Automatic Dependent Surveillance – Broadcast (ADS–B)

Service Availability Prediction Tool (SAPT)/Receiver Autonomous Integrity Monitoring (RAIM)/ADS–B Deviation Authorization Pre-Flight Tool (ADAPT)

User Guide

Version 1.0

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Revision History

Revision Level	Date	Comments
1.0	November 10, 2020	Initial release updated by AIMS216310, National_SAPT: Update SAPT User Guide to include ADAPT related materials.

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1. INTRODUCTION

The Automatic Dependent Surveillance – Broadcast (ADS–B) Service Availability Prediction Tool (SAPT) was developed by the United States (US) Department of Transportation (DOT), John A. Volpe National Transportation Systems Center (Volpe Center) for the Surveillance and Broadcast Services (SBS) organization within the Federal Aviation Administration (FAA).

The Receiver Autonomous Integrity Monitoring (RAIM) SAPT is intended mainly for situational awareness for pilots, dispatchers, and commercial operators to check their predicted navigation horizontal protection level.

In this document, the term SAPT refers to the system that includes both the ADS–B and RAIM prediction capability. When ADS–B SAPT is specified, the requirement applies only to the ADS–B-related predictions. When RAIM SAPT is specified, the requirement applies only to the RAIM part of the SAPT.

The SAPT is an Internet-accessible application with multiple interfaces. There are maps of predicted RAIM and ADS–B outages; downloadable files containing the outage information from the maps; and an eXtensible Markup Language (XML) interface that will accept planned routes of flight and return predictions. The ADS–B SAPT also provides a flight plan-like web form that will predict the ability of an aircraft to meet ADS–B airspace performance requirements along a given route of flight.

REMINDER: The SAPT provides maps of wide area outages as an informational flight planning aid for situational awareness only.

1.1 ADS–B Prediction

The ADS–B SAPT predicts the ability of an aircraft's avionics to meet performance requirements of 14 CFR 91.227(c)(1)(i) and (iii) along a given route of flight based on the predicted status of the Global Positioning System (GPS) constellation and a model of the aircraft's avionics. Avionics specified in the Technical Standard Orders (TSO) listed below are modeled by the SAPT:

- C129
- C129 with Selective Availability (SA) Aware
- C129 with FDE
- C129 with SA Aware & FDE
- C145/146 with WAAS[1]
- C145/146 outside WAAS coverage
- C196

The SAPT will also provide users with dispatch information based on the availability of other surveillance sources, such as Wide Area Multilateration (WAM) and Secondary Surveillance Radar (SSR) when ADS–B performance is predicted to be below requirements along a specified route of flight.

1. The availability of Wide Area Augmentation System (WAAS) under TSO–C145c/146c is not provided by the SAPT; however, predictions for TSO–C145c/146c are available both with WAAS and outside WAAS coverage.

The ADS–B prediction computes Navigation Integrity Category (NIC) and Navigation Accuracy Category for Position (NACp) and compares the results to the required values for each point within the indicated flight plan. SSR and WAM availability will be based on coverage volumes in the Service Volume Definition Document (SVDD), as modeled by Technologies Service Corporation (TSC), FAA-defined airspace definitions, and status feeds. It is your responsibility to know whether a point is in rule airspace defined in Title 14 Code of Federal Regulations (14 CFR) Part 91§ 91.225, Automatic Dependent Surveillance-Broadcast (ADS–B) Out equipment and use.

The ADS–B SAPT is primarily intended for pilots, dispatchers, and commercial operators to verify their predicted surveillance availability before flight; it is also accessible to others.

For ADS–B, if the aircraft avionics meet the requirements of 14 CFR § 91.227 (c)(1)(i) and (iii), but unexpected GPS degradations during the flight inhibit the position source from providing adequate accuracy and integrity for ADS–B, Air Traffic Control (ATC) will be alerted from the aircraft broadcasted data, and may provide services to that aircraft using the back-up strategy.

This information is in accordance with 14 CFR Part 91, Paragraph H.2, Automatic Dependent Surveillance – Broadcast (ADS–B) Out Performance Requirements to Support ATC Service2, hereafter referred to as the “Final Rule.”[2]

In addition, the ADS–B SAPT will allow the FAA to define different NIC and NACp requirements for a defined airspace. The changed NIC and NACp requirements for this airspace will be applied based on guidance from the FAA.

1.2 ADAPT

Operators intending to fly aircraft equipped with ADS–B that do not meet ADS–B Out rule performance requirements, or intending to fly aircraft without ADS–B equipment, must first receive ATC authorization to fly in rule airspace. The SAPT web site has been modified to automate the operator ATC authorization request and FAA response process. The new functionality that resides on the SAPT website and performs this process is called the ADS–B Deviation Authorization Pre-Flight Tool (ADAPT). Operator requests submitted via ADAPT may be automatically approved or denied. Requests that do not meet auto approval or denial criteria are placed into pending status. Pending status requests are forwarded to designated FAA personnel for review.

Reasons for categorical automatic denial include:

- Using aircraft without an operational transponder or without altitude encoding.
- Request submitted less than an hour before departure time.
- Using an aircraft on the No-Services Aircraft List (NSAL).

If your request meets any of those criteria, you cannot get an approval in ADAPT.

Additional reasons that may be cause for denial include:

- Proposed flight to/from a capacity constrained airport
- Proposed flight into non-surveillance areas

2. The Federal Register, Vol. 75, No. 103/Friday, May 28, 2010/Rules and Regulations.

- Routine or scheduled flight events without ADS–B equipment
- Repeated requests using aircraft without ADS–B equipment
- Repeated requests using with inoperative ADS–B equipment

NOTE: It is not possible to submit a request more than 24 hours prior to proposed time of departure.

1.3 RAIM SAPT

The RAIM SAPT provides situational awareness to users planning flights which are predicated on TSO–C129 GPS being the primary navigational aid supporting Area Navigation (RNAV) operations. The RAIM SAPT provides users with TSO–C129 GPS availability predictions along the desired route of flight and compares the results for operator-supplied Horizontal Alert Limit (HAL).

The intent is for users to submit requests that use the FAA required values for Required Navigation Performance (RNP) and RNAV in the En Route and Terminal environments, or better. If the predicted integrity does not meet the requested integrity for a five-minute period anywhere along the requested route, the SAPT returns a sufficiency value of “false”. Conversely, if predicted integrity levels meet or exceed these operational limits, the SAPT returns a sufficiency value of “true”.

The SAPT provides maps of wide area outages for use as a flight planning aid. Wide area outage maps are available for a limited subset of supported avionics for both ADS–B and RAIM. Instructions for using the RAIM tool are found in Section 10, *RAIM Prediction Tool*, of this user guide.

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2. BACKGROUND

ADS–B is a surveillance technology which uses aircraft avionics equipment to automatically broadcast aircraft identification, position, altitude, velocity, and other information to ATC automation systems. This information is used to provide ATC services in Terminal and En Route airspace, and airport surface operations.

The FAA ADS–B Final Rule requires that aircraft operating in certain airspace have ADS–B Out capabilities after January 1, 2020. The FAA ADS–B surveillance implementation involves two broadcast links, Air-to-Ground (A/G) and Air-to-Air (A/A):

- 1090ES — this refers to aircraft avionics broadcasting on 1090 Megahertz (MHz) frequency and conforming to the Mode S Extended Squitter (ES) signal protocol. Primary standards for 1090ES equipment are FAA TSO–C166b and RTCA, Inc., Minimum Operational Performance Standards (MOPS) DO–260B.
- UAT — this refers to aircraft broadcasts on 978 MHz frequency and conforming to the Universal Access Transceiver (UAT) signal protocol. Primary standards for UAT equipment are FAA TSO–C154c and RTCA MOPS DO–282B.

Because radar and ADS–B are different surveillance systems that determine aircraft positions differently, an ADS–B Aviation Rulemaking Committee (ARC) was formed to advise the FAA on the adoption of ADS–B. The ARC recommended that:

> “The FAA should create a function for centralized, expert calculation and reporting of predicted continuity of the required navigation performance (RNP) parameters….” (ARC, 2008).

The SAPT addresses the ARC recommendation. SAPT predictions factor in GPS satellite constellation status availability of other surveillance systems, such as WAM and SSR, to provide an encompassing picture of surveillance coverage. The following list outlines prediction capabilities of ADS–B SAPT:

- ADS–B integrity/accuracy for Terminal and En Route separation services (NIC 7, NACp 8; or better)
- ADS–B integrity/accuracy for separation services different than Terminal and En Route
- SSR coverage
- WAM coverage

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3. SCOPE

This document has been developed to aid users to operate the SAPT under SAPT 4.2, the ADAPT Release. Where known, FAA policy about interpreting SAPT results is presented.

Please refer to the published Final Rule on ADS–B (Docket No. FAA–2007–29305; Amdt. No. 91–314), specified in 14 CFR §§ 91.225, Automatic Dependent Surveillance-Broadcast (ADS–B) Out equipment and use, and 91.227, the grant of Exemption 12555, and Advisory Circular (AC) 90-114, current edition, for authoritative information.

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4. DEVELOPMENT CYCLE

The ADS–B SAPT development includes the following releases:

- RAIMPrediction.net Release (June 2009)
- Test Release (September 2011)
- Baseline Release (May 2013)
- RAIM Integration Release (April 2014)
- Enhancement Release (May 2016)
- Tech Refresh (FY 2016)
- SAPT 3.1 Google Earth TM Replacement (May 2017)
- SAPT 3.2 Industry Evaluation Prep (September 2017)
- SAPT 4.0 Industry Evaluation (September 2018)
- SAPT 4.1 (new requirements follow-on) (September 2019)

One additional major release is planned:

- SAPT 4.2 ADAPT Release (December 2019)

The Test Release of the SAPT system was delivered to the FAA in September 2011 to allow users and developers the opportunity to test and improve the system.

The Baseline Release was delivered in May 2013 and included changes based on user feedback, discovered bugs, algorithm changes, and additional levied requirements. The system is now fully operational and officially available for pre-flight predictions.

The RAIM Integration Release was delivered in August 2014. It incorporated TSO–C129 GPS RAIM predictions satisfying the operational requirement to check the availability of GPS RAIM for flights where TSO–C129 equipment will be used to satisfy the RNAV requirement per AC 90–100A, Paragraph 10(5)). That release established the baseline for the RAIM prediction system in the FAA inventory and allowed users to migrate from RAIMPrediction.net, which has been deprecated.

The Enhancement Release included the following features:

- Provided the FAA with the ability to define different NIC and NACp requirements for a defined airspace.
- Availability of alternate surveillance sources, such as SSR and WAM.
- An improved web form response that highlights results at each waypoint with a traffic light graphic and includes alerts for planned potential GPS Interference Tests.
- An interface with the SBS performance monitor.

The Tech Refresh Release updated the software to run on a different operating system and hardware.

SAPT 3.1, the Google Earth™ Replacement release, changed to a new graphical display technology: the maps on the webpage now use Cesium.

SAPT 3.2, the Industry Eval Prep release, incorporated changes related to security, including a randomized unique transaction key to enhance user privacy. It also added backup surveillance capability to the SAPT Validator. The Hypertext Transfer Protocol Secure (HTTPS) conversion was planned for SAPT 4.0, but was accomplished in February 2018, between releases.

SAPT 4.0, the Industry Evaluation release, added features requested by the Equip 2020 SAPT Industry Evaluation, including a simplified Go/No ADS–B response and the ability to paste in an International Civil Aviation Organization (ICAO) Flight Information Entry Form.

It also included a number of improvements to the airspace model and maps. This is planned to be the last release that includes changes to the XML form.

SAPT 4.2 added ADAPT.

5. LIMITATIONS AND RESTRICTIONS

The SAPT is a prediction service that is freely available over the Internet. While the system will be available 24/7, and the Contact Us link on the website will open a ticket with 24/7 phone coverage, operational help and full system-crash recovery will be limited to regular business hours. In the future there will be a NOTAM issued in the event of a SAPT product outage. There is no requirement to track users; i.e., no user names or passwords are required to use the tool. Predictions, however, will be stored in the database.

The pre-flight requests will be limited to a 72-hour prediction window. A prediction for a given flight should be done before the scheduled departure. For restrictions on when the prediction should be made relative to departure, refer to the policy in AC 90-114B, latest edition. A prediction may be applied to a flight that does not deviate significantly from the scheduled departure time (i.e., ±5 minutes) or geographically from the predicted route of flight (i.e., ±7 Nautical Miles (NM) perpendicular to the route of flight).

Operators must ensure that they have the most up-to-date information. Operators are allowed to run more than one prediction with different scheduled departure times before their flight.

If an operator's system exceeds the minimum performance specified in the Final Rule for ADS–B aircraft equipage, the operator may achieve higher availability than predicted by the SAPT. Operators may use an alternative prediction tool to take advantage of this increased availability. Operators and manufacturers are also free to build their own prediction tool based on their needs and requirements.

The SAPT will not be integrated with Flight Service Stations, and its use may constitute an additional step in the pre-flight routine. NOTAMs are issued for a variety of reasons, so the requirement to "check for NOTAMs" will remain.

Users who choose to employ the XML interface, who are designated as "XML users" or "Automated Users," must develop and implement their own interface into SAPT through the Internet.

The SAPT web form is for surveillance use only, and does not make predictions for navigational use because the RNP for ADS–B does not employ the same standard as navigation. RAIM prediction for a route of flight is available in XML format only.

REMINDER: SAPT users who want to use certain position sources for navigation must check for that availability separately.

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6. SAPT USE

The ADS–B SAPT is primarily intended to be used by aircraft operators and dispatchers during the flight plan filing process when ADS–B-out-only airspace will be encountered during any part of the flight.

The SAPT provides surveillance availability for the entire US airspace as defined in the FAA SBS SSVDD. The SVDD definition of US airspace includes Alaska, Hawaii, Puerto Rico, Guam, and the Gulf of Mexico.

6.1 Interface Requirements

The SAPT has updated website security since the previous release to: HTTPS Secure Socket Layer (SSL)/Transport Layer Security (TLS) V1.2; HTML 4.01 Transitional; CSS 2.1; and JavaScript 1.8.5. The SAPT website and services will function in web browsers and clients which implement these standards.

Minimum versions of popular client software include: Java 8; .NET 4.6, and Python V2.7.9/3.4.

NOTE: Java 8 implements TLS 1.2 by default, and is the only supported runtime environment for SAPT.

Some web browsers can't redirect you automatically from HTTP to HTTPS. All that means is that you may need to type HTTPS at the beginning of the website.

You will need JavaScript enabled in your browser in order to use the SAPT website.

New features have been implemented to make website navigation easier when using mobile devices. SAPT should work on most desktop and mobile browsers.

6.2 Interface Types

The SAPT offers two interface mechanisms that can be used to predict position quality for a route of flight. Both are available over the Internet:

- ADS–B or ADAPT Surveillance prediction only: An interactive Flight Information Entry Form on the website for users who require information for a few flights. In addition to direct data entry, the Flight Information Entry Form allows users to save and load flight and aircraft information, and paste it into ICAO flight plans.
- ADS–B or RAIM only: An automated (i.e., computer-to-computer) web service using XML (SOAP over HTTP), intended for commercial aircraft operators and third-party flight-planning service providers.

The SAPT website also provides Graphical Displays (maps) of predicted outages for both RAIM and ADS–B. (See Section 6.4, Prediction Window.)

6.3 Required Information

In addition to some standard information normally required on a flight plan form, the interactive user interface's Flight Information Entry Form also collects the following data:

- ADS–B Position Source TSO (or "unequipped" or "inoperative") — this is required information

- ADS–B Link TSO (or “unequipped” or “inoperative”) — this is required information
- Mask Angle — the default value is 5.0. Select N/A if your flight is unequipped, or your position source is inoperative.
- Barometric Aiding — this is required information. You must indicate if baro-aiding is present or not. If you do not check the box it means that baro-aiding is not present. If you do not know, leave the box unchecked.

The SAPT suggests completions to items you begin to type. You can accept the completion or continue to type.[3]

NOTE: Users may contact the manufacturer of their aircraft for details about its avionics.

The page uses Asynchronous JavaScript and XML (AJAX) to send your keystrokes to the Form Support Web Service so that the application can return suggestions to you. Once you submit the prediction request, a message below the form will indicate that the request is being processed. Once the matching results are returned, the message will be updated to display them.

6.3.1 GPS TSOs

The SAPT supports the following avionics MOPS:

- C129
- C129 with SA Aware
- C129 with FDE
- C129 with SA Aware & FDE
- C145/146 with WAAS
- C145/146 outside WAAS Coverage
- C196

A TSO–C129 GPS receiver’s availability will not always meet the ADS–B final rule NIC 7/NACp 8 requirement. This type of receiver includes Fault Detection (FD) but may not be equipped with Fault Detection and Exclusion (FDE) capability.

If you do not know if the receiver supports FDE, you should choose C129 without FDE, which is a conservative choice.

TSO–C145/146 augmented with WAAS will always provide the required availability as defined by the ADS–B Final Rule. This type of TSO uses FDE; accuracy deviations are corrected with the aid of WAAS ground stations. Operators of aircraft equipped with WAAS should not need to use SAPT to ensure compliance with 14 CFR 91.227(c)(1)(i) and (iii).

Where WAAS is unavailable, most TSO–C145/146 avionics will use FDE only. In these situations, avionics can detect and exclude satellites from the solution but accuracy deviations are not corrected. TSO–C196 is essentially the same as TSO–C145/146 avionics which employ FDE.

3. The page uses Asynchronous JavaScript and Xml (AJAX) to send your keystrokes to the Form Support Web Service so that the application can return suggestions to you. Once you submit the prediction request, a message below the form will indicate that the request is being processed. Once the matching results are returned, the message will be updated to display them.

TSO–C145/146 without WAAS and TSO–C196 will both provide much higher accuracy and availability than TSO–C129, but could still encounter periods of degraded performance.

You can select one of the following TSOs from the ADS–B Position Source drop-down menu:

- C129
- C129 with SA Aware
- C129 with FDE
- C129 with SA Aware and FDE
- C145/146 with WAAS
- C145/146 outside WAAS Coverage
- C196

SA adds error to a GPS solution, thus degrading its accuracy. If avionics equipment has SA set to “ON” (or “unaware”), an error of 33.3 meters is added to the prediction. If avionics are set to SA “OFF” (or “aware”), the error is not added to the prediction. The SAPT only supports the addition of the error for TSO–C129 avionics.

6.3.2 Mask Angle

The GPS mask angle is the angle from the horizon that the receiver uses to eliminate potential satellites from the solution. Users may select values between 0 and 5 degrees using half-degree increments from the Mask Angle drop-down menu.

6.3.3 Barometric Aiding

Barometric aiding (BA), or barometric altimeter, gives an additional altitude source which helps reduce the error when it is used in conjunction with GPS. It approximates the addition of a satellite in the view. SAPT users may check the BA box on the Flight Information Entry Form if their associated avionics includes BA. Note that RAIM availability demands that a minimum number of satellites be received. BA reduces this number by one.

6.4 Prediction Window

SAPT calculates the level of service that can be expected for a given time, including three-dimensional aircraft location (latitude, longitude and altitude) and the expected status of the GPS satellite constellation.

REMINDER: The predictions for the outages shown on the graphical display are generated differently from the predictions for individual flights.

6.4.1 Prediction for the XML and Flight Form Interfaces

The SAPT implements several GPS accuracy and integrity prediction algorithms, as specified in the FAA TSOs listed in Section 6.3.1 of this guide.

The available satellite constellation is modeled every 24 hours or upon a change to the status of any of the satellites. The model projects the position of each available GPS satellite every minute for 72 hours into the future.

The algorithm employs all satellites in view.

The prediction for an individual route of flight is calculated in real time for each waypoint in the route of flight based on the precomputed constellation.

6.4.2 Prediction for the Graphical Display

The graphical display is represented as an interactive map and can be selected from either the ADS–B or RAIM sections of the SAPT Home page to display a summary of outages over a six-hour period. You can request a display of outages from the response after you click **Check Availability** in the Flight Information Entry Form.

Data on the graphical display are calculated in advance for a configurable length of time and frequency for TSOs C129 and C196 and for mask angles 2.0 and 5.0.

NOTE: RAIM users should consult Section 10, *RAIM Prediction Tool*, and Section 11, *RAIM Summary Pages*, of this guide for more information.

While the graphical display is loading, it will report the total number of outages and the degree of resolution. By default, the graphical display will show outages for the Continental US (CONUS) at a low resolution.

Users can select a smaller specific region from the “View Outages for Area” drop-down menu, or they can employ the features of the interactive map to navigate to a particular region, and then display outages for that region at a higher resolution by clicking **Generate new KML for Area in View**.

The area within which SAPT will search for outages appears highlighted within a box. While the graphical display recalculates its position, it reports zero (“0”) outages.

REMINDER: Outages are only predicted within the airspace defined in the FAA SBS SVDD. An area outside this airspace may be highlighted but no outages will be shown.

6.5 ADS–B SAPT Algorithm

For each point along the route a maximum Horizontal Protection Limit (HPL) is calculated based on a 33-point grid. The grid scheme is illustrated in Figure 6–1, ADS–B SAPT 33-Point Algorithm. The grid scheme evaluates 33 points and applies the maximum HPL to the requested point on the route at the associated Estimated Time Over (ETO).

The grid is based on ± 5 minutes and ± 7.5 NM to project an aircraft’s possible location in both space and time.

NOTE: This projection accounts for only five minutes of variation in the departure time or other sources of uncertainty about the aircraft’s actual location compared to the operator’s plans.

Users may wish to submit additional requests for predictions with different departure times to account for variations in departure times and in estimated times over later waypoints.

Once an HPL has been calculated, it is transformed into NIC and NACp values and is compared to the threshold for ADS–B sufficiency.

NOTE: For further information please refer to Section 7.7.1.1, Sufficiency.

The Horizontal Figure of Merit (HFOM) is calculated and the result is converted into the NACp for TSO–C129, TSO–C196 and TSO–C145/146 outside WAAS coverage. For TSO–C145/146 w/ WAAS the horizontal confidence bounds are scaled to the containment radius.

NOTE: Figure 6–1 applies to ADS–B predictions only. RAIM users should refer to Section 10, *RAIM Prediction Tool* and Section 11, *RAIM Summary Pages*, in this guide for more information.

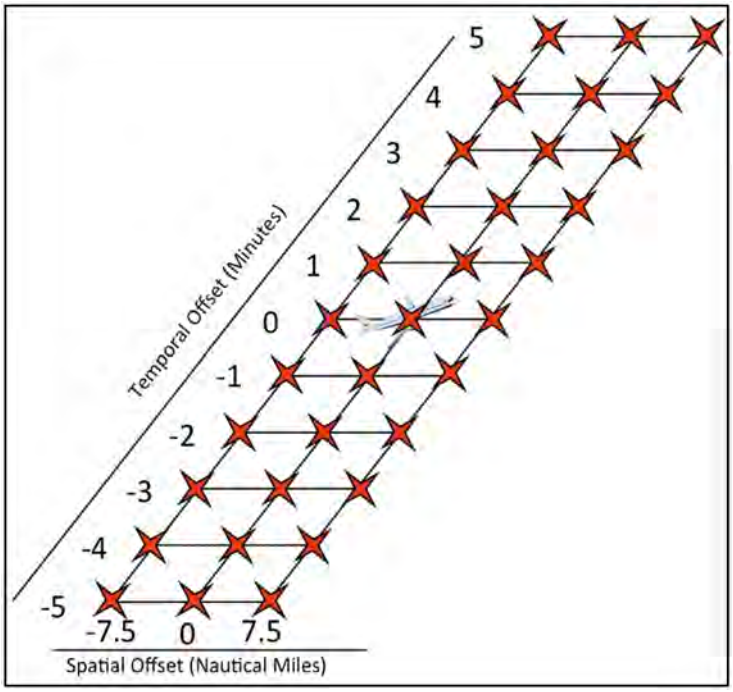


Figure 6–1. ADS–B SAPT 33-Point Algorithm

The SSLPM evaluates ADS–B predictions based on the following configurations, using one-minute GPS constellation intervals, and taking the maximum HPL of the 33 sample points:

- TSO–C145/146 with WAAS:
  - Time-window limits: -5 to +5 minutes
  - Position offsets: -7.5 to +7.5 NM
  - Scale the maximum HPL of the 33 sample points to approximate an HFOM
- TSO–C145/146 outside WAAS coverage:
  - Time window limits: -5 to +5 minutes
  - Position offsets: -7.5 to +7.5 NM
  - Take the maximum HFOM of the 33 sample points
- TSO–C129, with and without SA Awareness and/or FDE capabilities, and TSO–C196:

- Time window limits: -5 to +5 minutes
- Position offsets: -7.5 to +7.5 NM
- Take the maximum HFOM of the 33 sample points

6.6 Alternate Surveillance Coverage

The SAPT maintains a composite coverage profile of back-up surveillance (from SSR and WAM stations) in the form of a grid of five (5) NM by five (5) NM squares. Each square has an associated indexing key to determine available coverage above that area based on altitude.

If a waypoint does not meet the rule performance requirements, SAPT will check to see if it is covered by back-up surveillance. If back-up is available, an XML transaction will set “disposition = AlternateSurveillance”, and a waypoint on the Flight Information Entry Form web response will show a yellow traffic light and the text “AltSurveillance”.

6.7 RAIM Sufficiency

RAIM users submit XML, including a requested HAL for each waypoint.

RAIM users can ensure compliance without identifying the required HAL at each point by submitting the request with the most stringent required value, i.e., 1852 meters (one NM, which is required for Terminal airspace), throughout the route of flight for AC90-100 compliance. RNAV values are more strict.

7. INTERACTIVE GUI

The SAPT website can be accessed from https://sapt.faa.gov.

Users must click the **I Agree** button on the SAPT warning screen, depicted in Figure 7–1, SAPT Warning Page, before SAPT will open the SAPT Home web page.

If you click **I Do Not Agree** you will not be able to access the site.

Figure 7–1. SAPT Warning Page

7.1 ADS–B Home Page

When you select **I Agree** from the warning web page, the SAPT Home page is displayed (see Figure 7–2, SAPT Home Page). The home page offers you the four primary selections:

- ADS–B Prediction Tool
- ADAPT Authorization Tool
- RAIM Prediction Tool
- RAIM Summary Pages

NOTE: You must scroll down the screen to display the full web page that is illustrated here. The footer that is on every ADS–B SAPT web page has been omitted from this screenshot.

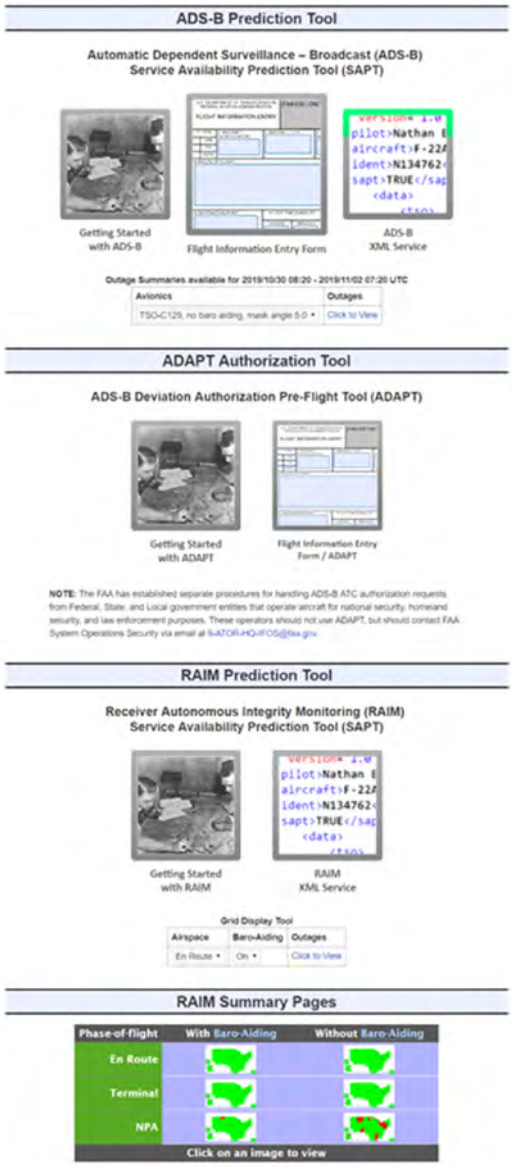


Figure 7–2. SAPT Home Page

7.1.1 ADS–B Prediction Tool

The ADS–B Prediction Tool is displayed at the top of the SAPT Home page, just below the banner section (see Figure 7–3, SAPT Home Page — ADS–B Prediction Tool Section).

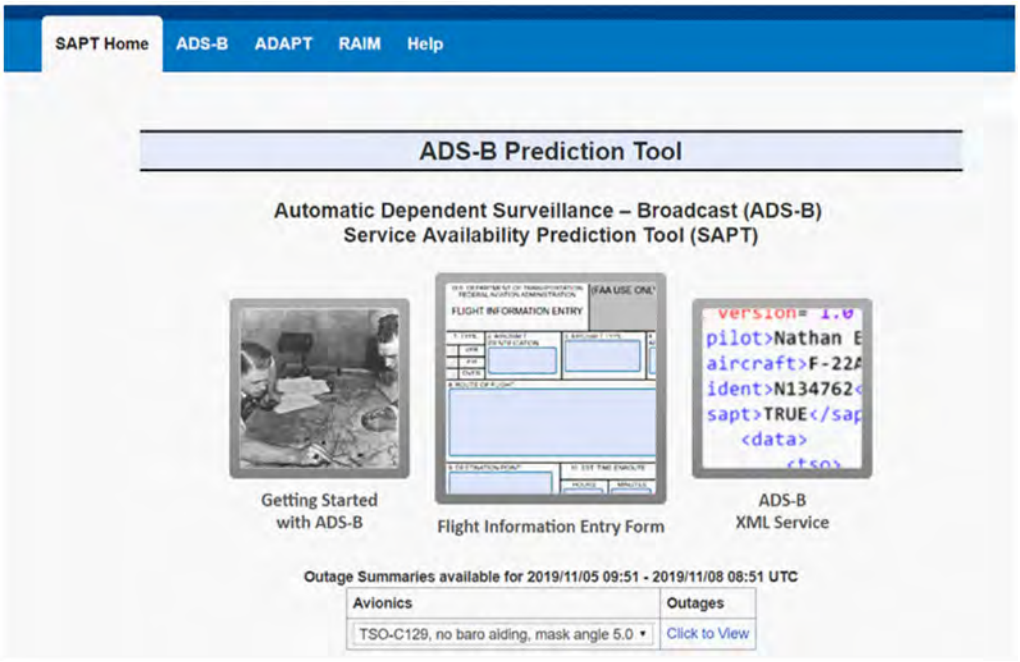


Figure 7–3. SAPT Home Page — ADS–B Prediction Tool Section

There are four primary selections in the ADS–B Prediction Tool section of the SAPT Home Page:

1. Getting Started with ADS–B
2. Flight Information Entry Form
3. ADS–B XML Service
4. Outages: The avionics selectors and link to view outages on a map

The “Getting Started” section of the Home page introduces the SAPT and links you to the user guide, which informs you of how to make a flight prediction.

