Working Together to Help Shape the Future of Aviation

Embry-Riddle Aeronautical Contact Information

James Crowell

Contracting Officer Representative/Program Manager

386-226-7766

Crowelj2@erau.edu

Diana Dunham

Program Management Office

386-323-8763

Dunhamd@erau.edu

Introduction

The Federal Aviation Administration (FAA) requires an environment for the development of Next Generation Air Transportation System (NextGen) concepts and technology. Engineering the nation's future air transportation system into reality, NextGen Test Bedswill foster the design, development, integration, evaluation and demonstration of future NextGen goals. All of this is done prior to the launch of full-scale operational capability.

Established as a scalable, expandable, cost-effective and repeatable process and architecture, the Test Bed sites are envisioned to allow gate-to-gate demonstration of NextGen components. Specifically, the following three sites that host the collective NextGen Test Beds are:

1. NASA's North Texas facility located near the Dallas/Fort Worth International Airport (DFW), TX
2. William J. Hughes Technical Center (WJHTC) located near Atlantic City, NJ
3. Florida NextGen Test Bed(FTB) located at the Daytona Beach International Airport (DAB), FL

Collectively, the NextGen Test Beds will:

- Provide NextGen rapid integration capability for prototypes
- Allow end-to-end (multi-domain) demonstrations
- Support demonstration of NextGen components and interaction with existing and arising NAS systems
- Act as an open evaluation platforms to analyze feasibility of new technologies
- Assist incremental migration of NextGen component
- Support integrated demonstrations to validate large scale modeling and simulation efforts
- Allow for potential human-in-the-loop demonstrations

The Florida NextGen Test Bed supports the above requirements and provides the following unique capabilities:

- A robust platform where integration, rapid prototyping, and demonstration takes place without affecting the air traffic operations in National Airspace System (NAS).

- Provides access to industry, government, and academia viaa unique development model which requires investment from all participating parties.

- Uses actual NAS systems supplied by industry and government and simulation systems are used where necessary.

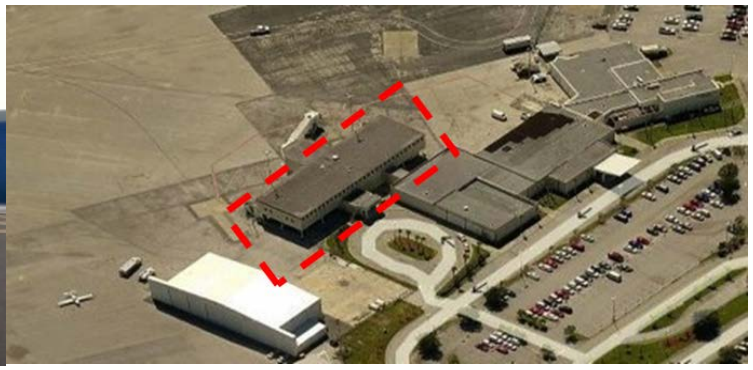
- Systems are linked via the System Wide Information Management (SWIM) and designed to support the Flight Data Object (FDO) which are key NextGen enabling technologies.
- Provides direct access to DAB airport facilities.

- Provides direct access to Embry-Riddle Aeronautical University (ERAU)resources, including aircraft, faculty, staff, students, and facilities.

Florida NextGen Test Bed

"Working Together to Help Shape the Future of Aviation"

The FTB is an FAA initiative to develop a NextGen research and demonstration facility at Daytona Beach. The FTB is developed in order to provide stakeholders with a rapid integration capability for testing Operational Improvements and enablers by leveraging the NASusing prototype capabilities. It utilizes a cost-effective and scalable architecture to allow for new growth as the Operational Improvements and enablers evolve. FTBis being used to integrate and demonstrate NextGen and legacy technologies into existing and planned enhancements for the NAS.



