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Agenda Item 6: **Surveillance**

STATUS OF THE FLIGHT 21

(Presented by USA)

SUMMARY

Safe Flight 21 (SF-21) is a cooperative government/industry program to evaluate Automatic Dependent Surveillance-Broadcast (ADS-B) and related technologies and capabilities to enhance aviation safety, efficiency, and capacity in the National Airspace System (NAS). The program's emphasis is on providing common, real-time traffic information to both air traffic controllers, flight crews, and the user community

REFERENCES

RTCA/DO-242 Minimum Aviation System Performance Standards (MASPS) for Automatic Dependent Surveillance Broadcast (ADS-B), February 19, 1998.

1. Introduction

1.1 The FAA, working with RTCA (an advisory group to the FAA), recognized that new communications, navigation, and surveillance (CNS) capabilities were needed to increase capacity, improve efficiency, and resolve safety problems. In 1998, the RTCA Free Flight Steering Committee comprised of members from aviation industry, FAA, and RTCA recommended to the FAA Administrator a strategy to resolve risks associated with the new CNS systems before these capabilities could be implemented. Under this strategy, the SF-21 Program was formed to address CNS issues and provide information to the FAA and industry so that they could make informative decisions about implementing these systems. SF-21 focuses on a manageable set of operational capabilities that are important to the user community. These include the cockpit display of traffic, weather, and terrain information, improved data for controllers, enhanced see-and-avoid and surface situational awareness. Technologies under

evaluation include Automatic Dependent Surveillance-Broadcast (ADS-B), Traffic Information Service-Broadcast (TIS-B), Flight Information Services-Broadcast (FIS-B), and the use of a multi-functional display in the cockpit and controller displays.

2.0 Safe Flight 21 Objectives

2.1. The SF-21 objectives are to identify, evaluate, and mitigate the risks associated with the selection, implementation, and integration of planned CNS capabilities and corresponding procedures. In mitigating these risks, the program will:

- Enhance safety
- Increase system capacity and efficiency
- Maximize user operational benefits
- Minimize user equipage costs and FAA operational costs
- Address pilot and controller human factors issues
- Develop and assess new operational procedures and associated training
- Streamline certification processes and procedures
- Develop a cost-effective avionics and National Airspace System (NAS) infrastructure, and
- Define a realistic NAS transition path supported by the user community.

3.0 Operational Enhancements

3.1 The Safe Flight 21 Program operational enhancements were identified by the operational users through RTCA. The operational enhancements are as follows:

1. Provides weather and other information to the cockpit
2. Affordable means to reduce controlled flight into terrain
3. Improved capability for approaches in low visibility conditions
4. Enhanced capability to see and avoid adjacent traffic
5. Enhanced capability to delegate aircraft separation authority to the pilot
6. Improved capability for pilots to navigate airport taxiways
7. Enhanced capability for controllers to manage aircraft and vehicle traffic on airport surface
8. Provide surveillance coverage in non-radar airspace
9. Establish ADS-B separation standards.

3.2 Each of these operational enhancements is further defined in terms of operational applications.

3.2.1 Operational Enhancement 1 - Provide Weather and Other Information to the Cockpit

- Initial FIS-B based on today’s available next generation weather radar (NEXRAD) graphics, aviation routine weather report/aviation selected special weather report (METAR/SPECI), terminal forecasts (TAFs), significant meteorological information (SIGMETs), pilot reports (PIREPs) and severe weather forecast alerts.

- Add products such as notices to airmen (NOTAMs), lightning, icing, turbulence, real time special use airspace (SUA), and volcanic ash.

3.2.1.1 There is a significant amount of data in the NAS that would make the flight safer through improved situational awareness (e.g., weather information) or more cost effective (e.g., knowledge of special use airspace (SUA) restrictions), if the pilot had access to this information in the cockpit.

3.2.1.2 This operational enhancement will use FIS-B to receive current and forecasted weather and weather-related information as well as the status of special use airspace. The enhanced weather products will be available to pilots and controllers, allowing them to share the same situational awareness. The information will be displayed in text and graphics to the pilot.

3.2.1.3 The expected benefits of this operational enhancement are: increased availability of flight services, increased timeliness and quality of data on weather and system status, increased access to airspace, and reduced flight times and distance.

3.2.2 Operational Enhancement 2 - Affordable means to reduce controlled flight into terrain

- Low cost terrain situational awareness.
- Increased access to terrain constrained low altitude airspace.

