REDAC / NAS Ops

Review of FY 2022 Proposed Portfolio

Runway Incursion Reduction Program (RIRP)

Benjamin Marple, ANG-C52

March 24, 2020

Federal Aviation Administration

Runway Incursion Reduction Program (RIRP) S09.02-00

- The objective of the Runway Incursion Reduction Program (RIRP) is to reduce the risk to people and property caused by collisions in the runway environment. The RIRP is focused on providing SAFETY benefits for the FAA.

- The program will research technologies, develop and evaluate prototype systems that can be used to detect the presence of hazards in the Runway Safety Area, and provide alerts to the individual(s) who can take corrective action.

- RIRP success is measured by the completion of the goals identified in the Research Management Plan (RMP) for each prototype activity. Initiatives that successfully complete all the RMP Goals identified are then presented as candidates for acquisition, or presented for AIP-funding eligibility.

RIRP/ S09.02-00
Overview Capabilities

People:

- Sponsor: Giovanni Dipierro, AJI-14 (A)

- Program Manager: Ben Marple, ANG-C52

- Support Contractors: GEMS Inc., Veracity Eng., DOT Volpe Center

Laboratories:

- MIT/LL:
    - Safety Logic and Technology Development
    - System Requirements Development
    - Technical Transfer Package Development
- MITRE:
    - Benefit Estimation Methodology
    - Research / Data Mining
    - Human Factors

Runway Incursion Reduction Program (RIRP) Accomplishments in Current FY(20)

- Small Airport Surface Surveillance (SASS)

  - Conducted active Mode-S Surface & Airborne Surveillance Proof of Concept for SASS with refactored SASS software

  - Prepared initial draft of System Design Document (SDD) and Doxygen code documentation for Technical Transfer preparation

- Runway Incursion Prevention through Situational Awareness (RIPSA)

  - Developed Request For Proposal (RFP) and Acquisition Package for RIPSA Technical Solicitation

- Surface Taxi Conformance Monitoring (STCM)

  - Developed report on draft airport surface database requirements

  - Developed report detailing capability refinements for digitizing taxi instructions and pilot feedback on digitized taxi instructions

Runway Incursion Reduction Program (RIRP) Anticipated Research in FY21

- ## Small Airport Surface Surveillance (SASS)

  - Activities: Conduct Air Traffic Control Radar Beacon System (ATCRBS) Surveillance Proof of Concept demonstration; Transfer SASS Technology to Industry for further development

  - Products: Refactored & Documented SASS software, SASS hardware package specifications, Technical Transfer documentation

- ## Runway Incursion Prevention through Situational Awareness (RIPSA)

  - Activities: Procure technologies for RIPSA through contract solicitation; conduct vendor site surveys and initiate installation of RIPSA technologies at test site(s)
  - Products: Contract Award(s) for system hardware and vendor engineering support, Site survey reports, Test plans.

- ## Surface Taxi Conformance Monitoring (STCM)

  - Activities: Evaluate methods for capturing taxi clearances from within the cockpit and for presenting taxi conformance information to the pilot; begin developing a tower-based prototype by soliciting design feedback from Air Traffic Controllers in a series of tabletop exercises, with a focus on smaller towered general aviation airports.
  - Products: STCM technology prototype for cockpit; results of pilot HITL evaluations for the STCM cockpit prototype

Runway Incursion Reduction Program (RIRP) Emerging FY22 Focal Areas

- Incorporation of Speech Recognition capability and cooperative surveillance into RIPSA technologies for surface safety.

- Wrong Surface Landing Prevention: Using air traffic and cockpit technologies to allow ATC and pilots to detect alignment problems that could result in Wrong Surface Landing (WSL) incidents.

Runway Incursion Reduction Program (RIRP)

Research Requirement

- Develop Program Requirements, prototype, test and evaluate potential technologies at candidate airports as identified in the RIPSA report.

