year later and includes expanded locations of service.

Safe Flight 21 is a major government/industry initiative to reduce the risk of new Communications, Navigation, and Surveillance (CNS)-based capabilities through the limited implementation and evaluation of nine operational enhancements related to automatic dependent surveillance broadcast (ADS-B), Flight Information Services (FIS), and affordable terrain information in the cockpit. In the Ohio Valley, members of the Cargo Airline Association are implementing ADS-B and new cockpit displays to increase pilot situational awareness, enhance surveillance provided to controllers, and introduce new procedures that build on advanced cockpit capabilities. In Alaska, SafeFlight 21 addresses urgent needs for increased safety, especially in the reduction of accidents related to adverse weather or controlled flight into terrain. In addition, efficiency improvements are being explored with the Alaskan air carrier and air taxi operators.

In support of Safe Flight 21, CAASD has developed concepts and technologies and served as the system integrator, working with the government, users, vendors, and service providers to facilitate coordinated schedules while leveraging the contributions of individual organizations. CAASD has been a long-standing contributor in Data Link and Weather research, and is seen as an industry leader in ADS-B. These skill areas have been essential to understanding not only the technical needs for data link initiatives, but the procedural and institutional concerns that must be addressed to fully implement any capability.

Free Flight Phase Two

To sustain the momentum, government and industry reached a consensus about follow-on steps to FFP1in December 1999. These next steps, to be implemented by 2005, are called Free Flight Phase Two (FFP2). During FFP2, the FAA will implement FFP1 capabilities at additional locations with enhancements and incremental updates as research progresses.

CAASD provided analytical support to the process of developing FFP2 recommendations by helping government and industry to recognize the urgency of addressing system-wide problems. CAASD's problem-based analysis led to implementation recommendations to address major NAS problems enabling the receipt of the greatest benefits. Examples include the implementation of URET and Traffic Management Advisor (TMA) to locations with the greatest need. The problem-based analysis also disclosed a need to increase our ability to predict system constraints, assess the impacts of flow management initiatives, and to more equitably distribute flow restrictions.

CAASD research initiatives will also play a major role during FFP2. Ongoing URET research should yield the fielding of the Problem Analysis, Resolution, and Ranking (PARR) capability to reduce the controller workload associated with the development of conflict resolutions. Furthermore, CAASD research will continue to be instrumental in defining requirements for incorporation into the TFM infrastructure. Other very promising areas of research include the development of decision support capabilities that assist controllers merge aircraft transitioning from en route to terminal airspace as well as aircraft departing terminal for en route airspace, a high-priority problem area.

Future Steps

The Free Flight environment will increase flexibility, capacity, and efficiency while accommodating users with differing levels of sophistication and equipage. System restrictions will be limited to those needed to address resource constraints or to maintain safety of operations. Where appropriate and mutually agreed to, separation responsibility will be delegated to pilots, furthering efficiency gains and increasing the capability of users to determine their own optimum responses to traffic conditions. Increased information exchange and the implementation of tools to facilitate collaboration between flight operation centers and the FAA will allow users to continue growth in response to demands for additional air transportation services while increasing the overall predictability of the NAS.

What's next? Free Flight will continue to be an evolutionary path, focusing on continuous improvement and incremental evolution of systems, procedures, and processes. As the NAS becomes more flexible, we'll be seeing improvements that build not on individual improvements but rather integrate multiple capabilities. In particular, the synergy between new CNS and ATM systems will dramatically increase the ability for users to achieve their individual goals in concert with overall system-wide needs. A common view will continue to be essential to ensure that all stakeholders adequately support joint priorities. CAASD will be ready to work with the entire community to see that the NAS continues to grow, expand its service, and maintain its world preeminence in safety.

For more information, contact:

Deborah A. Kirkman
703.883.5964
dkirkman@mitre.org

Center for Advanced Aviation System Development (CAASD)

The MITRE Corporation
7515 Colshire Drive
McLean, VA USA 22102-7508

www.mitrecaasd.org

MITRE

CAASD

MP 95W0000226R2