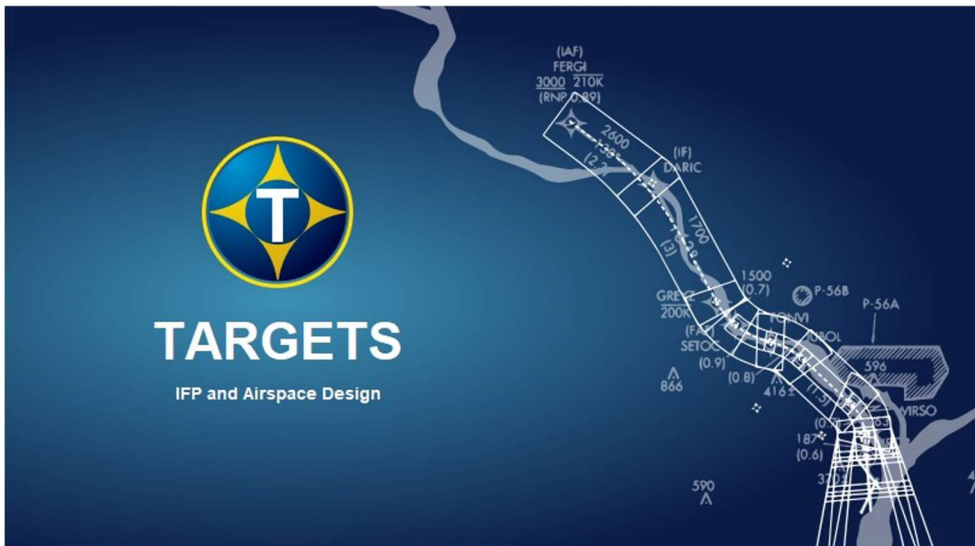




TARGETS is developed by The MITRE Corporation's Center for Advanced Aviation System Development and sponsored by the Federal Aviation Administration. This software enables design and operational analysis of procedures and airspace. It is used by a variety of FAA and non-government users supporting the implementation of Instrument Flight Procedures.

Federal Aviation Administration Mission for Instrument Flight Procedures

The FAA's National Airspace System (NAS) consists of an inventory of approximately 20,000 approach, arrival, departure, and en route instrument flight procedures (IFPs) utilized by over 44,000 flights within the United States and its territories on a daily basis. While originally only supporting conventional IFPs, or navigation using ground-based equipment, the NAS has evolved to include Performance Based Navigation (PBN) procedures, which are IFPs that use more precise satellite enabled navigation. This inventory of conventional and PBN procedures must be continuously evaluated as IFPs are added or cancelled, navigational aids are implemented or discontinued, new obstacles are identified, airspace is redesigned, and the regulations governing the NAS evolve. TARGETS is the FAA's enterprise solution that supports that mission and enables the NAS to continue to be the safest and most efficient airspace system in the world.

Who Uses TARGETS?

TARGETS has a diverse user base that consists of various government and non-government entities including:

- FAA IFP Developers
- FAA Regional Flight Procedure Teams (FPTs)
- FAA Obstacle Impact
- Air Traffic Controllers
- FAA Flight Standards Service (AFS)
- FAA Facilities
- FAA Office of Airports
- Non-FAA Service Providers
- Research and development partners

