Runway Incursion
Joint Safety Implementation Team

Implementation Plan
For
Situational Awareness Technologies for Air Traffic Control

Statement of Work:
The purpose of this project is to develop and implement technology tools including data link that will provide and/or enhance airport surface situational awareness to air traffic controllers. Examples of these technology tools include, but are not limited to, Airport Movement Area Safety System (AMASS), Airport Surface Detection Equipment (ASDE-X), Automated Dependent Surveillance – Broadcast (ADS-B), Next Generation Air-Ground Communications System (NEXCOM), Surface Movement Advisor (SMA), and Airport Target Identification System (ATIDS). The strategies for accomplishing this project include:

- New technology tools will be developed by the FAA to enable enhanced surveillance, information, communication and conflict detection for ATC operations.
- FAA and airport operators will provide airport surface surveillance equipment with conflict alerting capability at air traffic control towers.
- Digital data link capability will be developed and implemented to enable automatic transmission of ATC instructions/information (between the ground & aircraft).
- Situational Awareness Displays developed in support of the above listed strategies will incorporate industry best practices for computer-human interface (CHI) design to enhance and support ATC decision-making.

One of the most fundamental improvements to safety is sharing information between pilots and controllers. Uniform availability of shared, reliable data to both controllers and pilots is necessary to assure safety in the future environment of increased demand. The pilot needs unambiguous understanding of airport layout and clearance instructions to avoid blunders onto uncleared surfaces in all visibility conditions. Improved and more reliable (fewer false reports) surface surveillance will be necessary.

Lead Organization for Overall Project Coordination (LOOPC):
ARI-1

Safety Enhancement 1: (SE-53)
Aviation safety will be improved by installation of enhanced airport surveillance equipment.

Accident Prevention Index:
(To Be Completed by JIMDAT)

Total Resource Requirements:
20 to 35 FTE's

Completion Date:
9 years

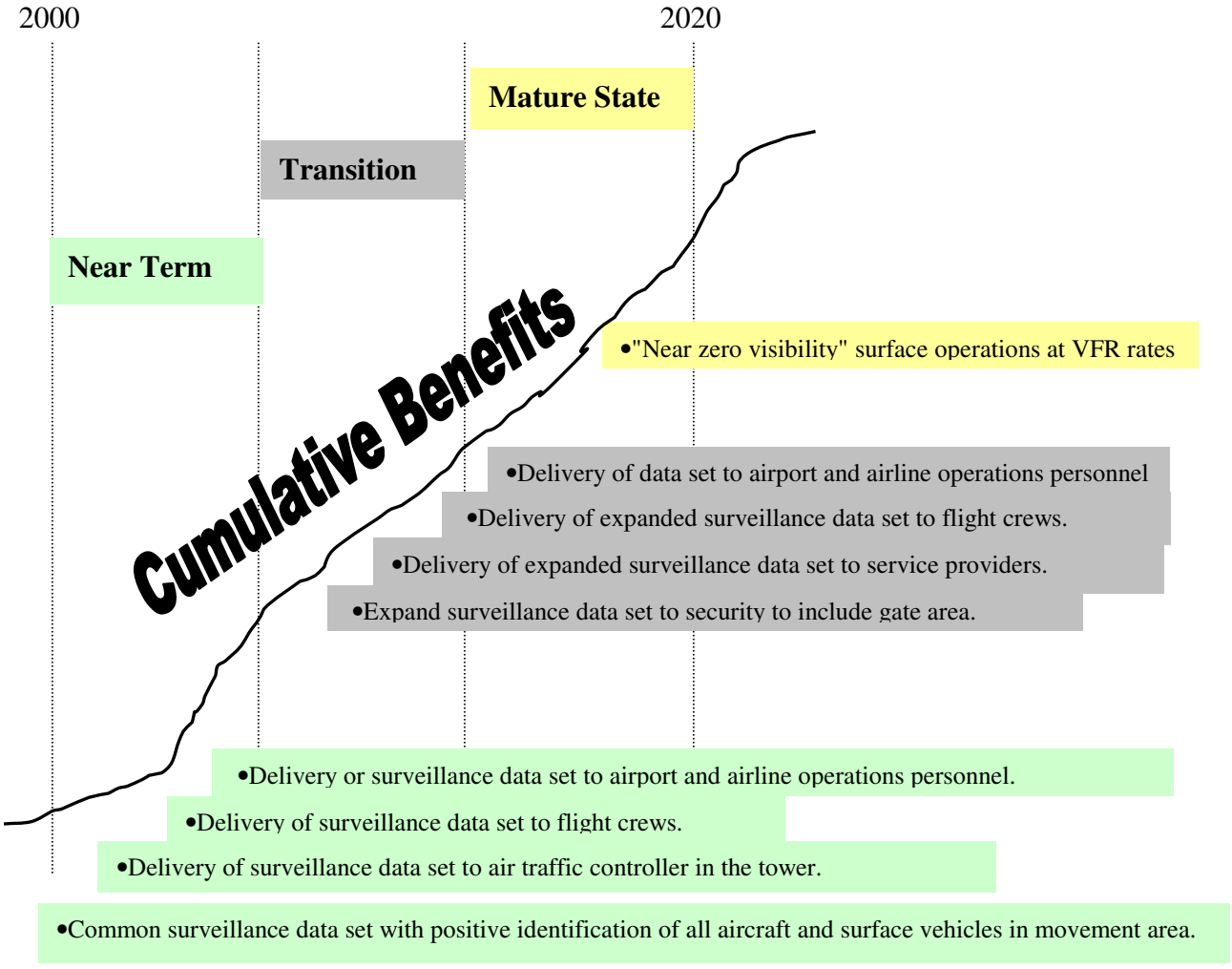
Outcome:
Provide and/or enhance airport surface situational awareness to air traffic controllers with the intent of improving runway safety.