- Develop low cost surface surveillance sensor

- Refine concept and develop tools for tower-based and cockpit-based taxi conformance monitoring

- Sponsor: Runway Safety Group (AJI-14)
  POC: Giovanni Dipierro, Manager(A), AJI-14

Outputs/Outcomes

Products:

- Localized surveillance and annunciation technology test systems at RIPSA candidate airports

- STCM technology prototype for cockpit and tower

- RIPSA operational evaluation reports and system requirements

FY 2022 Planned Research

- SASS prototype development with industry partner

- ATCT based STCM technology prototype development and demonstration

- RIPSA Annunciator Simulation Study

- RIPSA test system operational evaluation

- Technology Feasibility Assessment for Wrong Surface Landing Prevention

Out Year Funding Requirements

FY20	FY21	FY22	FY23
$ 4M	$ 3M	$ 3.5M	$ 3.5M

Backup Slides

Federal Aviation Administration

Small Airport Surveillance Sensor (SASS)

Small Airport Surveillance Sensor (SASS) Overview

- SASS is a "proof-of-concept" research project to determine if candidate technology is feasible

  - End result: Technology transfer to industry

- SASS provides low-cost secondary surveillance for small airports

  - Goal: Accurate surface surveillance (30ft) and airborne surveillance out to 20nm or greater

- Technology investigated:

  - Phase I: Mode S Passive

  - Phase II: Mode S Active

  - Phase III: ATCRBS (Air Traffic Control Radar Beacon System)

- Target airports

  - GA airports with Class D airspace towers

SASS Overview (continued)

Key design features

- Highly accurate, low-cost phased array (non rotating antenna)

- Low cost commercial off-the-shelf signal processing equipment

- State-of-the-art digital signal processing leveraged from prior Department of Defense research