The Flight Information Entry Form is where you can request predictions for actual flight plans. All of the active fields require you to enter relevant data. You may save and load field information as well. The “Flight Information Entry Form” will accept some information via the cut-and-paste interface from an ICAO Flight Plan.

The “XML Service” section provides information on how to use the XML interface. If you want to employ the XML interface you must download the Web Service Description Language (WSDL) file. Please refer to Section 9.1, WSDL, for details on downloading the WSDL. This file outlines the required fields and their structures for the XML interface.

The selectors and links to view outages on the large area display are shown below the first three primary selections at the bottom of the section (refer to Figure 7–4, ADS–B Home Page — Outage Summary).

Figure 7–4. ADS–B Home Page — Outage Summary

Press **Click to View** to display the map for the avionics selected from the drop-down list (refer to Figure 7–5, SAPT Graphical Display With Outages). The default value -- TSO-C129, no baro aiding, mask angle 5.0 – is the most conservative and will show you the most outages.

NOTE: It takes a few moments for the map to load and develop.

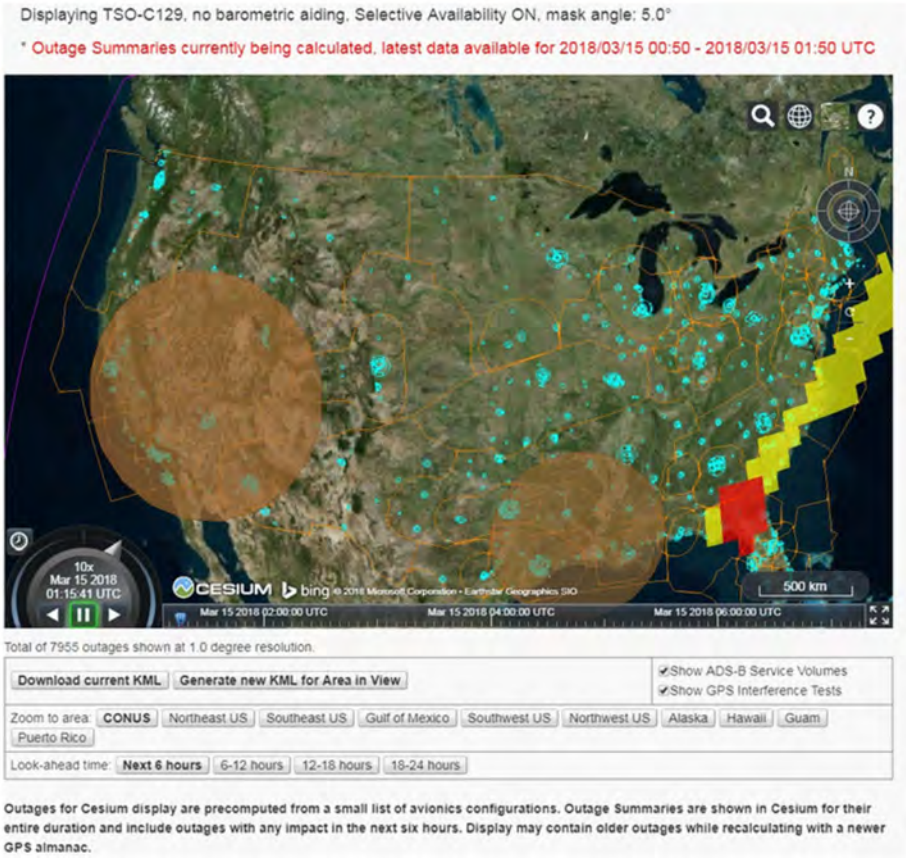


Figure 7–5. SAPT Graphical Display with Outages

The following sections of this document describe the SAPT in detail.

7.2 Getting Started With ADS–B SAPT

The Getting Started page provides a summary introduction to the SAPT and explains what you can accomplish as in the SAPT Web page. It also lays out the limitations of the tool (refer to Figure 7–6, Getting Started with ADS–B SAPT Page).

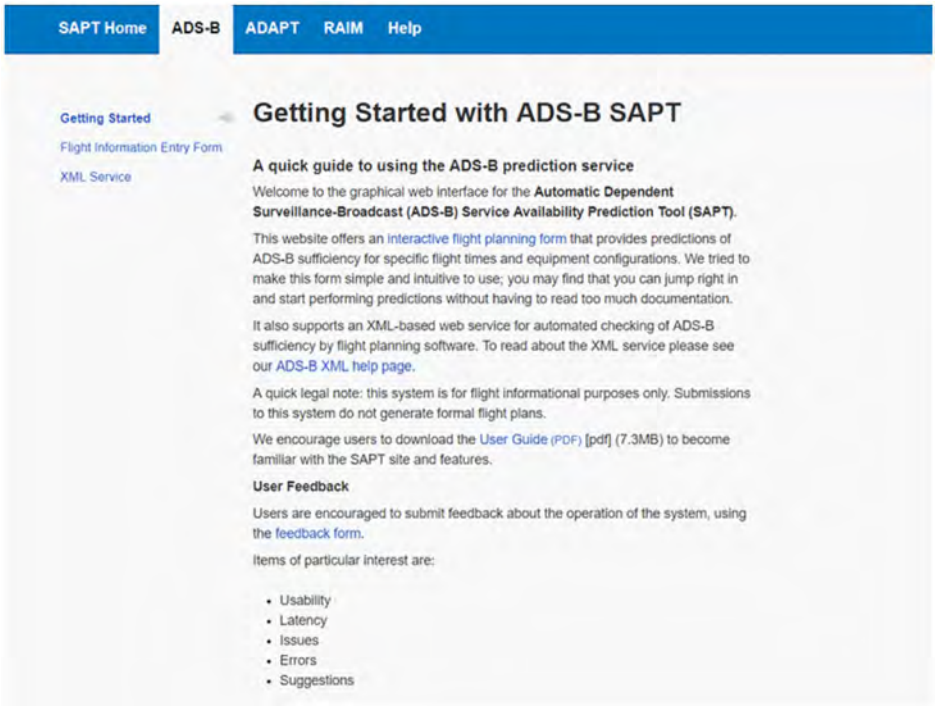


Figure 7–6. Getting Started with ADS–B SAPT Page

If you are interested in the XML service, you can access it from the link on this page as well as directly from the Home page.

You may download this user guide in a .pdf file from the SAPT/RAIM web site if you wish.

NOTE: You must have Adobe Reader or another pdf viewer installed on your workstation in order to view the downloaded user guide.

You may submit any questions or comments to the development team.

7.2.1 User Feedback

You are encouraged to submit feedback about the operation of the ADS–B SAPT or RAIM portions of the application using the feedback form found at https://enroutesupport.faa.gov/sapt/feedback.aspx.

Items of particular interest to the development team include:

- Usability

- Latency
- Issues
- Errors
- Suggestions

To submit a question or suggestion, please click the feedback form link on the Getting Started with ADS–B or Getting Started with RAIM pages (scroll to the middle of the page to see this section, which is illustrated and discussed in Section 10, *RAIM Prediction Tool* of this document) in order to open the form (refer to Figure 7–7, Feedback Form).

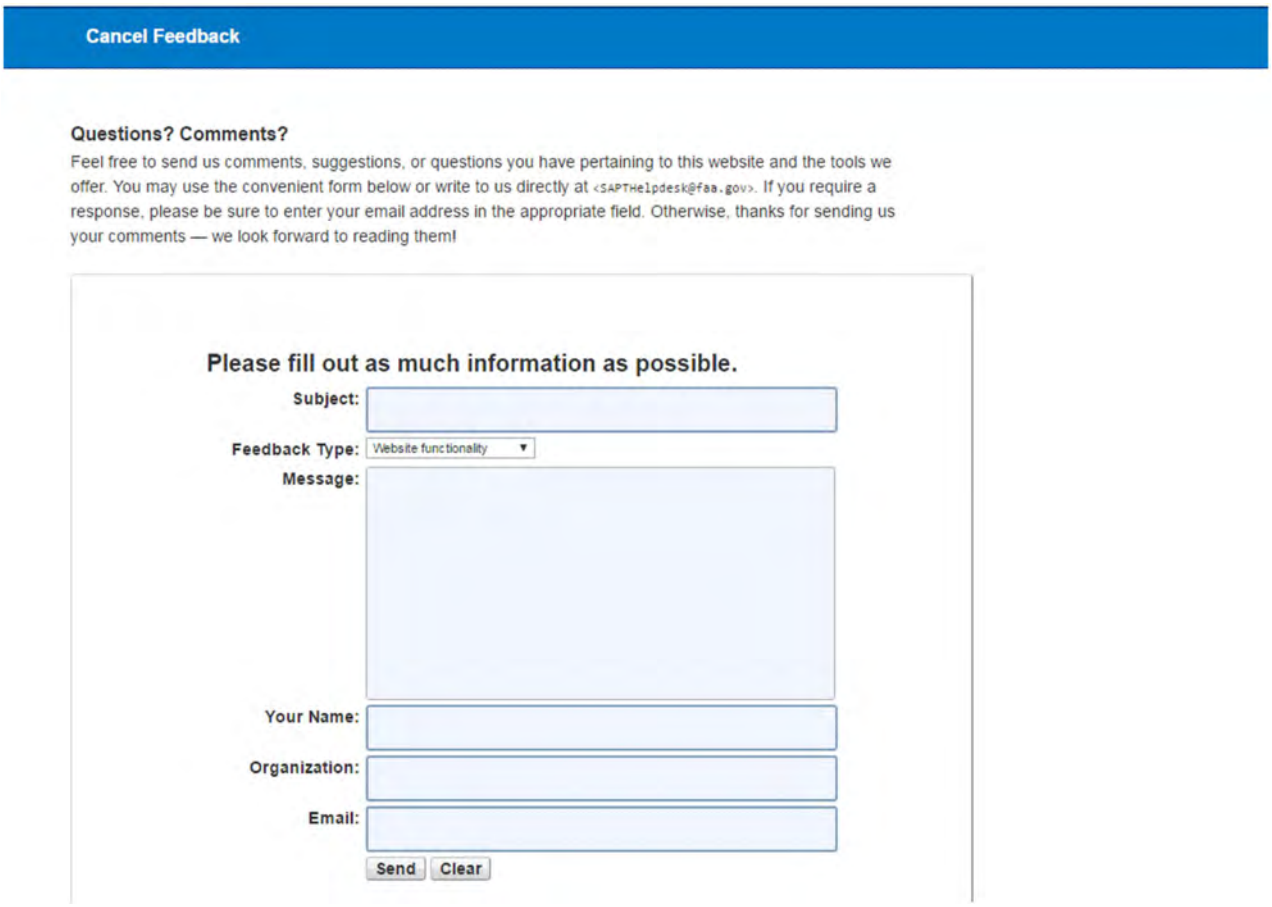


Figure 7–7. Feedback Form

Please specify the subject of your feedback, enter your question or comment, and add your name and email address so the SAPT team can send you a reply.

Click **Submit Feedback** to deliver the message, or click **Cancel Feedback** if you change your mind. You can also click **Cancel Feedback** in the header.

7.3 SAPT Header

The Home page and Flight Information Entry Form display headers and footers, which are described in the following sections. The ADS–B SAPT header is illustrated in Figure 7–8, SAPT Header.

Figure 7–8. SAPT Header

7.3.1 Header Layout

The header provides direct paths to other information and sites:

- The FAA logo is in the top-left corner.
- The current day and time are shown in the top-right corner.
- Beneath the date and time is the search text box.
- Along the banner are menus to open sections of the Web site.
  - On the home page, these menus are ADS–B, RAIM and Help.
  - On the Flight Plan Form page, the menus are ADS–B, RAIM, Save & Load, and Help.

Click the menu item of interest to open that page.

7.3.2 Search Feature

When filling out the Search field to query the official FAA site, the application will suggest results from your search history that include the letters that you enter.

The more characters that you enter, the fewer matches will be retrieved, as illustrated below in Figure 7–9, SAPT Search Text-box (Single Character), and Figure 7–10, SAPT Search Text-box (Full Word).

In Figure 7–9, the user only entered one character in the search box:

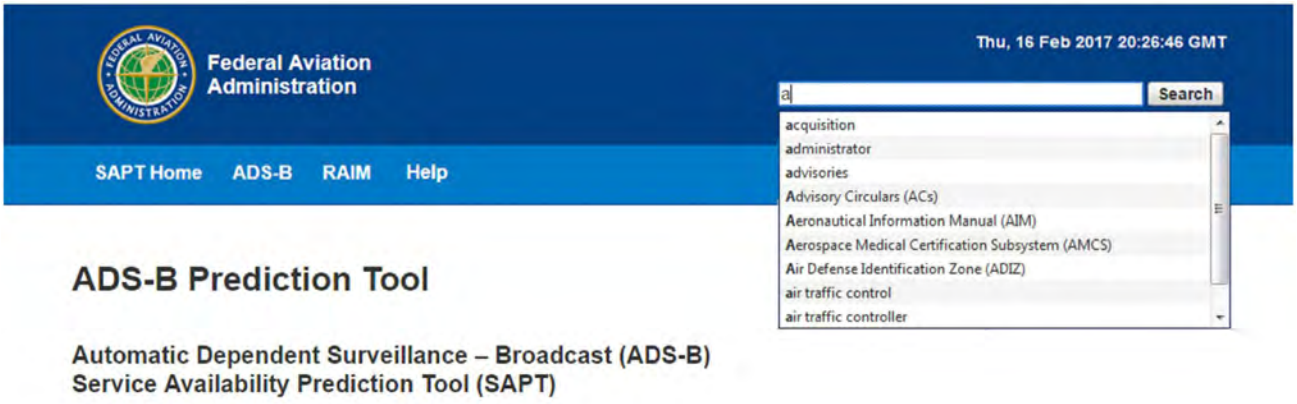


Figure 7–9. SAPT Search Text-box (Single Character)

By adding more characters this user targeted the subject of interest more closely.

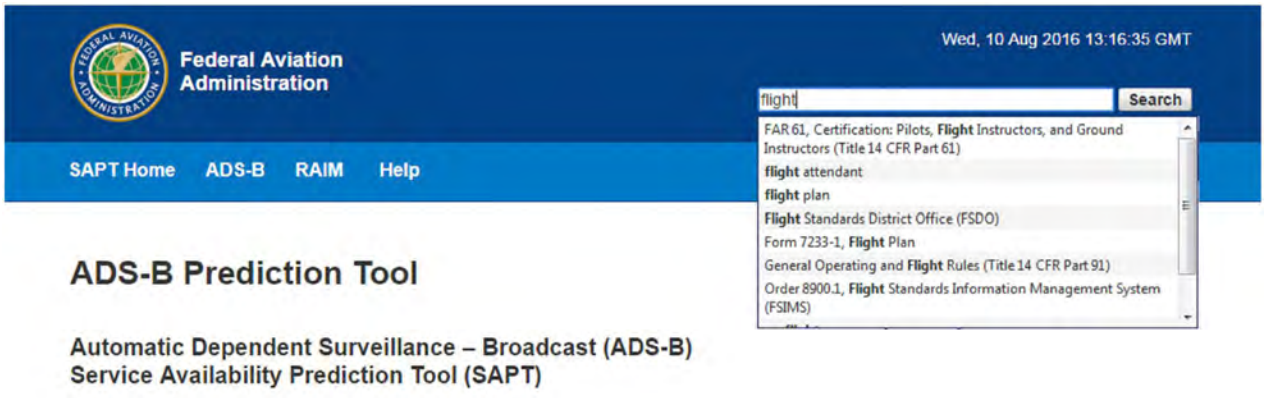


Figure 7–10. SAPT Search Text-box (Full Word)

7.3.3 FAA Logo

Click the FAA logo in the top-left corner to open the FAA government site.

7.3.4 ADS–B Menus

The menus and sub-menus on the banner at the top of each page are illustrated below. To open a particular page, hold the cursor over a menu to display its sub-menus, and click the item of interest.

The ADS–B menu on the Home page, Flight Information Entry Form, and XML Service pages lists the pages within that specific portion of the Web site.

- Step 1: Click the top menu item and use the sub-menu to the left, or hold the cursor over the top menu and click the page name in order to navigate directly to it (refer to Figure 7–11, ADS–B Menu).

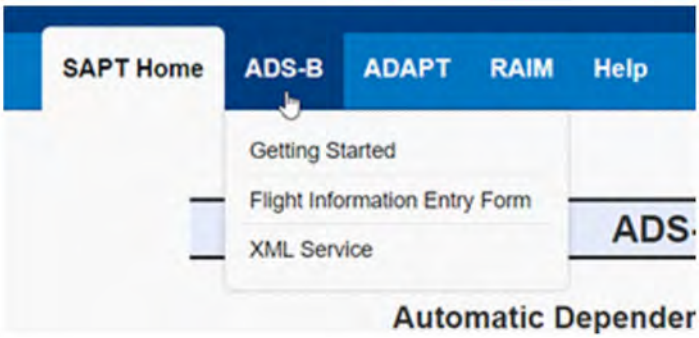


Figure 7–11. ADS–B Menu

- Step 2: On the Flight Information Entry Form, click the **Save** & **Load** menu and use the sub-menu to the left, or hold the cursor over the **Save** & **Load** menu to display the options (refer to Figure 7–12, Save & Load Menu).

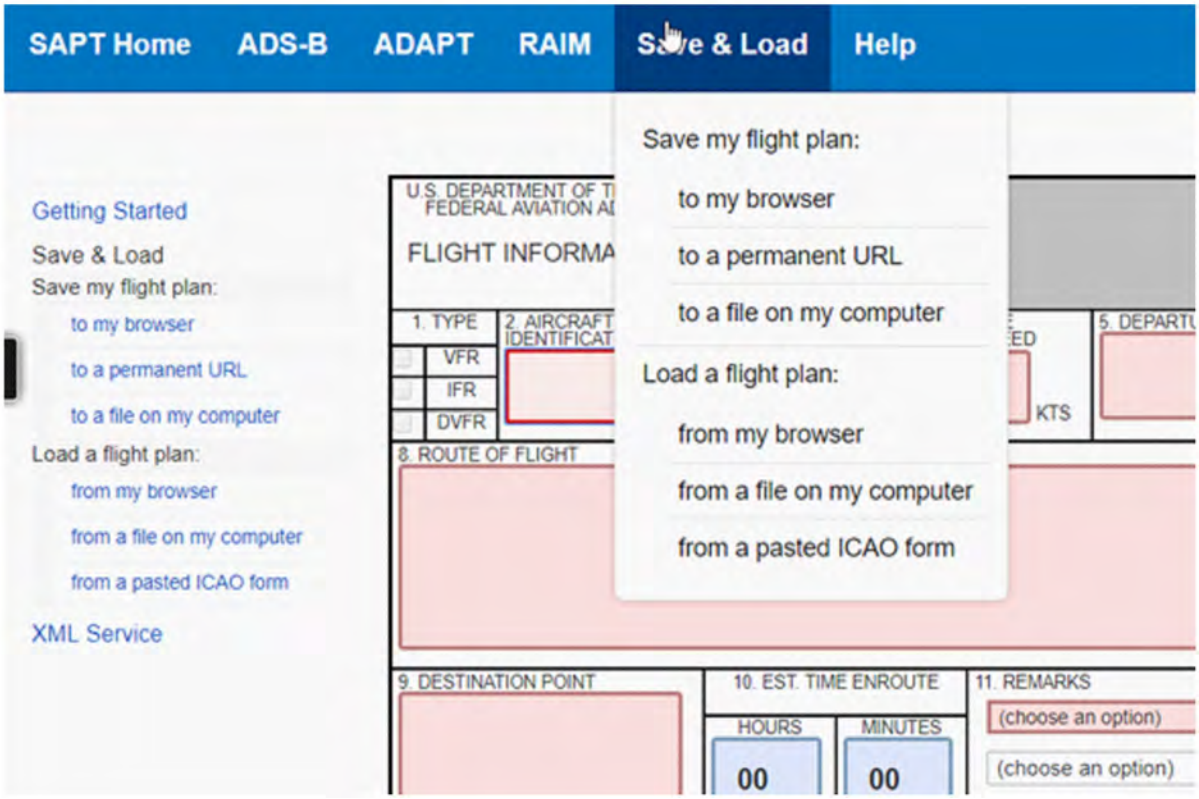


Figure 7–12. Save & Load Menu

Saving or importing pre-filled Flight Information Entry Forms can be done in multiple ways:

- Step 1: Click your preferred option and save the Flight Information Entry Form as defined in Section 7.7.1, Flight Information Entry Form Results.
  - — To my browser
  - — To a permanent Uniform Resource Locator (URL)

— To a file on my computer

— If the flight plan is saved to a URL, you will be able to copy and paste it into the address bar of the browser to bring up a pre-populated Flight Information Entry Form.

- Step 2: To load a flight plan that was saved, choose one of the options in Figure 7–12.

  NOTE: You can only load a flight plan from a browser or a file if you had previously saved one to the corresponding option. To load from a pasted ICAO form, you will need an ICAO flight plan in plain text format.

- Step 3: Click the option that applies and import the saved Flight Information Entry Form.

  NOTE: You will have to import the Flight Information Entry Form from where it was saved previously. The ICAO form import will prefill many, but not all, of the fields in the SAPT Flight Information Entry Form. Only the Flight Information Entry Form can be saved. The ADAPT form information must be reentered for each request.

If you need to consult help, hold the cursor over the Help menu item to display sub-menu items and pick the one that applies (refer to Figure 7–13, Help Menu).

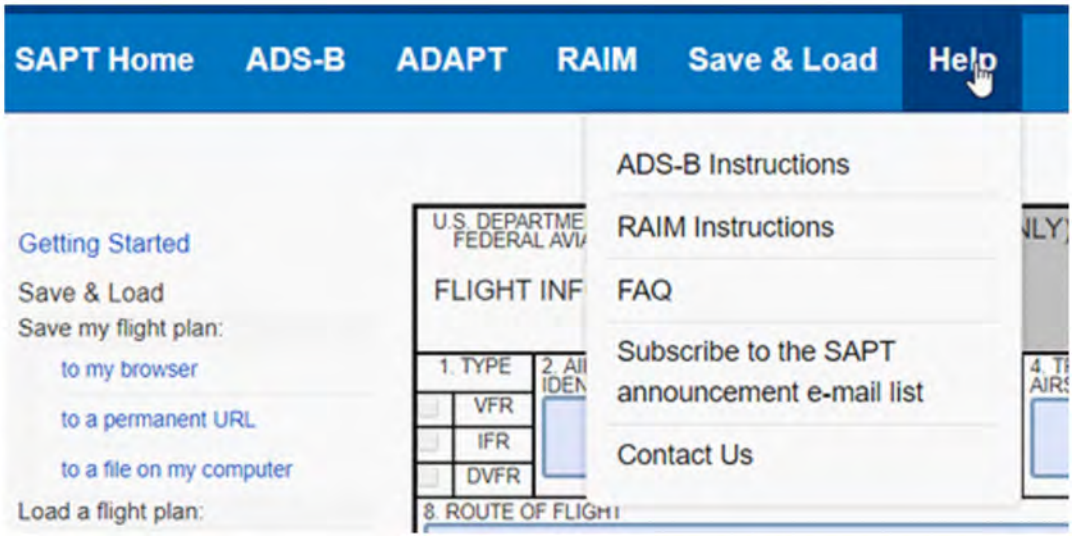


Figure 7–13. Help Menu

The ADS–B Instructions link opens the Getting Started with ADS–B page. The RAIM Instructions link opens the Getting Started with RAIM SAPT page.

The Contact Us option leads to the Feedback form, which is discussed in Section 7.2.1.

7.4 SAPT Footer

The SAPT footer contains links to official government sites as well as information about Web policies and a way to contact the SAPT/RAIM developers.

The footer is illustrated in Figure 7–14, SAPT Footer.

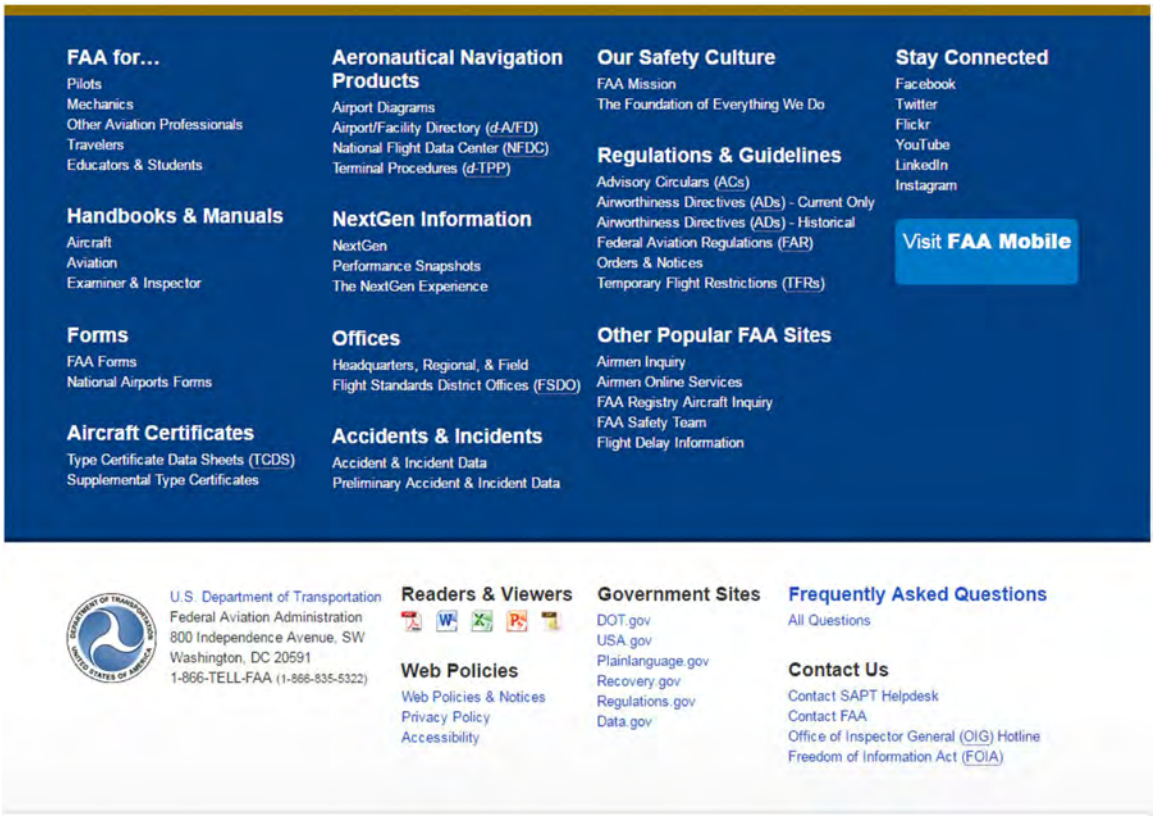


Figure 7–14. SAPT Footer

7.5 Flight Information Entry Form

The SAPT-modified FAA Flight Information Entry Form allows you to make an interactive flight prediction.

Required text-boxes have blue borders. To see what information is required in each field, click anywhere in the field to display a tool tip. Enter all of the required information and press **Check Availability** to submit a request.

To clear the fields, press **Clear All** and then click **OK** on the pop-up confirmation window. The form is shown in Figure 7–15, Flight Information Entry Form.

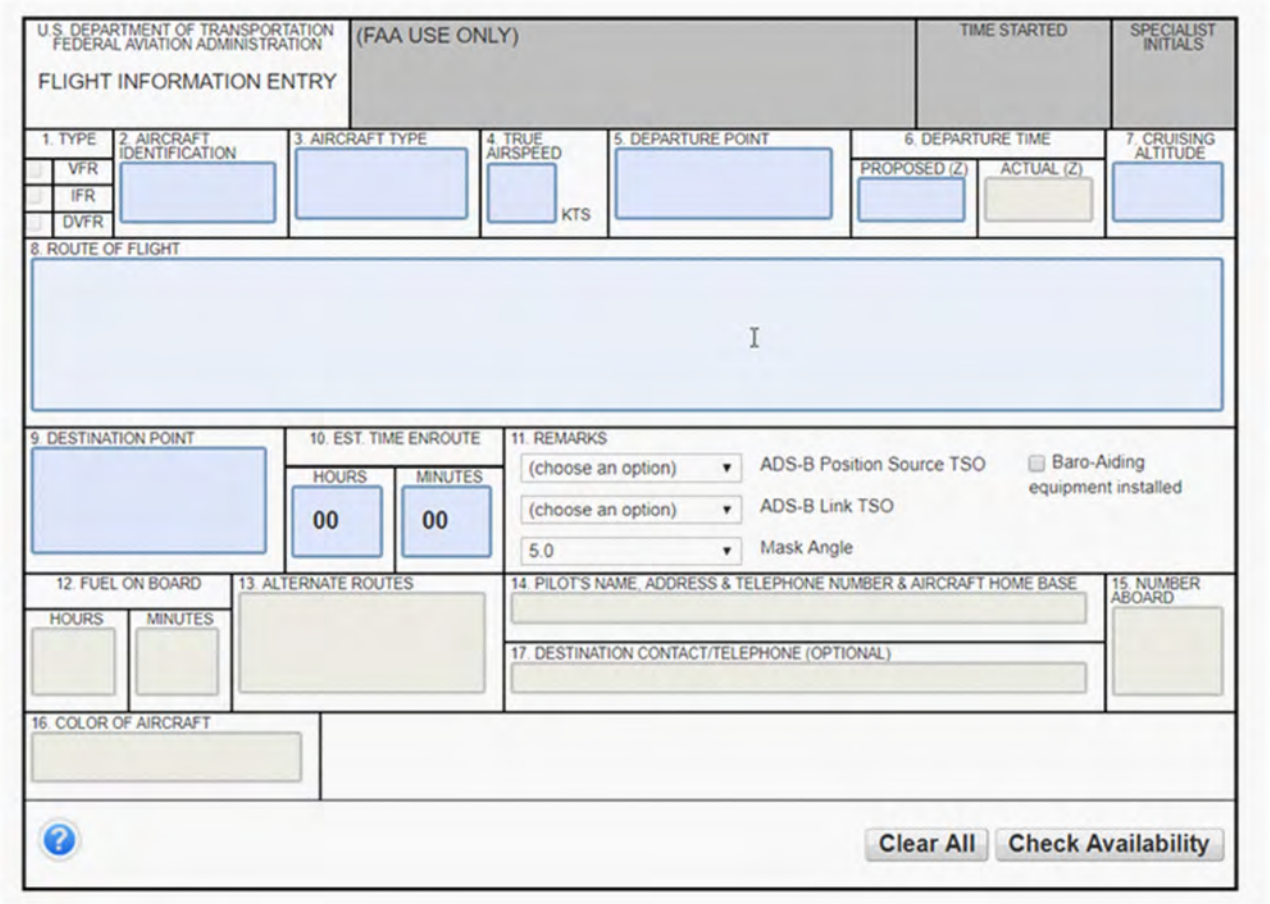


Figure 7–15. Flight Information Entry Form

7.5.1 Required Fields

A prediction will not be accepted and submitted unless all of the required fields are populated. If a text field is blank or if the entry is invalid, the relevant field border will turn red and/or an error message will be displayed to alert you to fix that entry.