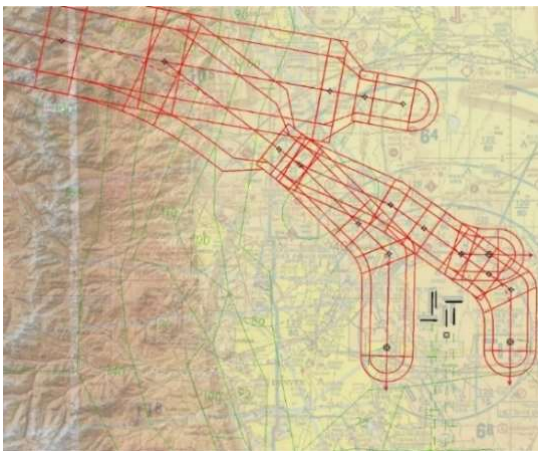
TARGETS Core Functionality

The manual procedure design process can be complex and time consuming involving a diverse group of stakeholders. In some cases, manual evaluation is prohibited by FAA order due the complexity of calculations. TARGETS allows stakeholders to work collaboratively to examine the many constraints that must be considered and evaluated during the development of a procedure including conformance to FAA design criteria, navigation coverage, visibility, procedure flyability, and environmental screening.

TARGETS takes advantage of a vast array of data and design automation, enabling a procedure designer to more rapidly develop and evaluate different designs than would be possible when performing manual IFP design. Many constraints that historically were not addressed until late in the development process may now be assessed earlier and in less time. TARGETS users follow a straightforward process to develop new arrival, departure, en route, and approach procedures.

IFP Design

TARGETS includes procedure design tools tailored to each supported procedure type for users to define the lateral and vertical procedure path using published or user-defined navigation data (e.g., points, runways, NAVAIDs). Procedures are defined using ARINC 424 leg types and embedded business logic helps ensure compatible leg combinations are specified. Assumed tailwind values can be generated based on local historical wind data in lieu of formula-based wind values for use in criteria evaluations when historical tailwind data is installed.



Criteria Engines

TARGETS includes software components referred to as criteria engines that automate the FAA's U.S. standard for Terminal Instrument Procedures (TERPS) criteria for IFP evaluations. These criteria engines validate procedure configuration, create obstacle evaluation areas that are displayed in TARGETS, and evaluate obstacles and terrain around the procedure to ensure the procedure meets safety and flyability criteria. The criteria engines report many calculations, such as minimum altitudes and any deviations from IFP criteria.

Detailed evaluation results (i.e. informational, warnings, waiver to criteria required) are provided to the user in a tabular format and within the GIS view. Results can be exported for dissemination to stakeholders (e.g. IFP quality control, PBN working groups) and for documentation purposes. As FAA criteria evolves, the criteria engines are updated to allow TARGETS users to evaluate procedures against the most current criteria. The criteria engines are also used to automate manual processes such as IFP periodic review and Obstacle Impact Assessments.

Supported Procedure Types

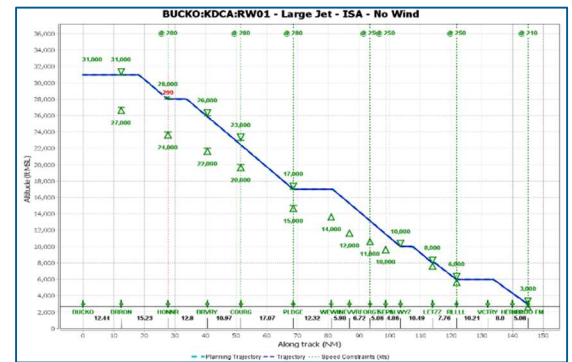
- Conventional Approach
- Conventional Route
- Conventional Standard Terminal Arrival Route (STAR)
- Diverse Departure
- Diverse Vector Areas (DVA)
- Holding Pattern
- RNAV Departures
- RNAV Route
- RNAV STAR
- RNAV (Global Positioning System [GPS]) Approach
- RNAV (Required Navigation Performance [RNP]) Approach
- Visual Climb Over Airport (VCOA)