Research conducted by

- Massachusetts Institute of Technology's Lincoln Laboratory at Hanscom Field (KBED)
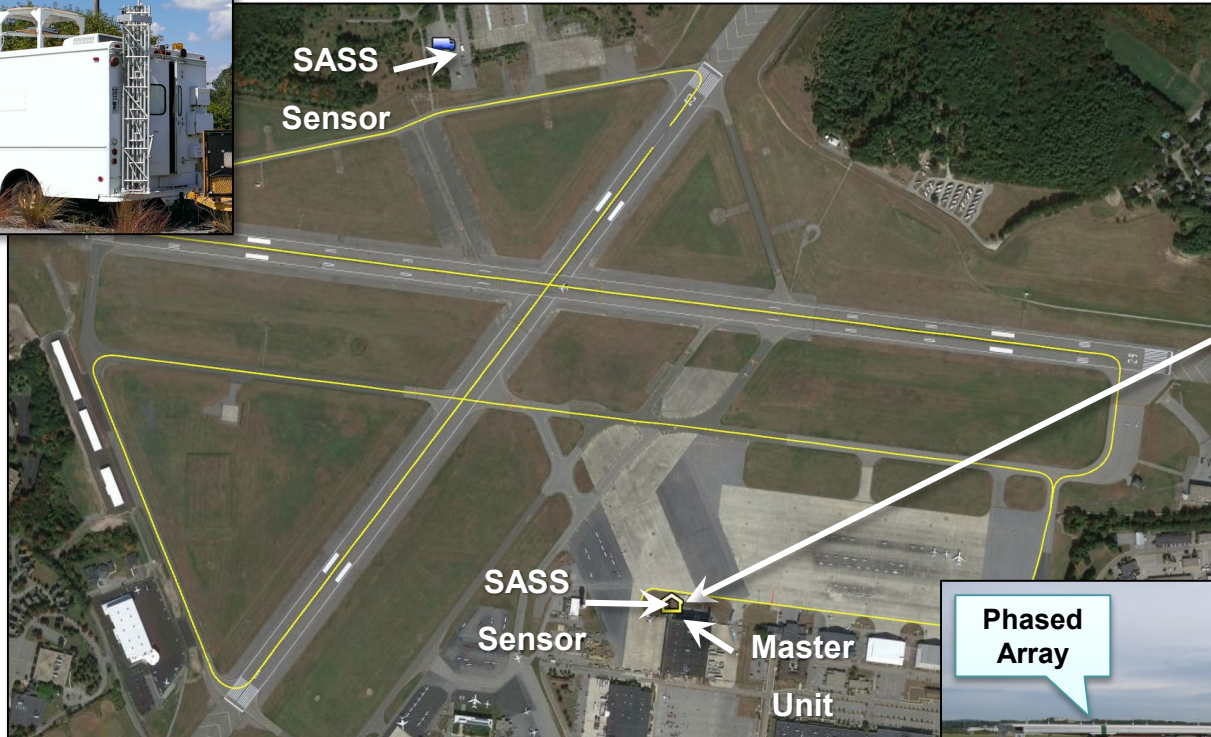
SASS Diagram
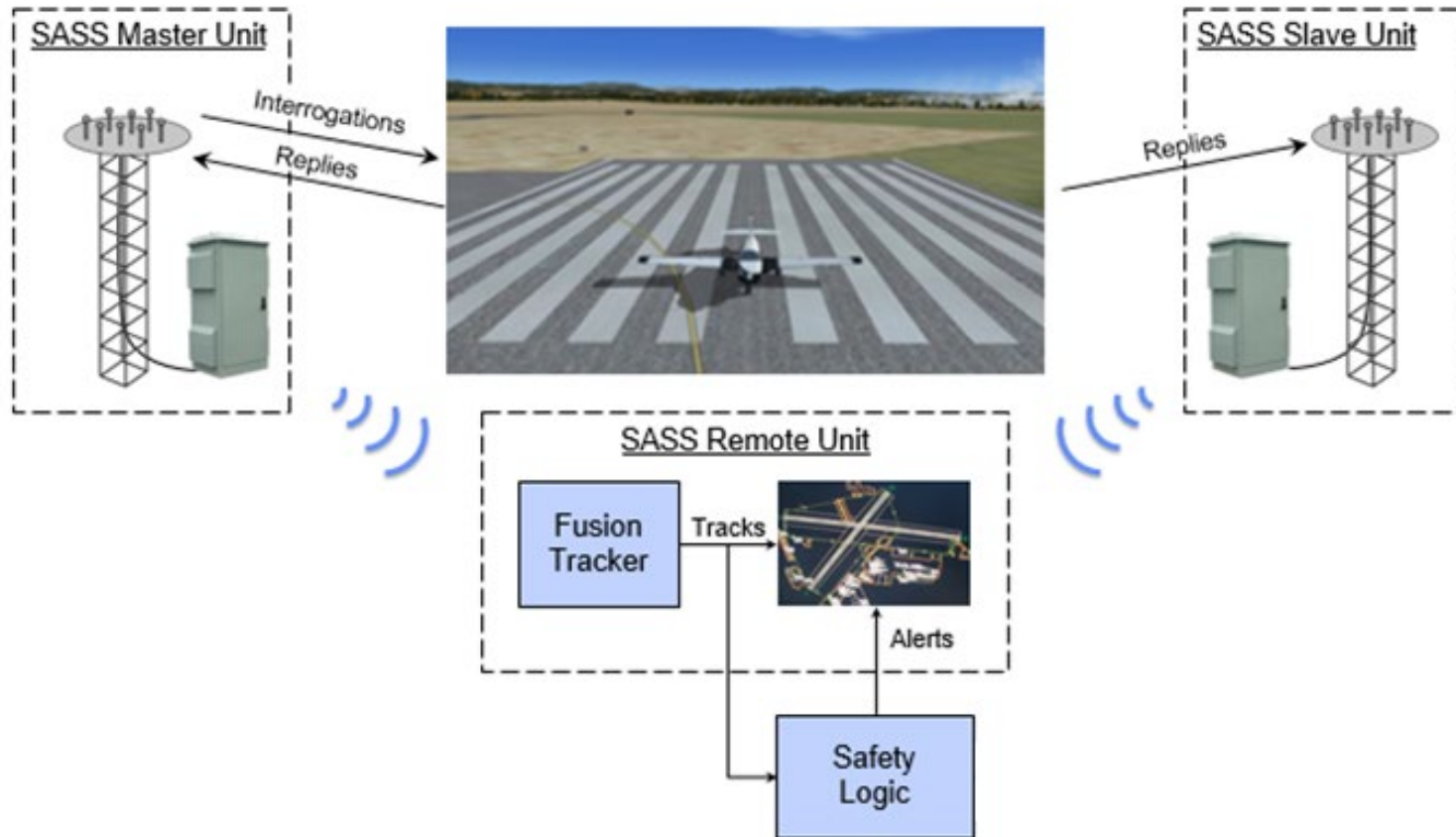
- Provides transponder-based surveillance of airport surface and nearby airspace
- Passively and actively interrogates surface and airborne non-ADS-B aircraft
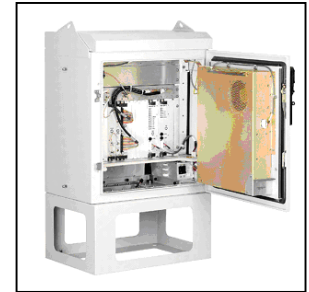
Hanscom Field Sensor Units
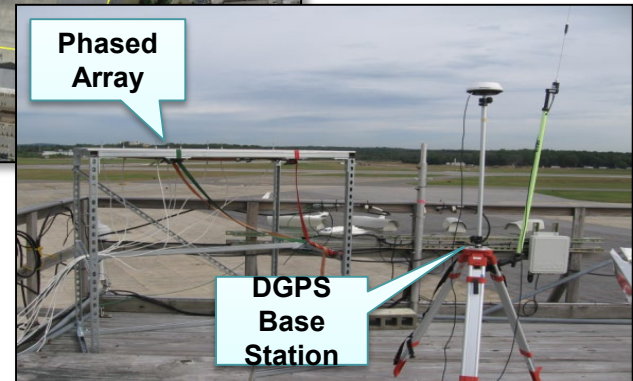