NOTE: Fields that are grayed out do not need to be completed.

REMINDER: You can display a field description by placing the cursor in the field.

Table 7–1, Required SAPT Fields, defines fields on the Flight Information Entry Form page.

Table 7–1. Required SAPT Fields

Field	Description	Units	Example of Field Value
Aircraft Identification	Flight ID of the aircraft that will be flown.	None	UPS1234
Aircraft Type/Special Equipment	The ICAO identifier for the type of aircraft that will be flown. **NOTE:** Small, Medium, and Large aircraft types are supported in the enhancement release.	None	C172 sml, med, lrg **NOTE:** DO NOT include an equipment suffix; e.g. “/g”. Use 4-character designations only. Aircraft Type is case insensitive.
True Airspeed	The aircraft’s cruising speed. **NOTE:** Departure and Arrival times are currently used to estimate ground speed in the final prediction calculation.	Knots	110
Departure Point	This is either the four-character ICAO identifier for the departure airport OR the latitude and longitude (in square brackets) for airports outside the supported area.	Decimal latitude, decimal longitude	KBOS or [43.3389,-79.6194] Latitude/longitude pairs should be in the form “[42.3630,-71.0064]” where latitude and longitude are in decimal degrees. **NOTE:** There should be no spaces in the latitude/longitude string.
Departure Time Proposed (Z)	The time within the next 24 hours that the aircraft is expected to depart.	Zulu 24-hour notation	1800
Cruising Altitude	The expected cruising flight level (FL).	FL	This value must be between 10 and 600.

Table 7–1. Required SAPT Fields (Continued)

Field	Description	Units	Example of Field Value
Route of Flight	The anticipated route of flight from departure to arrival.	See example.	Enter waypoints, routes, or standard procedures. DO NOT include departure or destination airport in the route. Airports may not be placed in the route. Waypoints may be specified by name (e.g., “BOSOX”), by radial (e.g., “IGN265”), or by latitude/longitude pairs in the correct form (e.g., “[42.3630,- 71.0064]”) **NOTE:** See Departure Point for more information. Waypoints should be separated by spaces; the form will automatically replace the spaces with an ellipsis (…). Routes must follow, and be followed by, a named waypoint on the route, e.g., “NEWES…J225 …PVD”. The system will automatically add the points along the route between the start and end points (“J225” automatically added between NEWES, the start point, and PVD, the end point, in the example). Standard Procedures (Standard Instrument Departures(SID)/Standard Terminal Arrivals (STAR)) should be specified with their fully-qualified name, if you intend to join the procedure (e.g., “ORW3.JFK”), or simply with the Standard Instrument Departure (SID) (e.g., “ORW3”), if you want the system to determine the join point. The system will automatically add the waypoints along the procedure.

Table 7–1. Required SAPT Fields (Continued)

Field	Description	Units	Example of Field Value
			NOTE: If flying direct from one airport to another, simply press the space bar. This field cannot be blank.
Destination Point	This is either the four-character ICAO identifier for the destination airport OR the latitude and longitude (in square brackets) for airports outside the supported area.	None	KJFK or [43.3389 ,79.6194] **NOTE:** See Departure Point for more information.
Estimated Time En Route Hours/Min-utes	The length of the flight from departure to destination.	Hours and minutes: HHmm	01 45 **NOTE:** You must account for wind and other weather factors in this calculation.
ADS–B Position Source TSO	The TSO number corresponding to the aircraft's GPS position source used for ADS–B Out surveillance support, or unequipped, or inoperative.	None	C129 **NOTE:** For results to be valid, this entry must accurately reflect the aircraft equipage. If unsure, select C129.
ADS–B Link TSO	The TSO number corresponding to the aircraft's ADS–B transponder, or unequipped, or inoperative	None	260B (1090ES)
Mask Angle	The minimum number of degrees above the horizon that your position source can make use of a GPS Satellite, or N/A if your aircraft is unequipped, or your ADS–B position source is inoperative.	Degrees	5.0
Baro-Aiding equipment installed	Barometric Aiding equipment, if installed, augments the GPS by using a non-satellite input for altitude.	None	Check the box or remove the checkmark to indicate if baro-aiding is present. **NOTE:** This box should be checked only if you are certain that BA equipment is installed in the aircraft. Do not check the box if your ADS–B equipment is inoperative.

Click **Clear All** to erase the entries or click **Check Availability** to generate a prediction.

REMINDER: If you neglect to enter required information the system will display an error message (refer to Figure 7–16, Flight Information Entry Form with Errors: Pop-up Example) for each incorrect data-point, which is identified by name (e.g., in this illustration the user forgot to specify an ADS-B Position Source TSO).

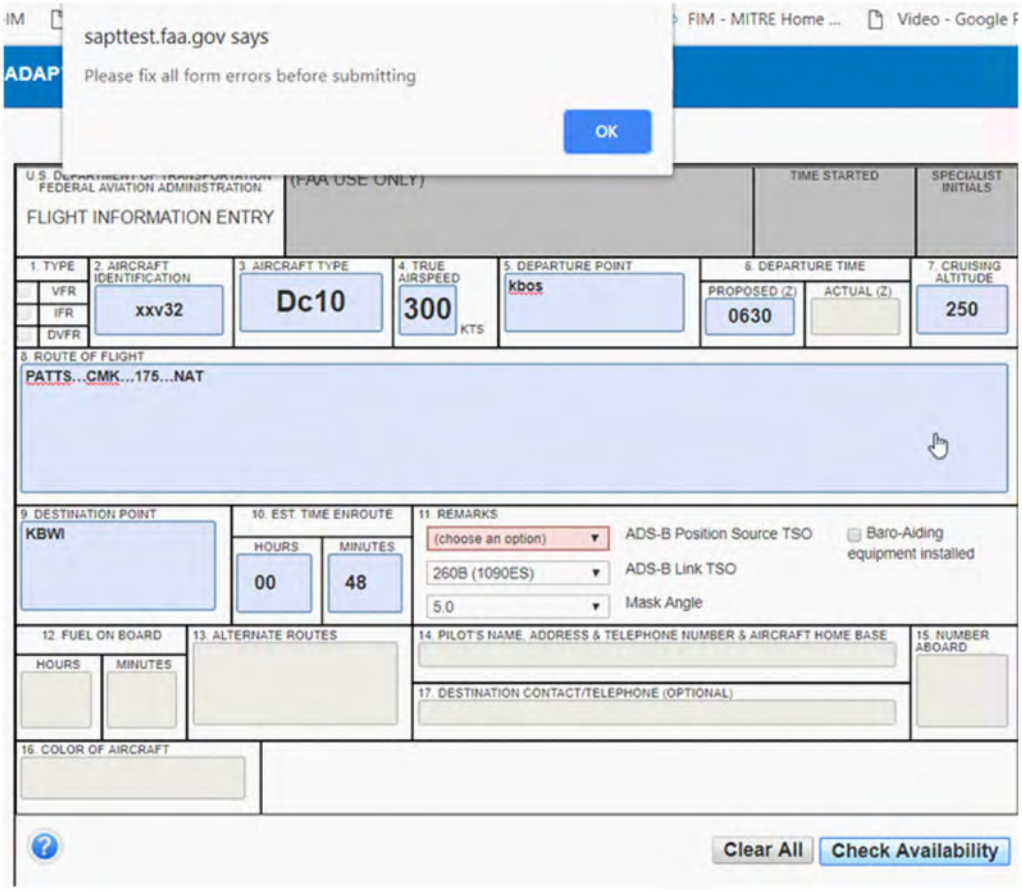


Figure 7–16. Flight Information Entry Form with Errors: Pop-up Example

In Figure 7–17, Flight Information Entry Form with Errors: Example, the SAPT could not parse the way-points which the user chose.

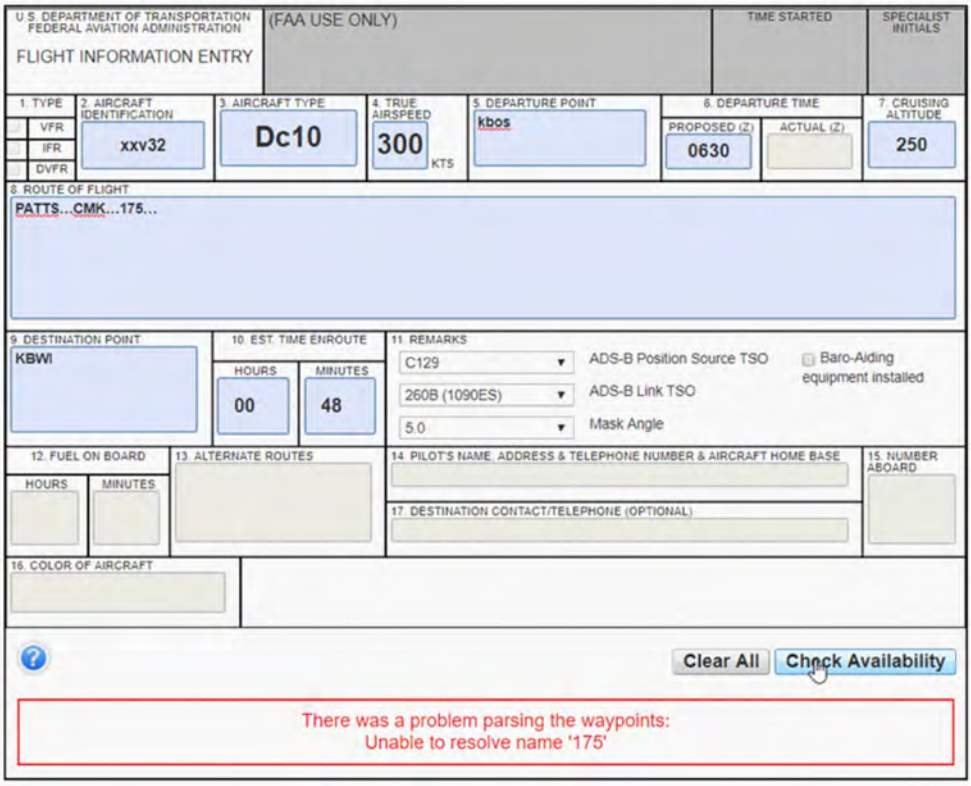
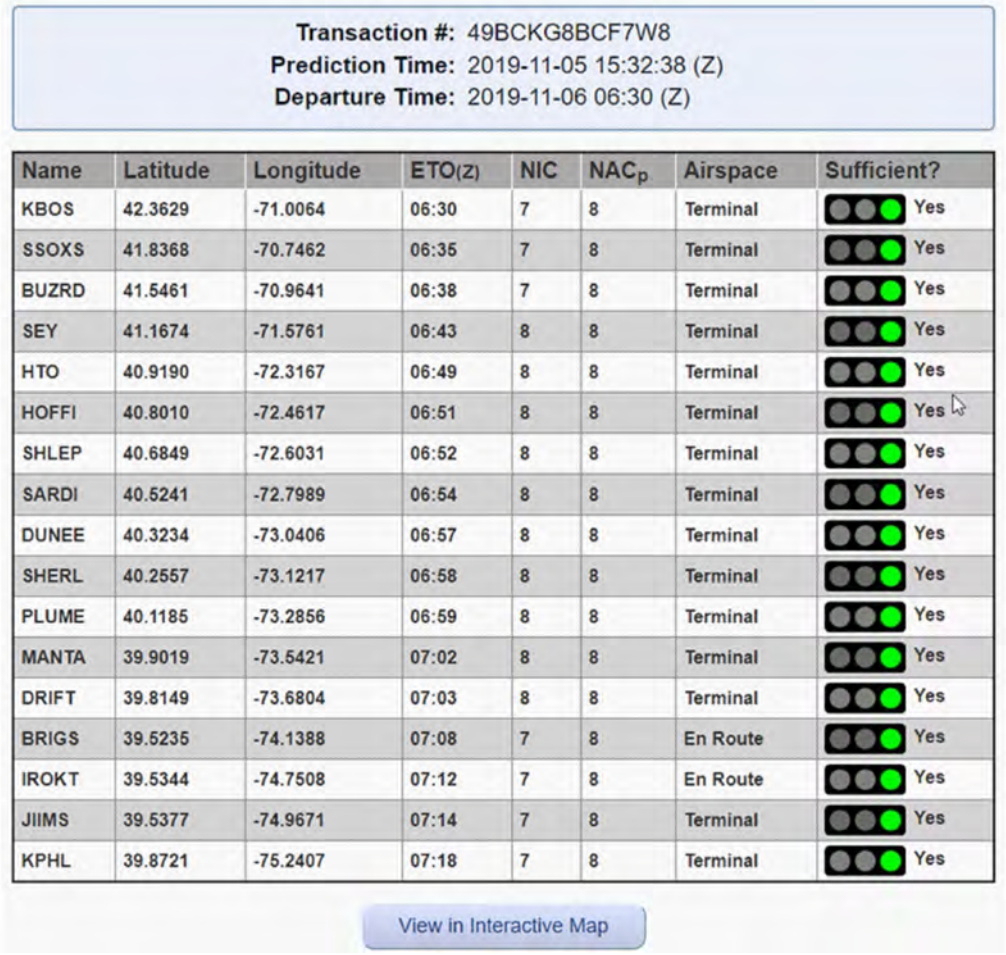


Figure 7–17. Flight Information Entry Form with Errors: Example

The SAPT does not return a prediction until the form is correctly filled in. When the flight plan is correctly filled in, the system displays the prediction beneath the form, as shown in Figure 7–18, Flight Information Entry Form with Prediction.

A transaction number and the date and time when the prediction was completed are shown at the top of the notification box. The transaction number is a unique identifier to facilitate a reference to the request and provides proof that a prediction was run for that flight.



Transaction #: 49BCKG8BCF7W8
Prediction Time: 2019-11-05 15:32:38 (Z)
Departure Time: 2019-11-06 06:30 (Z)

Name	Latitude	Longitude	ETO(Z)	NIC	NAC_p	Airspace	Sufficient?
KBOS	42.3629	-71.0064	06:30	7	8	Terminal	Yes
SSOXS	41.8368	-70.7462	06:35	7	8	Terminal	Yes
BUZRD	41.5461	-70.9641	06:38	7	8	Terminal	Yes
SEY	41.1674	-71.5761	06:43	8	8	Terminal	Yes
HTO	40.9190	-72.3167	06:49	8	8	Terminal	Yes
HOFFI	40.8010	-72.4617	06:51	8	8	Terminal	Yes
SHLEP	40.6849	-72.6031	06:52	8	8	Terminal	Yes
SARDI	40.5241	-72.7989	06:54	8	8	Terminal	Yes
DUNEE	40.3234	-73.0406	06:57	8	8	Terminal	Yes
SHERL	40.2557	-73.1217	06:58	8	8	Terminal	Yes
PLUME	40.1185	-73.2856	06:59	8	8	Terminal	Yes
MANTA	39.9019	-73.5421	07:02	8	8	Terminal	Yes
DRIFT	39.8149	-73.6804	07:03	8	8	Terminal	Yes
BRIGS	39.5235	-74.1388	07:08	7	8	En Route	Yes
IROKT	39.5344	-74.7508	07:12	7	8	En Route	Yes
JIIMS	39.5377	-74.9671	07:14	7	8	Terminal	Yes
KPHL	39.8721	-75.2407	07:18	7	8	Terminal	Yes

View in Interactive Map

Figure 7–18. Flight Information Entry Form with Prediction

7.5.2 Field-Entry Help and Suggestions

When you place the cursor in a field, the Flight Information Entry Form will provide information on that field in a black floating tip box. The tip includes information such as required format and character limits.

The tip boxes for the Departure Point, Route of Flight, and Destination Point fields offer suggestions to populate these fields based on the leading characters you entered. The tip box appears where you stopped typing. Enter a value or accept the suggestion that matches your desired selection from a drop-down list.

A tip box for the Route of Flight text-box is depicted in Figure 7–19, Field and Overlaid Suggestion Tip Box.

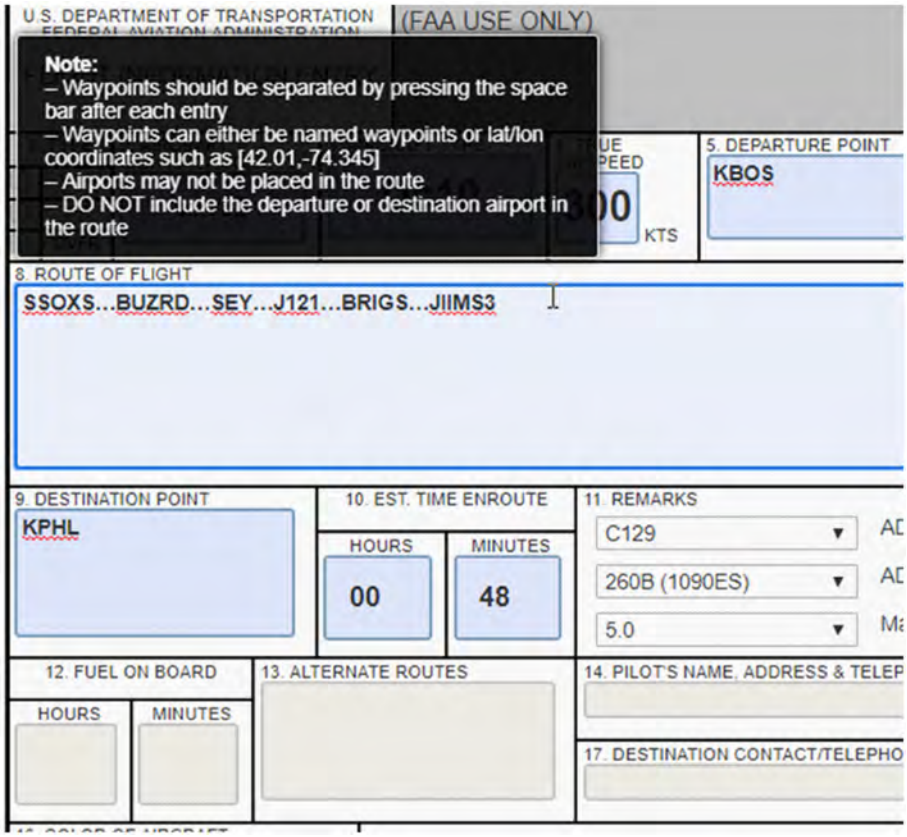


Figure 7–19. Field and Overlaid Suggestion Tip Box

The SAPT determines suggestions through the following process:

- If an entry is the first waypoint, the SAPT checks if a departing airport was entered; if so, it uses the airport to find SID fixes within 100 NM.
- If the entry is not the first waypoint, the SAPT uses the last waypoint to find a nearby route. If an arrival airport was entered, the SAPT will also attempt to find a STAR.
- If the last waypoint entered was a route, the SAPT only looks for fixes along that route.

You may enter a waypoint that is not in the list of nearby suggestions.

There is a further pop-up tool tip on how to save a Flight Information Entry Form (refer to Figure 7–20, Save & Load Menu Pop-up Tip).

Hover your mouse over the blue question mark in the bottom-left corner [ ] to see it.

Figure 7–20. Save & Load Menu Pop-up Tip

7.6 Saving and Loading a Flight Information Entry Form

You may save and load entries on the Flight Information Entry Form for later use.

This feature allows you to use the same aircraft or route to save information which you can recall in the future, thereby saving time in the pre-flight planning process.

7.6.1 Saving a Flight Information Entry Form

You can save populated fields in the Flight Information Entry Form to a browser, to a URL, or to a computer file, as shown in Figure 7–21, Flight Plan Saving Options.

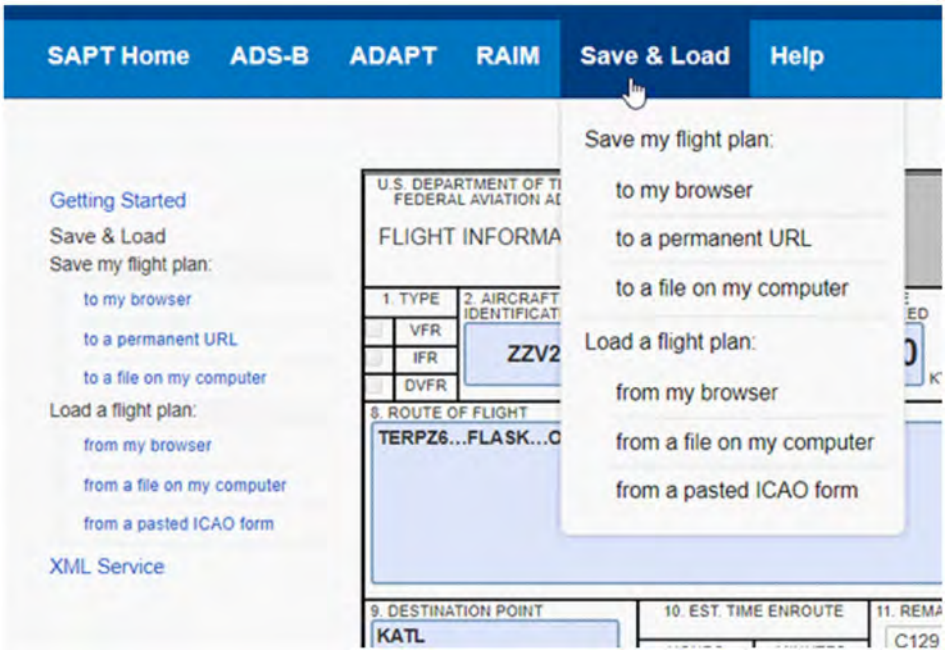


Figure 7–21. Flight Plan Saving Options

7.6.1.1 Save to My Browser Option

When you select the ‘Save my flight plan' → ’to my browser’ option, all of the information is saved to a browser in a cookie. Each time this feature is selected, the saved field entries are over-written. If multiple

users save information with the “to my browser” feature in the same browser instance, they risk changing or losing information that was saved earlier by someone else.

NOTE: The saved information will be lost if you erase the browser cookies.

As depicted in Figure 7–22, Flight Information Entry Form Saved to a Browser — Notification Message, a successful save will be identified at the bottom of the Flight Plan Form by the message, “The form has been saved to your browser.”

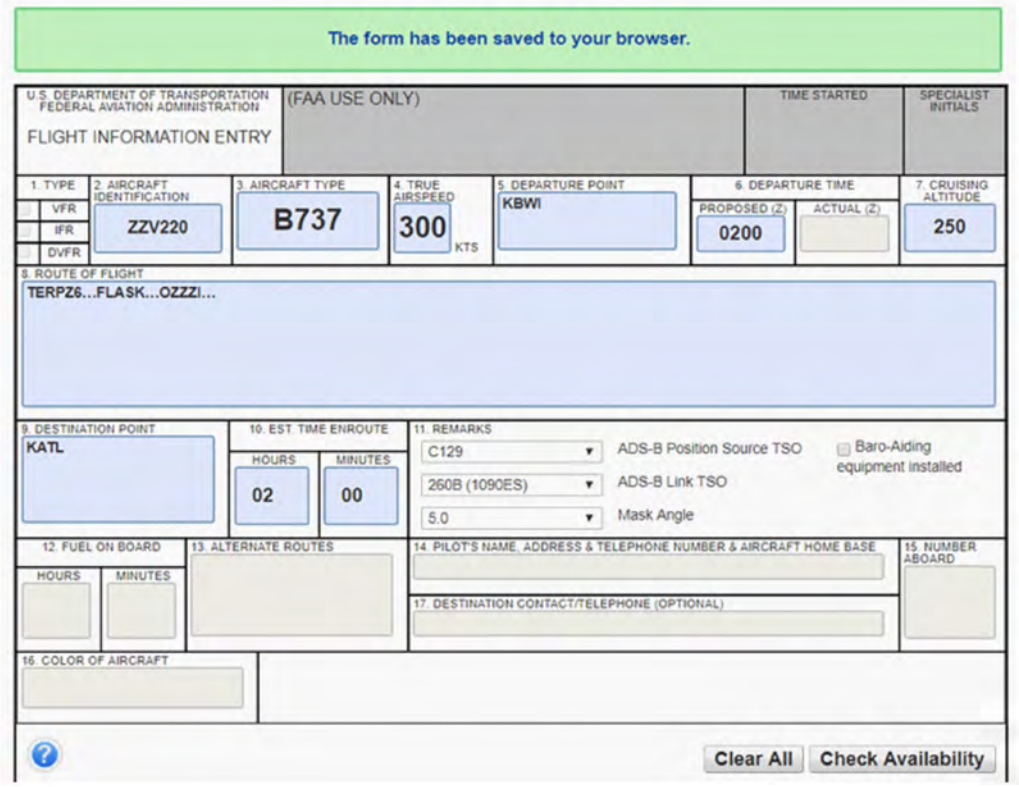


Figure 7–22. Flight Information Entry Form Saved to a Browser — Notification Message

7.6.1.2 Save to Uniform Resource Locator (URL) Option

When you save the flight plan to a permanent URL, SAPT creates a URL including the information that you entered into the form. The URL can be copied from the notification box at the top of the Flight Information Entry Form and pasted into a browser address bar to create a new, pre-populated Flight Information Entry Form.

NOTE: This option is shown in the yellow highlighted area in Figure 7–23, Flight Information Entry Form Written to a URL — Notification Message.

You can also click the link, as identified in the notification box. When you do so it will open the URL, which will enable you to navigate back to the request after reviewing the request in the interactive map by pressing **BACK** on the browser. You can save the URL as a bookmark (favorite) in the browser for quick access to the form.

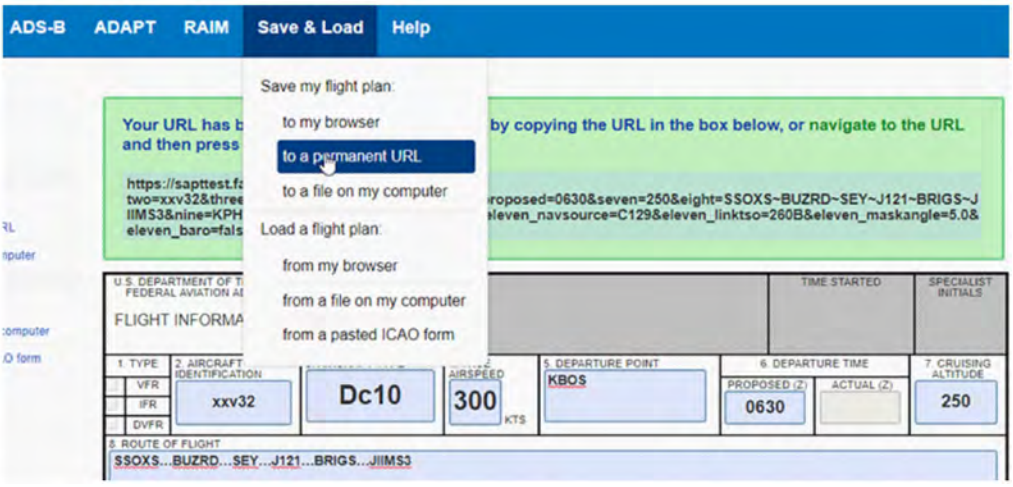


Figure 7–23. Flight Information Entry Form Written to a URL — Notification Message

7.6.1.3 Save As A Computer File Option

When you save the flight plan ‘to a file on my computer’, the field information is saved to a text file on the active computer, as shown in Figure 7–24, Flight Information Entry Form Saved to a File — Notification Message.

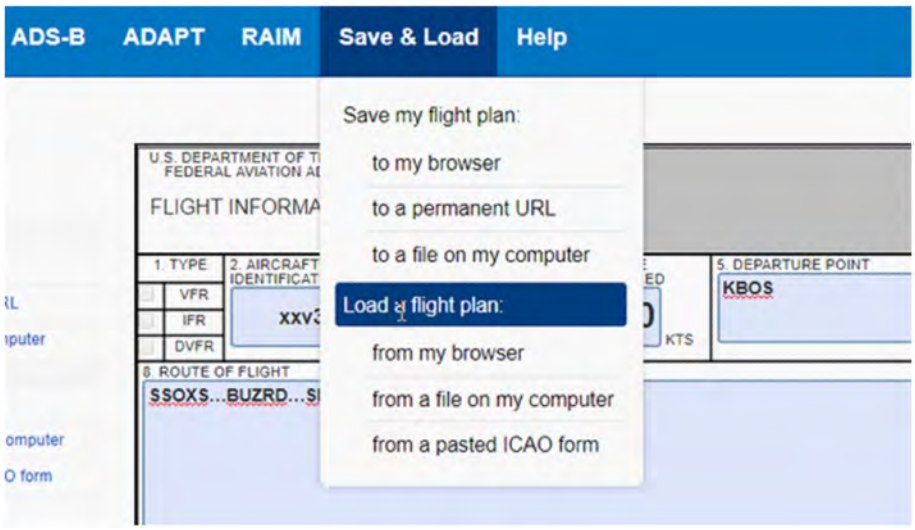


Figure 7–24. Flight Information Entry Form Saved to a File — Notification Message

This action will prompt you to download and save the file in a manner consistent with the active browser settings and operating system.

7.6.2 Loading Saved Data

You can load previously saved field information in three ways:

1. From browser bookmarks (favorites)

2. From browser cookies
3. From a file

You can also load from an ICAO flight plan in text format.

If you employ a browser favorite, you must remember its name and select the correct entry. This action can be performed without first navigating to the Flight Information Entry Form.