Mission

The mission of the FTB is to provide a microcosm of the NAS, with prototype NextGen capabilities that are aligned with planned functionality as depicted by the NAS Enterprise Architecture and Infrastructure Roadmaps. The FTB can be used to evaluate concepts, operational research, capabilities, and technologies prior to these being funded, implemented, or fielded at a NAS facility. The FTB integrates multiple flight domains within its facility in order to provide for end-to-end or multi-domain demonstrations and concept evaluations. It will provide an open platform to help evaluate and examine the feasibility of new technologies.

Access

Through governance, the FTB will allow access to industry, government, and academic institutions interested in the development of NextGen technologies. Partnerships with industry are seen as key to the mission of the FTB. The FTB is currently supported by ERAU through an Other Transaction Agreement (OTA) with the FAA to operate the FTBand work with industry in support of NextGen goals.

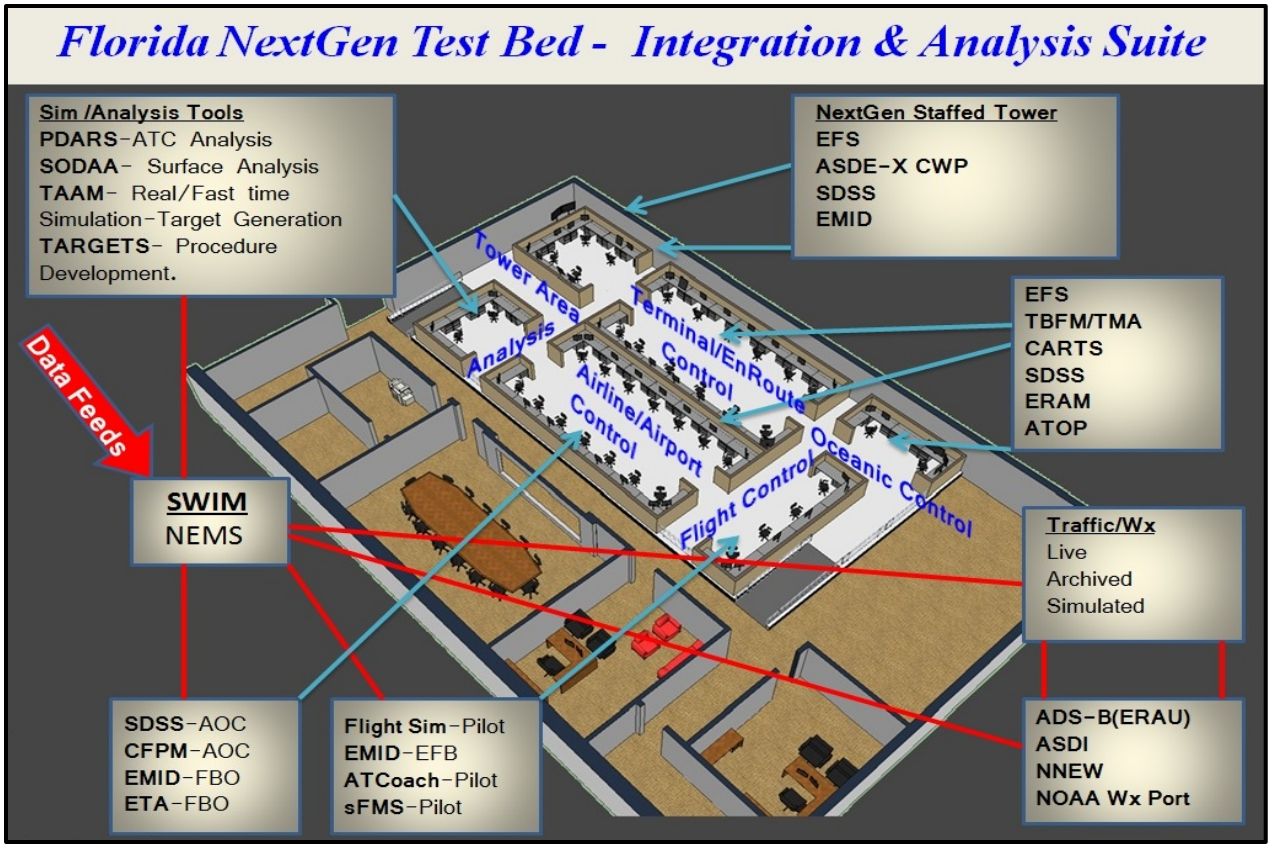
Facilities and Capabilities

The FTB consists of two primary areas: The Integration Suite and the Demonstration Suite. Additionally, theData Center houses the network equipment, rack mounted servers, and other equipment required to drive the operational capabilities in the Integration and Demonstration Suites.