Governing IFP Criteria Orders

- 8260.19
- 8260.3
- 8260.46
- 8260.58

Flyability Assessment

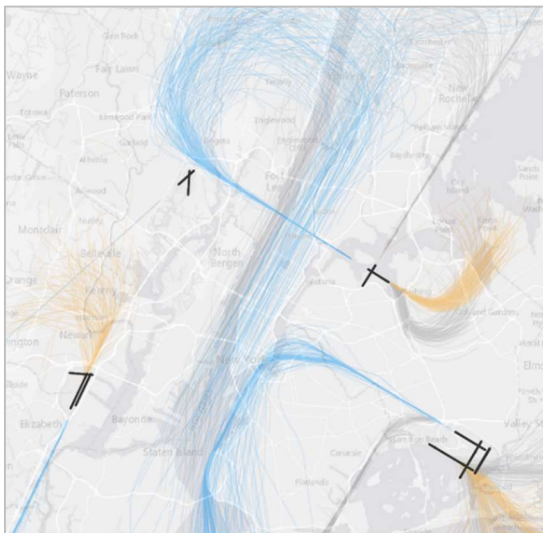
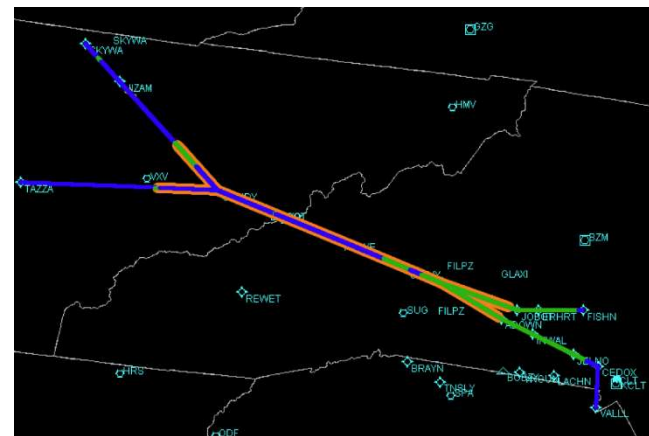
Flight Evaluator is a procedure screening tool used to assess the flyability of RNAV STAR and SID procedures under anticipated operating conditions. Flight Evaluator applies specified scenarios to each path through a procedure to simulate the aircraft's trajectory. The resulting predicted trajectory is used to measure conformance of the simulated flight against the altitude and speed restrictions along the procedure.



The user is presented with the modeled trajectories, their conformance comparison to the route, simulation notes/assumptions, and warnings about conditions/behaviors for review. Detecting situations where conformance fails early in the procedure design process improves efficiency, since these issues become more challenging to address when discovered later during the procedure implementation process.

RNAV Navigation Coverage Evaluation

TARGETS analyzes RNAV STAR, RNAV standard instrument departure (SID), Q-Routes, and Approach Procedures for Distance Measure Equipment (DME)/DME/Inertial Reference Unit (IRU) navigation coverage. The capability analyzes navigation coverage by checking the line of sight between the procedure and available NAVAIDs based on terrain data, NAVAID service volumes, and restrictions. The tool identifies solutions of paired DMEs at every given point within appropriate geometries and accounting for inertial drift. Data export and report generation facilitate data sharing with IFP quality control and Flight Inspection.



Air Traffic Surveillance Data Analysis

Viewing track data in relation to published navigation data and airspace improves procedure designer understanding of air traffic operations and design options. Historical track data can be imported using several methods, including the NAS Data Warehouse (NDW) when connected to the FAA network. Once imported, users can visualize the data in both lateral and vertical profiles; organize tracks by airports, runways, arrival/departure; and quickly calculate metrics. With options to change the color and transparency of different track sets, users can highlight key operations for graphics and presentations.

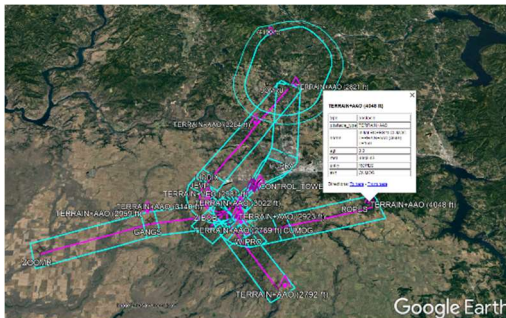
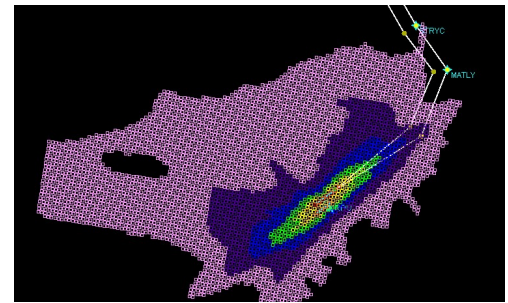
TARGETS Plugins