Output 1:
FAA is developing an airport surface systems architecture roadmap, that includes, but is not limited to, sensor systems, display systems (both ground and aircraft-based), and communications systems (voice and data). This surface systems architecture roadmap should be consistent with future updates of the NAS Architecture Plan (Current Version 4.0).

Resources: ARI-1, ASD, ATS, AVR, AND (AND-500 – LOOC), ARS, AOZ, NATCA, PASS, SUPCOM

Timeline: 12 months

Actions:
- FAA should develop a surface technology roadmap to meet the emerging future needs of today's surface environment and present to industry for coordination (i.e., JSIT).
- FAA should capitalize on existing government/industry working groups.
- FAA should define the operations for Surface Movement in accordance with the Operational Evolution Plan (OEP) released in June 2001.
- The FAA and industry should continue their collaboration in implementing the key elements of the airport surface modernization roadmap as outlined in the RTCA document *Government/Industry Operational Concept for the Evolution of Free Flight, Addendum 3.1: Surveillance*. As stated in this RTCA document, "One key capability is the formulation of a common surveillance data set that contains positive identification and accurate position of all aircraft and surface vehicles in the movement area."



Airport Surface Capabilities Timeline

(as shown in RTCA document *Government/Industry Operational Concept for the Evolution of Free Flight, Addendum 3.1: Surveillance*)

Output 2:
FAA should periodically release Broad Agency Announcements (BAA) to solicit industry ideas and concepts that will lead to new or enhanced technology tools to enable enhanced surveillance, information, communications, and conflict detection for ATC operations.

Resources:
AND-500 (LOOC), AND-400, ARI-1, ARS, AVR, NATCA, PASS, SUPCOM

Timeline:
Ongoing & Continuous

Actions:
- The FAA (AND-500) should continue to oversee technology assessment of new and emerging surface technologies.
- The FAA (AND-500) should continue to be the FAA's focal point with industry for technology activities aimed at an overall reduction in runway incursions and an overall improvement of safety on airport movement areas.
- The FAA (AND-500) should ensure that proposed solutions offered in response to the BAA announcements reflect the needs and requirements of the individual(s) who utilize the controlled airport surface movement area, including air traffic controllers, flight crews, vehicle operators and pedestrians.
- The FAA budget should support runway incursion prototyping and development activities over the next 5 years (FY02-FY06).
- AND-500, ARI-1, ARS, NATCA and PASS will collaboratively establish exit criteria and participate actively in BAA evaluation and demonstration.
- The FAA Federal Acquisition Executive (ARA-1) will initiate implementation programs, as appropriate, to field successful capabilities proven during the BAA process.