Phased Array

SASS Sensor

SENSIS RTU Interrogator (GFE)

SASS Sensor

Master Unit

Phased Array

DGPS Base Station

SASS Timeline

- FY14: Performed Engineering Study for SASS aperture design

- FY15: Conducted proof-of-concept data collection at Hanscom Field

- FY16: Conducted passive Mode-S Surface & Airborne Surveillance Proof of Concept

- CY17: Conducted active Mode-S Surface & Airborne Surveillance Proof of Concept

- CY18: Software refactoring for Technical Transfer preparation

- CY19: Conduct ATCRBS Surveillance Proof of Concept; Initiate SASS Technology Transfer to Industry

- FY20: SASS ATCRBS surveillance capability demonstration; SASS Technology Transfer

# Runway Incursion Prevention through Situational Awareness (RIPSA)

# Runway Incursion Prevention through Situational Awareness (RIPSA)

- Surveillance Performance and RI Risk reduction analysis:
  - Examine airport layout with relation to errors
  - Construct runway incursion scenarios with relation to errors
  - Identify existing runway incursion trends at individual airports and the root causes
  - Determine surveillance functionalities necessary to mitigate incursions based on scenario and error analysis

- Evaluate performance of potential surveillance solutions:
  - Release Market Survey to Industry
  - Identify Technologies useful for RI mitigation focusing at runway-taxiway intersections
  - Research annunciation methods to increase communication to controller/pilot

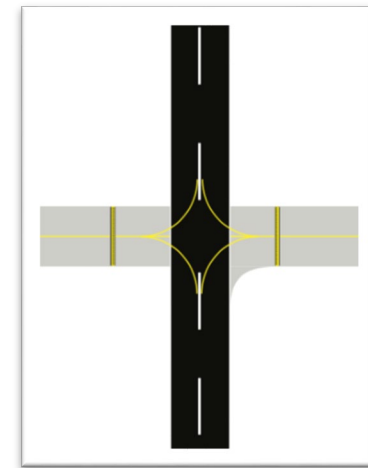# RIPSA - Evaluate Performance of Potential Surveillance