In the other loading options, which are displayed in Figure 7–25, Flight Information Entry Form Loading Options, you must open the Flight Information Entry Form.

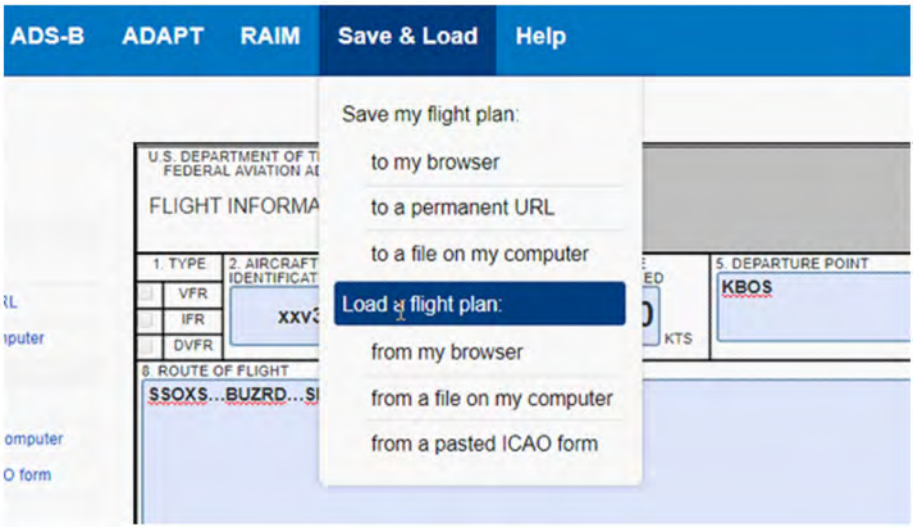


Figure 7–25. Flight Information Entry Form Loading Options

7.6.2.1 Load Data From Browser

If you want to load field information from the browser cookie, select the '**Load a flight plan**' 'from my browser' option. The fields will automatically be populated with the most recent entries.

The application will display a notification at the top of the Flight Information Entry Form that "All existing flight data loaded," as shown in Figure 7–26, Flight Information Entry Form Loading Options — Browser.

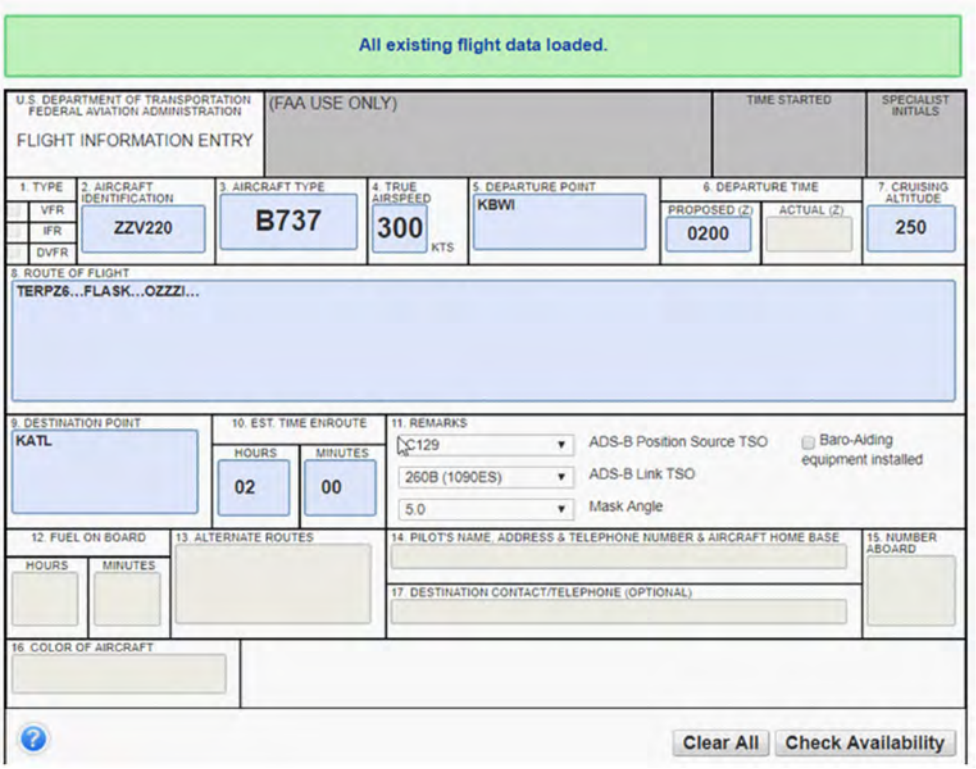


Figure 7–26. Flight Information Entry Form Loading Options — Browser

7.6.2.2 Load Data From File

Loading field information using the ‘Load a flight plan’ - ‘from a file on my computer’ option will load data from a text file to the Flight Information Entry Form.

- Choose “**Select a saved flight plan from your computer to load**” when a pop-up box is displayed in the middle of the Flight Planning Form, as shown in Figure 7–27, Flight Information Entry Form Loading Options — File.

Figure 7–27. Flight Information Entry Form Loading Options — File

When you click **Browse**, the SAPT opens a pop-up box containing the ‘Choose File to Upload’ prompt, as displayed in Figure 7–28, Flight Information Entry Form Loading a File — Choose a File to Upload. Click on **Choose File** and select a file using the OS pop-up file browser, and then click on **Load**.

NOTE: The file manager shown may differ in appearance from other models.

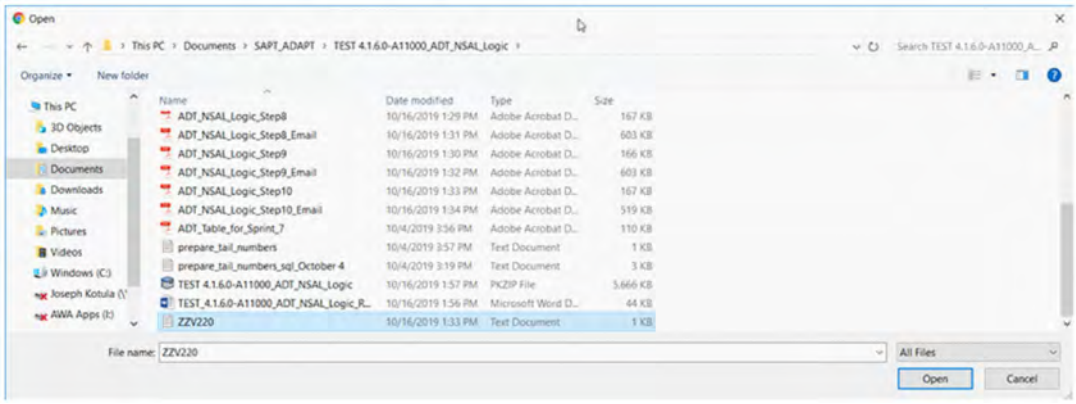


Figure 7–28. Flight Information Entry Form Loading a File — Choose a File to Upload

Select the desired file and click **Open**. This action will enter the file name and location in the box at the bottom of the Flight Information Entry Form.

Click **Load** to populate the fields with the information in the file.

7.6.2.3 Load Data From ICAO Flight Plan

The final option for loading a Flight Information Entry Form is not from previously saved data, but from an ICAO flight plan in text format.

7.7 Prediction Output

After you submit a prediction request via the Flight Information Entry Form's **Check Availability** (refer to Figure 7–29, Flight Information Entry Form Request), the SAPT will issue a response.

This result will be shown at the bottom of the form, as illustrated in Figure 7–30, Sufficiency Suggestion.

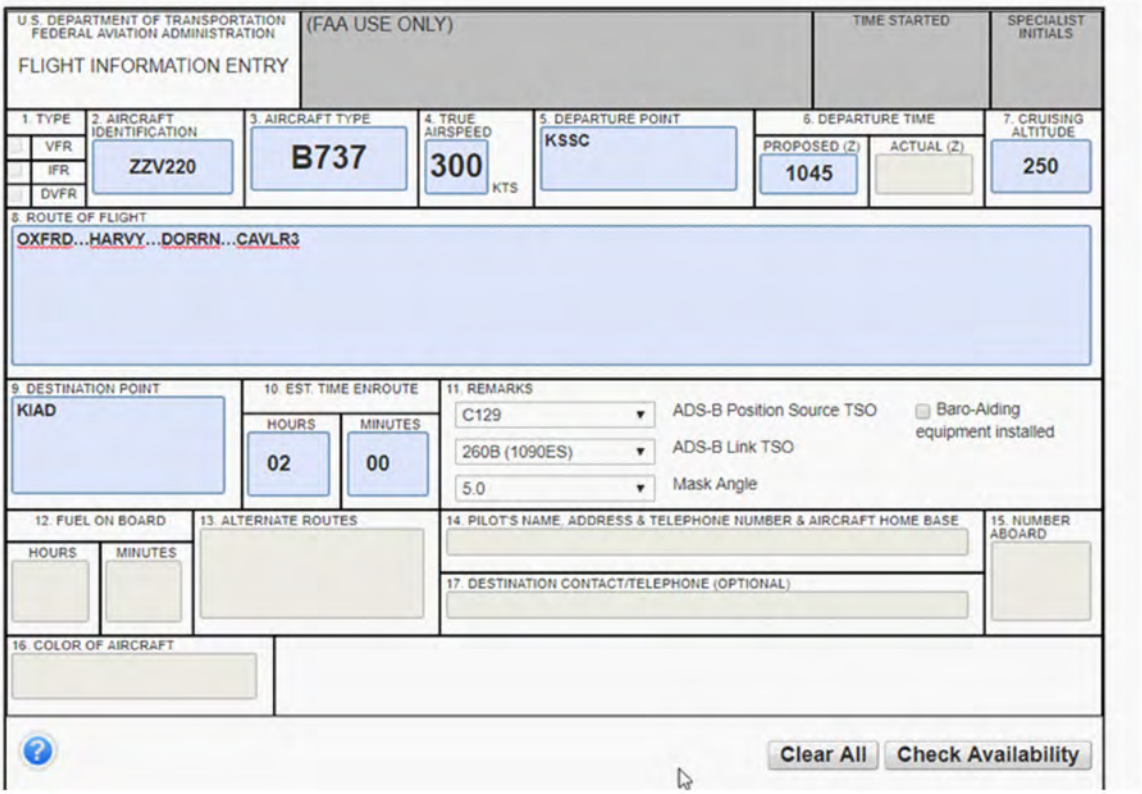


Figure 7–29. Flight Information Entry Form Request

Transaction #: 7YJWKG8BCM0M3
Prediction Time: 2019-11-05 15:58:43 (Z)
Departure Time: 2019-11-06 10:45 (Z)

Unable to suggest an alternative departure time.

Name	Latitude	Longitude	ETO(Z)	NIC	NAC_p	Airspace	Sufficient?
KSSC	33.9727	-80.4706	10:45	7	8	Terminal	Yes
DIRECT@24.78NM	34.3241	-80.2086	10:53	7	8	Unknown	N/A
DIRECT@49.56NM	34.6750	-79.9444	11:02	6	8	Terminal	AltSurveillance
DIRECT@74.34NM	35.0252	-79.6780	11:11	6	8	Terminal	AltSurveillance
DIRECT@99.12NM	35.3749	-79.4093	11:20	6	8	Terminal	AltSurveillance
DIRECT@123.90NM	35.7240	-79.1383	11:29	7	8	Terminal	Yes
DIRECT@148.67NM	36.0724	-78.8648	11:37	7	8	En Route	Yes
OXFRD	36.4203	-78.5890	11:46	7	8	En Route	Yes
HARVY	36.7462	-78.4719	11:54	8	8	En Route	Yes
DIRECT@27.33NM	37.1393	-78.1844	12:03	8	8	Terminal	Yes
DORRN	37.5317	-77.8938	12:13	8	8	Terminal	Yes
PERKN	37.6533	-77.8247	12:16	8	8	Terminal	Yes
KHOOD	37.8820	-77.6977	12:21	8	8	Terminal	Yes
BNTLY	38.0542	-77.6014	12:25	8	8	Terminal	Yes
CAVLR3@107.31NM	38.5008	-77.5311	12:35	8	8	Terminal	Yes
KIAD	38.9474	-77.4599	12:45	8	8	Terminal	Yes

Figure 7–30. Sufficiency Suggestion

7.7.1 Flight Information Entry Form Results

The results issued by the SAPT Flight Information Entry Form will include the following information for each point in the route of flight. The route of flight includes points entered in the form, but may also include intermediate points that were inserted automatically by the SAPT:

- Name of the point
- Latitude
- Longitude
- ETO (in Greenwich Mean Time (GMT))
- NIC
- NACp
- Airspace

- Sufficient?

In addition, a transaction number and the date and time when the prediction was completed are returned at the top of the notification box. The transaction number is a unique identifier that you can use to reference the request and it is also proof that a prediction was run for that flight.

You must interpret the flight information that is returned in order to determine if the route and time will be adequate to support ADS–B surveillance. The primary SAPT indicator in that determination is the sufficiency value, which is described in the following section of this guide.

7.7.1.1 Sufficiency

Under the Sufficient heading, a point will be considered sufficient if the NIC and NACp values are equal to, or higher than, the required minimum values as defined in the ADS–B Final Rule: NIC≥7 and NACp≥8. If a point falls outside US-controlled rule airspace, the SAPT will return “N/A”.

NOTE: The SAPT approximates rule airspace. You are responsible for knowing whether a waypoint in the flight plan is in rule airspace.

If any point has a sufficiency value of “No,” you should not take that route. In that case, you must find another route and time that meets sufficiency rules. A sufficiency value of “N/A” can be treated as a “Yes,” since that airspace falls outside US control and is irrelevant.

A prediction that denotes that all sufficiency values are “Yes” or “N/A,” means that all points meet the required accuracy. You may accept the route and time for the flight. You may want to print the form and prediction for your records.

The stoplight icons shown in the following table indicate sufficiency:

Table 7–2. Sufficiency Indication

	ADS–B performance is sufficient at the waypoint. The flight may proceed, as per the rules.
	ADS–B performance is NOT sufficient at the waypoint but alternate surveillance is predicted to be available. Operators holding Exemption 12555 may be approved to conduct the flight. Refer to FAA policy, including the conditions of Exemption 12555.
	ADS–B performance is NOT sufficient at the waypoint and NO adequate alternative surveillance is predicted to be available. The flight may NOT proceed, unless authorized by ATC (refer to 14 CFR Part 91 § 91.225).
	ADS–B coverage is not computed for points outside of supported airspace. This point has no bearing on ADS–B sufficiency or on whether the flight may proceed.

For more information, please refer to Table 7–3, Interpreting Results for SAPT Pre-flight Availability Predictions.

7.7.1.2 FAA SAPT Policy with Exemption 12555

Publication of FAA regulation and policy is outside the scope of this guide. However, correct interpretation of SAPT results requires some mention of Exemption 12555 and FAA policy in this document.

You are cautioned to refer to the published Final Rule on ADS–B (Docket No. FAA–2007–29305; Amdt. No. 91–314), specified in 14 CFR §§91.225 and 91.227, the Grant of Exemption 12555 (Docket No. FAA-2015-0971) and FAA Advisory Circular (AC) 90–114A CHG 1, for authoritative information.

The FAA has issued a limited grant of exemption (viz. Exemption 12555) from specific performance requirements of the ADS–B Out rule during certain periods of GPS satellite constellation performance.

A fact-sheet on the exemption is available here:
https://www.faa.gov/nextgen/equipadsb/research/exemption/media/Exemption12555.pdf

NOTE: Operators must follow the procedures described in FAA Information for Operators (InFO) 16003, Exemption 12555 Process to obtain the exemption.

Exemption 12555 does not amend or change 14 CFR §§91.225 or 91.227. Beginning January 1, 2020, operators must still be equipped with ADS–B Out, as specified in 14 CFR §§91.225 and 91.227 to fly in rule airspace.

Whether an operator holds Exemption 12555 will affect the following factors:

- When the operator needs to run a prediction
- Whether an operator needs to request an authorized deviation
- The correct interpretation of the SAPT response
- GPS performance to TSO–C129, SA ON (Jan 1, 2020 – Dec 31, 2024)
- With Exemption 12555, pre-flight prediction required:
  - — When EVERY point in the route of flight that does not meet the ADS–B Rule performance requirements is predicted to have alternate surveillance, a deviation is authorized by the FAA when using SAPT.
- No Exemption 12555, pre-flight prediction required:
  - — When ANY point in the route of flight does not meet the ADS–B Rule performance requirements the operator must request an ATC authorization.
- GPS performance to TSO–C129/C196, SA–AWARE (Jan 1, 2020 – Dec 31, 2024)
  - — With Exemption 12555, flight authorized without pre-flight prediction.
  - — NO Exemption 12555, pre-flight prediction required:
    - When ANY point in the route of flight does not meet the ADS–B Rule performance requirements the operator must contact ATC to obtain authorization.

Table 7–3, outlines the expected SAPT response for these conditions.

Table 7–3. Interpreting Results for SAPT Pre-flight Availability Predictions

Equipment	2020–2024								After 2024
	Exemption 12555				No Exemption 12555				Exemption Expires
SA ON (TSO-C129)	Exemption required? **YES**				**YES**				**YES**
	If SAPT predicts alternate surveillance, the exemption permits the flight to depart without contactingATC for authorization.	Condition	XML disposition keyword	Web Form: "Traffic Light"	Operator must contact ATC to obtain authorization if they don't meet the rule	Condition	XML disposition keyword	Web Form: "Traffic Light"	Operator must contact ATC to obtain authorization. **Same "Conditions"** apply as do for "No Exemption 12555"
		No Action	Unregulated or Expired	Traffic Light: gray Text: "N/A"		No Action	Unregulated or Expired	Traffic Light: gray Text: "N/A"	
		Meets Rule	Sufficient	Traffic Light: green Text: "Yes"		Meets Rule	Sufficient	Traffic Light: green Text: "Yes"	
		Authorized Deviation from SAPT	AlternateSurveillance	Traffic Light: yellow Text: "AltSurveillance"		Fails", No Authorized Deviation from SAPT	AlternateSurveillance	Traffic Light: yellow Text: "AltSurveillance"	
		Fails", No Authorized Deviation from SAPT	Insufficient	Traffic Light: red Text: "No"		Fails", No Authorized Deviation from SAPT	Insufficient	Traffic Light: red Text: "No"	
	Prediction required? **NO**				**YES**				**YES**

Table 7–3. Interpreting Results for SAPT Pre-flight Availability Predictions (Continued)

Equipment	2020–2024		After 2024
	Exemption 12555	**No Exemption 12555**	**Exemption Expires**
SA AWARE (ITSO-C129 or C196)	Exemption authorizes flight without the need for Pre-flight Prediction	Operator must contact ATC to obtain authorization. **Same "Conditions" apply as do for "No Exemption 12555" under SA ON**	Operator must contact ATC to obtain authorization. **Same "Conditions"** apply as do for "No Exemption 12555" under SA **ON**
SBAS (TSO-C145 or 146)	Prediction required? **NO**	**NO**	**NO**
	No Pre-flight Availability Prediction Required	No Pre-flight Availability Prediction Required	No Pre-flight Availability Prediction Required
NOTE: These XML values are returned for each waypoint. A Fail at any waypoint fails the route.			

7.7.1.3 Considerations: Departure and ETO Timing

The following considerations must be taken into account for departure and ETO timing:

- Each waypoint that the SAPT checks.
- ETO and each minute for 5 minutes forward and backward.
- Waypoint and one point 7.5 NM to either side.
- The worst values are used for the waypoint.

This means an SAPT prediction applies to a ten-minute window at each waypoint.

NOTE: This is not the same as the RAIM prediction algorithm.

7.7.1.4 Considerations: When to Run a Prediction

The questions and considerations that must be taken into account when running a prediction are:

NOTE: Refer to AC 90–114B to determine the required timeframe to submit a transaction and obtain an authorized deviation.

- How far in advance should I run the prediction?
- The GPS constellation model is built at least once a day for 72 hours.
- The SAPT should always cover the next 48 hours.
- XML transactions can be entered 48 hours before arrival.

7.7.2 Insufficiency and Suggested Flight Times

When the SAPT returns a prediction request with a sufficiency value of “No,” it will suggest a better time to fly the requested route if it can find one within an hour of the proposed time. A sample of this type of notification is provided in Figure 7–30.

Since TSO–C129 provides near worst-case results with regards to availability with a low computational overhead, the system will use TSO–C129 SA–ON to search for a time that may provide better results. The system search pattern uses the following times, and stops if it finds a combination that works:

- +15 (fifteen minutes later)
- -15 (fifteen minutes earlier)
- +30 (thirty minutes later)
- -30 (thirty minutes earlier)
- +45 (forty-five minutes later)
- -45 (forty-five minutes earlier)
- +60 (sixty minutes later)
- -60 (sixty minutes earlier)

Please keep in mind that when the SAPT returns a suggested time, the suggested time may not work. While the suggestion process uses a quick algorithm intended to save you time, it is your responsibility to verify that suggestion by modifying the prediction request – either forward or backward in time – and re-running the SAPT to make sure the actual avionics pass. If the system cannot provide a suggestion, it will issue a notification. In such cases, a change of route may be advised.

7.7.3 Inserted Route Points

The system will add points to the route of flight as required in order to guarantee that the distance between the points is never more than 60 NM.

All points, whether ones you have specified or ones that have been added by the system, will be returned in the SAPT response. Points that are marked as redundant (and are removed from the calculation) are included in the results, with the estimated NIC and NACp taken from the previous point.

When a point is added, the name of that point will either be “Direct@,” “<Route Name>@,” or “<Radial>@” (depending on the type of the previous point) followed by the distance.

7.7.4 Graphical Display

The following two types of graphical displays have been implemented in the SAPT:

1. Large area display
2. Route-specific display

The interactive map is built on Cesium, an open-source JavaScript library for world-class 3D globes and maps. Cesium is based on the Web Graphics Library (WebGL) engine. WebGL is a JavaScript Application Programming Interface (API) for rendering interactive 3D and 2D graphics within any compatible web browser without the use of plug-ins. WebGL does so by introducing an API that closely conforms to Open Graphics Library for Embedded Systems (OpenGL ES) 2.0 that can be used in HTML5 <canvas> elements.

WebGL 1.0 is supported in the stable releases of most major browsers on both desktop and mobile platforms. Chrome, Firefox, Internet Explorer, Opera, and Safari are all known to have good WebGL support on both desktop and mobile browsers.

Although iOS and Android are not officially supported, early testing indicates that they work with reduced functionality.

- On an iOS product, pressing **Download KML** should automatically open the Google Earth™ application if it has been installed.
- On an Android product, you must first download and then open the Keyhole Markup Language (KML) file.

7.7.5 Large Area Display

The large area display has been developed to allow you to see configuration-specific degradations in ADS–B performance based on the GPS constellation, ADS–B Position Source TSO, and time.

This display, depicted in Figure 7–31, Large Area Graphical Display, includes six configurations:

- Configuration 1: TSO–C129, no baro-aiding, mask angle 5.0
- Configuration 2: TSO–C129, no baro-aiding, mask angle 2.0
- Configuration 3: TSO–C129, baro-aiding, mask angle 5.0
- Configuration 4: TSO–C129, baro-aiding, mask angle 2.0
- Configuration 5: TSO–C196, no baro-aiding, mask angle 5.0
- Configuration 6: TSO–C196, no baro-aiding, mask angle 2.0

Configuration 1 represents the worst-case scenario that you might encounter. Configuration 6 represents the best-case scenario, other than WAAS.

NOTE: WAAS was not recommended for inclusion because it always meets the required availability defined in the ADS–B Final Rule. Configuration 2 will be slightly better than Configuration 1 but typically worse than Configuration 3.

If you have a different configuration, choose the one that most closely represents the aircraft you will use.

REMINDER: The large area display should only be used as a reference as it does not replace the need for an actual route-specific prediction request.

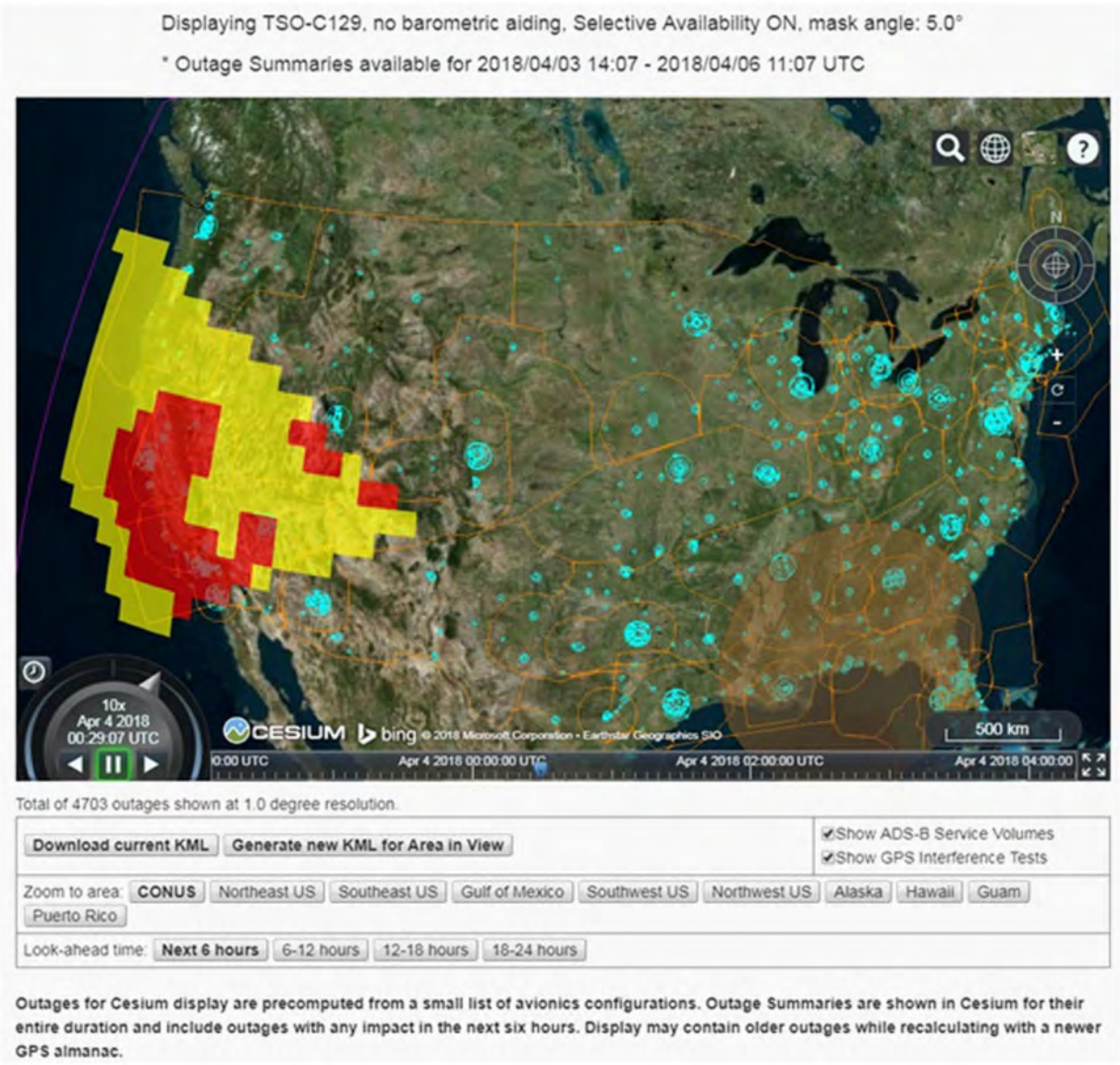


Figure 7–31. Large Area Graphical Display

To select a large area display, open the main SAPT web page (please refer to Figure 7–2 and scroll to the Outage Summaries section below the Flight Information Entry Form). Perform the following steps:

- Select either TSO–C129 or TSO–C196 with mask angles of either 2.0 or 5.0 from the drop-down box. The default of TSO-C129 mask angle 5.0 will show the most outages.
- Click the Click to View link in the Outages column to open an interactive map outage display, as shown in Figure 7–31.

The display identifies all of the outages under the selected configuration. In Figure 7–31 all outages over the next six hours of the prediction window are shown.

NOTE: Depending on the number of outages, the large area display may take some time to initialize and display.

A status message below the lower-left corner of the map reports when the tool is generating and retrieving the KML file, and reports the total number of outages and the resolution when the file is finished. A status message indicating that there are no outages is displayed while the map is rebuilding. The status message in Figure 7–31 is “Total of 4703 outages shown at 1.0 degree resolution.”

The predicted outages are displayed in red and yellow. Both red and yellow highlighted areas are regions where ADS–B performance with the specified avionics is not predicted to be sufficient to meet the Final Rule. Some of the regions are yellow because the SAPT graphical display was able to confirm that there would be alternate surveillance available for the area. However, the graphical display does not have access to all the acceptable sources of alternate surveillance, so a specific flight prediction may well turn yellow where the map shows red, or even green, if it is at a higher altitude.

The large area display defaults to show the CONUS outages at a low resolution. You may select a region from the buttons below the map to zoom to an area or use the interactive map features to navigate to a custom region and display outages at a higher resolution. Once you have selected the desired region, click **Generate New KML For Area In View** to see the outages for the new view. The area within which outages are searched will be highlighted within a box.

NOTE: Outages are NOT generated for the entire world, but even inside the highlighted search box are only predicted within the airspaces inside the ADS–B Service Volumes.

To help distinguish airspace that is free of outages from airspace that is outside the relevant ADS–B-required volume, the ADS–B Service Volumes are also marked on the map, outlined in orange (En Route) and cyan (Terminal).

These service volumes do not correspond directly to rule airspace. It is your responsibility to know if they are in rule airspace. A “Show ADS–B” checkbox in the lower-right corner allows you to display or hide the ADS–B Service Volume outlines. Click the Show GPS Interference Tests check-box in the lower-right corner in order to display or hide it.

Several controls are available on this window:

- The large area display will play outages (in brown using a standard Cesium™ time slider at the bottom. All outages and route-point ETOs are displayed in GMT.
- The time slider can move forward and backward to determine outages at specific times.
- Any outages that are active within the time will be shown. You can click the outages to display the latitude and longitude of the outage and its starting and ending times.
- **Play, Pause,** and **Reverse** controls are set at the lower-left corner of the map. These controls function as follows:
  - — Click  to allow the timeline slider to play.
  - — Click  to stop the timeline slider.
  - — Click  to reverse the play of the timeline slider.
- A limitation in the Cesium API prevents the slider from automatically stopping when it hits the end of the slide bar. The timeline controller will reset to the beginning when it reaches the end and continue to play.
- Click **Pause** to stop the time slider at its current position.