Output 3:
FAA should provide active and/or passive airport surface surveillance capability at all FAA air traffic control towers and provide conflict-alerting capabilities, as it becomes available. (Note: Surface surveillance capability covers a wide range of potential solutions and is not limited to radar-centered solutions. Capability can be provided through active sensors, e.g., ADS-B, or passive sensors, e.g., magnetic/infrared sensors.)

Discussion:
Controllers at towered airports need complete situational awareness. Systems that show cooperative aircraft miss non-cooperative aircraft . Sensors can miss targets that are outside their coverage area yet remain as threats for the targets within the coverage area.

Decision criteria should be established for determining surveillance equipage for each primary category of towered airports, i.e., Level I, II, etc. The FAA should provide the ground infrastructure to enable fusion of surveillance data and the subsequent broadcast (TIS-B) to capitalize on surface moving map technology.

Resources:
ARA-1 (LOOC), AND-400, AND-500, ARS, AVR, NATCA, PASS, SUPCOM, Airports, Airport Operations, and NASA.

Timeline:
0-9 years

Actions:

- AND-400 is currently implementing Airport Surface Detection Equipment (ASDE-3)/Airport Movement Area Safety System (AMASS) at 34 major airports, scheduled to be completed in FY 2002. These sites will be upgraded to have functionality equivalent to ASDE-X by 2009.

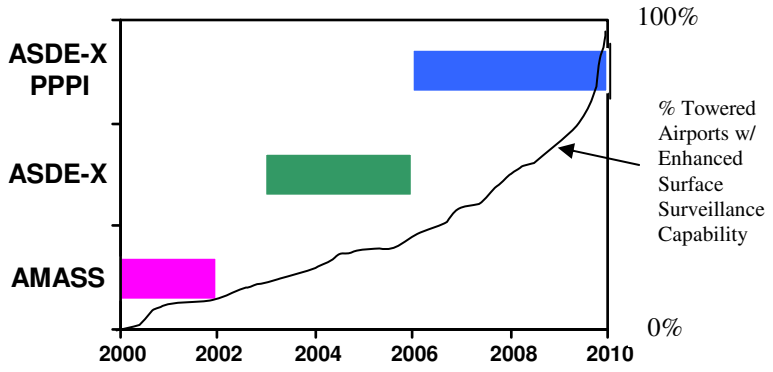
- AND-400 is managing ASDE-X initial implementation, scheduled to begin FY 2003 at 25 additional airports. Initially, it will not contain conflict alerting capability; however, its Pre-Planned Product Improvement (PPPI) requirements will include conflict alerting capability. Timeline for ASDE-X PPPI is TBD.

- Remaining ATC towered airports should receive surface detection capability (functionality will vary with each airport) with integrated conflict alerting capability through new acquisition efforts to be initiated in accordance with FAA acquisition practices. These new efforts will be phased-in, dependent upon new, simple and **low-cost** technical approaches. Airports beyond the top 59 airports will be subject to cost/benefit analyses and may receive varying definitions of surveillance equipment that could offer enhanced surface safety.

- AND-500 will manage the technical development of new approaches targeted at improving airport surface surveillance capability.

- AND-500, as part of the Safe Flight 21 (SF-21) Program and Runway Incursion Reduction Program activities, is currently demonstrating ADS-B/multilateration surface functionality at selected airports (Louisville, Memphis and Dallas-Fort Worth). Also, as part of the SF-21 program, moving map technology is being advanced and demonstrated. This will include demonstration by four vendors at the Spring 2002 Operational Evaluation in Memphis.

AND-500, in partnership with NASA, as part of the Runway Incursion Reduction Program, will continue to periodically demonstrate multi-sensor airport surface surveillance fusion using primary radar, multilateration, and data fusion. NASA should continue its research into improvements to conflict alerting shared between controllers and the flight deck.



Key Decisions, as outlined in the June 2001 OEP, are as follows:

- New tools for airport surface traffic management.
- Improved situational awareness to increase efficiency in surface movement.
- Installation of cockpit displays and enhanced surface surveillance systems to improve airport surface movement efficiency and robustness.
- Surface navigation using cockpit displays to augment visual data and provide common situational awareness.
- Animated airport surface displays for all vehicles on the airport surface to display information in real time to interested parties.