3.2.2.1 There have been many fatal accidents involving controlled flight into terrain (CFIT) due to poor situational awareness. This operational enhancement will increase the pilot's situational awareness by providing a cost/effective terrain database and display in the cockpit.

3.2.2.2 The expected benefits of this operational enhancement are: reduction in the CFIT rate and increased access to low altitude airspace where terrain imposed restrictions exist.

3.2.3 Operational Enhancements 3 – 9

3.2.3.1 Operational enhancements 3 – 9 are based on the use of ADS-B and are included in the RTCA/DO-242 Minimum Aviation System Performance Standards (MASPS) for Automatic Dependent Surveillance Broadcast (ADS-B), February 19, 1998. The MASPS describe the operational applications for each of these enhancements, operational requirements, system level performance standards, interfaces, and minimum system test procedures to ensure that performance meets system level performance standards.

3.2.3.2 Improved terminal operations in low visibility

- Enhanced visual approaches (visual acquisition with existing procedures, ADS-B only)
- Enhanced visual approaches (with new procedures using ADS-B only)
- Enhanced visual approaches (with new procedures using ADS-B and TIS-B)
- Approach spacing (for visual approaches)
- Approach spacing (for instrument approaches)
- Departure spacing/clearance (visual meteorological conditions (VMC) in radar)

3.2.3.2.1 During approach operations there are a number of operational problems that limit efficiency. On visual approaches, it is often difficult to identify the aircraft to follow. It is also difficult to judge the distance and speed of the aircraft to follow.

3.2.3.3 ADS-B, Cockpit Display of Traffic Information (CDTI), and TIS-B could be used during low visibility approach operations to enable the crew to better identify the aircraft to follow and accomplish approaches at lower minimums, thus maintaining VFR throughput longer. The crew will also be able to maintain better spacing during VFR and IFR approaches.

3.2.3.3.1 The expected benefits of this operational enhancement are increased access to airports, increased arrival rates, reduced arrival and departure delays, increased predictability of arrival times, and increased flexibility of arrival scheduling.

3.2.3.4 Enhanced see-and-avoid

- Enhanced visual acquisition of other traffic for see-and-avoid (using ADS-B only)
- Enhanced visual acquisition of other traffic for see-and-avoid (ADS-B and TIS-B)
- Conflict detection enhanced see and avoid
- Conflict resolution.

3.2.3.4.1There are limitations with today's "Out the Window" system, resulting in safety and efficiency issues. It is advantageous to increase safety for all aircraft by maintaining situational awareness of the traffic around them, in instrument meteorological conditions (IMC) and VMC.

3.2.3.5 ADS-B, CDTI, and TIS-B could provide traffic information to the cockpit. This will enable the pilot to maintain situational awareness of surrounding traffic.

3.2.3.5.1 The expected benefits of this operational enhancement are: increased pilot access to traffic information for situational awareness resulting in greater safety.

3.2.3.6 Enhanced en route air-to-air operations

- Pilot situational awareness beyond visual range.

3.2.3.6.1 Today's separation standards and procedures provide limited efficiency due to the lack of, and/or limitations associated with the radar-based surveillance (i.e. the requirement for two-way pilot/controller communications, and the lack of a data link which prevents common situational awareness and/or collaborative decision making).

3.2.3.6.2 CDTI and ADS-B could allow delegation of separation authority to the cockpit, resulting in increased efficiency.

3.2.3.6.3 Expected benefits: increased access to airspace, reduced flight delays and distances flown, increased predictability of flight times and distances flown, and increased flexibility in routes flown.

3.2.3.7 Improved surface surveillance and navigation for the pilot

- Runway and final approach occupancy awareness (using ADS-B only)
- Runway and final approach occupancy awareness (using ADS-B and TIS-B)
- Airport surface situational awareness

3.2.3.7.1 It is difficult for pilots to navigate the taxiways of an airport especially in low visibility. Under reduced visibility conditions, the pilots may not be able to see other traffic.

3.2.3.7.2 A moving map display would enable pilots in the cockpit and the operators of equipped vehicles on the airport surface to "see" all the other traffic, resulting in safer and more efficient surface operations. Aircraft can use augmented GPS navigation and maps in extremely low visibility conditions.

3.2.3.7.3 The expected benefits of this operational enhancement are: reduced runway incursion incidents, reduced taxi delays, and increased predictability of taxi times.