In addition to the core functions of TARGETS several plugins have been developed that expand the capabilities of the system to support specific mission needs within the FAA.

ARINC 424 provides access to data in the ARINC 424 standard format including CIFP, up to ARINC 424 version 19. It also has the capability to create user defined navigation data elements within TARGETS and export the data in the ARINC 424 version 19 format. More than one ARINC 424 database may be installed. Each ARINC 424 database is identified by a user supplied name.

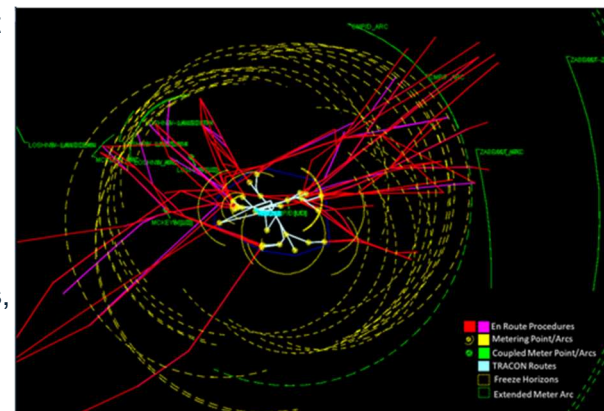
PBN STAR & SID Best Practices provides RNAV STAR and SID procedure designers with an interactive checklist and automated checks based on design guidance documentation captured from more than a decade of PBN design activities. Users receive notifications when designs do not align with the best practices with embedded links to the design guidance documentation.

Environmental Screening allows facilities to evaluate and understand the impact of the changes on the current noise footprint early in the procedure development process. Using geographic information system (GIS) visualization, track data processing, and simulation capabilities in conjunction with an embedded version of the FAA's Aviation Environmental Design Tool (AEDT) capability, the TARGETS application allows noise screenings to occur in the early phase of the procedure design process.



Google Earth Export allows users to export TARGETS data elements to KML/KMZ formats for three-dimensional (3D) visualization. Exported files are used by Flight Inspection on tablet devices as well as facilitate data sharing and presentations with other IFP development stakeholders.

Integrated PBN & TBM Design Capability allows users to import Time-Based Flow Management (TBFM) adaptation data to support integrated PBN and Time-based Management (TBM) visualization, design, and analyses activities. The plugin displays key arrival metering design elements in the TARGETS plan view and allows users to inspect adaptation parameters through the user interface. TBFM adaptation data elements can be defined or modified, including Terminal Sequencing and Spacing (TSAS) data elements, and analysis can be performed to validate design changes. TBFM adaptation files can be exported based on the changes within TARGETS to streamline TBFM adaptation specialist workflows.



Other plugins include Flight Validation, 8260 Forms Generation, Spaceport Site Assessment, 3D Visualization, and Arrival Departure Window (ADW) Analysis.

TARGETS Data

One of the key elements of IFP design is the use of an accurate and complete set of foundational data. Procedure design is heavily dependent on data from various categories such as: Airports, NAVAIDs, Obstacles, Points (fixes), Airspace, Terrain, Historical Winds, and procedures across various spatial reference models (e.g. NAD-83, WGS-84). TARGETS compiles data from various trusted government (e.g. FAA, United States Geological Survey (USGS), National Geospatial-Intelligence Agency (NGA)) and non-government (e.g. MITRE) sources into a streamlined user interface that ensures users have the most precise and up-to-date data as possible.