Integration Suite

The Integration Suite, approximately 5,000 square feet, is used to carry out development, test, and integration efforts for the operational capabilities being evaluated at the FTB. The Integration Suite includes the following:

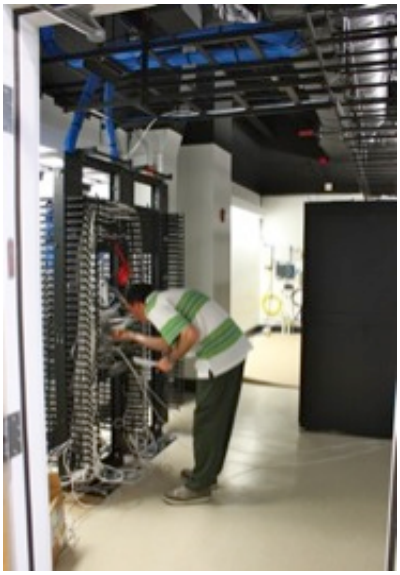
- **Integration Area**. This area will allow engineers to work together on development, test, integration, and related activities either separately or collectively.



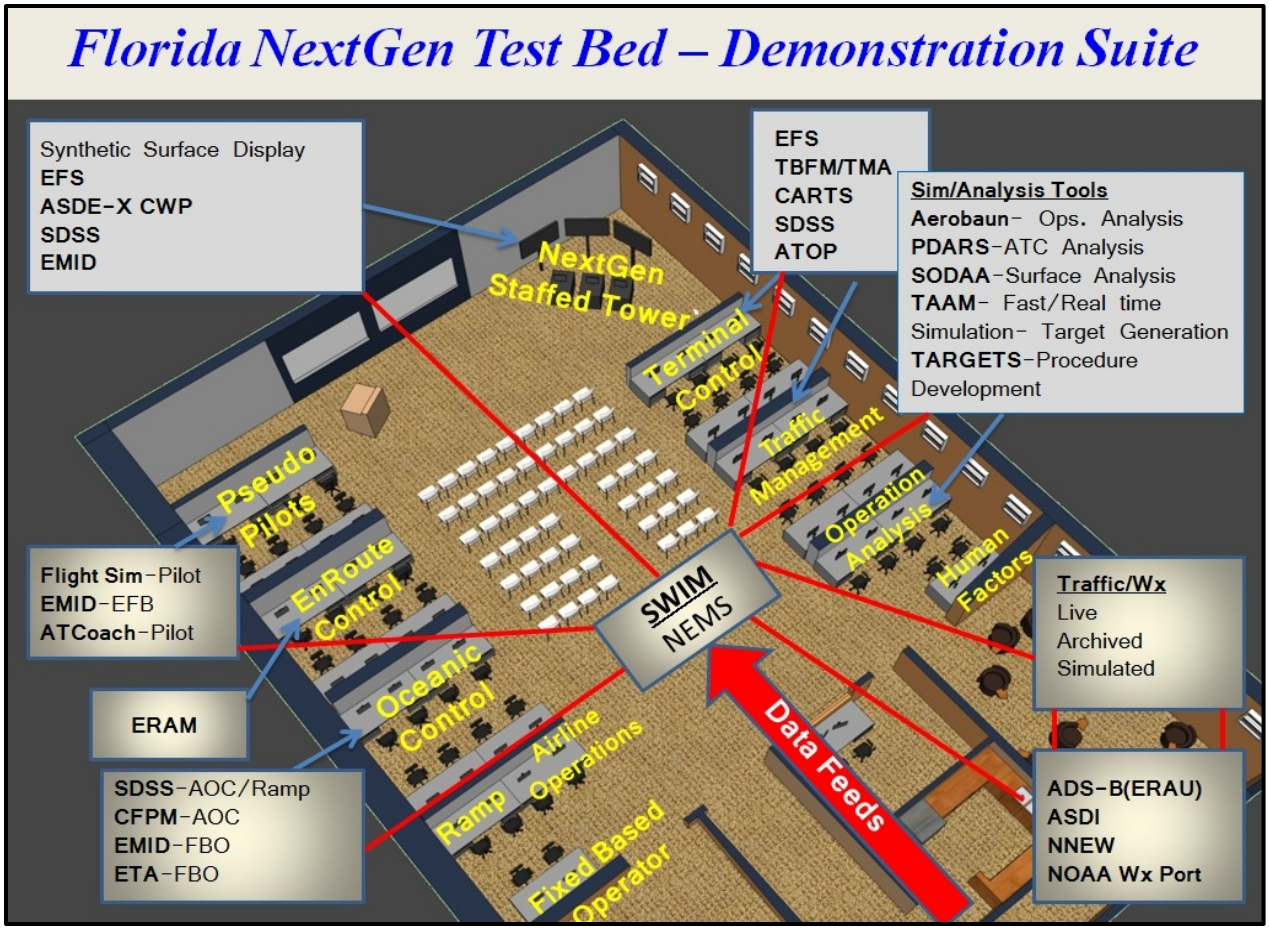
- **Video Conference Room**. This area will allow for meetings and teleconferences for approximately twenty people with a high degree of technology.