3.2.3.8 Enhanced surface surveillance for the controller

- Enhance existing surface surveillance using ADS-B
- Surveillance coverage at airports without existing surface surveillance.

3.2.3.8.1 Under low visibility conditions, it is difficult for the tower controllers to manage aircraft and other vehicular traffic on the airport surface.

3.2.3.8.2 Equipage of aircraft and ground vehicles in the airport movement area with ADS-B using augmented GPS-derived positions will allow the local and ground controllers in the tower to monitor the position and speeds of all the traffic in the movement area.

3.2.3.8.3 Expected benefits: reduced runway incursion incidents, reduced taxi delays, reduced arrival delays, increased predictability of taxi times, and increased departure/arrival rates.

3.2.3.9 ADS-B surveillance in non-radar airspace

- Center situational awareness with ADS-B
- Radar-like services with ADS-B
- Tower situational awareness beyond visual range.

3.2.3.9.1 Today's system contains areas of airspace that are outside of radar coverage. The lack of surveillance information limits a controller to the use of procedural separation to provide separation services. This type of separation limits both airport and airspace capacity.

3.2.3.9.2 ADS-B can provide additional surveillance coverage and fill gaps in radar coverage.

3.2.3.9.3 Expected benefits: increased access to airspace, increased arrival and departure rates, reduced flight delays and distances flown, increased predictability of flight times and distances flown, reduced deviations from the intended route, and increased flexibility in the routes flown and increased safety.

3.2.3.9.4 Establish ADS-B separation standards

- Radar augmentation with ADS-B to support mixed equipage in terminal airspace
- Radar augmentation with ADS-B to support mixed equipage in en route airspace.

3.2.3.9.5 Current automation is limited in providing benefits to users based on existing radar accuracy. ADS-B data can be integrated with radar and conflict alert to determine if separation standards can be reduced. Ultimately ADS-B will be integrated with advanced decision support automation.

3.2.3.9.6 The expected benefits of this operational enhancement are increased efficiency and maintained or increased safety.

4.0 Safe Flight 21 Demonstration and Evaluation

4.1 SF-21 demonstrates and evaluates the benefits of the applications described above. Prior to committing the FAA and the users to a full-scale implementation of these enhancements, there will be a consensus of the feasibility and business case for the enhancements among the stakeholders. The FAA and industry will jointly define, develop, and evaluate the enhancements.

4.2 The SF-21 Program Office continues to demonstrate and evaluate the benefits of this new technology. This includes operational and procedural issues, as well as cost/benefit matters. The review of operations and procedures will ensure that pilot, controller, operator, FAA air traffic maintenance, and flight standards issues are addressed. The cost/benefit activity will define the cost of the data link and quantify and qualify the economic and safety benefits derived from each capability.

4.3 In 2000, the SF-21 program conducted an Operational Evaluation in Louisville, Kentucky to demonstrate the efficiency and safety benefits of using ADS-B and to evaluate air traffic controller use of ADS-B in the terminal area environment. In addition, tests were conducted to develop and evaluate avionics and procedural modifications to improve the following applications: departure spacing, approach spacing, runway and final approach occupancy awareness, and airport surface situational awareness. The tests provided more data supporting the potential for using ADS-B avionics in the cockpit in combination with revised procedures to improve aircraft spacing and enhance surface safety.

4.4 In 2001, the SF-21 program conducted an air traffic modernization forum in Memphis, Tennessee to demonstrate newly installed multilateration surveillance capabilities and the use of on-board moving map displays for monitoring surface aircraft and vehicle movement. Multilateration infrastructure was also ordered for the Louisville, Kentucky test site. Other efforts included the award of four contracts for avionics development and evaluation, the development of a visual concept of use for surface moving map displays, and initial development of a surface moving map database to support this effort.