- Drag the arrow located in outer ring of the timeline controller to change the speed of the timeline animation.
- Buttons labeled **Next 6 Hours, 6–12 Hours, 12–18 Hours,** and **18–24 Hours** at the bottom of the screen allow the user to select the look-ahead time for outages.
- The Zoom to Area buttons labeled **CONUS, NORTHEAST US, SOUTHEAST US, GULF OF MEXICO, SOUTHWEST US, NORTHWEST US, ALASKA, HAWAII, GUAM,** and **PUERTO RICO** allow you to select a region quickly. (After selecting a region, you must wait for the new outages to be retrieved and displayed.)

NOTE: As shown in Figure 7–32, Northeast Region – Illustrated Selection, outages are not searched for Ottawa or other parts of southern Canada even though they are selected and included in the highlighted region outlined in pink; they are outside the US service volumes outlined in orange.

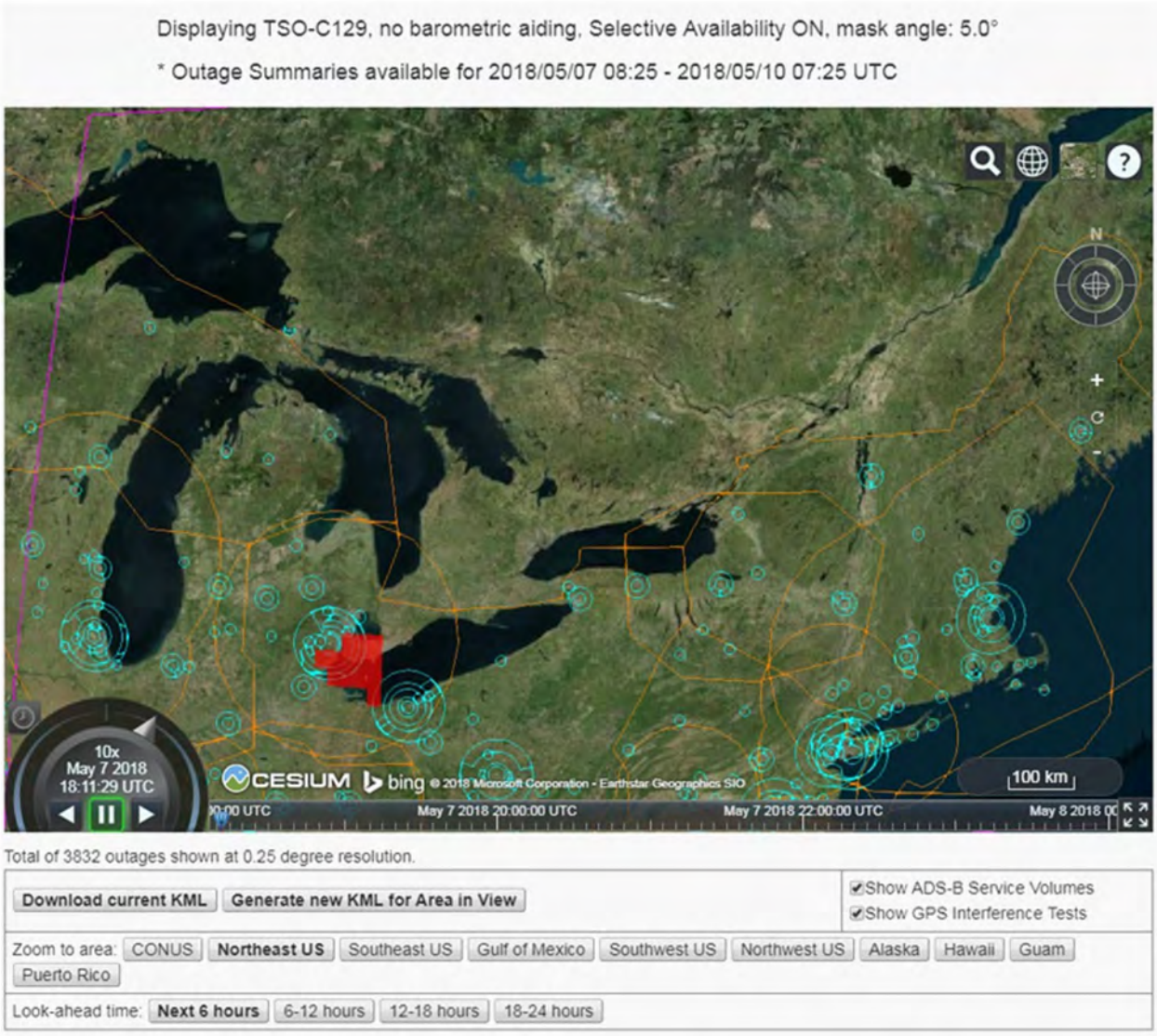


Figure 7–32. Northeast Region — Illustrated Selection

— When network performance is slow, it may be difficult to display outages. By clicking **Download KML**, you can download the outage file using the browser's download function.

The file is named "outages-<number>.kml" where (<number> is either the transaction ID or an internal number for non-route specific outages). The file may be renamed, but the "kml" file extension should not be changed. When opening the downloaded file, it should be displayed in the desktop application.

NOTE: The downloaded KML file will include the GPS Interference Tests, but not the Service Volume information. The interactive map includes checkboxes so you can show or hide the GPS Interference Tests, as well as the Service Volume layers. These checkboxes do not affect the downloaded KML file.

7.7.6 Route-Specific Display

The route-specific display (refer to Figure 7–33, Create Route-Specific Flight Information Entry Form) provides the submitted route-of-flight superimposed on the interactive map in the graphical display. Outages will be displayed along the route-of-flight when predicted to be present at the indicated ETO.

Transaction #: 39RWHG3MGHS2H
Prediction Time: 2018:03:29 17:12:20 (Z)
Departure Time: 2018:03:30 01:15 (Z)

Try again with your departure time offset by 15 minutes.

Name	Latitude	Longitude	ETO(Z)	NIC	NAC_p	Airspace	Sufficient?
KPHX	33.4343	-112.0116	01:15	7	8	Terminal	Yes *
IZZZO	33.4528	-112.8000	01:23	7	8	En Route	Yes
CULTS	33.5842	-113.5112	01:30	7	8	En Route	Yes
HRRBR	33.6499	-113.8652	01:34	7	8	En Route	Yes
MESSI	33.7998	-113.8032	01:36	7	8	En Route	Yes
ESTWD	33.9051	-114.1136	01:40	7	8	En Route	Yes
DIRECT@36.43NM	33.9636	-114.8407	01:47	7	8	En Route	Yes
DIRECT@72.91NM	34.0236	-115.5690	01:55	7	8	En Route	Yes
HLYWD	34.1042	-116.2988	02:02	7	7	En Route	AltSurveillance
BRUEN	34.0732	-116.5884	02:05	7	7	En Route	AltSurveillance
AVATR	34.0452	-116.8880	02:09	7	7	En Route	AltSurveillance
DAAAY	34.0267	-117.0310	02:10	7	8	En Route	Yes
WADUP	34.0031	-117.2291	02:12	7	8	En Route	Yes
NEILE	33.9936	-117.3085	02:13	7	8	En Route	Yes
SEAVU	33.9724	-117.4885	02:15	7	8	En Route	Yes
KLAX	33.9425	-118.4081	02:25	7	8	Terminal	Yes

* GPS Interference testing may be present

View in Interactive Map

Notes: Try again with your departure time offset by 15 minutes.

Figure 7–33. Create Route-Specific Flight Information Entry Form

When you click **View in Interactive Map** in the response on the Flight Information Entry Form, the route of flight will be superimposed on the interactive map above the list of route-points with Name, Latitude, Longitude, ETO, NIC, NACp, and Sufficiency.

The waypoints on the map will be labeled and hyperlinked. Click the hyperlinked waypoints to display the named route-point and ETO. The route-specific display includes standard controls, including a zoom feature and a time slider.

Outages will be displayed in red along the route of flight as you progress through the route ETOs. Subsequently, a plane icon will also move along the route of flight. The route display only shows outages within a 60 NM-wide corridor along the planned route of flight. A green band will indicate the distance from the route of flight for which the outages are displayed.

Outages for the grid display do not use the weighting algorithm, specified in Section 6.5, ADS–B SAPT Algorithm, of this guide, as used in the prediction. The grid display calculates the HPL (and HFOM for TSO–C129 and TSO-C196) once per minute and compares the NIC and NACp that are generated to rule values. If the predicted NIC or NACp is insufficient, the time is marked as an outage.

The map will give you an idea of where and when to expect outages, but these values may not be identical to the values in a prediction for a specific route of flight. In addition, the map knows about some, but not all, back-up surveillance. If back-up surveillance is expected to be available in an outage, the region is marked yellow on the map. Otherwise the outage will be red.

NOTE: A prediction done for a specific flight is more precise, and also uses additional sources for back-up surveillance. A point in a prediction will often be yellow when the corresponding point on the map shows red.

These differences occasionally lead to instances in which the grid display and the route-of-flight prediction disagree. Figure 7–34, Route-Specific Graphical Display, shows an example of a route-specific display where the background outages on the map are red, but the waypoints are yellow.

Displaying TSO-C129, no barometric aiding, Selective Availability ON, mask angle: 5.0°

* Outage Summaries available for 2018/05/07 08:25 - 2018/05/10 07:25 UTC

Total of 1494 outages shown at 0.125 degree resolution.

Download current KML

Show ADS-B Service Volumes
Show GPS Interference Tests

Click here to see a more extended view of outages.

Outages for Cesium display are precomputed from a small list of avionics configurations. Flight Predictions will show all related outages based on closest available avionics. Display may contain older outages while recalculating with a newer GPS almanac.

Transaction #: 3SBCKG3YKT4Q7
Departure Time: 2018:05:08 23:00 (Z)

Name	Latitude	Longitude	ETO(Z)	NIC	NAC_p	Airspace	Sufficient?
KDCA	38.8514	-77.0377	23:00	6	8	Terminal	Alt Surveillance *
PALEO	39.0280	-76.3727	23:08	6	7	Terminal	Alt Surveillance *
AGARD	39.0436	-76.0698	23:12	6	7	Terminal	Alt Surveillance *
SPEAK	39.0581	-75.7461	23:16	6	7	Terminal	Alt Surveillance *
CANNY	39.0611	-75.6780	23:17	n/a	n/a	Unknown	N/A
DONIL	39.0765	-75.3053	23:22	7	8	En Route	Yes *
SIE	39.0955	-74.8003	23:28	7	8	Unknown	N/A
KACY	39.4576	-74.5772	23:35	7	8	Terminal	Yes *

* GPS Interference testing may be present

Figure 7–34. Route-Specific Graphical Display

7.8 Printing a Request

After you submit a prediction and receive a result, you can print the web page using the standard print options with the printer icon on the menu bar, as shown in Figure 7–35, Print a Prediction Menu.

When you click the icon the form should resemble the example shown in Figure 7–36, Sample Printed Prediction.

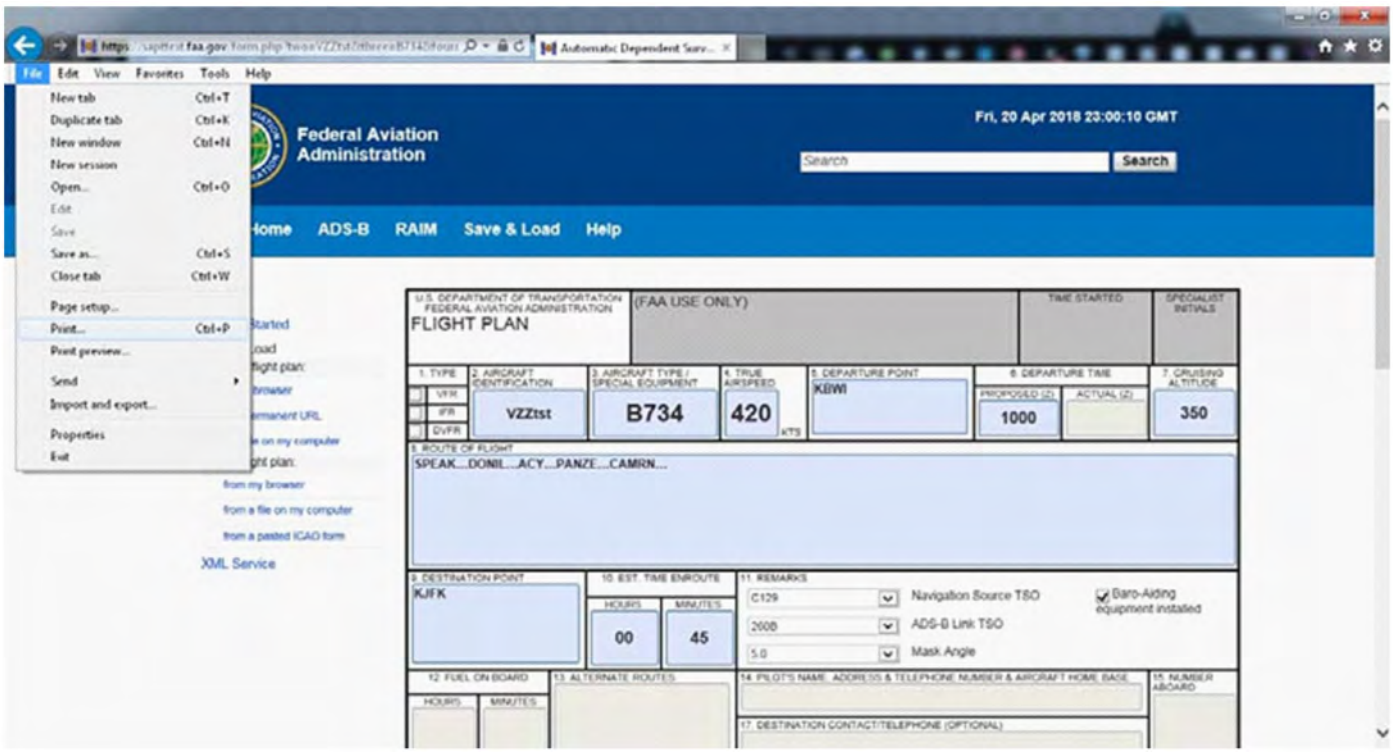
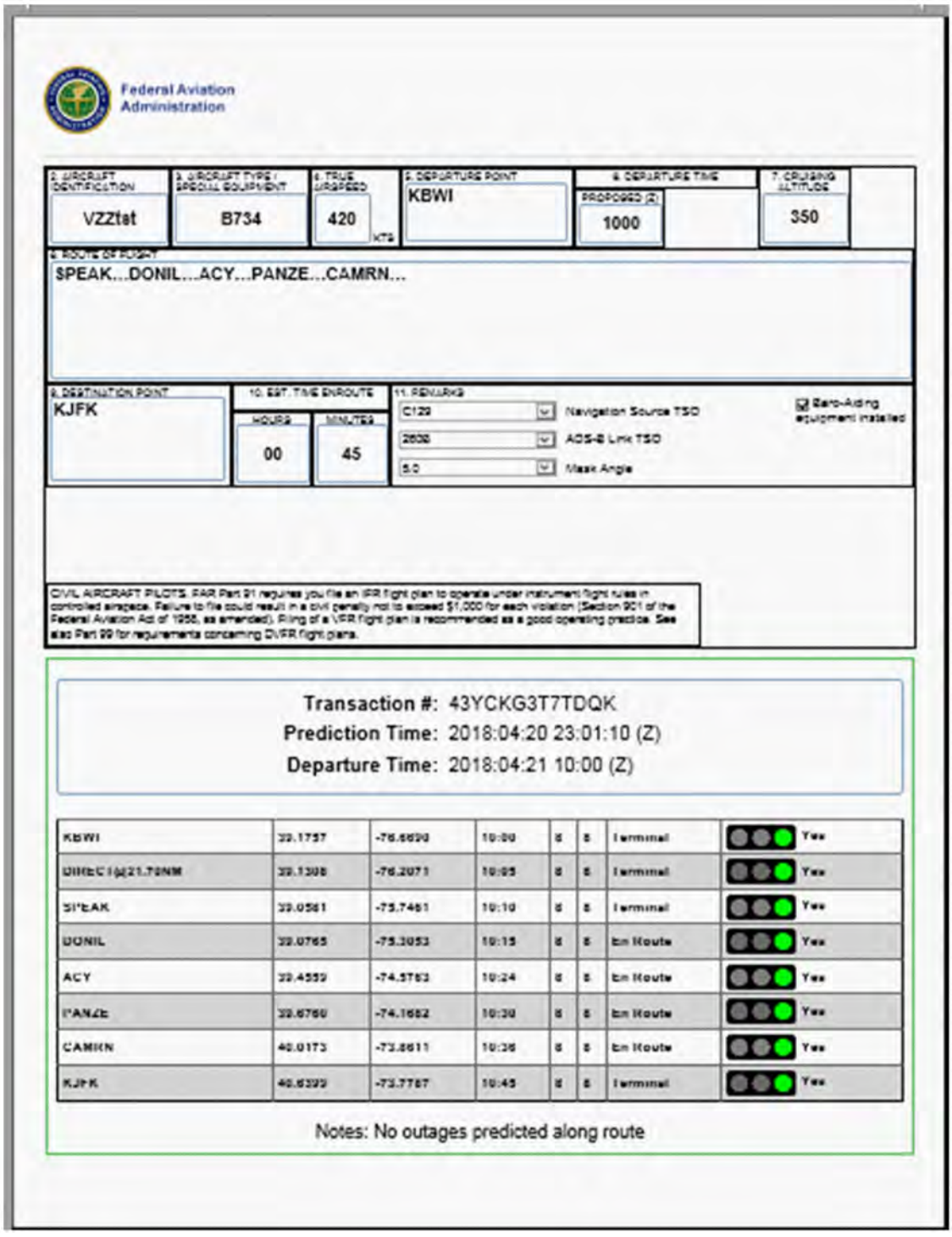


Figure 7–35. Print a Prediction Menu



Federal Aviation Administration

2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE / SPECIAL EQUIPMENT	4. TRUE AIRSPEED	5. DEPARTURE POINT	6. DEPARTURE TIME	7. CRUISING ALTITUDE
VZZtst	B734	420 KTS	KBWI	PROPOSED (Z) 1000	350

8. ROUTE OF FLIGHT: SPEAK...DONIL...ACY...PANZE...CAMRN...

9. DESTINATION POINT	10. EST. TIME ENROUTE HOURS	MINUTES	11. REMARKS
KJFK	00	45	C129 Navigation Source TSO; 2630 ADS-B Link TSO; 5.0 Mask Angle; Geo-Aiding equipment installed

CIVIL AIRCRAFT PILOTS: FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.

Transaction #: 43YCKG3T7TDQK
Prediction Time: 2018:04:20 23:01:10 (Z)
Departure Time: 2018:04:21 10:00 (Z)

KBWI	39.1757	-76.6684	10:00	6	6	Terminal	Yes
DIRECT@21.70NM	39.1308	-76.2071	10:05	6	6	Terminal	Yes
SPEAK	39.0561	-75.7461	10:10	6	6	Terminal	Yes
DONIL	39.0765	-75.3053	10:15	6	6	En Route	Yes
ACY	39.4559	-74.5763	10:24	6	6	En Route	Yes
PANZE	39.6760	-74.1662	10:30	6	6	En Route	Yes
CAMRN	40.0173	-73.8611	10:36	6	6	En Route	Yes
KJFK	40.6399	-73.7787	10:45	6	6	Terminal	Yes

Notes: No outages predicted along route

Figure 7–36. Sample Printed Prediction

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8. ADAPT INTERFACE

The ADS–B Deviation Authorization Pre-Flight Tool (ADAPT) functions as an extension of the SAPT interface. If you intend to fly an aircraft that will fail to meet Title 14 – Code of Federal Regulations Part §91.225 or §91.227, you have an opportunity to ask for a deviation from Air Traffic Control under certain circumstances.

There are two ways to get to the ADAPT interface. One method is to scroll down the SAPT Home page until the ADAPT Authorization Tool section of the web site is in view (refer to Figure 8–1, ADAPT Authorization Tool on SAPT Home Page).

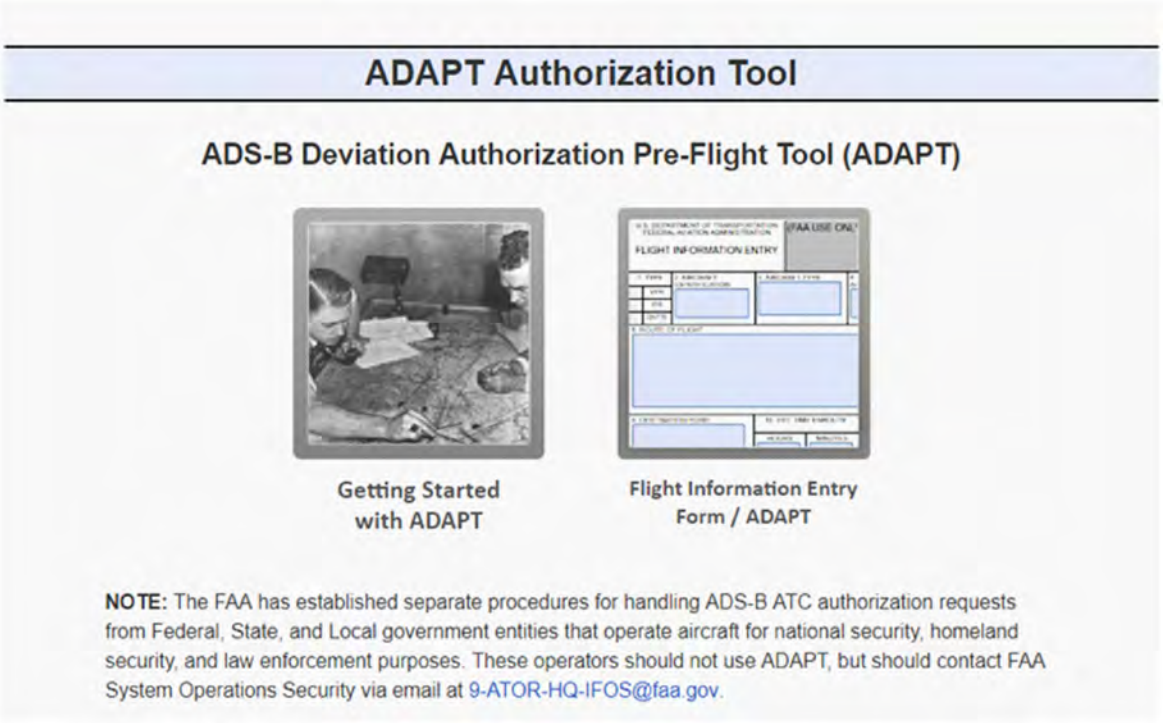

Figure 8–1. ADAPT Authorization Tool on SAPT Home Page

Click the **Getting started with ADAPT** tab to display the ADAPT quick-start guide. This same page can also be found by clicking **Getting started with ADAPT** under the ADAPT header on the SAPT Home page.

The Getting Started information includes links to additional items related to ADAPT, including:

- “Getting started with ADS–B” page found in Section 7.2.
- A Copy of this User Guide in Section 7.2.
- FAA Systems Operations Security detailed in the following Section 8.1.1, User Feedback.
- User Feedback form details found in Section 7.2.1.

A snapshot of the *Getting Started with ADAPT* page is shown below in Figure 8–2, Getting Started with ADAPT.

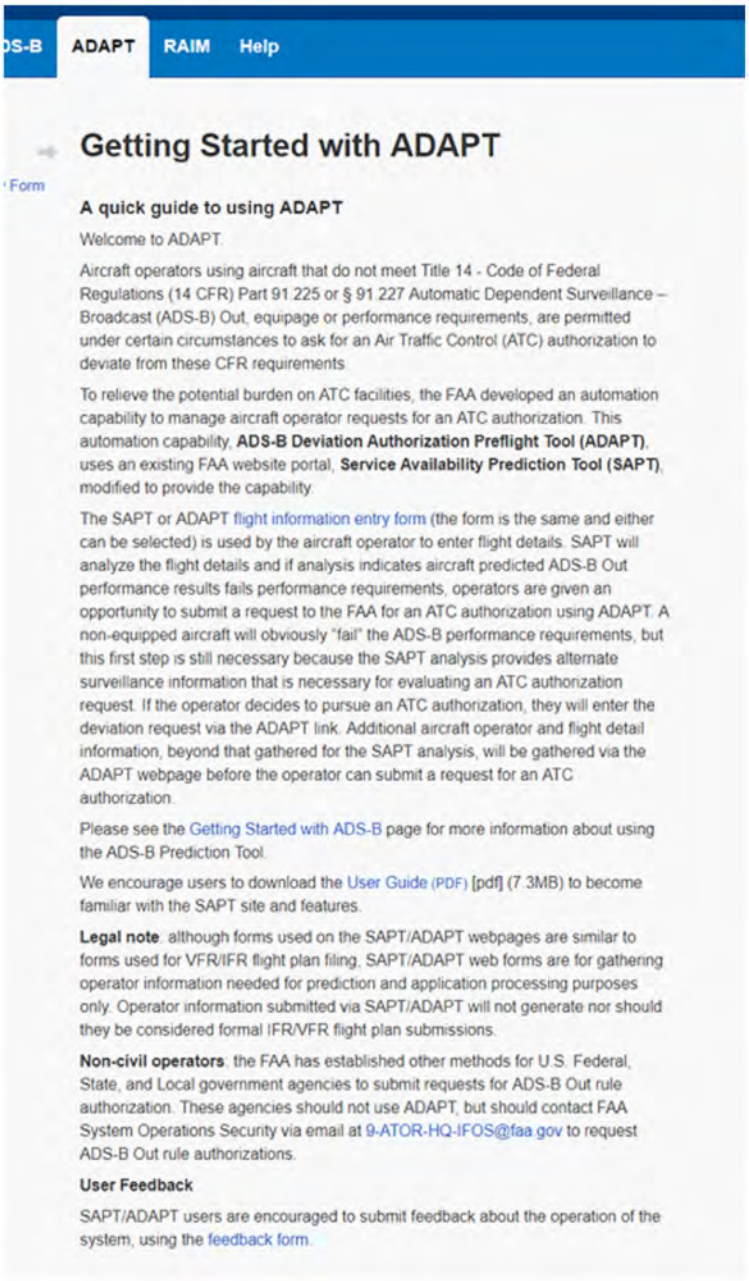

Figure 8–2. Getting Started with ADAPT

8.1 Non-civil Operators

The FAA has established separate procedures for handling ADS–B ATC authorization requests from Federal, State, and Local government entities that operate aircraft for national security, homeland security, and law enforcement purposes. These operators should not use ADAPT, but should contact FAA System Operations Security via email at 9-ATOR-HQ-IFOS@faa.gov.

8.1.1 User Feedback

The user feedback form for ADAPT follows the same methods established for SAPT. Details for submitting user feedback are found in Section 7.2.1.

8.2 Flight Information Entry Form

Click the Flight Information Entry Form to open it and enter flight plan information. Further instructions are presented in Section 7.5, Flight Information Entry Form and Section 7.6, Saving and Loading a Flight Information Entry Form.

After you enter your flight plan details into the form, you will see an updated page showing the predicted ADS–B coverage along the proposed route of flight. ADAPT uses the SAPT system to predict ADS–B outages within rule airspace, and alternate surveillance coverage availability for any waypoints not predicted to meet the required position accuracy or integrity.

NOTE: For unequipped aircraft or aircraft with inoperative ADS–B avionics, the SAPT will check for alternate surveillance at all waypoints in rule airspace. The ADS–B coverage prediction is described in Section 7.7, Prediction Output.

If there is insufficient ADS–B coverage predicted for the proposed route of flight, you have the option to submit a deviation request for the route. This option is displayed using an additional button below the ADS–B Prediction. An example of this for a prediction of insufficient performance is shown in Figure 8–3, Deviation Request Button. For an example of the button for a prediction for an unequipped flight, see Figure 8–4, Deviation Request Button with prediction results for unequipped flight.