- **Offices**. These will be used for visiting personnel to have temporary private work space while at the FTB.

- **Data Center**. Available for server hosting and telecom. Connectivity to FAA R&D Domain research network



Demonstration Suite



The demonstration suite is at the core of the FTB mission. It is approximately 5,000 square feet andis used to conduct demonstrations of the operational capabilities deployed at the FTB. Designed to accommodate flexibility and future growth, the suite contains reconfigurable bay areas positioned along the periphery to accommodate demonstrating and visualizing different flight domains or operational areas.

Large screen displays throughout the suite enable the audience to view activity on certain monitors within the various flight domains, while screens at the front of the suite provide projections of presentations, displays or other materials. Seats can be organized in a stadium / theatrical arrangement in order to maximize the audience members' views of the operational capabilities being demonstrated.

FTB Capabilities and Strengths

With its location at an operational airport, access to the airport infrastructure, and airport tenants, the FTB provides several important capabilities for NextGen research and demonstrations:

- Early Stage Concept Evaluation.
- Rapid Prototype Design.
- Integration Suite integration does not disrupt Demonstration Suite demonstrations.
- Ease of access for industry and academia participation.

The following sections describe the FTB capabilities and strengths in greater detail.

Industry and Academia

The FTB has its origins in work conducted by ERAU and members of an Industry Consortium on the Integrated Airport Initiative (IAI), which began in 2006. The IAI project was aimed at demonstrating emerging concepts and capabilities related to NextGen within the scope of air traffic control, airport, and airline operations. The IAI envisioned an environment where industry partners worked together in bringing their skills and technologies into one facility. The goal was to develop a "microcosm" of the NAS where systems communicated in a "SWIM-like" manner.

Leveraging the work performed and contributions provided by the IAI, the FAA has since established the FTB as a Government facility while maintaining a

cooperative relationship with the industry members. The team has continued to support the needs of the FAA, while building a solid technological capability. The FTB is envisioned to be an agile research and integration facility designed to allow government, industry, and academia to showcase their ideas and technologies in a NextGen NAS environment. Throughout the development of the FTB, industry has contributed expertise, NAS technologies, and a myriad of other resources to help make the FTB a success.