RIPSA will research "direct to pilot" safety systems capable of providing localized detection capabilities for all aircraft or vehicles at RI hotspot locations, such as hold short lines at runway-taxiway intersections
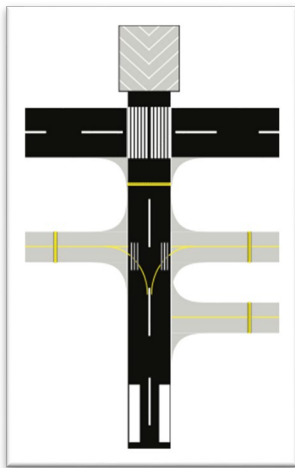
Converging Runways
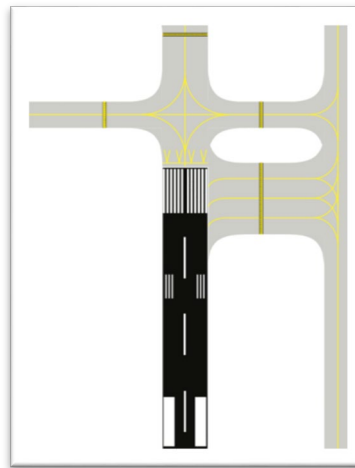
Runway with Multiple, Converging Taxiway Intersections

Runway with Intersecting Taxiway

RIPSA Program Timeline

- FY20: Release RFP for Technology Acquisition

  - Contract Award(s)

  - Commence technology installation at candidate airport(s)

- FY21: Continue technology installation at candidate airport(s)

- FY22-24: Operational Test & Evaluation (OT&E) at candidate airport(s)

- FY24-25: Site Removal and Restoration/ AMS Documentation / Technology Transfer

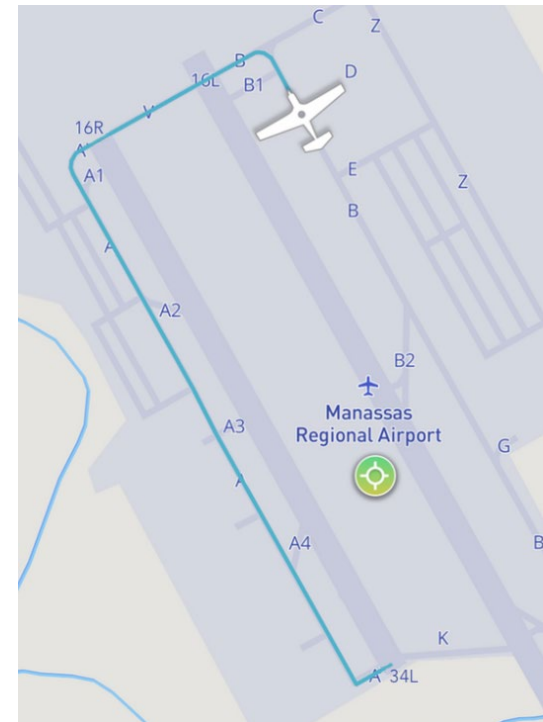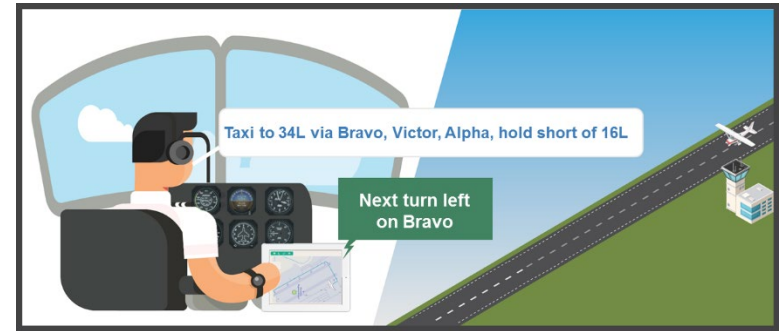# Surface Taxi Conformance Monitoring (STCM)

Surface Taxi Conformance Monitoring (STCM)

Mission:

Conduct research to determine if cockpit and/or tower-based Taxi Conformance Monitoring systems can be developed to reduce Runway Incursions (RI) that result from taxi errors

- Use electronic devices to monitor pilot compliance with taxi clearances
- Goal is to catch taxi errors before they escalate into an RI

Surface Taxi Conformance Monitoring (STCM)

Phase 1 (CY18)

- Develop report on identified state-of-the-art capabilities in Surface Taxi Conformance Monitoring (STCM) technology used around the world.
    - Identify initial list of existing technologies
    - Research characteristics of each technology
    - Develop table of functions associated with each technology
    - Draft description of technologies that support taxi conformance