Safety Enhancement 2: (SE-54)
Aviation safety will be improved by utilizing digital data link for ATC instructions.

Accident Prevention Index:
(To Be Completed by JIMDAT)

Total Resource Requirements:
5 to 7 FTE's

Completion Date :
6 years

Output 4:
Although FAA plans such as the Operational Evolution Plan, do not address timeframes for implementing use of digital data link in the terminal area, the FAA should implement digital data links to enable automatic transmission of ATC instructions/information (between the ground & aircraft operating on the airport surface) for aircraft equipped with data link enabled avionics. This capability will supplement voice communications. Aircraft not equipped with data link enabled avionics will see no degradation in current service and will not be required to install any new equipment on aircraft unless mandated by the FAA through the rule making process. Human factors issues will be addressed in the Detailed Implementation Plan.

Resources:
AOZ, AUA (LOOC), AVR, ARS, NATCA, SUPCOM, ALPA, ATP

Timeline:
0-6+ years

Status:
Development of the *Controller-Pilot Data Link Communications Roadmap for Human Factors Activities* was step one of the FAA/industry CPDLC implementation process leading to the fielding of CPDLC. The plan spells out the human factors and related issues that must be addressed by the FAA and the user community before CPDLC can become a reality. The plan will be executed jointly by the FAA and industry, and will provide an end-to-end operational demonstration of CPDLC. The lessons learned during the demonstration will serve as the foundation for CPDLC human interfaces and procedures in the future.

The first two phases of CPDLC implementation, Builds-I and IA have been approved for implementation. Beginning with Build-I, CPDLC will use the Aeronautical Telecommunication Network (ATN), as defined by the International Civil Aviation Organization. As part of the Free Flight Phase 1 (FFP1) Program, AOZ-1 is currently implementing an initial build for Controller-Pilot Data Link Communications (CPDLC),

known as Build 1/1A, that will enable a limited set of ATC messages via VHF Digital Link Mode 2 (VDL-2) for the enroute environment.

Human Factors Focus:
As part of the NAS Modernization Task Force Data Link Issues Team, the FAA and industry agreed on a CPDLC development and implementation path that proceeds directly to an ATN CPDLC implementation. The FAA Aeronautical Data Link Integrated Product Team convened a human factors working group. The recommendations of the working group were presented as a CPDLC human factors roadmap, consisting of a set of activities and a timeline. The five CPDLC human factors activities proposed in the roadmap are described below:

- **Review and update human factors requirements and guidance** – Development of the human factors content for FAA CPDLC system specifications and advisory material, including Advisory Circulars (AC 20-DC and AC 120-COM), the Airman's Information Manual (AIM), training bulletins, and FAA Order 7110.65.

- **Test and evaluate Air Traffic Service Specialist (ATSS)/ground system HCI** – Evaluation of prototype hardware/software (display system replacement [DSR]) to identify usability and CPDLC task integration issues, and validate and refine associated FAA guidance material.

- **Test and evaluate pilot/flight deck HCI** – Evaluation of prototype hardware/software (e.g., American Airlines avionics) to identify usability and CPDLC task integration issues, and validate and refine associated FAA guidance material.

- **Test and evaluate ATSS/pilot/system integration** – Operational tests of as much actual hardware/software as possible (ground, air, and system) supplemented by prototype equipment to run simulation trials and to identify issues associated with the interaction of controller/pilot operational communication procedures, controller team procedures, and flight crew procedures.

- **Demonstrate ATSS/pilot/system integration** – Operational system demonstration using production airborne and ground hardware and software in a simulated operational environment to validate the effective interaction of controller/pilot operational communication procedures with controller team procedures, and flight crew procedures.

Actions:
Build II implementation will follow Build 1/1A, and will represent an expansion of the ATC message set. Current implementation plans are to focus CPDLC Build II service for the enroute environment only. If benefits of CPDLC messaging are to be realized for the prevention of runway incursions in the 2007 timeframe, plans for CPDLC messaging in the terminal environment should be accelerated to begin the provisioning of CPDLC terminal service earlier than currently scheduled.