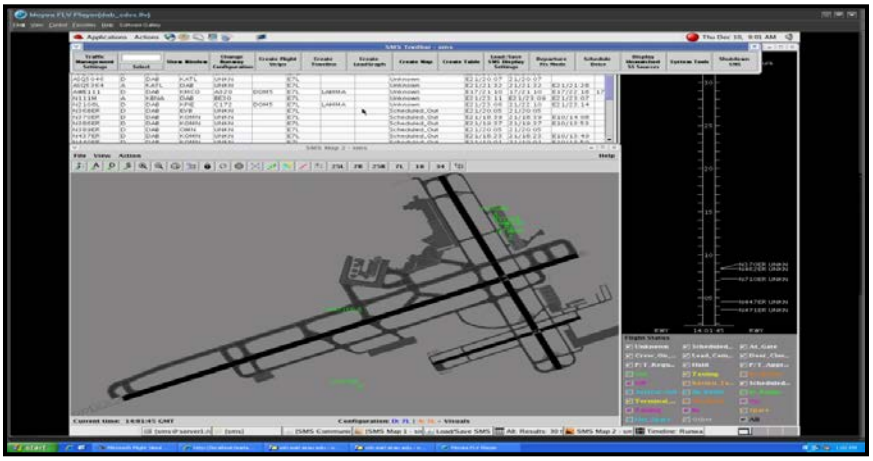
The industry manufacturers and service providers of existing NAS systems have the specialized expertise necessary to implement and operate the systems that they have developed and maintained. As ideas and concepts emerge, these industry members can rapidly develop prototype and integrate capabilities while maintaining control of their own intellectual property.

As a premier academic and research institution with a focus on aeronautics and aviation, ERAU has access to professors and students involved with many aspects of aviation. These include student and retired controllers, professionals and student pilots who help bring new and innovative concepts and capabilities to the FTB activities at a relatively low cost. ERAU has a number of labs that support various aspects of aviation research, including Air Traffic Management (ATM), weather, and Unmanned Aircraft Systems (UAS). The human factors department at ERAU offers faculty skill sets to help conduct experiments and Human-In-The Loop (HITL) simulations.

Airport, Aircraft, and Services

The FTB has a number of advantages afforded to it by its location at the DAB, which is a medium size airport environment consisting of a large number of General Aviation (GA) operations. DAB has a class C airspace with a minimal amount of commercial air traffic, making it easier for the FTB activities not to interfere with airport operations. The DAB tower and airport authorities have strong ties to ERAU, which can help facilitate the FTB activities such as coordinating field operations, installing equipment, or performing specific air operations. In addition, a jet bridge directly off the FTB allows for easy access to aircraft on the tarmac.

The FTB has access to the local ERAU fleet of aircraft, which can participate in live tests and demonstrations of NextGen operational concepts and capabilities. The Automatic Dependent Surveillance – Broadcast (ADS-B) equipped fleet presents the ability to demonstrate all aspects of ADS-B in an operational environment.



Specific features include:

- State-wide coverage of 300 nm from ground based transceiver (surface level to FL 600)
- DAB Airport surface coverage
- Wi-Fi coverage of the airport surface with AeroMACS System