- Develop shortfall analysis report identifying Runway Incursions that may be prevented by various STCM concepts at controlled airports in the NAS.
    - Identify initial subset of RI from Volpe database that may benefit from taxi conformance monitoring
    - Assess those RI and corresponding data fields
    - Complete Inter-Rater-Reliability, code RI database
    - Characterize the extent to which the various surface monitoring technologies might potentially mitigate these RIs

Phase 2 (CY19)

- Research capabilities needed to digitize taxi route instructions
- Research airport surface database requirements for taxi conformance monitoring

• FAA Surface Safety Initiative Team (SSIT) Portfolio

Existing Technology Investments

Potential to cover approximately _50 airports _ with:

ASDE 3/AMASS

ASDE-X (SMR)   **ASDE-X (SMR) with RWSL**

ASDE-X (ASDE-3)   **ASDE-X (ASDE-3) with RWSL**

ASSC   **ASSC with RWSL**

Provide conflict detection and alerting

- *direct to controller*

- *and direct to pilot/ vehicle operator*

FAA Runway Incursion Reduction Program Research

Potential to cover approximately _25 airports_ with no technology and highest rates of runway safety events.

Build on existing success to continue providing conflict detection and alerting

- *direct to controller*

- *and direct to pilot/ vehicle operator*

Concept Development

Surface Memory Aids required at all remaining _446 towered airports_

Leverage speech recognition as an enhancement to memory aids.

SURFACE SAFETY INITIATIVES TEAM VISION
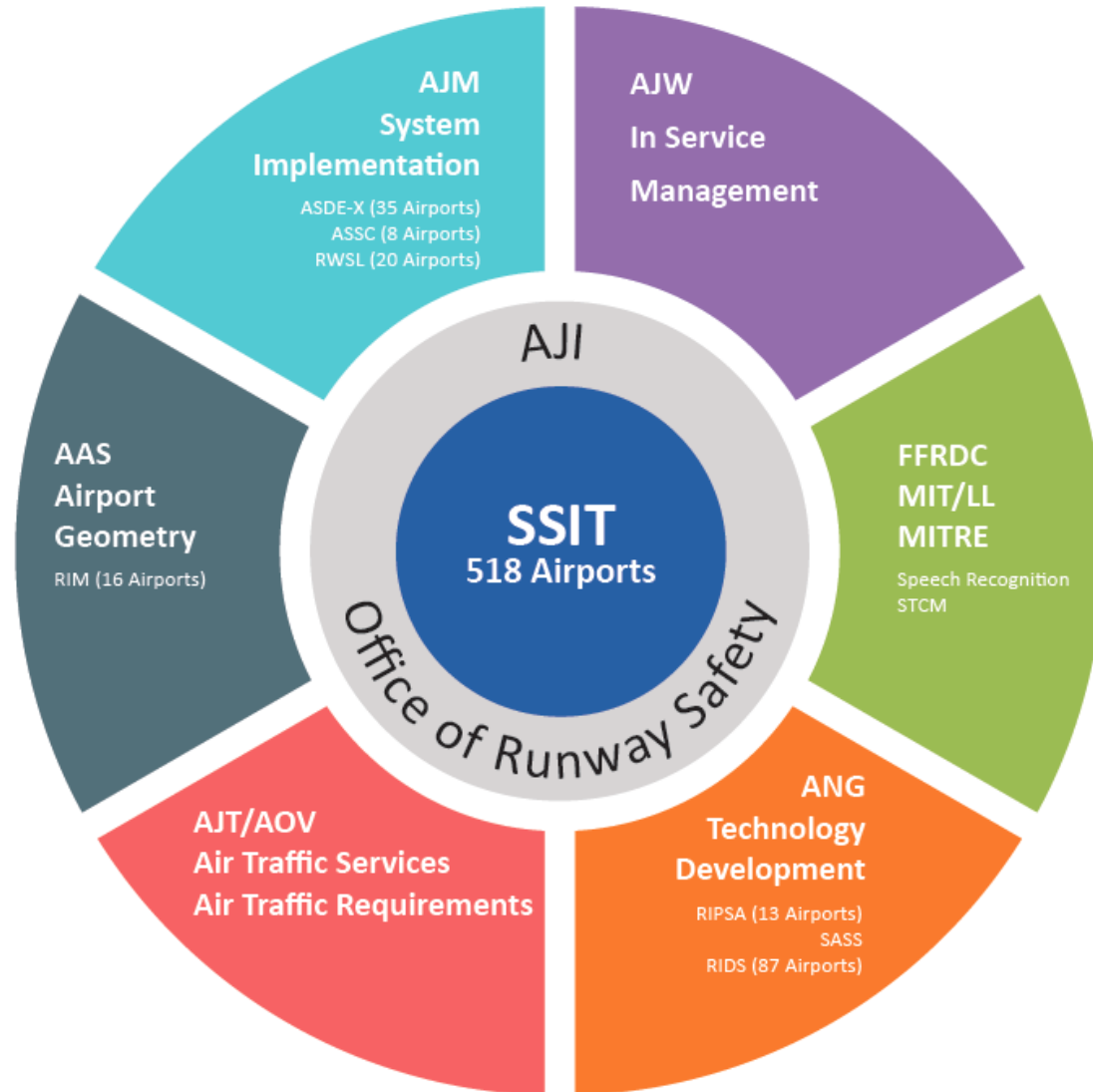
External and Internal Analysis (Current)