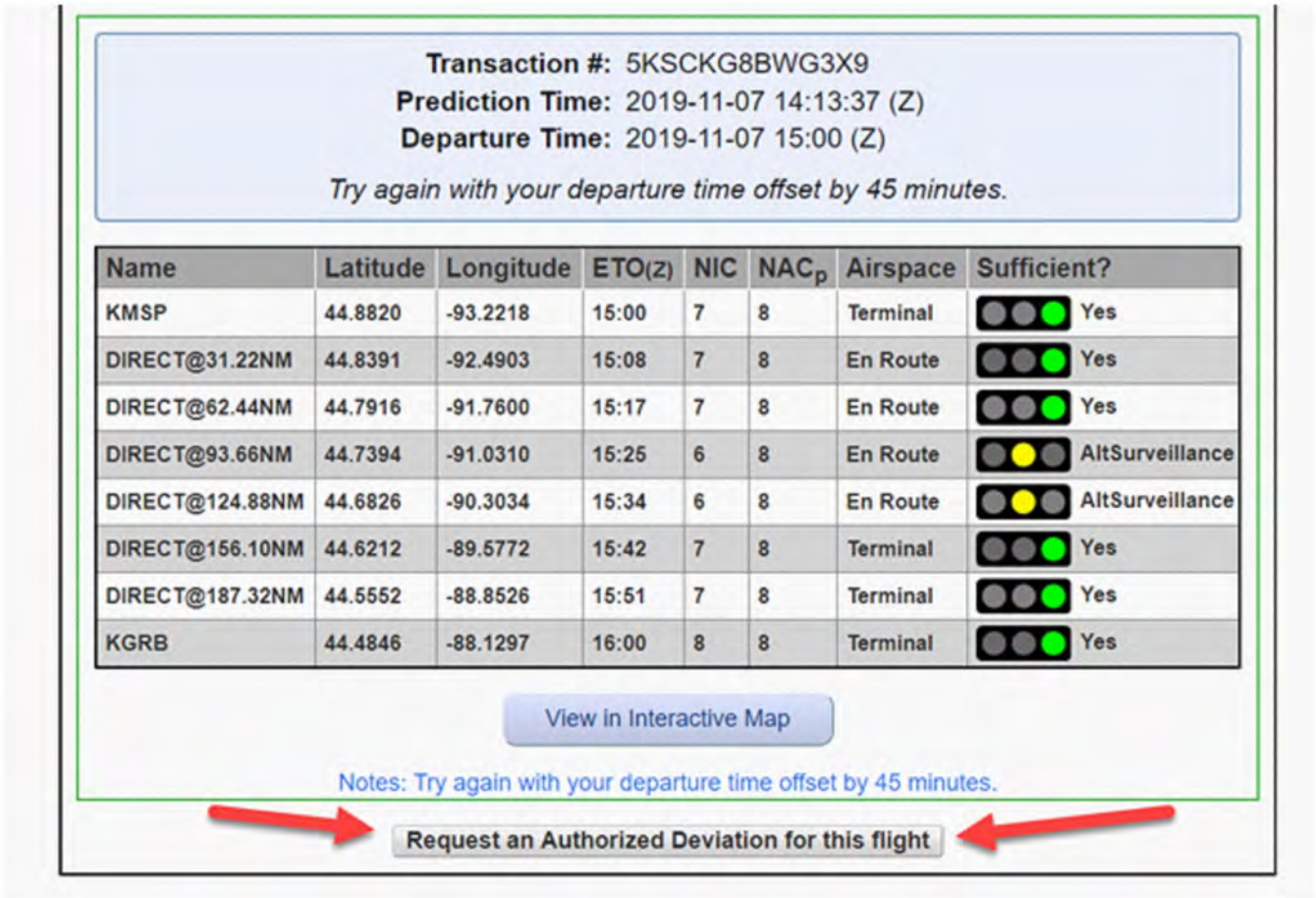

Figure 8–3. Deviation Request Button

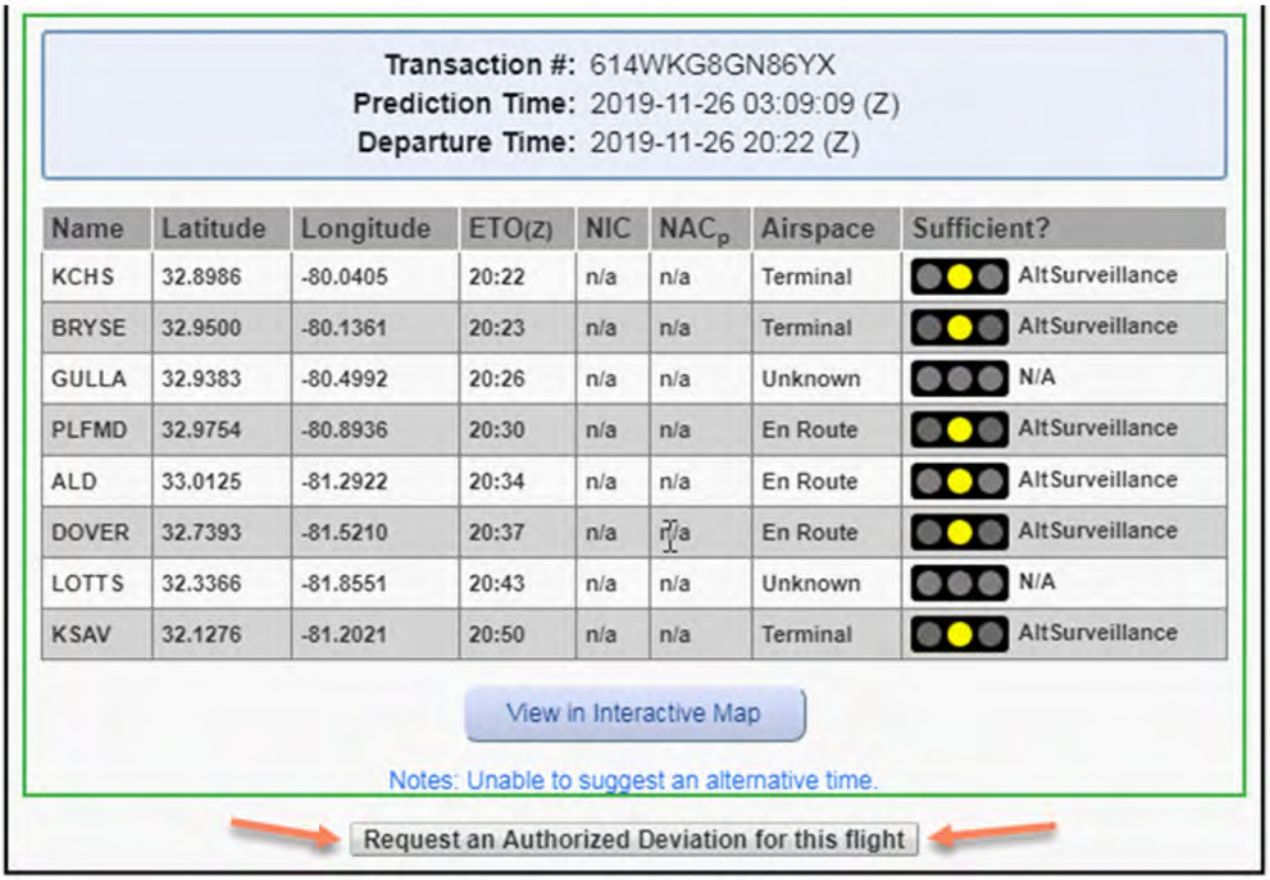

Figure 8–4. Deviation Request Button with prediction results for unequipped flight

Clicking on this button will display the Deviation Request form, where additional user details will be gathered.

It is recommended that you save your completed Flight Information Entry Form to a file or a URL so that you will not need to retype it. You should consider rerouting if possible to avoid any red points on your route, as flights without surveillance coverage are more likely to be denied. Or, for an aircraft with ADS–B equipment installed and working, it will be worth the effort to reroute or reschedule around the insufficient waypoints to get to a green prediction, avoiding the need to request an ATC authorized deviation.

8.2.1 Deviation Request Form

The Deviation Request form allows you to input details describing the nature of your request. To complete the request, each of the following fields must be filled. Some information must be entered manually; other items have drop-down menus:

- Pilot-in-Command (PIC) name*
- PIC Telephone Number*
- PIC Email address*
- Aircraft Identification

- Reason for the request
- Flight Classification
- ADS–B Equipment Status
- Operational Transponder with Altitude Encoding
- Comments
- Check-box certifying the truthfulness of the form. This box must be checked or the “submit’ button can’t be activated.

*PIC or designated representative

An example of the Deviation Request Form is shown in Figure 8–5, Deviation Request Form.

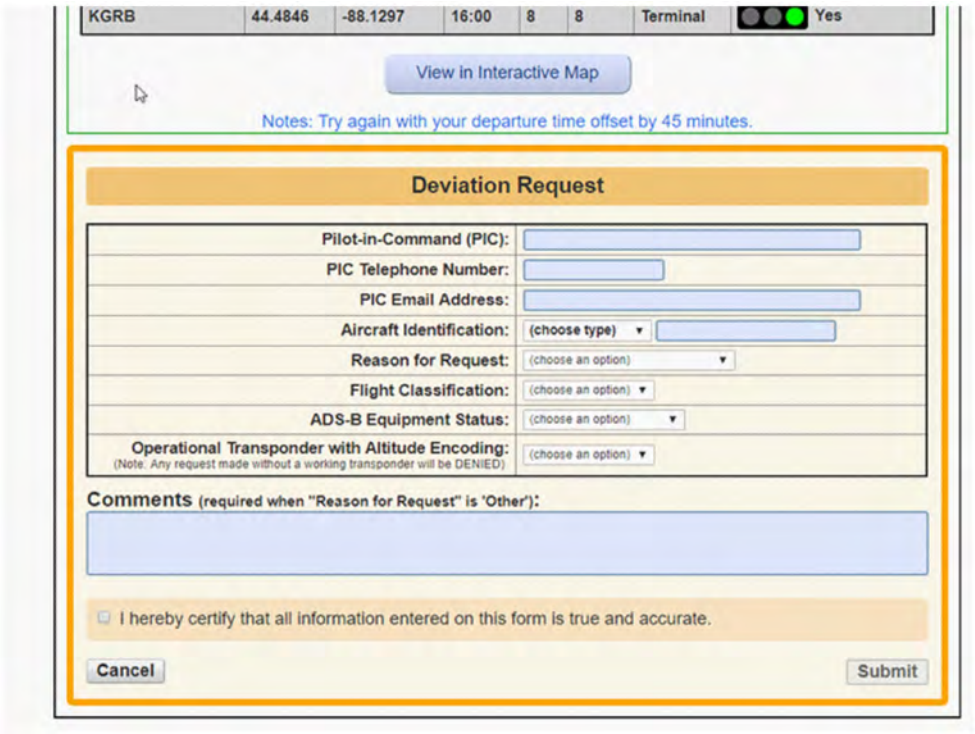

Figure 8–5. Deviation Request Form

You may enter the aircraft identification as either a US Tail Number or an ICAO address, however, the correct corresponding format in the drop-down menu from the list below must be specified:

- US Tail Number
- ICAO (Hexadecimal)
- ICAO (Octal)
- ICAO (Decimal)

See the example in Figure 8–6, Aircraft Identification Drop-down Menu

Figure 8–6. Aircraft Identification Drop-down Menu

NOTE: The US Tail Number option is only available for US-registered aircraft. Non-US operators will need to use one of the ICAO address formats.

For the Reason for Request you should select a reason that applies to your proposed flight, but if no reason applies, or if the reason field is inadequate to describe your intent, you may choose “Other.” If you do select “Other,” you must also enter a comment. If your request is referred for adjudication and forwarded to FAA personnel for review, i.e., marked “Pending,” the reviewer will see your comment. This is an opportunity for you to provide additional event details and present a case for approval. However, there are some situations in which a request is automatically denied – i.e., there is no working transponder with altitude, the flight plan was logged within an hour of departure, or the aircraft is on the NSAL. Below is the list of reasons from which you can choose:

- ADS–B Equipment Installation
- ADS–B Equipment Repair
- Insufficient GPS
- Ferry Aircraft
- Fringe Operation
- Crop Duster
- Antique
- Other

You will need to select the flight classification for the request from a limited list:

- Part 91 (If no other Part applies, use Part 91.)
- Part 121
- Part 129
- Part 135

You will also have to select the ADS–B Equipment Status from the list:

- Unequipped
- Inoperative
- Insufficient performance (This selection is for the circumstance where the GPS position source for ADS–B is not predicted to meet requirements of the rule for all waypoints.)

The last field on the form is Operational Transponder with Altitude Encoding. Select either Yes or No for this field.

NOTE: Any request made for an aircraft without a working transponder will be **DENIED.**

You are allowed to enter additional comments if necessary to support your request. This field is optional unless you have selected “Other” for your Reason for Request. Your comment will not be seen if your request is automatically approved.

You must click the check box at the bottom of the page to certify that the information you have entered is true and accurate before you will be allowed to submit the Deviation Request form.

Click **Submit** at the bottom right corner to submit the request. Press **Cancel** in the bottom left corner if you change your mind. Doing so will remove the deviation request from your screen, leaving the prediction and flight information entry form open.

8.2.2 Deviation Request Submission

After you press **Submit,** you should see an immediate response and an updated screen describing the status of the request. You will also receive an official email which will contain additional request status details. For requests labelled “Pending,” an immediate email response will be sent advising that the request is in pending status. A second email will be sent when a pending request has been resolved. There are only two responses available for pending requests, either approved or denied. It is possible that a pending request may “time out” because an adjudicator was not able to review the request between the time the request was submitted and 30 minutes prior to the proposed departure time. A “timed out” event will automatically result in a denial email. You can minimize the possibility of that happening by submitting your request further in advance.

NOTE: If you have not received an update 30 minutes prior to the proposed departure time the request will be denied.

You may wish to keep your approval email. Sample emails are in Appendix B. Sample responses are below:

- Approved (Figure 8–7, Approved Request Status)
- Denied (Figure 8–8, Denied Request Status)
- Pending (Figure 8–9, Pending Request Status)

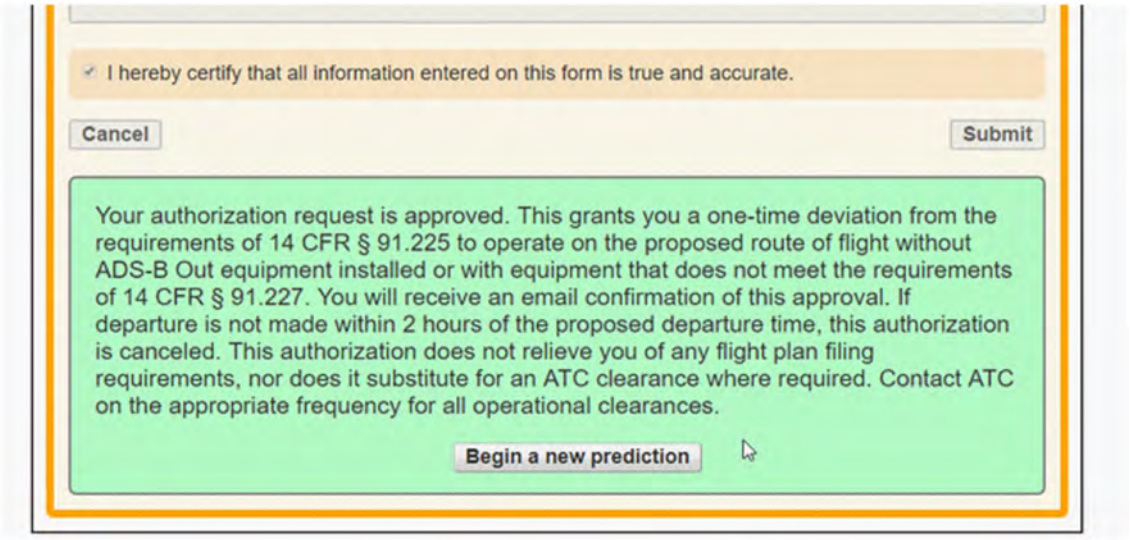

Figure 8–7. Approved Request Status

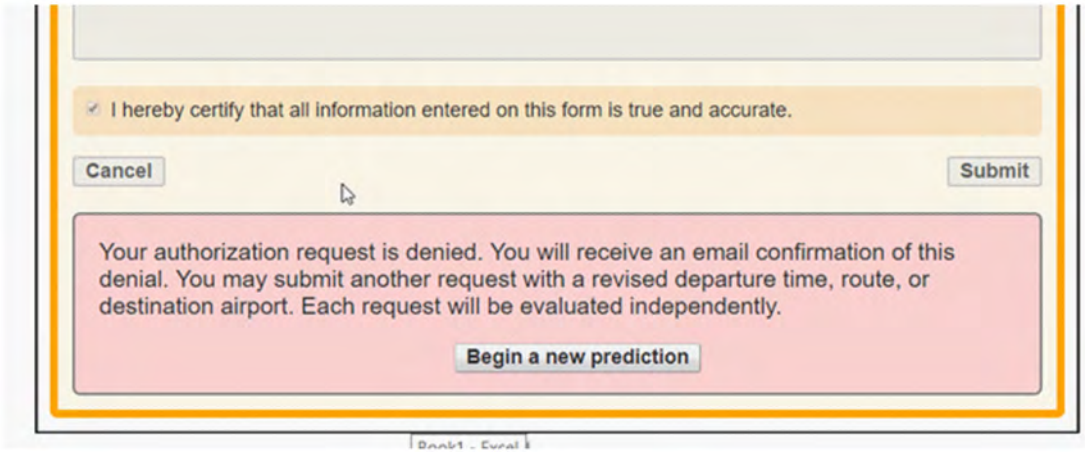

Figure 8–8. Denied Request Status

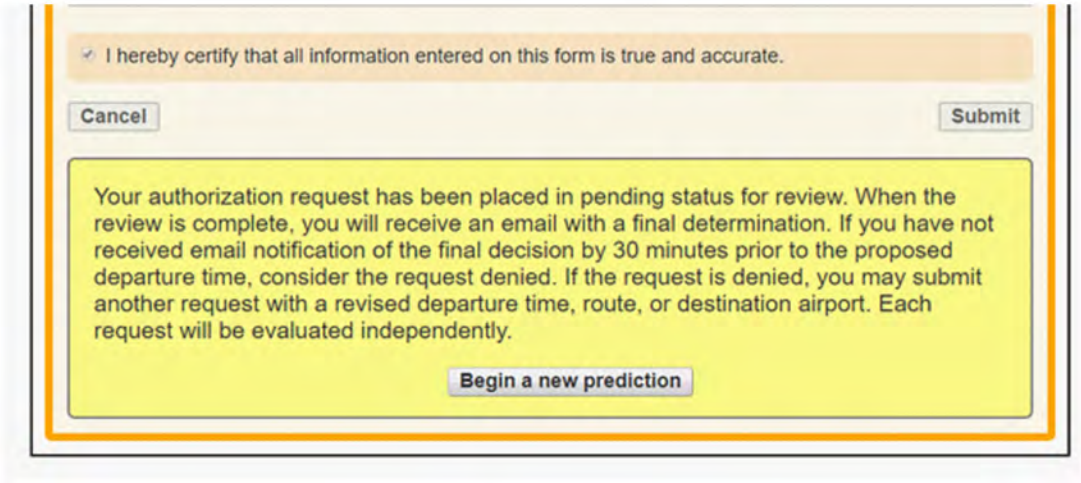

Figure 8–9. Pending Request Status

The Flight Information Entry Form locks when a request is submitted for an authorized deviation based on a prediction. Once your request is submitted and you have received a response with the status of your request, you have the option of starting a new prediction. You can also save your current prediction request as a URL and then copy and paste that URL into your browser address bar. Up until the point that you click **Request an Authorized Deviation**, you can continue to change the route of flight in an attempt to optimize surveillance coverage and improve your chances of getting approval. Try to find a route with no red waypoints, or, if your aircraft is equipped with ADS–B, try to find a route and time with the fewest yellow waypoints.

To start a new prediction from scratch in the same window, click **Begin a new prediction** at the bottom of the webpage. That will unlock and clear the Flight Information Entry Form. This new prediction will start from a blank Flight Information Entry Form where new flight information entries will be required.

9. ADS–B XML INTERFACE

The SAPT is primarily an XML-based web service. For users who periodically need to check if their GPS-based position source will be adequate for ADS–B along their route of flight, the HTML front end will work well. Many users employ flight planning software, however, which may be developed in-house or from a third-party vendor. The XML web service is recommended for these users.

If you use flight planning software from a third-party vendor, please contact that vendor to request that the XML web service be incorporated into the software. If you have more control over the flight planning software, please follow the procedure in Section 9.1, WSDL to request a copy of the SAPT WSDL and Software Development Kit (SDK). Most Integrated Development Environments (IDE) can build a skeleton structure from the WSDL and streamline the development process.

9.1 WSDL

The ADS–B web service is being updated and the present WSDL, which is documented here, is being replaced. The new version is referred to as 'sapt-2.2'. This version incorporates changes for SAPT 4.0, including the new “disposition” keyword. Another change is that waypoints in the past at the beginning of a route of flight will no longer be grounds for returning an error for the route. This is intended to make it easy to run a SAPT check midflight to validate a potential route change.

You may request the 'SAPT20-SDK' WSDL through the RAIM or ADS–B XML pages. To request the WSDL from the ADS–B XML page, scroll to the bottom of the page and click the **Request a copy of the SAPT WSDL and SDK** link (refer to Figure 9–1, WSDL Request Link).

Figure 9–1. WSDL Request Link

When you click **DOWNLOAD**, the application generates a pop-up dialog (refer to Figure 9–2, Download the SAPT SDK Pop-up).

Figure 9–2. Download the SAPT SDK Pop-up

Clicking **Save As** allows you to choose the location where you want to save it on the computer (refer to Figure 9–3, Save the SAPT SDK).

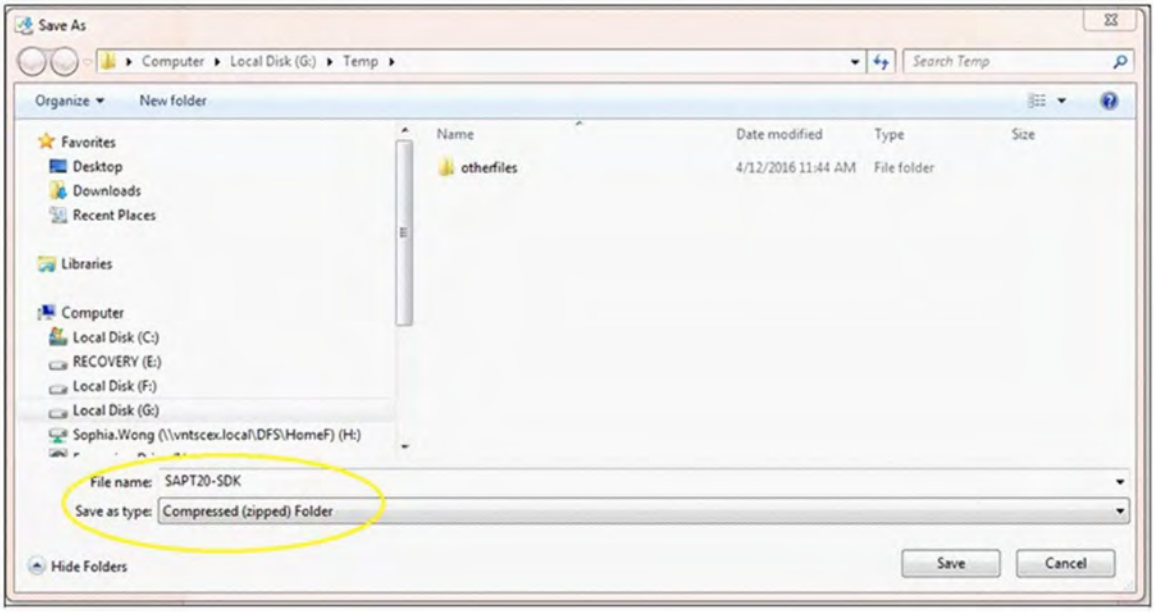

Figure 9–3. Save the SAPT SDK

Click **Open** to save the file to the temporary internet files folder on the computer (refer to Figure 9–4, Open the SAPT SDK).

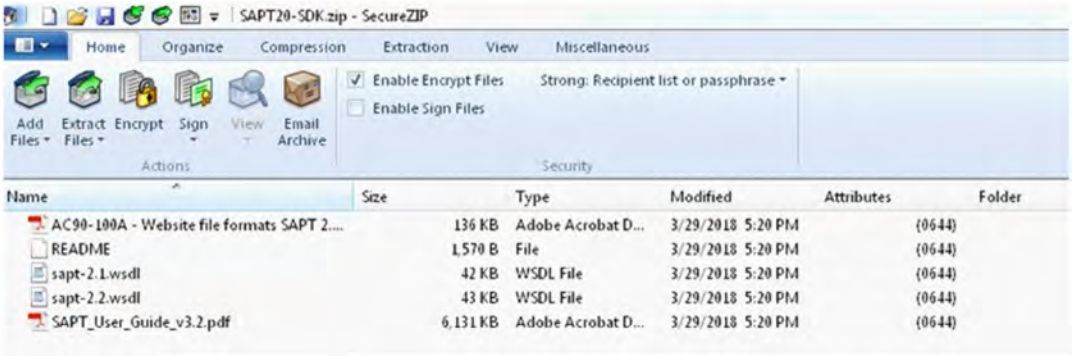

Figure 9–4. Open the SAPT SDK

The SDK archive contains the WSDL and other files that might be useful for developing software to interface with SAPT.

Figure 9–5, XML Web Service — Classes and Types, is a Unified Modeling Language (UML) diagram of the various information classes and types employed by the web service.

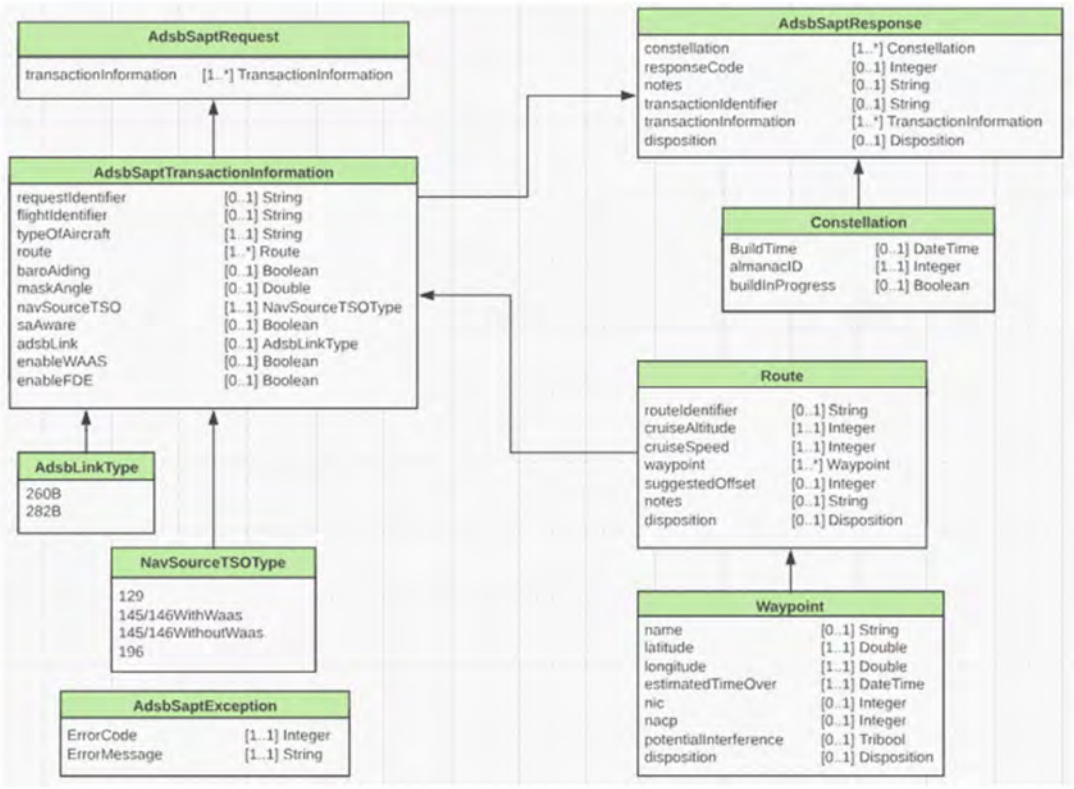

Figure 9–5. XML Web Service — Classes and Types

9.2 Classes and Types

The primary class is the ‘AdsbSaptTransactionInformation’ class, shown in Table 9–3, ADS–B SAPT Transaction Information, which contains all the information that requests and responses have in common.

The ADS–B for Route Request (refer to Table 9–1, ADS–B Sufficiency for Route Request) contains only what is in AdsbSaptTransactionInformation, while the ADS–B Sufficiency for Route Response shown in Table 9–2, ADS–B Sufficiency for Route Response, contains more fields.

Table 9–5, Route Information, and Table 9–6, Waypoint Information, provide more details about the Route and Waypoint. Table 9–8, ADS–B SAPT Exception, describes AdsbSaptException information classes used by the XML web service. Table 9–7, Disposition Information, describes the results returned in the Disposition keyword.

For sample responses, please refer to Figure 9–6, ADS–B SAPT Request, Figure 9–7, ADS–B SAPT Response with Alternate Surveillance, Figure 9–8, Example: Code for an Expired Route, and Figure 9–9, Example: Code for a Sufficient Route. Figure 9–6, Figure 9–7, and Figure 9–8 provide examples of valid SAPT requests and responses in XML format.

Table 9–1. ADS–B Sufficiency for Route Request

Field Name	Type	Required?	Definition
transaction Information	Transaction Information	Yes	The requested transaction information. **NOTE:** Refer to Table 9–3.

Table 9–2. ADS–B Sufficiency for Route Response

Field Name	Type	Required?	Definition
constellation	Constellation	No, Response Only	Constellation build information (refer to Table 9–4, Constellation Information).
responseCode	Integer	No, Response Only	0 if the request was successfully processed, a negative number otherwise.
Notes	String	No, Response Only	An explanation for a failed request and/or information about upcoming system outages/changes.
transaction- Identifier	String	No, Response Only	The transaction number assigned to the request by the system.
disposition	Disposition	No, Response Only	Describes the prediction result for the transaction (see Disposition).
transaction- Information	Transaction Information	No, Response	The requested transaction information. **NOTE:** Refer to Table 9–3.

Table 9–3. ADS–B SAPT Transaction Information

Field Name	Type	Required?	Definition
requestIdentifier	String	No	Optional string to identify your request.
flightIdentifier	String	No	Optional string to identify the flight to which the request pertains (either tail number or flight Identification (ID)).
typeOfAircraft	String	Yes	The ICAO identifier of the aircraft.

Table 9–3. ADS–B SAPT Transaction Information (Continued)

Field Name	Type	Required?	Definition
route	Route	Yes	One or more routes on which to perform the prediction (refer to Table 9–5).
baroAiding	Boolean	No	True if the aircraft is equipped with a GPS-based navigation source that utilizes BA. False otherwise. Default is False.
maskAngle	Double	No	The mask angle (in degrees) utilized by the GPS-based navigation source. Default is 5.0 (degrees).
navSourceTSO	Nav-SourceTSO Type	Yes	The TSO number for the navigation source.
adsbLink	AdsbLinkType	No	The TSO number for the aircraft's ADS–B transponder.
saAware	Boolean	No	True if the aircraft is equipped with a TSO–C129 with no saAware navigation source. False with saAware.
enableWAAS	Boolean	No	A true or false value specifying whether "WAAS" is supported by the avionics.
enableFDE	Boolean	No	A true or false value specifying whether "FDE" is supported by the avionics.
disposition	Disposition	No, Response Only	Describes the prediction result for the transaction (see Disposition).

Table 9–4. Constellation Information

Field Name	Type	Required?	Definition
buildTime	DateTime	No, Response Only	The time that the constellation is being built
almanacId	Integer	No, Response Only	To identify the GPS almanac that was used in the constellation build.
buildInProgress	Boolean	No, Response Only	True if the constellation is currently being rebuilt. This indicates that the data used for the prediction may be obsolete and that the prediction should be retried after a short delay.

Table 9–5. Route Information

Field Name	Type	Required?	Definition
routeIdentifier	String	No	Optional for the waypoint.
cruiseAltitude	Integer	Yes	Aircraft Cruising Altitude specified in ft
cruiseSpeed	Double	No	Aircraft Cruising Speed specified in knots
waypoint	Waypoint information	Yes	Waypoint information (refer to Table 9–6).
suggestedOffset	Integer	No, Response Only	Returns a value of zero when all waypoints in the route have sufficient coverage and a value of -1 when at least one waypoint does not have sufficient coverage. Any other non-zero integer indicates a suggested change to departure time (specified in minutes) that may result in an increased chance of meeting the rule (however this is not supported for XML-based requests).
notes	String	No, Response Only	Returned note on the route

Table 9–6. Waypoint Information

Field Name	Type	Required?	Definition
name	String	No	An optional name for the waypoint.
latitude	Double	Yes	The latitude of the waypoint in decimal degrees.
longitude	Double	Yes	The longitude of the waypoint in decimal degrees.
estimatedTimeOver	DateTime	Yes	The anticipated time the aircraft is expected to arrive at the waypoint.