ALPA and NATCA will continue involvement in the design, testing and evaluation for digital data link transmission of ATC instructions/information. FAA and Industry will continue collaboration with ALPA and NATCA to address identified issues and concerns. ATP will create procedures for the certified operation.

The planned expansion of the FAA AIR division with additional certification personnel will facilitate certification activities necessary to expedite the implementation of digital data link capability for CPDLC functionality in the terminal environment. CAST should encourage OMB to approve the funding requests FAA has made to support the expanded AIR staff. These AVR resources should be dedicated resources to rapidly field key enabling technology contained within this project's outputs.

Relationship to Current Aviation Community Initiatives:

- Runway Safety Program Blueprint
- NAS Architecture
- NASA Aviation Systems Technologies Advanced Research (AvSTAR)
- EuroControl Surface Movement Guidance & Control (SMGS)
- NASA Aviation Safety Program (AvSP)
- NASA Advanced Aviation Technologies (AATT)
- FAA Research Projects not associated with BAA (e.g., Radio Frequency Identification (RFID))
- Contract Tower Equipage
- NEXCOM Aviation Rulemaking Committee (NARC) continues to meet to discuss the future of ATC communications links.
- RTCA continues to develop standards for ATC communication (voice and data). These standards are scheduled to be completed by 2002.
- The Free Flight Steering Committee continues to advocate digital links as enabling technology critical to the achievement of full benefits. CPDLC is considered to be crucial to enhancing situational awareness between controllers and pilots by offloading routine voice communications and enabling unambiguous information to be transferred between parties.

Performance Goals & Indicators for Outcomes/Outputs:

- Goal: Develop a community supported, FAA approved Surface Technology Roadmap.
- Indicator: Community voices support; FAA approves Surface Technology Roadmap.

- Goal: Focus Future technology research on needs identified within Surface Technology Roadmap.
- Indicator: Technology research efforts identified and funded that supports Surface Technology Roadmap.

- Goal: Continue implementation of existing technology efforts in support of surface systems identified within the approved Surface Technology Roadmap.
- Indicator: Funding lines identified and supported for existing technology efforts in support of surface systems identified within the approved Surface Technology Roadmap.

- Goal: Award contracts that fit the needs of the Surface Technology Roadmap.
- Indicator: BAA successfully awarded contracts to qualifying subset of commercial vendors.

- Goal: Demonstrate enabling technology for each BAA contract awarded.
- Indicator: Technology demonstrated in a relevant operational environment.

- Goal: Transfer enabling technology to airport surface.
- Indicator: Technology transferred to a relevant operational environment.

- Goal: Eliminate surface accidents by enabling better situational awareness of the airport surface to the air traffic controller.
- Indicator: Reduction in number and rate of runway incursion accidents at all U.S. airports with FAA Air Traffic Control Towers

- Goal: Installation of surface surveillance capability (functionality) at all FAA Air Traffic Control Towers**.** Airports beyond the top 59 airports will be subject to cost/benefit analysis and the definition of surveillance equipment that could offer enhanced surface safety.
- Indicator: Certification of surface surveillance capability (functionality) at all FAA Air Traffic Control Towers**.**

- Goal: Reduce the number of repeat voice messages.

- Indicator: Repeat voice messages concerning surface movement are reduced for datalink-equipped aircraft.

- Goal: Reduce the number of erroneous readback voice messages.
- Indicator: Reduction in number and rate of runway incursions involving datalink-equipped aircraft drops below that of non datalink-equipped aircraft.

- Goal: Reduce the number of hearback/readback messages.
- Indicator: The number of hearback/readback messages is reduced for datalink-equipped aircraft.

- Goal: Reduce the number of pilot taxi deviations.
- Indicator: The number of pilot taxi deviations is reduced for datalink-equipped aircraft.

- Goal: Contract Tower Equipage should keep pace with tower equipment upgrades.
- Indicator: Coordinate Contract Tower Equipage with Tower modernization/upgrade plans.