Previous and Currently Planned NextGen Research and Demonstrations

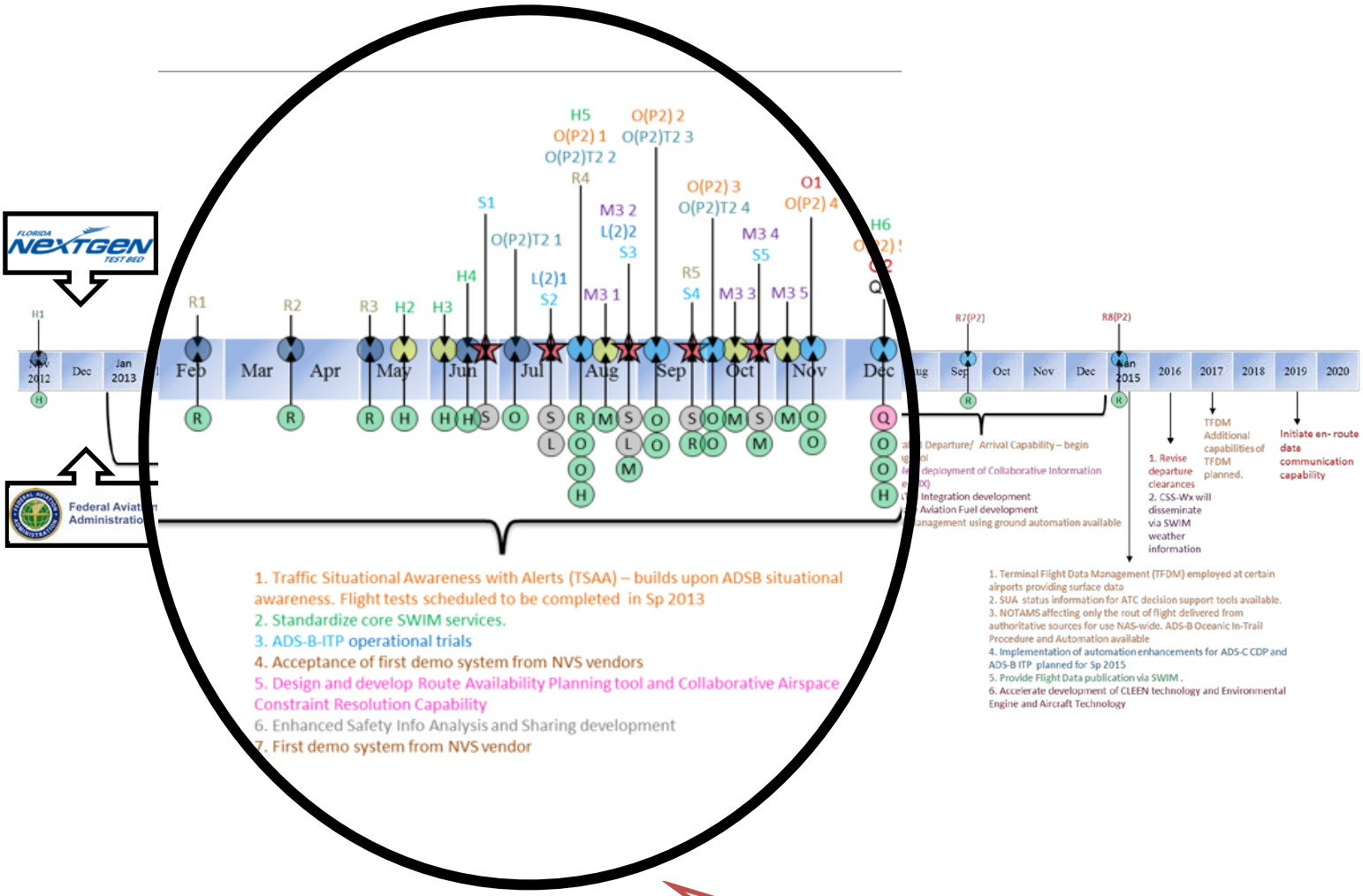
Demo Activities	FY	Contract Vehicle	Short Description	Systems Used
Wx Integrated into TMA/ERAM (Complete)	FY08	ERAU OTA (Task A) <u>Industry Partners:</u> ERAU Lockheed-Martin CSC ENSCO Mosaic ATM Frequentis Saab-Sensis	Improve weather detection and prediction, pass to TMA via SWIM-like network Evaluate SWIM-Enabled CONOPs and controller user interface concepts for ERAM based re-planning around convective weather for flights En-route to meter fix	ERAM CARTS TMA SDSS Vendor Wx data CWIS
International Flight Data Object (Complete)	FY09	ERAU OTA (Task D) <u>Industry Partners:</u> ERAU Lockheed-Martin	Lab demonstration of international flight data exchange between ATOP/ERAM and ATOP/SATL	ATOP ERAM SWIM like interface Single Thread SATL
UAS (Follow-On) (Complete)	FY09/10	ERAU OTA (Task E) <u>Industry Partners:</u> ERAU Lockheed-Martin Harris Saab-Sensis General Atomics	Investigate ATC and UAS Pilot interaction Demonstrate use of 4D Flight Management Systems (FMS) as a control mechanism for precise/manageable flight trajectory. Improve UAS pilot traffic / weather "situational awareness" with ADS-B	ADS-B NVS Prototype TMA ERAM STARS/CARTS