4.5 In 2002, the multilateration system was installed at Louisville, Kentucky, and a new automation platform for that facility to support on-going ADS-B test and evaluation efforts was procured. Development and evaluation continued on avionics and the procedural modifications needed to improve surface situational awareness to enhance existing surface surveillance using ADS-B. Interoperability and shakedown testing of avionics capable of transmitting and receiving ADS-B messages, receiving TIS-B messages, and displaying the combined ADS-B and TIS-B information to flight crews was conducted in April and May at Memphis International Airport. This data collection effort was designed to demonstrate the end-to-end functionality of the TIS-B infrastructure installed at Memphis, and provided data to assist in the validation of the avionics. It also provided an opportunity to document the air-to-air and air-to-ground surveillance performance of ADS-B. A vehicle tracking system test bed was established in Memphis with the installation of ten surface moving map displays in airport operation vehicles and evaluation activities were initiated. Thirty-six (36) digital airport surface moving maps were developed

as part of a prototype database available to industry for product development. The FAA ADS-B link decision was made in July 2002 and approved two data links. The 1090 MHz extended squitter ADS-B data link is to be used by air carrier and private/commercial operators operating in the higher altitudes, while a universal access transceiver (UAT) ADS-B link will be used by the typical, general aviation users. The UAT Minimum Operational Performance Standard (MOPS) was approved. Simulations were conducted using the CDTI electronic flight rules (CEFR) to determine pilot/controller suitability, acceptance and human factors. In partnership with UPS, SF-21 procured 107 ship sets of ADS-B avionics for installation on UPS 757/767 and will support evaluation of enhanced visual approach applications.

4.6 In 2003, the SF-21 program continued to conduct CEFR simulations, survey and deliver new airport digital maps to the surface moving maps database (56), expand the vehicle tracking evaluation in Memphis (additional vehicles) and established a vehicle tracking test bed in Louisville, KY. RTCA Program Management approved the 1090 MHz ADS-B MOPS, Rev A, and approved the TIS-B MASPS. A demonstration to evaluate the integration of ADS-B on the STARS automation system was conducted, along with human factors evaluations. In partnership with Embry-Riddle Aeronautical University (ERAU) the SF-21 program will procure ADS-B ground stations and ERAU has procured 104 sets of ADS-B avionics for their training aircraft in Prescott, AZ and Daytona Beach, FL. Based on ERAU's commitment, the FAA will establish two pockets of ADS-B implementation in the lower 48 states. This will enable broadcast service (traffic/weather) applications and flight following for ERAU. Building on the ADS-B pocket of implementation established in Daytona Beach, FL and the test infrastructure currently operating in Frederick, MD, McLean, VA and Atlantic City, NJ, a plan has been established to provide ADS-B coverage to support broadcast service applications along the east coast of the US by installing additional ADS-B ground stations. ADS-B demonstrations are occurring in the Gulf of Mexico in partnership with NASA, Petroleum Helicopter Inc. and Continental Airlines. ADS-B ground stations have been installed on oil platforms to demonstrate surveillance applications in a non-radar environment.

4.7 In 2004, SF-21 focused considerable effort on securing the documentation necessary for the FAA to make an investment decision. To date, this requirement has centered on reviewing and authenticating the results of previously completed operational evaluations and preparing an initial investment analysis based on deploying ADS-B in three implementation spirals between 2005 and 2016, as follows:

- Spiral One: Fielded in 2005-2008, will provide low altitude broadcast services and a surface management system (SMS) capability. The infrastructure supporting this capability will consist of broadcast services ground stations and broadcast control facilities, which provide the Broadcast Services Manager (BSM) and TIS-B Surveillance Data Processor (TSDP) functions. The ground stations will be located at towered airports and at en route radar sites across the country. The BSMs and TSDPs will be primarily located at the Air Route Traffic Control Centers (ARTCC).

- Spiral Two: Fielded in 2009- 2012, will build on the spiral one architecture by adding additional ground stations that will also be located at towered airports. Additionally, interfaces will be developed with terminal automation systems to support ADS-B based surveillance capability on air traffic automation and support systems including STARS, Common Automated Radar Tracking System (Common ARTS), Automatic Surface Detection Equipment (ASDE), and Enhanced Traffic Management System (ETMS).

- Spiral Three: Fielded in 2013-2016, will not add any additional ground stations, but will provide additional interfaces into en route automation systems (En Route Automation Modernization System (ERAM) and Advanced Technology Oceanic Procedures System (ATOPS) to support ADS-B-based surveillance capability.

4.7.1 In addition to the infrastructure identified above, additional digital maps were produced for the Airport Map Database. A total of 82 are now complete, and are being maintained while the database is completed. The Surveillance Branch of the Operational Support Office at the Mike Monroney Aeronautical Center, Oklahoma City, Oklahoma, will produce, maintain and verify this map database.