- **Little to No Collaboration Across Lines of Business**
- **Numbers Based Analysis**
- **No Comprehensive Strategy**

Formulation of a Business Strategy (Planned)

- **Collaboration Across Lines of Business. To include Union and Industry Stakeholders**
- **SMS – Risk Based Analysis**
- **Implement Runway Safety Roadmap**

Portfolio Management

(Surface Safety Technology)

- **Enhancements to Existing Technology in the NAS**
- **Right size, Right Site for Emerging Technology**

AJI

SSIT
518 Airports

Office of Runway Safety

AJM
System Implementation
ASDE-X (35 Airports)
ASSC (8 Airports)
RWSL (20 Airports)

AJW
In Service Management

FFRDC
MIT/LL
MITRE
Speech Recognition
STCM

ANG
Technology Development
RIPSA (13 Airports)
SASS
RIDS (87 Airports)

AJT/AOV
Air Traffic Services
Air Traffic Requirements

AAS
Airport Geometry
RIM (16 Airports)

RIRP

Runway Safety Roadmap

2003-2011

AIRPORT SURVEILLANCE DETECTION EQUIPMENT – MODEL X

- 35 SITES

ASDE-X

2013-2020

AIRPORT SURFACE SURVEILLANCE CONCEPT

- 8 SITES

ASSC

SURFACE ENHANCEMENTS

2018-2020

- ASDE-X TAXIWAY ARRIVAL ALERTS
- ASSC TAXIWAY ARRIVAL ALERTS
- RWSL CONVERGING RUNWAY OPERATIONS (PROPOSED)

RWSL

2008-2020

RUNWAY STATUS LIGHTS

- 20 SITES

Runway Safety Roadmap

SURFACE SAFETY OUTLOOK

RIDs

RIPSA

SAFRE

FUTURE AT RUNWAY SAFETY

2018-2020

RUNWAY INCURSION DEVICES

- BASELINE PROGRAM (87 SITES) FOR DEPLOYMENT OF MEMORY AIDS

2020-2024 (PHASE I)

RUNWAY INCURSION PREVENTION THROUGH SITUATIONAL AWARENESS

- NON-COOPERATIVE SURVEILLANCE FOR RIGHT SITE, RIGHT SIZE SOLUTIONS
- LOCALIZED DIRECT TO PILOT INDICATOR

2024-2028 (PHASE II)

SITUATIONAL AWARENESS FOR RUNWAY ENTRANCES

- INTEGRATION OF COOPERATIVE SURVEILLANCE/SPEECH INTO RIPSA TECHNOLOGIES

CURRENT TECHNOLOGY DEVELOPMENT INITIATIVES

- ADS-B ONLY
- SASS
- SPEECH RECOGNITION
- TAXI CONFORMANCE MONITORING