IFPA or Instrument Flight Procedures Automation is the FAA's authoritative data source for IFP development. It contains important temporal data (including points, NAVAIDs, runways, obstacles, etc.) with their production status and a multitude of chart dates. TARGETS utilizes Aeronautical Information Exchange Model (AIXM) web services to connect to IFPA databases, allowing users to view historical, active, and planned future states of key NAS components. Users can review their assigned work, link that work to their current procedure designs (forces alignment of data to the correct AIRAC chart cycle) and then automatically push that data back to the appropriate IFPA data source to reduce manual data reentry.

CIFP is the FAA's Coded Instrument Flight Procedures navigation dataset. It is updated by the FAA every 28 days, according to the Aeronautical Information Regulation and Control (AIRAC) update cycle and comes in the ARINC 424 version 18 format. This format can be installed into TARGETS to import published records including airports, runways, procedures, and airways.

NASR is the FAA's National Airspace System Resources (NASR) navigation dataset produced by the National Flight Data Center and updated every 28 days in sequence with the AIRAC update cycle. Like CIFP, NASR also contains airport and procedure navigation data, but NASR also includes airspace boundaries, special use airspace, and military training routes.

Digital Terrain Elevation Data from NGA is used for obtaining elevation data throughout the application for use in IFP development. TARGETS can also produce terrain visualizations and displays the elevation under the mouse pointer within the GIS view. TARGETS provides website downloads for the United States (U.S.) regions and global data. The U.S. regional data is three arc-second data, approximately 90 square meters resolution, in Digital Terrain Elevation Data (DTED) format. Additional supported formats include Shuttle Radar Topography Mission (SRTM), GridFloat, and Digital Elevation Model (DEM) files.

Key Data Elements

- Navigation Data (airports, runways, points, NAVAIDs)
- Procedures (Arrival, En Route, Departure, Approach)
- Existing and Proposed Obstacles
- Digital Terrain Elevation Data
- Airspace and Geographical Boundaries
- Maps and Imagery
- Air Traffic Surveillance Data
- Air Traffic Video Maps
- Aeronautical Charts
- Historical Wind
- ARINC 424 Coding

Other Supported Data Sources

- Digital Obstacle File (**DOF**)
- Obstacle Evaluation/Airport Airspace Analysis (**OEA**)
- Digital Aeronautical Flight Information File (**DAFIF**)
- NavAid Discontinuance List (**VORMON**)

Historical Wind Data is available for use in PBN procedure designs by specifying local tailwind overrides by fix or leg. The historical wind data is updated annually and includes 99th percentile directional wind statistics for the Continental United States (CONUS) computed over a five-year period in alignment with FAA Order 8260 Appendix A.

TARGETS Continued Evolution

The roadmap for TARGETS outlines a broad and comprehensive approach for capability and technology improvements that will enable the FAA to achieve its strategic goals for IFP design. Some of the key milestones of the current roadmap include:

- Updates to support the latest FAA IFP design criteria outlined in FAA 8260 Orders
- New functionality to automate manual IFP design for:
 - Conventional Standard Instrument Departure (SID)
 - Transitions from PBN to Conventional Approach
 - Instrument Landing System (ILS) Category (CAT) II/III
- IFP design to support emerging new criteria
 - Advanced Required Navigational Performance (a-RNP) and RNP Authorization Required (RNP AR)
 - PBN and Conventional Helicopter
- Utilization of High-Resolution Digital Terrain data to reduce or eliminate manual map studies
- System recommended optimal procedure design based on user defined parameters

For information about MITRE's TARGETS capability, contact targets@mitre.org.

This work was produced for the U.S. Government under Contract DTFAWA-10-C-00080 and is subject to Federal Aviation Administration Acquisition Management System Clause 3.5-13, Rights In Data-General, Alt. III and Alt. IV (Oct. 1996).

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