4.7.2 SF-21 continues to support RTCA and ICAO activities in the development and harmonization of ADS-B standards. In December 2003, RTCA approved DO-289: Aircraft Surveillance Applications (ASA) Minimum Aviation System Performance Standards (MASPS), which provides the application descriptions and requirements for five fully developed applications:

- Enhanced Visual Acquisition
- Enhanced Visual Approach
- Airport Surface Situation Awareness
- Final Approach and Runway Occupancy Awareness
- Conflict Detection

4.7.3 Preliminary analysis has also been conducted to develop requirements for three advanced applications in DO-289. RTCA Special Committee 186 approved DO-282A, Universal Access Transceiver MOPS, Revision A, and these MOPS are expected to be approved by the RTCA Program Management Committee (PMC) in July 2004. Additionally, DO-267A, FIS-B MASPS, was approved by the RTCA PMC in April 2004. EUROCONTROL, EUROCAE, RTCA and the FAA are collaborating to develop operational and technical standards for seven airborne surveillance applications and five ground surveillance applications. The ICAO UAT Standards and Recommended Practices (SARPs) is in the validation stage of the approval process. A draft UAT SARPs, technical manual and validation plan have been completed.

4.7.4 ERAU is equipping 104 training aircraft at its two main campuses in Florida and Arizona with ADS-B capability as a safety enhancement. The FAA has begun installing the ground infrastructure to support this equipage, and will provide FIS-B and TIS-B uplink capabilities in those areas. Further, each campus will be provided real time surveillance of their aircraft operations on the surface as well as in the training areas.

4.7.5 In the Gulf of Mexico, both Continental Airlines and several oil exploration and production helicopter operators, in conjunction with FAA and NASA, have conducted demonstrations to support the use of ADS-B in high and low altitudes. These demonstrations were directed at radar-like services to enhance capacity, safety, search and rescue operations. NAS architectural engineering efforts have been supported by these developmental efforts and the proposed surveillance, communications, and weather applications provided by ADS-B technology can be installed to support operational en route applications and production operations in the Gulf.

4.7.6 The Louisville Standiford Field airport (SDF) in Louisville, Kentucky has been designated as a FAA ADS-B technology test-bed airport. SF 21, in partnership with United Parcel Service Airlines (UPS), home-based at SDF, have invested significant resources to mature the airfield, its surface vehicles, and UPS aircraft with ADS-B equipment to allow development and validation of terminal and surface domain ADS-B applications. SDF is focused on developing, validating, integrating, and implementing airfield surface vehicles and aircraft operational applications. This includes a Surface Management System (SMS), enhanced surface surveillance technology with automation and data distribution interface, and airborne aircraft operational applications that can be supported by ADS-B technologies. UPS has equipped 107 of their aircraft with ADS-B extended squitters and multifunction displays. The installation of these new displays, supported by the on-going installation of surface vehicle squitters and surface vehicle moving map displays, along with the installation of the Airport Surface Detection Equipment-3X (ADSE-3X) and the NASA developed SMS, provide terminal area surveillance data distribution between air traffic control, airlines operations, and the airport authority.

4.7.7 SF 21 with Memphis International Airport (MEM) and Federal Express (FedEx) continues to operate FAA and NASA ADS-B terminal and surface technology development. This effort includes the FedEx ramp tower management system development, and ground station positioning, communications and infrastructure validation from early ASDE development. Memphis and FedEx continue to operate and validate many of these developmental systems, pending installation of NAS-production equipment.

4.7.8 SF-21 has continued its efforts to conduct near-term development and evaluation of these ADS-B driven applications with investment at the W. J. Hughes Technical Center (WJHTC), Atlantic City, New Jersey. WJHTC is supporting SF-21 efforts to develop certification standards for vehicle moving map equipment producers. These standards will ensure FAA system compatibility and positioning accuracy, for these fully integrated vehicle applications.

4.7.9 In 2005, SF-21 continues the effort to provide service delivery of Traffic Information Service-Broadcast (TIS-B) over both ADS-B links (UAT and 1090) and Flight Information Services-Broadcast (FIS-B) on the UAT data link in the lower 48 states. More than 25 Ground Based Transceivers (GBTs) have been installed along the East Coast, and in North Dakota and Arizona. Near term milestones include Stage II Control Facility Software cutover and Stage II Security Certification Authorization Package testing.

4.7.10 The FAA is working in partnership with state and local aviation authorities to deliver ADS-B services for improved flight safety. More than $1.9 million has been received from state partnerships to date. These partnerships are helping to meet the goal of delivering ADS-B services to 20% of the US by the end of FY 05; and will help to expand those services to 50% of the US by the end of FY 06. An early partnership with the State of Maryland has led to providing ADS-B services within the Metropolitan Washington Air Defense Identification Zone.