Table 9–6. Waypoint Information (Continued)

Field Name	Type	Required?	Definition
nic	Integer	No, Response only	The NIC as predicted by the system. Anything provided by you is overwritten by the system. NIC is not computed or returned for expired waypoints.
nacp	Integer	No, Response Only	The NACp as predicted by the system. **NOTE:** Anything provided by you is overwritten by the system. NACp is not computed or returned for expired waypoints.
disposition	Disposition	No, Response Only	Describes the prediction result for the transaction (see Disposition).
potentialInterference	Tribool	No, Response Only	Returns "true" if the waypoint is predicted to be subject to potential GPS Interference Tests and "false" if not. Returns "unspecified" for waypoints that are outside of US airspace.

Table 9–7. Disposition Information

Field Name	Type	Required?	Definition
disposition	String	No, Response Only	Describes the prediction result: On the Waypoint, returns a value determined by the first matching condition as follows: *Expired:* If the waypoint ETO is in the past (no prediction was performed) *Unregulated:* If the waypoint is outside controlled US airspace *Sufficient:* If the waypoint is predicted to meet the required

Table 9–7. Disposition Information (Continued)

Field Name	Type	Required?	Definition
			integrity and accuracy, i.e., if NIC is predicted to be >= 7 and NACp is predicted to be >= 8 *AlternateSurveillance:* If the position fix at the waypoint is predicted not to meet the required integrity or accuracy, but to be covered by another form of surveillance *Insufficient:* None of the above, i.e., if the position fix at the waypoint is predicted not to meet the required integrity or accuracy, or to be covered by another form of surveillance On the Route, returns a value determined by the first matching condition as follows: *Expired:* If all waypoints in the route are either unregulated or expired *Unregulated:* If all waypoints in the route are unregulated *Sufficient:* If all waypoints in the route are sufficient, unregulated or expired *Insufficient:* If any waypoint in the route was insufficient

Table 9–7. Disposition Information (Continued)

Field Name	Type	Required?	Definition
			AlternateSurveillance: If one or more waypoints in the route returns AlternateSurveillance and no points are insufficient On the Transaction, returns a value determined by the first matching condition as follows: *Expired:* If all routes in the transaction are either unregulated or expired *Unregulated:* If all routes in the transaction are unregulated *Sufficient:* If all regulated, unexpired routes in the transaction are sufficient *Insufficient:* If any route in the transaction is insufficient *AlternateSurveillance:* If any routes in the transaction returned AlternateSurveillance and none returned insufficient

Table 9–8. ADS–B SAPT Exception

Field Name	Type	Definition
ErrorCode	Integer	This number should be included when requesting help.
ErrorMessage	String	A description of the error.

9.3 Request and Response Example

The following two images provide examples of a valid AdsbSaptRequest and of AdsbSaptResponse in XML form, respectively.

```
23T03:32:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>GRAYM</name>
                          <latitude>42.10118</latitude>
                          <longitude>-72.03152</longitude>
                          <estimatedTimeOver>2015-12-
23T03:37:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>WITNY</name>
                          <latitude>42.04939</latitude>
                          <longitude>-72.23665</longitude>
                          <estimatedTimeOver>2015-12-
23T03:42:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>BDL</name>
                          <latitude>41.94101</latitude>
                          <longitude>-72.68857</longitude>
                          <estimatedTimeOver>2015-12-
23T03:47:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>BRISS</name>
                          <latitude>41.70129</latitude>
                          <longitude>-73.01558</longitude>
                          <estimatedTimeOver>2015-12-
23T03:51:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>K4B8</name>
                          <latitude>41.69037</latitude>
                          <longitude>-72.86482</longitude>
                          <estimatedTimeOver>2015-12-
23T04:26:19.112Z</estimatedTimeOver>
                    </waypoint>
              </route>
        </getAdsbSufficiencyForRoute>
        </soapenv:Body>
</soapenv:Envelope>
  <?xml version="1.0" encoding="utf-8"?>
  <soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soapenv:Body>
        <getAdsbSufficiencyForRoute>
              <requestIdentifier>REQTODO1</requestIdentifier>
              <flightIdentifier>ZZVTSTFLT1</flightIdentifier>
              <typeOfAircraft>DC10</typeOfAircraft>
              <baroAiding>false</baroAiding>
              <maskAngle>2.5</maskAngle>
              <navSourceTso>129</navSourceTso>
              <saAware>false</saAware>
              <adsbLink>260B</adsbLink>
              <route>
              <routeIdentifier>TSTRT1</routeIdentifier>
                    <cruiseAltitude>35000</cruiseAltitude>
                    <cruiseSpeed>450</cruiseSpeed>
                    <suggestedOffset>0</suggestedOffset>
                    <notes/>
                    <waypoint>
                          <name>KLWM</name>
                          <latitude>42.71719</latitude>
                          <longitude>-71.12341</longitude>
                          <estimatedTimeOver>2015-12-
  23T02:59:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>COTEE</name>
                          <latitude>42.49506</latitude>
                          <longitude>-71.11886</longitude>
                          <estimatedTimeOver>2015-12-
  23T03:06:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>SOSYO</name>
                          <latitude>42.48734</latitude>
                          <longitude>-71.43215</longitude>
                          <estimatedTimeOver>2015-12-
  23T03:17:19.112Z</estimatedTimeOver>
                    </waypoint>
                    <waypoint>
                          <name>BOSOX</name>
                          <latitude>42.20188</latitude>
                          <longitude>-71.62767</longitude>
                          <estimatedTimeOver>2015-12-
```

Figure 9–6. ADS–B SAPT Request

```
<?xml version="1.0" encoding="utf-8"?>
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<soapenv:Body>
      <getAdsbSufficiencyForRoute>
            <requestIdentifier>REQTODO1</requestIdentifier>
            <flightIdentifier>ZZVTSTFLT1</flightIdentifier>
            <typeOfAircraft>DC10</typeOfAircraft>
            <baroAiding>false</baroAiding>
            <maskAngle>2.5</maskAngle>
            <navSourceTso>129</navSourceTso>
            <saAware>false</saAware>
            <adsbLink>260B</adsbLink>
            <route>
            <routeIdentifier>TSTRT1</routeIdentifier>
                  <cruiseAltitude>35000</cruiseAltitude>
                  <cruiseSpeed>450</cruiseSpeed>
                  <suggestedOffset>0</suggestedOffset>
                  <notes/>
                  <waypoint>
                        <name>KLWM</name>
                        <latitude>42.71719</latitude>
                        <longitude>-71.12341</longitude>
                        <estimatedTimeOver>2015-12-
23T02:59:19.112Z</estimatedTimeOver>
                  </waypoint>
                  <waypoint>
                        <name>COTEE</name>
                        <latitude>42.49506</latitude>
                        <longitude>-71.11886</longitude>
                        <estimatedTimeOver>2015-12-
23T03:06:19.112Z</estimatedTimeOver>
                  </waypoint>
                  <waypoint>
                        <name>SOSYO</name>
                        <latitude>42.48734</latitude>
                        <longitude>-71.43215</longitude>
                        <estimatedTimeOver>2015-12-
23T03:17:19.112Z</estimatedTimeOver>
                  </waypoint>
                  <waypoint>
                        <name>BOSOX</name>
                        <latitude>42.20188</latitude>
                        <longitude>-71.62767</longitude>
                        <estimatedTimeOver>2015-12-
```

Figure 9–7. ADS–B SAPT Response with Alternate Surveillance

9.4 Request and Response: Examples for Expired and Sufficient Routes

The following images illustrate the code for one expired and one sufficient route.

```
<?xml version="1.0" encoding="utf8"?>
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
 xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
 <soapenv:Body>
  <AdsbSufficiencyForRoute_Response xmlns="">
   <requestIdentifier>ZZV_Cally#2</requestIdentifier>
   <constellation>
    <buildTime>2018-03-29T08:05:00.000Z</buildTime>
    <almanacId>1522310700000        </almanacId>
    <buildInProgress>false</buildInProgress>
   </constellation>
   <flightIdentifier>HI2345</flightIdentifier>
   <typeOfAircraft>DC10</typeOfAircraft>
   <navSourceTso>129</navSourceTso>
   <adsbLink>260B</adsbLink>
   <maskAngle>2.5</maskAngle>
   <baroAiding>false</baroAiding>
   <saAware>true</saAware>
   <enableNAAS>false</enableNAAS>
   <enableFDE>false</enableFDE>
   <route>
    <routeIdentifier>Cally#2A</routeIdentifier>
    <cruiseAltitude>35000</cruiseAltitude>
    <cruiseSpeed>450.0</cruiseSpeed>
    <waypoint>
     <name>KBOS</name>
     <latitude>42.363</latitude>
     <longitude>-71.0064</longitude>
     <estimatedTimeOver>2018-03-29T18:00:00.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>9</nacp>
     <disposition>Sufficient</disposition>
     <potentialInterference>false</potentialInterference>
    </waypoint>
    <waypoint>
     <name>DIRECT@14.28NM</name>
     <latitude>42.30371300403917</latitude>
     <longitude>-71.31755342173712</longitude>
     <estimatedTimeOver>2018-03-29T18:07:30.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>9</nacp>
     <disposition>Sufficient</disposition>
     <potentialInterference>false</potentialInterference>
    </waypoint>
    <waypoint>
     <name>BOSOX</name>
     <latitude>42.20188</latitude>
     <longitude>-71.62767</longitude>
     <estimatedTimeOver>2018-03-29T18:15:00.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>9</nacp>
     <disposition>Sufficient</disposition>
     <potentialInterference>false</potentialInterference>
    </waypoint>
    <waypoint>
     <name>DIRECT@4.62NM</name>
     <latitude>42.13104033515916</latitude>
     <longitude>-71.58752461315876</longitude>
     <estimatedTimeOver>2018-03-29T18:23:48.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>9</nacp>
     <disposition>Sufficient</disposition>
     <potentialInterference>false</potentialInterference>
    </waypoint>
    <waypoint>
     <name>DIRECT@9.50NM</name>
     <latitude>42.05552224506438</latitude>
     <longitude>-71.54749138914913</longitude>
     <estimatedTimeOver>2018-03-29T18:32:36.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>9</nacp>
     <disposition>Unregulated</disposition>
     <potentialInterference>unspecified</potentialInterference>
    </waypoint>
    <waypoint>
     <name>DIRECT@14.74NM</name>
     <latitude>41.97340247502529</latitude>
     <longitude>-71.50757988218776</longitude>
     <estimatedTimeOver>2018-03-29T18:41:24.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>9</nacp>
     <disposition>Unregulated</disposition>
     <potentialInterference>unspecified</potentialInterference>
    </waypoint>
    <waypoint>
     <name>DIRECT@20.59NM</name>
     <latitude>41.88059792703905</latitude>
     <longitude>-71.46780343313623</longitude>
     <estimatedTimeOver>2018-03-29T18:50:12.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>8</nacp>
     <disposition>Sufficient</disposition>
     <potentialInterference>false</potentialInterference>
    </waypoint>
    <waypoint>
     <name>KPVD</name>
     <latitude>41.724</latitude>
     <longitude>-71.428222</longitude>
     <estimatedTimeOver>2018-03-29T18:59:00.000Z</estimatedTimeOver>
     <nic>8</nic>
     <nacp>8</nacp>
     <disposition>Sufficient</disposition>
     <potentialInterference>false</potentialInterference>
    </waypoint>
    <disposition>Sufficient</disposition>
    <suggestedOffset>0</suggestedOffset>
    <notes/>
   </route>
```


Figure 9–8. Example: Code for an Expired Route

```
<route>
  <routeIdentifier>Cally#2B</routeIdentifier>
  <cruiseAltitude>35000</cruiseAltitude>
  <cruiseSpeed>450.0</cruiseSpeed>
  <waypoint>
    <name>KBOS</name>
    <latitude>42.363</latitude>
    <longitude>-71.0064</longitude>
    <estimatedTimeOver>2018-03-29T00:00:00.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>DIRECT@14.28NM</name>
    <latitude>42.30371300403917</latitude>
    <longitude>-71.31753542173712</longitude>
    <estimatedTimeOver>2018-03-29T00:07:30.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>BOSOX</name>
    <latitude>42.20188</latitude>
    <longitude>-71.62767</longitude>
    <estimatedTimeOver>2018-03-29T00:15:00.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>DIRECT@6.72NM</name>
    <latitude>42.310051470233745</latitude>
    <longitude>-71.58967685038363</longitude>
    <estimatedTimeOver>2018-03-29T00:23:48.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>DIRECT@13.83NM</name>
    <latitude>42.425041531484375</latitude>
    <longitude>-71.55151991351367</longitude>
    <estimatedTimeOver>2018-03-29T00:32:36.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>DIRECT@21.52NM</name>
    <latitude>42.549801042509515</latitude>
    <longitude>-71.51318358134297</longitude>
    <estimatedTimeOver>2018-03-29T00:41:24.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>DIRECT@30.15NM</name>
    <latitude>42.6906431618468</latitude>
    <longitude>-71.47464259012341</longitude>
    <estimatedTimeOver>2018-03-29T00:50:12.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <waypoint>
    <name>KMHT</name>
    <latitude>42.9328</latitude>
    <longitude>-71.4358</longitude>
    <estimatedTimeOver>2018-03-29T00:59:00.000Z</estimatedTimeOver>
    <disposition>Expired</disposition>
  </waypoint>
  <disposition>Expired</disposition>
  <suggestedOffset>-1</suggestedOffset>
  <notes>Unable to suggest an alternative time.</notes>
</route>
<transactionIdentifier>3QEHG3MGKD3N</transactionIdentifier>
<disposition>Sufficient</disposition>
<responseCode>0</responseCode>
<notes> Prediction Complete: 2018-03-29 17:21:13</notes>
</AdsbSufficiencyForRoute_Response>
</soapenv:Body>
</soapenv:Envelope>
```


Figure 9–9. Example: Code for a Sufficient Route

9.5 Interpreting The Results

You are responsible for interpreting the results. The results will include most of the same information as submitted, with the addition of NIC, NACp, and Sufficiency.

A point that does not have the ‘isSufficientForAdsb’ field is not within the defined ADS–B Service volume, and sufficiency does not apply. This situation is analogous to being set to “N/A” in the graphical interface.

The Notes section will include error information or other information that is useful to you, such as any planned system downtime. The XML response will also include a transaction ID that is unique to that transaction.

9.6 Error Conditions

Error conditions will typically be in the form of an AdsbSaptException, returned within a standard SOAP Fault response.

An AdsbSaptException may be generated in the event of a malformed request or non-nullable field being null, but may also be generated for less obvious reasons.

Lists the error code, error message, and corrective actions you should take for the less obvious error conditions (refer to Table 9–9, ADS–B SAPT Exception Error Information).

Table 9–9. ADS–B SAPT Exception Error Information

Error Code	Error Message	Corrective Actions
-2	Invalid number of routes submitted	Invalid number of routes submitted. Fix the number of routes to be sent to process.
-3	Invalid typeOfAircraft value (SAPT)	Fix the aircraft type that is supported by SAPT.
-4	Invalid value for navSourceTso (SAPT)	Fix the navSourceTso. Choose from this list: The valid values for this element are currently: "129", "145/146", and "196"
-6	Invalid cruiseAltitude value (SAPT)	Fix the cruiseAltitude to be within the range of 10 – 600.
-7	Too few waypoints submitted	Increase the number of waypoints to be submitted.
-9	Invalid latitude value	Change the waypoint latitude value. Latitude must be between +/-90.0 degrees.
-10	Invalid longitude value	Change the waypoint longitude value. Longitude must be between +/-180.0 degrees.
-11	Missing estimatedTimeOver value	Make sure the estimated-TimeOver value is entered.
-12	EstimatedTimeOver value is in the past	Make sure the estimated-TimeOver value is in the future.

Table 9–9. ADS–B SAPT Exception Error Information (Continued)

Error Code	Error Message	Corrective Actions
-13	Timed-out due to maxWaitAccepted	Set the maxWaitAccepted value to a larger number.
-14	Validator configuration error (SAPT)	Contact us at https://enroutesupport.faa.gov/sapt/feedback.aspx1
-15	Time-out from prediction servers	Try again in a couple of minutes. If you get the error again, contact us at https://enroutesupport.faa.gov/sapt/feedback.aspx1
-17	Invalid avionics options (TSO + SA,FDE,WAAS) (SAPT)	Make sure the avionics options are correct. • C129 • C129 with SA Aware • C129 with FDE • C129 with SA Aware & FDE • C145/146 with WAAS • C145/146 outside WAAS Coverage • C196
-18	Invalid maskAngle value (SAPT)	Make sure the maskAngle value is between 0 to 5.0 using half-degree increments
-19	HAL input is out of valid range (RAIM)	Make sure the HAL value is within range.
-99	Internal exception	None of the above errors. Contact us at https://enroutesupport.faa.gov/sapt/feedback.aspx

10. RAIM PREDICTION TOOL

The RAIM prediction model constructs the GPS constellation from a given almanac. The constellation is iterated over the prediction window using the specified time interval.

The RAIM algorithms implemented in the ADS–B SAPT have a confidence level of 99.99999 percent.

RAIM needs a minimum of five satellites in view, or four satellites and a barometric altimeter (baro-aiding), to detect an integrity anomaly. The GPS receiver verifies the usability of the signals received from the GPS constellation through RAIM to determine if a satellite is providing corrupted information.

In addition to the satellites required for navigation, at least one must be in view for the receiver to perform the RAIM function.

RAIM capability cannot be determined by simply counting the number of satellites in view. Since ADS–B reports rely primarily on GPS for information regarding aircraft position, the accuracy of the solution must be validated.

The HPL is calculated for each user's time and location. The HPL is a radius in the horizontal (latitude-longitude) plane around your calculated GPS position. The RAIM model ensures that, within the specified confidence level, your actual position is within the HPL radius of the calculated position. The HPL is converted to the NIC value which is used to determine sufficiency.

The SAPT provides maps of wide area outages as a flight planning aid for informational situational awareness only. Wide area outage maps are available for a limited subset of supported avionics for both ADS–B and RAIM.

10.1 Getting Started With RAIM

This page provides a summary introduction to the RAIM prediction tool, explains what users can accomplish in the web pages, and lays out the limitations of the tool. This page is shown in Figure 10–1, Getting Started with RAIM SAPT Page.

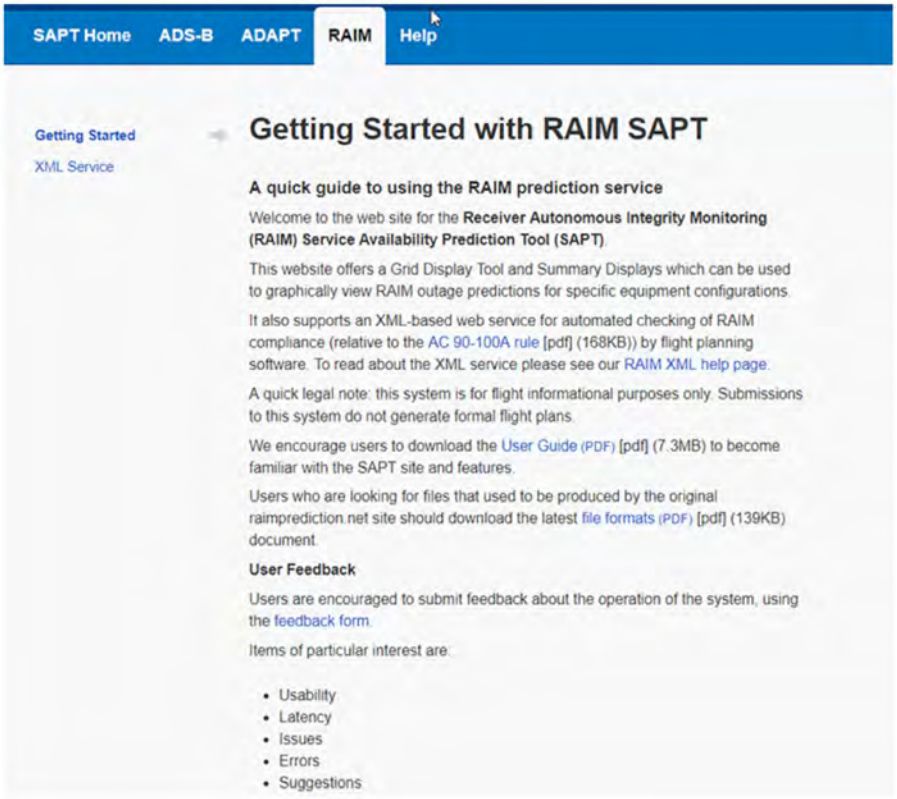

Figure 10–1. Getting Started with RAIM SAPT Page

10.2 RAIM XML Service

The RAIM SAPT is exclusively an XML-based web service, most commonly used by flight planning software (including both custom and third-party solutions).

If you use flight planning software from a third-party vendor, please contact the vendor and request that they incorporate our web service into their software.

If you build and/or maintain your own flight planning software, you may obtain a copy of the SAPT SDK and the WSDL file for the SAPT web service (refer to Figure 10–2, RAIM XML Service Page).

A WSDL file is a technical description of the software interface to a web service that programmers can use to write software that can communicate with a web service. The SAPT WSDL allows the SAPT service to be integrated with your flight planning capabilities.

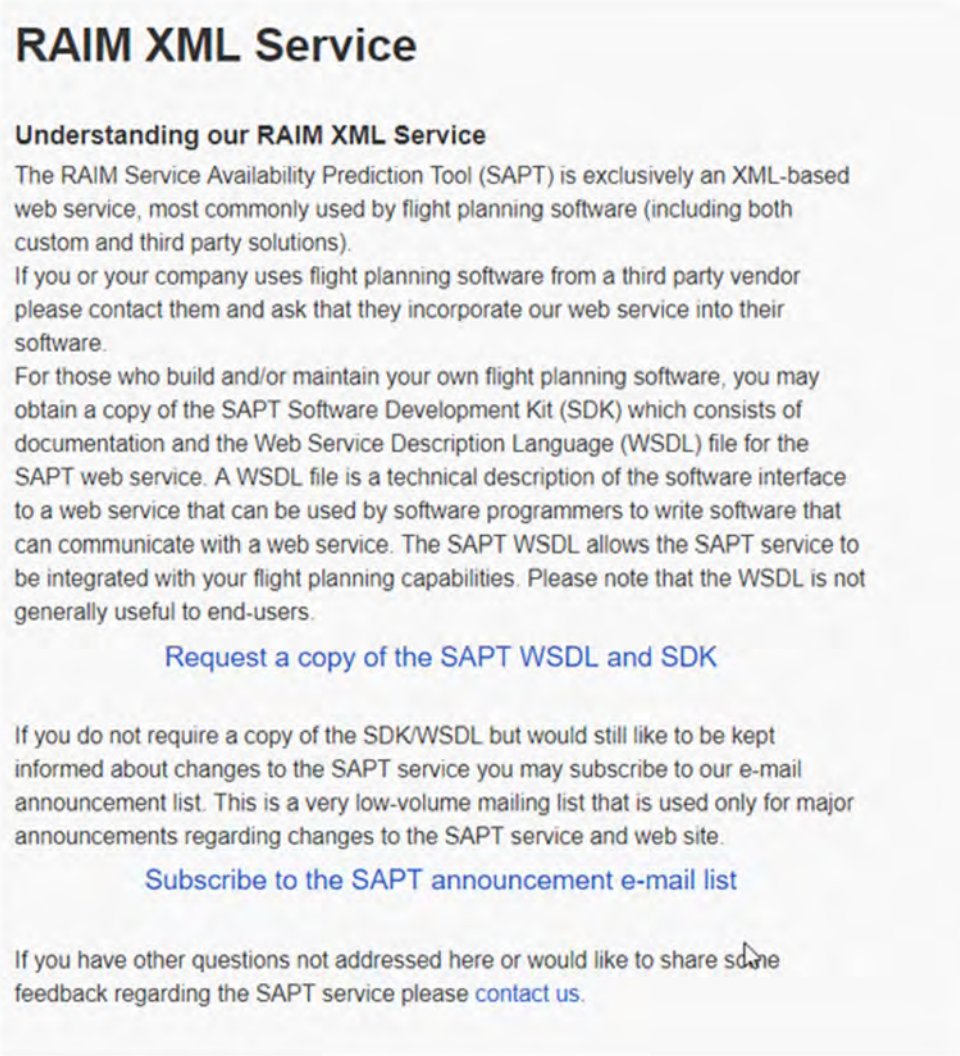

Figure 10–2. RAIM XML Service Page

10.2.1 Request The SAPT WSDL and SDK

If you do not require a copy of the SDK/WSDL but would like to be informed about changes to the SAPT service, you may subscribe to our e-mail announcement list. This is used only for major announcements regarding changes to the SAPT service and web site.

Click the **Request a copy of the SAPT WSDL and SDK** link on the RAIM XML Service page to open the download page (refer to Figure 10–3, Download the SAPT SDK).

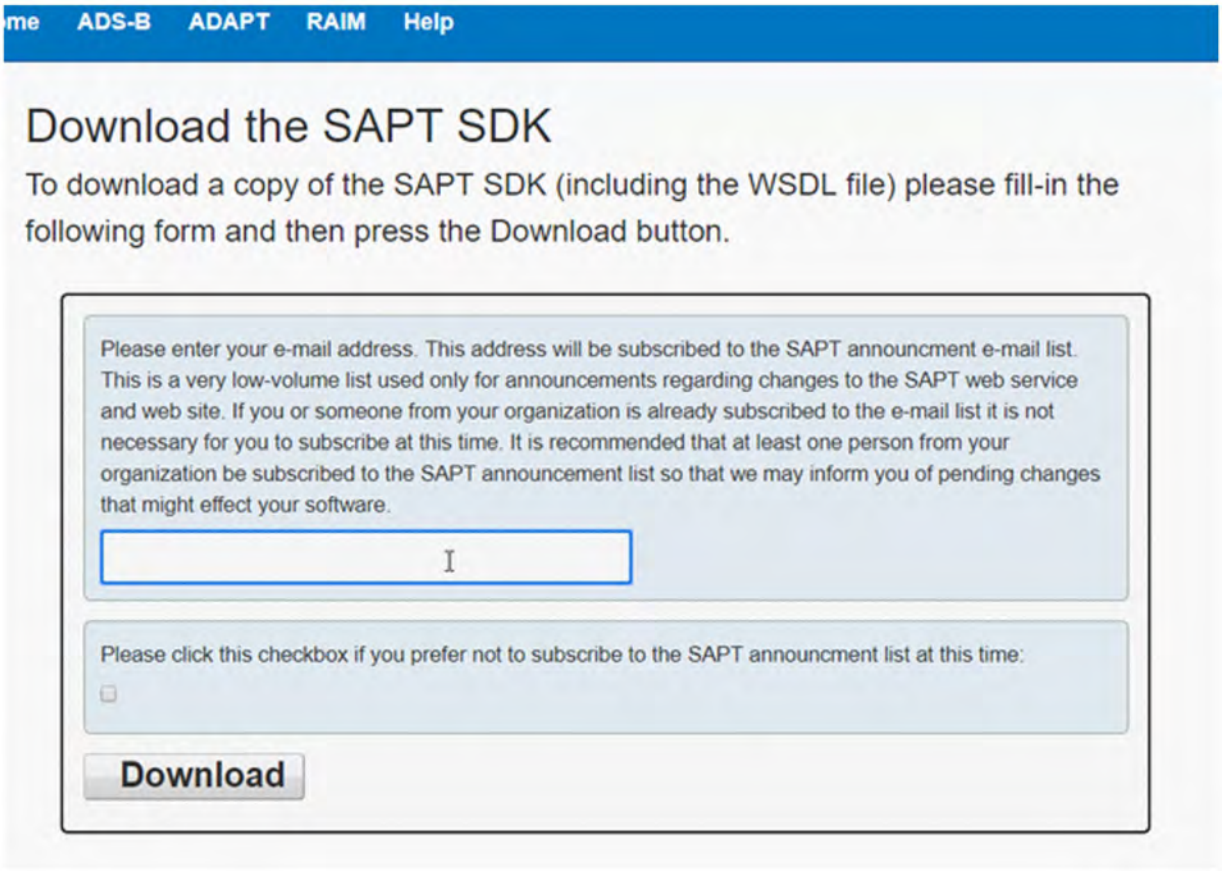

Figure 10–3. Download the SAPT SDK

When you click **Download**, the application generates a pop-up dialog (refer to Figure 10–4, Download the SAPT SDK Pop-up Window).

Figure 10–4. Download the SAPT SDK Pop-up Window

Click **Save As** if you want to choose the location where you save the file on your computer (refer to Figure 10–5, Save the SAPT SDK).

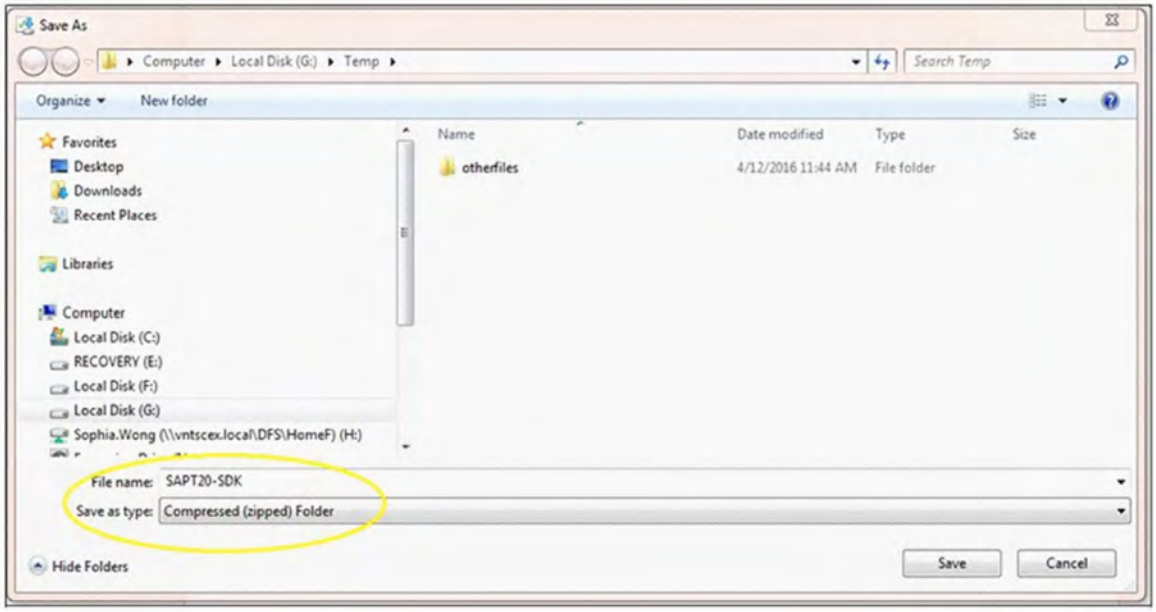

Figure 10–5. Save the SAPT SDK

Click **Open** to save the file to the temporary internet files folder on your computer (refer to Figure 10–6, Open the SAPT SDK).