Surface Exchange of Flight Data Objects **(Complete)**	FY09	ERAU OTA (Task F) <u>Industry Partners:</u> ERAU Lockheed-Martin Harris Saab-Sensis Mosaic ATM Frequentis ENSCO NATS UK	Extends flight data object to include airport surface operation & demonstrate collaboration and info exchange	ASDE-X Surface Decision Support Tools
4-D FMS **(Follow-On)** **(Complete)**	FY09/10/11/12	ERAU OTA (Task G) <u>Industry Partners:</u> ERAU GE Aviation LMCO	Characterizing the performance of advanced FMS capabilities in relation to future Air Traffic Required Time of Arrival (RTA) concepts Follow-on include trajectory sync between ERAM and FMS. Work is in collaboration with CLEEN program.	TMA GE FMS ERAM
Oceanic In-Flight Advisory Operational Trial Planning **(Complete)**	FY09/10/11	ERAU OTA (Task H) <u>Industry Partners:</u> ERAU Lockheed-Martin Adacel Saab-Sensis Harris ENSCO	Plan an operational trial that makes available the Oceanic In-flight Advisory tool to AOCs via SWIM-like infrastructure	ATOP SATL Oceanic In-flight Advisory tool
Aircraft Arrival Management System (AAMS) **(Follow-On)** **(Complete)**	FY10/11/12	ERAU OTA (Task J) <u>Industry Partners:</u> ERAU ATH Group	Collect data and determine potential benefit of using an AOC based metering tool and provide analysis in support of future NAS enhancements towards the implementation of point in space metering in the NAS	AAMS Metering Tool AOC Partner systems
Flight Data Objects Phase 3 **(Follow-On)** **(Complete)**	FY11/12	ERAU OTA (Task K) Industry Contribution <u>Industry Partners:</u> ERAU Lockheed-Martin Harris	Develop a Preliminary FDO Benefits Analysis Initiate the Demonstration engineering analysis Establish Demonstration scenarios data elements, procedures, stakeholders, engineering needs and scheduling.	ATOP ERAM SWIM like interface Single Thread SATL

Standard Color Palette for Air Traffic Displays (Complete)	FY10	ERAU OTA (Task L) Industry Contribution <u>Industry Partners:</u> ERAU	Define a set of colors to be used to uniquely code information on computer-driven Air Traffic Displays to be used in the Next Generation Air Transportation System (NextGen).	ERAM ATOP CARTS ASDE-X
NNEW & 4D Weather Cube (Follow-On) (Complete)	FY11/12	ERAU OTA (Task N) <u>Industry Partners:</u> ERAU Lockheed-Martin Harris ENSCO	Investigate whether integration and republication capabilities	NNEW Weather Distribution Server / Client
Aircraft Access to SWIM (In Progress)	FY12/13	ERAU OTA (Task O) <u>Industry Partners:</u> ERAU Harris Corp. Honeywell Rockwell Collins NetJets Virgin America Other carriers	Develop a platform leveraging the FTB infrastructure to demonstrate the use of an EFB to access SWIM information.	SWIM (DEX)(NEMS) Data Messaging Service Electronic Flight Bag AeroMacs Aerobaun
Automation Convergence (Complete)	FY12/13	ERAU OTA (Task P) <u>Industry Partners:</u> ERAU LMCO Harris Mosaic ATM	Demonstrate the technical and operational feasibility of extending Flight Data services from the EnRoute automation system to provide an infrastructure to TRACON and Tower facilities.	ERAM NEMS SDSS
Airborne Execution of Flow Strategies (Follow On) (In Progress)	FY12/14	ERAU OTA (Task Q) <u>Industry Partners:</u> ERAU LMCO Metron	Demonstrate the technical and operational feasibility of allowing airlines to provide priorities to their fleet to be managed by Traffic Based Flow Management.	TBFM