4.7.11 The Airport Map Database (AMDB), also known as the Surface Moving Map, will supply current digital airport maps to cockpit avionics and airport vehicle displays to enhance airport surface situational awareness and improve runway safety. SF-21 objectives for the program include establishing data specifications and processes leading to AMDB certification and obtaining an investment decision for AMDB implementation. Completion of the certification pre-audit by FAA Aircraft Certification is expected in June 2005.

4.7.12 In April, the FAA published a Notice to Airmen (NOTAM) to announce initial ADS-B availability along the East Coast, and in locations in the upper Midwest and in Arizona. The NOTAM will educate pilots about ADS-B technology, procedures and approvals, as well as the outage reporting and notification process.

4.7.13 SF-21 continues standards development for ADS-B technology to facilitate implementation and global interoperability. Standards include RTCA Minimum Operational Performance Standards (MOPS), Minimum Aviation Performance Standards (MASPS) and ICAO Standards and Recommended Practices (SARPs). ICAO Aeronautical Communications Panel Working Group (WG) approval of UAT SARPs is expected by June 2005.

4.7.14 Efforts continue to obtain approval for use of ADS-B as a surveillance source in both terminal and en route environments in the NAS to support ATC separation standards. Those efforts are to: coordinate the collection of radar and ADS-B data; analyze the accuracy and technical capability of ADS-B; and provide recommendations to the Agency for approval of ADS-B separation standards throughout the NAS.

4.7.15 Surface Management System (SMS) is a NAS information tool used by airline ramp controllers to more efficiently manage assets and surface movement in the airport ramp area. SMS combines surveillance, flight plan, and other data to display flight status and position, runway departure queues, and predict arrival and departure times. Efforts underway include demonstrating SMS using ADS-B surface surveillance as a tool to provide incentive for airline ADS-B voluntary equipage, deploying and integrating SMS at the UPS hub in Louisville, Kentucky. Near-team milestones include: Install initial ADS-B SMS in Newark, New Jersey by August 2005 and complete Phase 1 development effort at Louisville by September 2005.

4.8 In 2000, under the Capstone initiative, the FAA equipped approximately 80 aircraft (out of 150 planned) with avionics equipment that includes a Global Positioning System (GPS), ADS-B using the Universal Access Transceiver (UAT) data link, and a terrain database to aid in terrain situational awareness. An ADS-B ground infrastructure consisting of one ground-based transceiver was established in the Bethel area (Yukon-Kuskokwim Delta region) of southwestern Alaska. Nine of eleven standalone GPS approaches were published for smaller village airports in the surrounding delta region. Two of ten Automated Weather Observation Systems (AWOS's) were installed. In addition, the MicroEARTS automation system at the Anchorage Air Route Traffic Control Center (ARTCC) was modified so controllers can track and monitor ADS-B-equipped aircraft. Based on the completion of these initial Capstone activities, on January 1, 2001, controllers in Anchorage began providing ADS-B "radar-like" services to aircraft in the Bethel area, the first use of non-radar surveillance for control purposes in the United States. The same data link that transmits target data to Anchorage also provides weather text and graphics information to the pilots in the Bethel area.

4.9 In 2001, Alaska continued "radar-like" service coverage in the Bethel area. One additional GPS approach was published, and eight weather systems were installed. In addition, the FAA installed ADS-B avionics on sixty additional aircraft operating in the area. While the Bethel avionics have been approved for Instrument Flight Rules (IFR) radar-like services, initial equipage has been for VFR use only, to allow pilots to adjust to equipment capabilities as well as to fully develop the operational concepts for using ADS-B under IFR conditions. These operational enhancements will be implemented incrementally in the area, based on their potential for improving safety and addressing user requirements. Additional air

traffic control planning and procedural development is underway to enhance air traffic services in the Bethel area.

4.10 A plan to extend the Capstone initiative to southeastern Alaska was initiated in 2001 to enhance flight safety and provide a useable IFR infrastructure. This included avionics suites with upgraded certification for IFR applications and an IFR area navigation (RNAV) infrastructure using GPS for primary means of navigation in Southeast Alaska. Operators equipped to receive the wide area augmentation system (WAAS) signal would automatically begin to receive lateral navigation (LNAV) information also. Approximately 200 commercial service airplanes and helicopters operating in the area would be equipped with the upgraded ADS-B systems.