Programmatic Approach:

Organizational Strategy

The RI JSIT identified Vincent Schultz, NASA Aviation Safety Program, as the JSIT Project Lead for Situational Awareness Technologies for Air Traffic Control. The project lead formulated a team of industry representatives, including NATCA, Air Traffic Supervisors, ALPA, AOPA, other FAA managers and NASA. The Project Lead will coordinate implementation activities outlined in the Implementation Plan and will provide progress reports, when requested, to the RI JSIT through G-Level approval of the Detailed Implementation Plan. Implementation is viewed as a shared responsibility and tasks will be divided between the FAA, its unions, and organizations within the aviation industry. Union active participation in the implementation activities associated with each output is key to the success of achieving operational benefits from each of these outputs. The Lead organization for Overall Project Coordination (LOOPC) is ARI-1. The Lead Organizations for Output Coordination (LOOC) are identified in each Output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

Implementation Activities

In collaboration with industry the FAA will publish its Airport Surface Systems Architecture Roadmap. The FAA will periodically release BAAs to solicit new technology ideas in support of this Roadmap. The FAA will continue to conduct cost benefit analyses to justify additional purchase of surface surveillance capability and will work to streamline its implementation. FAA will hire additional certification personnel to facilitate certification activities necessary to expedite the implementation of digital data link capability for CPDLC functionality in the terminal environment. These AVR resources should be dedicated resources to rapidly field key enabling technology contained within this project's outputs.

Key Products and Milestones:

- Complete Draft of Surface Technology Roadmap 4/01
- BAA Contracts Awarded, beginning February 2001.
- Surface Technology Roadmap Approved Internally and sent to Industry for Comment 9/01
- Surface Technology Roadmap Baselined 1/02
- Existing Technology Efforts Identified and Funding Lines Supported 4/02
- New Technology Efforts identified and Funding Lines Supported 4/02
- Demonstrations of BAA technologies 2001-2003, assuming budget authority.
- Subsequent BAA competition and awards periodically, assuming budget authority.

Plan and Execution Requirements:

Once this project is approved, FAA and operators must commit adequate resources to support Situational Awareness Technology for ATC implementation. Tasks must be shared by all parties to ensure equal resource allocation by all involved organizations. Some activities are already underway, but many others should be accelerated to meet the needs in an earlier timeframe than currently supported.

Risk Description:

- Community support for and/or FAA management approval of the Surface Technology Roadmap could be withheld or delayed.

- Funding for future technology research needs identified within the Surface Technology Roadmap may be reduced or deleted.

- Demonstration and validation of enabling technology for each BAA contract awarded is scheduled to be conducted in parallel during the next year, which could create schedule conflicts and/or stretch FAA resources thin.

- It is anticipated that System users (controllers, pilots, and maintenance technicians or their respective unions) will raise human factors issues and concerns with respect to the usability and acceptance of some or all of the BAA contract award technologies planned for implementation.

- Cost/Benefits Analyses may not support implementation of surface surveillance capability at "all ATC Towers" as recommended in the RI JSAT Report.

- The reduction in the number of phraseology-related errors (e.g., repeat voice messages, readback voice messages, and hearback/readback messages) may not be achieved, or if achieved, may not be sufficient to justify the costs associated with implementation of the proposed technology.

- The reduction in the number of pilot taxi deviations may not be achieved, or if achieved, may not be sufficient to justify the costs associated with implementation of the proposed technology.

- Certain new technologies created from some of these outputs may result in a change to procedures, training, and user workload.

Risk Mitigation Plan:

FAA and other stakeholders must commit to adequate levels of staffing and funding to support the Surface Technology Roadmap, including adequate special expertise (e.g., human factors).

FAA will coordinate BAA activities with site coordinators to ensure schedule and demonstration success.

Document system impacts to failure to implement surface surveillance capability at all airports. Develop a low-cost surface surveillance capability that could be justified for implementation at all ATC airports.

Continue to follow ongoing efforts/studies that are being conducted as part of the community CPDLC preparation as the community heads toward full CPDLC implementation.

Continue robust testing/validation of operational concepts to ensure that projected impacts will be realized upon full implementation of surface surveillance technologies.

Incorporate industry best practices for human factors in the design and development of training, procedures, and cognitive workload to enhance and support ATC decisionmaking.

Impact on Non - Part 121 or International Applications:

Impacts to General Aviation (Part 91) are addressed in part by the fact that this RI JSIT has been co-chaired by an officer of AOPA (and a member of the GAJSC).

Coordination with international organizations such as ICAO and JAA is continuous.