Mini Global **(In Progress)**	FY13/14	ERAU OTA (Task R) <u>Industry Partners:</u> ERAU LMCO Harris Mosaic ATM NATS Int'l Partners TBD	Mini Global will demonstrate the applicability of the global exchange models for Flight, Aeronautical and Weather information. MG will show how the FAA, International ANSPs and flight operators, in both the Pacific and Atlantic regions, are able to share common information to: ▪ Improve collaborative decision making (CDM) ▪ Improve air traffic management (ATM) ▪ Promote international harmonization	NEMS ERAM ATOP TBFM SDSS CFPM TGF NCR OV Dex Mini Global Cloud Int'l Systems

Roadmap



NextGen Roadmap

- Purposes of the roadmap:
  - Roadmap based on FAA NextGen documents and FTB projects
  - Communication tool to illustrate NextGen initiatives and their relationship of FTB Tasks
  - Analysis tool to help identify gaps in NextGen operational initiatives and current or planned FTB Tasks

Key for Florida NextGen Test Bed Tasks

Task H – Oceanic Conflict Advisory Trial (OCAT) – Phase 3
Task L(2) Color Palette
Task M3 – FTB Core SWIM Infrastructure
Task O – Aircraft Access to Swim (AAtS) – Research
Task O – Aircraft Access to Swim (AAtS) - Phase 2 - Team #1
Task O – Aircraft Access to Swim (AAtS) - Phase 2 - Team #2
Task Q – AEFS Phase 2 (Notional)
Task R – Mini Global – Risk Mitigation Demo (Yr1)
Task R – Mini Global – Phase II (2014 - 2015)
Task S – Air Traffic Control Facilities Survey

Frequently Asked Questions

How have Florida NextGen Test Bed activities furthered NextGen?

The Test Bed has furthered NextGen activities by:

1. Acting as a platform to conduct NextGen technology and concept evaluations and demonstrations
2. Allowing FAA to understand prospects of the early-stage concept or technology for implementation and understand potential benefits and risks
3. Helping FAA make decisions on potential operational implementations

What are some specific examples as to how Florida NextGen Test Bed activities have helped the FAA's NextGen decision making?

The Test Bed allowed for concept demonstrations and evaluations that have/will lead to NextGen implementation decision making in the following areas:

1. Unmanned Arial Systems (UAS) concept demonstrations
2. 4-D Flight Management System (FMS) concept demonstrations
3. Flight Data Object (FDO) concept demonstrations
4. Aircraft Arrival Management System (AAMS) concept demonstrations
5. Oceanic Trajectory Based Operations (TBO) concept demonstrations

How haveFlorida NextGen Test Bed activities supported the RTCA Taskforce 5 recommendations?

The Test Bed supports RTCA Task Force 5 recommendations by enabling demonstrations & evaluations in the areas of:

1. Convective weather integration with TMA/TBFM and ERAM to improve flow metering during convective weather events. This supports the following Task Force 5 recommendations:

    a. Cruise Segment Recommendation: Expand use of Time Based Metering

    b. Integrated ATM Recommendation: Improve CATM automation to negotiate user-preferred routes and alternative trajectories

2. Oceanic Conflict Advisory Tool (OCAT) development with Airline Operations Center (AOC) involvement. This supports the following Task Force 5 recommendations:

    a. Integrated ATM Recommendation: Facilitate integrated system-wide approach (CDM/TFM/ATC)

    b. Integrated ATM Recommendation: Improve CATM automation to negotiate user-preferred routes and alternative trajectories

3. Surface Flight Data Object (FDO) development. This supports the following Task Force 5 recommendations:

    a. Surface Recommendation: Establish TFM common operational picture & interoperability standards for sharing surface data among AOC & FAA

    b. Surface Recommendation: Situational Awareness Phase 2 – integrated airport movement management decision support tools, standards, processes

4. Network Enabled Operations (NEO) Spiral 2 demonstration. Supports Task Force 5 recommendation:

    a. Cruise Segment Recommendation: Special Activity Airspace (SAA) real-time status and scheduling