4.11 In 2002, Alaska Capstone program completed installation of remaining ground transceivers, weather systems, and ADS-B avionics in the Bethel area, to expand ADS-B “radar-like services”. In addition, development of the low-level IFR route infrastructure for southeast Alaska continued. A contract was awarded for 200 primary flight and navigation displays that will be incorporated in the upgraded avionics suites and installations began. A contract for a Minimum Operational Performance Standards (MOPS)-compliant ADS-B avionics transceiver was awarded to demonstrate a useable system in 2003.

4.12 In 2003, the Alaska Capstone program conducted the first commercial flight using an “optimized” RNAV Special FAR 97 route structure in conjunction with enhanced Capstone Phase 2 avionics that includes a GPS/WAAS receiver certified under TSO 145a, in airspace inaccessible with conventional avionics. An additional 41,000 feet of airspace along 1,521 nautical miles of the existing route structure in Southeast Alaska is now available for aircraft with Capstone Phase 2 avionics. A Request for Offer (RFO) was released for ADS-B capable ground based transceivers (GBT) and is currently being evaluated. The RFO requires Universal Access Transceiver (UAT) as the data link with a migration path to a dual link (UAT/1090 MHz) GBT and includes up to 250 units for Alaska and an option for up to 1,000 units for lower 48. Capstone Phase 2 avionics are continuing to be installed. The Bethel approach control plan was approved and will use ADS-B as a surveillance source. Evaluation of wide area multilateration to provide additional aircraft position to other pilots, air traffic controllers and flight service specialists was initiated. Capstone also began testing the use of the Iridium satellites to augment ADS-B data transfer.

4.13 In 2004, the Capstone program awarded contracts for the next generation MOPS-compliant GBTs, UAT data link avionics to be deployed in Southeast Alaska, and the replacement of developmental systems operating in the Bethel area. In Southeast Alaska, fifty-three aircraft have been equipped with primary flight and navigation displays. The GBT and UAT data link installations are scheduled to begin installation in late 2004. As part of a runway safety demonstration, vehicles were equipped with a UAT and a moving map display. Other displays were installed various airport operation offices. Capstone plans to demonstrate the feasibility of a direct aircraft-to-satellite data link using Iridium satellite technology to support both ADS-B and voice communications as a gap-filler in very remote locations, over water, or in mountainous terrain. This technique may help to avoid high cost GBT sites. A controller display was commissioned in the Bethel Air Traffic Control Tower to provide situational awareness to the tower by displaying the position of Capstone-equipped aircraft using ADS-B. Developmental testing of TIS-B was conducted for Capstone-equipped aircraft operating in the Anchorage area. This data augments the positional information that equipped aircraft already receive from other ADS-B-equipped aircraft, further enhancing the pilot’s ability to see and avoid other aircraft.

4.14 In 2005 MOPS compliant GBTs were installed in the Bethel area and aircraft avionics were changed out to be compatible with the GBTs. GBTs were also installed in Southeast Alaska and are awaiting an Air Traffic Organization approval in order for them to become operational. Final approval is expected in September 2005. In addition, Capstone is planning to begin statewide implementation of the ADS-B and GPS/WAAS operational capabilities that have proven beneficial in both Bethel and Southeast Alaska.

5. Conclusion

5.1 As a result of SF-21demonstration activities in Alaska, along the East Coast and in the Ohio River Valley, progress has been made toward implementing operational enhancements and applications related to the use of GPS, ADS-B, TIS-B, FIS-B, and the multi-functional display in the cockpit. Pockets of ADS-B implementation in Alaska, along with the establishment of ADS-B ground infrastructure in Prescott, AZ and Daytona Beach, FL will allow users to take advantage of a variety of initial ADS-B benefits. The avionics market place has now recognized the potential for ADS-B applications/benefits and has begun to offer products that incorporate ADS-B capabilities to a variety of commercial and general aviation customers. The FAA ADS-B link decision will recognize a national deployment of 900 ADS-B ground based transceivers by 2012.

5.2 Meeting participants are requested to note the material presented in this information paper and consider its applicability to improving safety and efficiency of civil aviation operations within the Asia-Pacific Region. The members are also invited to visit the FAA's Safe Flight 21 websites at:

http://www.faa.gov/safeflight21 and
http://www.alaska.faa.gov/capstone

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