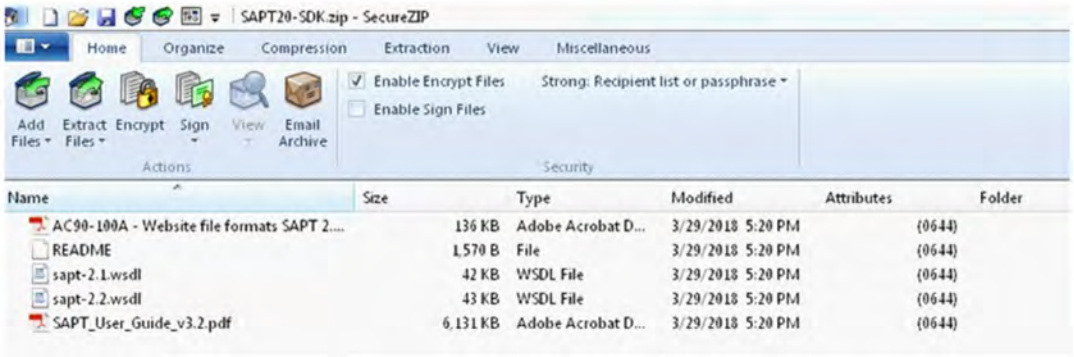

Figure 10–6. Open the SAPT SDK

The SDK archive contains the WSDL and other files that might be useful in developing software to interface with the SAPT.

10.2.2 Software Connectivity

The following ADS–B and RAIM files are available for download by navigating to https://sapt.faa.gov/ and appending the full filename to the URL in your address bar:

- RAIM Files – Format descriptions can be found in AC90-100A - Website file formats SAPT 2.0.pdf (included in the SDK).
  - — interference.dat

  - last_outages.dat locations.dat
  - locations_highres.dat /outages.dat
  - outages_highres.dat status.txt
- ADS–B Files – Format descriptions can be found in ADSB_Outage_File_Formats.txt (included in the SDK).
  - TSOC129_ADSB_BARO_FIVE_RES15.csv
  - TSOC129_ADSB_BARO_FIVE_RES30.csv
  - TSOC129_ADSB_BARO_FIVE_RES60.csv
  - TSOC129_ADSB_BARO_FIVE_RES7.csv
  - TSOC129_ADSB_BARO_TWO_RES15.csv
  - TSOC129_ADSB_BARO_TWO_RES30.csv
  - TSOC129_ADSB_BARO_TWO_RES60.csv
  - TSOC129_ADSB_BARO_TWO_RES7.csv
  - TSOC129_ADSB_NOBARO_FIVE_RES15.csv
  - TSOC129_ADSB_NOBARO_FIVE_RES30.csv
  - TSOC129_ADSB_NOBARO_FIVE_RES60.csv
  - TSOC129_ADSB_NOBARO_FIVE_RES7.csv
  - TSOC129_ADSB_NOBARO_TWO_RES15.csv
  - TSOC129_ADSB_NOBARO_TWO_RES30.csv
  - TSOC129_ADSB_NOBARO_TWO_RES60.csv
  - TSOC129_ADSB_NOBARO_TWO_RES7.csv
  - TSOC196_ADSB_FIVE_RES15.csv TSOC196_ADSB_FIVE_RES30.csv
  - TSOC196_ADSB_FIVE_RES60.csv TSOC196_ADSB_FIVE_RES7.csv
  - TSOC196_ADSB_TWO_RES15.csv TSOC196_ADSB_TWO_RES30.csv
  - TSOC196_ADSB_TWO_RES60.csv TSOC196_ADSB_TWO_RES7.csv

10.2.3 SAPT Announcement Subscription

Announcements regarding changes to the SAPT web service and web site will be made periodically. At least one person from each organization should be subscribed to the SAPT announcement list so that all users at that organization can learn of pending changes.

If you are interested in receiving SAPT announcements, click the Subscribe to the SAPT e-mail Announcement List link to open the subscription page (refer to Figure 10–7, SAPT E-mail Subscription Page).

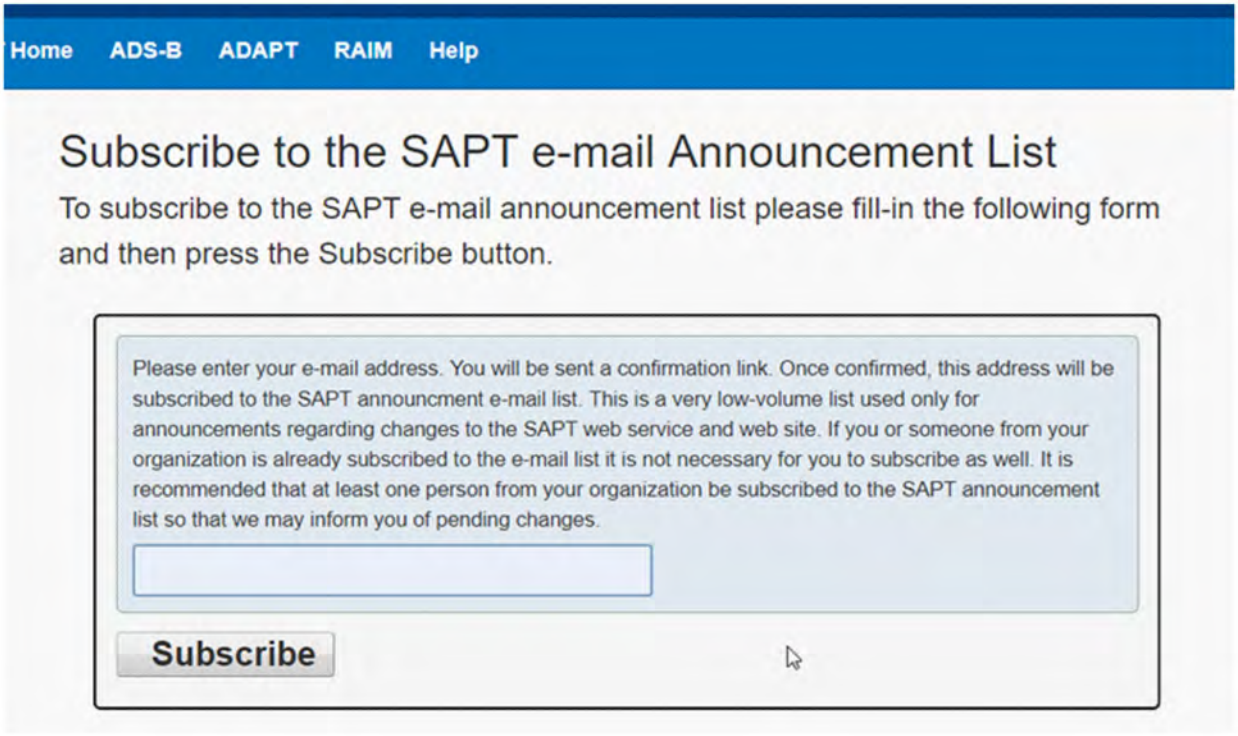

Figure 10–7. SAPT E-mail Subscription Page

Enter your e-mail address and press **Subscribe**.

This page intentionally left blank.

11. RAIM SUMMARY PAGES

Scroll down the ADS–B SAPT Home page to see the RAIM Summary Pages section of the site (refer to Figure 11–1, RAIM Summary Section).

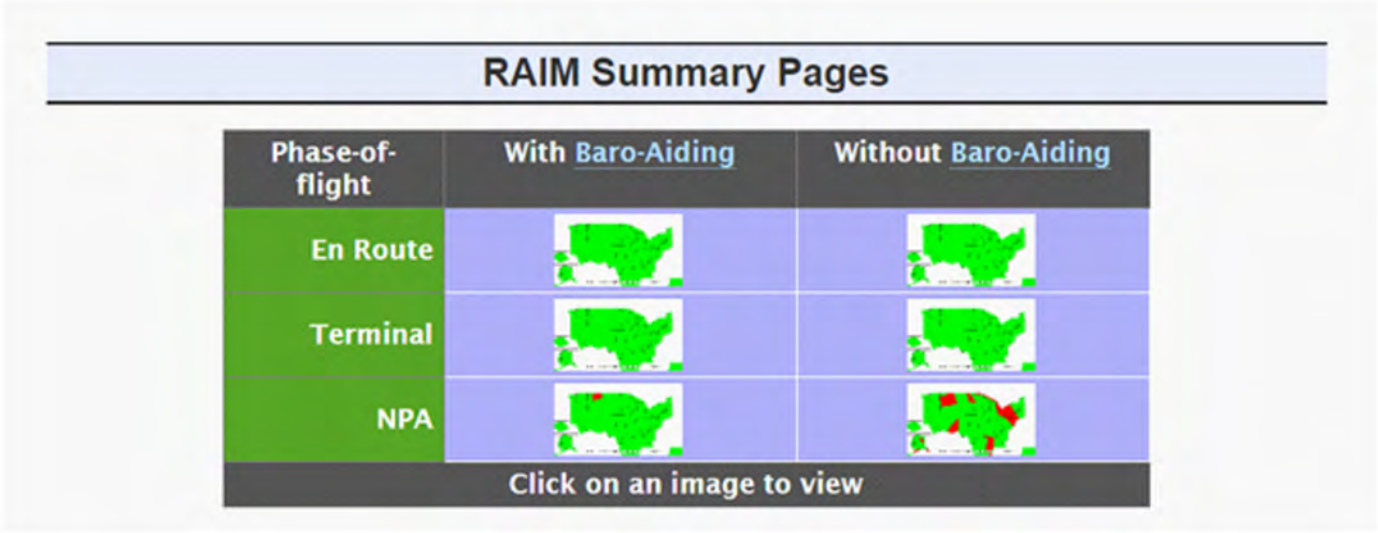

Figure 11–1. RAIM Summary Section

Click the image that mirrors the avionics on your aircraft and the phase of flight you are interested in to see an overview.

The image shown in Figure 11–2, RAIM Summary — NPA Airspace, SA On and BA Enabled, illustrates the summary for NPA airspace with SA and BA both enabled.

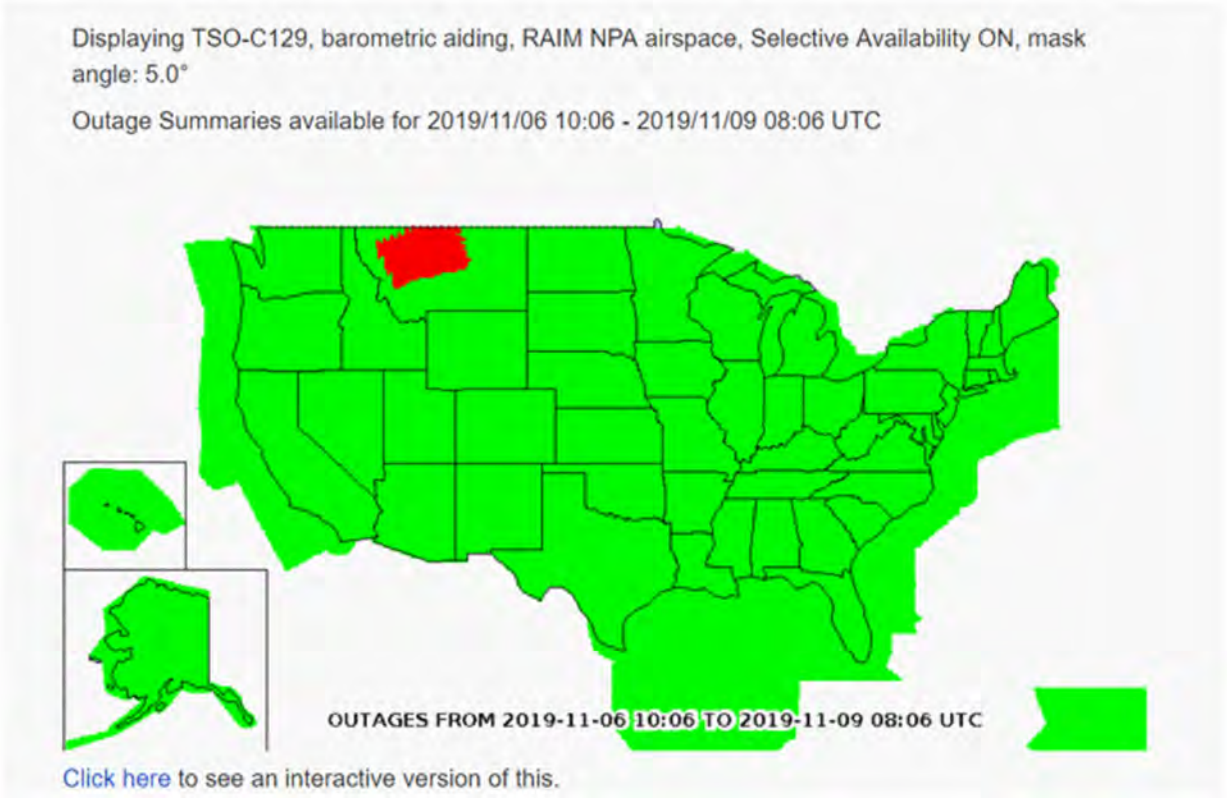

Figure 11–2. RAIM Summary — NPA Airspace, SA On and Baro-aiding Enabled

Your parameters are displayed at the top of the screen, along with the timeframe for which outages have been predicted and are available. The outage summary beneath them is a static map for quick review. It shows a cumulative summary of the predicted outages within the timeframe described by the caption, a prediction window of at least 24 hours. In other words, a ten-minute outage an hour from now in Maine and a 20-minute outage tomorrow morning, and every other predicted outage in the prediction window would all show as red on the map,

The snapshots offer a 24-to-72-hour window on the airspace. If the area where you intend to fly is colored green there are no predicted RAIM outages in that area and you may proceed with your trip.

Red blocks indicate outages. If there are red sections of the map near where you plan to travel, or if you are unsure if the outages will affect your flight, you should get a more detailed forecast.

You can see a detailed map with a time slider by clicking the *Click here* link in the lower-left corner of the screen, or you can submit a transaction for your specific flight plan.

Please refresh the summary page each time you review it in case it has been cached in your browser.

The following image illustrates the summary for NPA airspace with SA ON and no barometric aiding (refer to Figure 11–3, RAIM Summary — NPA Airspace, with SA On and No Baro-aiding).

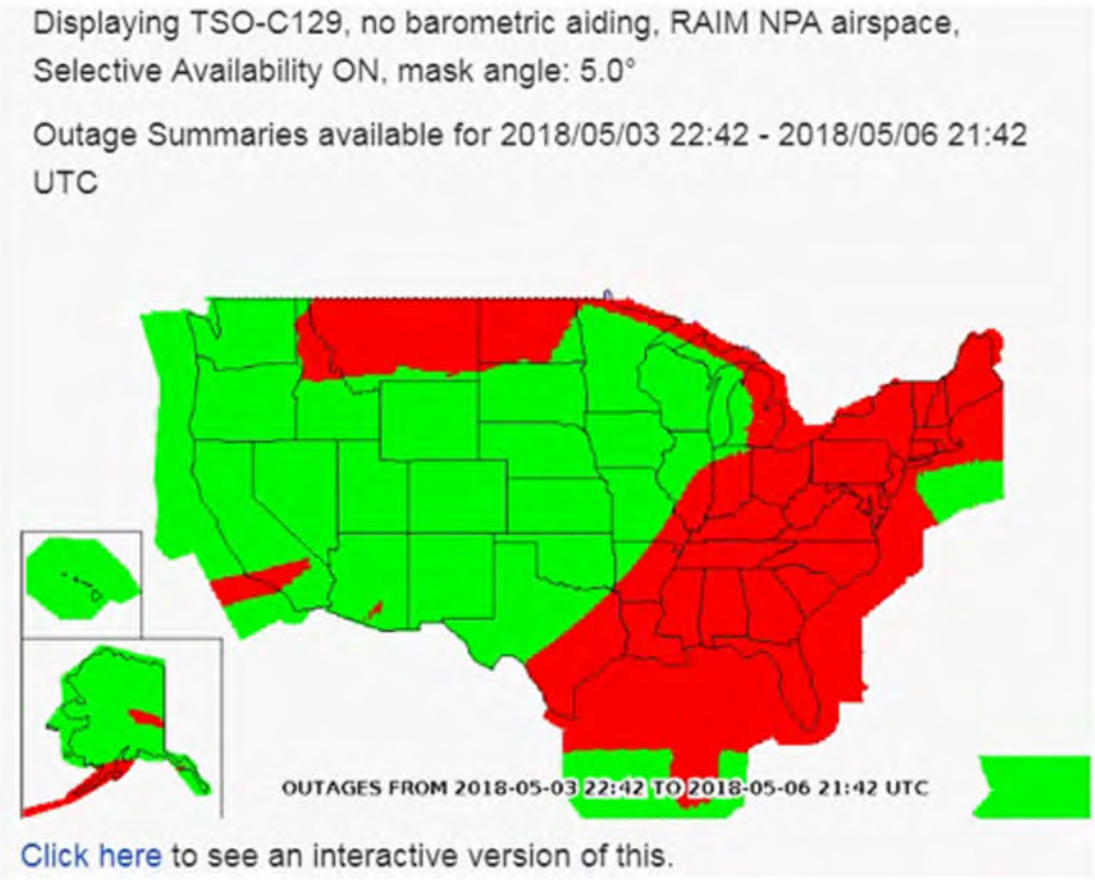

Figure 11–3. RAIM Summary — NPA Airspace, with SA On and No Baro-aiding

To see the interactive map representation of a mapped route of flight, click the hyperlink in the bottom-left corner of the screen ("Click here to see an interactive version of this"). It will take a few moments to generate the map.

The following image is the Cesium™ representation, as show in Figure 11–4, RAIM Summary — NPA Airspace, SA On and Baro-aiding.

NOTE: You will see outages over the next six hours only in the interactive presentation. Review the summary pages again later or use the SAPT Flight Information Entry Form for more information.

Figure 11–4. RAIM Summary — NPA Airspace, SA On and Baro-aiding

Some of the features of this tool are displayed at the bottom of the interactive map. They are described briefly here:

- The graphical display is provided through Cesium and functionality consistent with the SAPT ADS–B requirements.
- Outages are shown in red for En Route, Terminal and Non-Precision Approach (NPA) areas, and are available both with and without baro-aiding
- GPS Interference Test outages are shown in brown. Press **Download KML** to download the KML servlet.

  NOTE: The downloaded KML file will include the GPS Interference Tests, but not the Service Volume information. The interactive map contains checkboxes that allow users to show or hide the GPS Interference Tests, as well as the Service Volume layers. These checkboxes do not affect the downloaded KML file.

- The most important feature of the tool is the time slider at the bottom of the window. Using the blue slider, you can see the outages play across the map.
- Check the boxes for Show ADS–B Service Volumes and Show GPS Interference Tests, if you want to see that information. The region defaults to the continental US outages at a low resolution. You may

select a region from the buttons on the right to zoom to an area, or use the interactive map features to navigate to a custom region and display outages at a higher resolution.

To zoom in on an area of interest you can use any of these four different methods:

Method 1. Select an area by pressing one of the buttons below the map to zoom to it.

Method 2. You can zoom using the plus/minus tool on the right side of the screen, illustrated here.

Method 3. Use the hand tool in the interactive map to ‘grab’ a section of the map and move it in the desired direction.

Method 4. Use the scroll wheel on your mouse to zoom in/out.

You can also use the **ZOOM** feature to open an area of interest to see outages in more detail:

- Press **CONUS, Northeast US, Southeast US, Gulf of Mexico, Southwest US, Northwest, US, Alaska, Hawaii, Guam** and **Puerto Rico** to select the area of interest.
- Look-ahead time: Press **Next 6 Hours, 6–12 Hours, 12–18 Hours** and **12–24 Hours** to select the look-ahead time for outages.

Once you have selected a region, click **Generate KML for Area In View** to see the outages for it. The area where outages are searched will be highlighted in a box.

NOTE: You must press **Generate Kml For Area In View** to refresh the outage detail for the area you have chosen. If you zoom in, you may see more detail of the outages.

NOTE: Outages are NOT generated for the entire world. Even outages inside the highlighted search box are only predicted within the airspace located inside the orange Service Volumes.

To reverse whichever methods you used – i.e., to select a different region – use the slider tool or the hand icon.

NOTE: To return to the original region, press **CONUS**, not **Refresh**, on the plus/minus tool, which will attempt to show everything.

For details of an outage, position the mouse over an area and press the left button on your mouse. The system displays the information in a pop-up window.

NOTE: This works for both GPS Interference Test (Brown) outages and RAIM (red) outages.

Brown outages are shown in Figure 11–5, RAIM Summary — GPS Test Outage Detail, NPA On and No Baro-aiding.

Red outages are shown in Figure 11–6, RAIM Summary — RAIM Outage Detail, NPA On and No Baro-aiding.

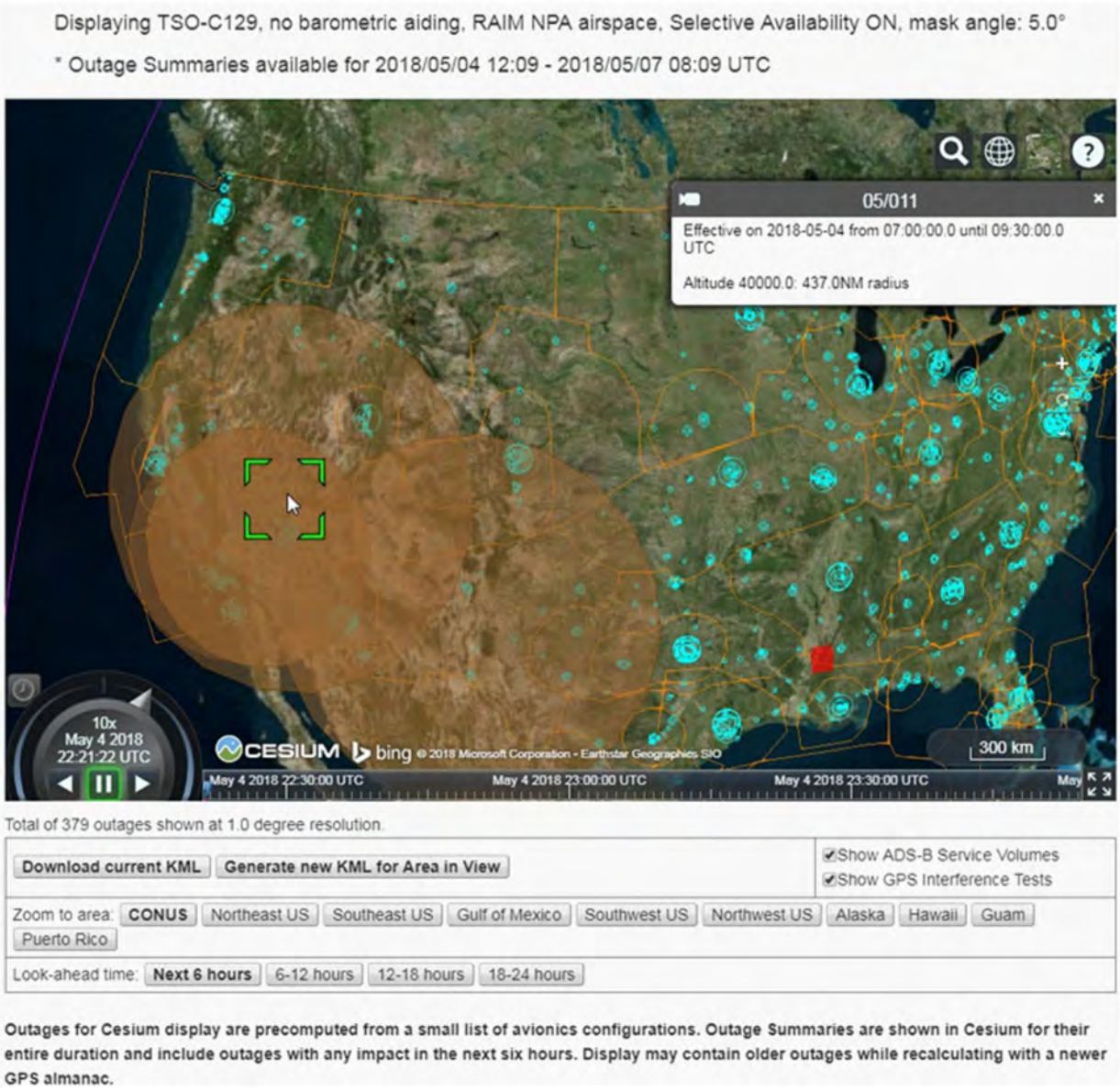

Figure 11–5. RAIM Summary — GPS Test Outage Detail, NPA Airspace, SA On and No Baro-aiding

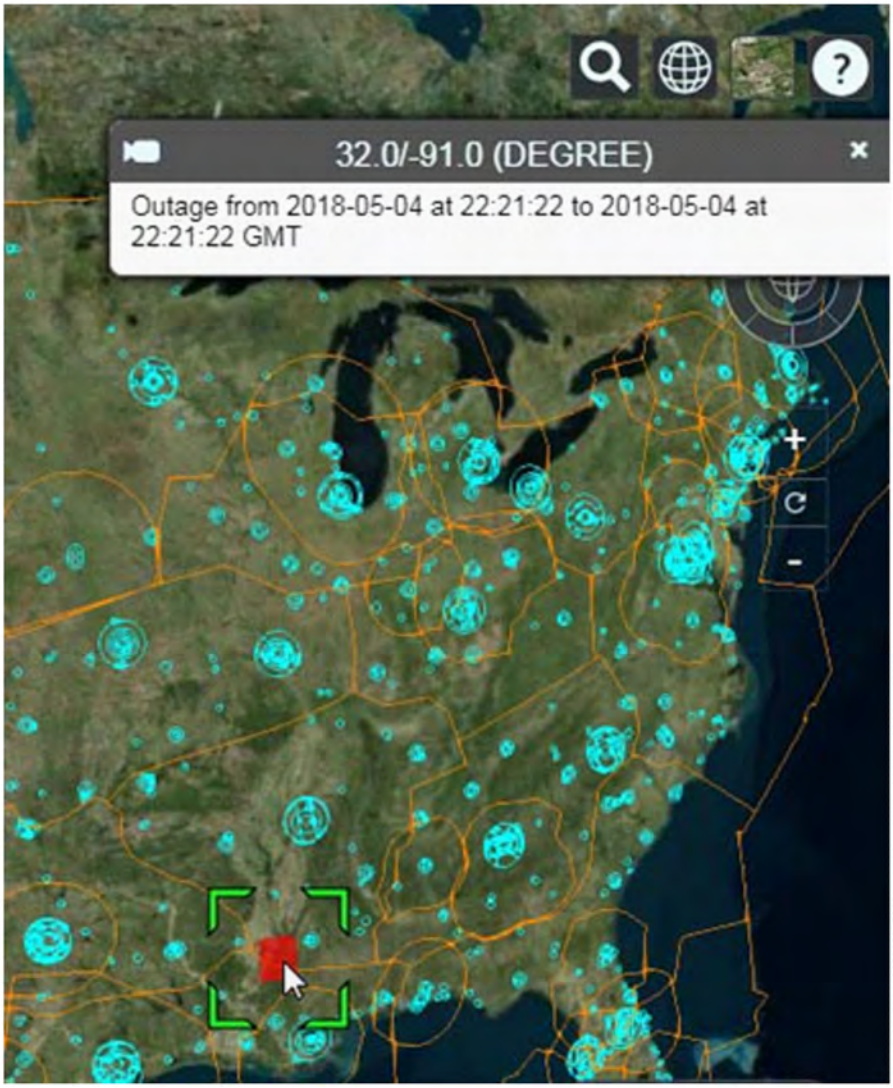

Figure 11–6. RAIM Summary — RAIM Outage Detail, NPA Airspace, SA On and No Baro-aiding

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Appendix A. List of Acronyms and Abbreviations

The following acronyms and terms may be found in this document.

Term	Definition
3D	Three-dimensional
A/A	Air-to-Air
A/G	Air-to-Ground
AC	Advisory Circular ACs are publications offered by the FAA to provide guidance for compliance with aviation regulations. They define acceptable means, but not the only means, of accomplishing or showing compliance with aviation regulations. Generally informative, ACs are neither binding nor regulatory yet some have the effect of de facto standards or regulations.
AC 90–100A	Advisory Circular “US Terminal and En Route Area Navigation (RNAV) Operations” ACY
ADAPT	ADS–B Deviation Authorization Pre-Flight Tool
ADS–B	ADS–B provides significant operational capabilities by addressing some of the limitations of the present surveillance system. The aircraft’s avionics system automatically transmits messages containing position and velocity information to the ATC. This makes the aircraft visible to the ATC and other appropriately equipped ADS–B aircraft. ADS–B allows ATC to monitor and separate aircraft with more precision. Because ADS–B uses GPS signals, it expands surveillance services into areas where little or no radar coverage exists.
AJAX	Asynchronous JavaScript and XML
API	Application Programming Interface
ARC	(ADS–B) Aviation Rulemaking Committee
ATC	Air Traffic Control
BA	Barometric Aiding, baro-aiding A method of augmenting the GPS integrity solution by using a non-satellite input source. To ensure that baro-aiding is available, the current altimeter setting must be entered as described in the operating manual.
CICA	Convention on International Civil Aviation
CIFP	Coded Instrument Flight Procedures (formerly the National Flight Database (NFD))

Term	Definition
CONUS	Continental United States
DoD	Department of Defense
DOT	Department of Transportation
ETO	Estimated Time Over
FAA	Federal Aviation Administration
FD	Fault Detection
FDE	Fault Detection and Exclusion
Final Rule	Title 14 Code of Federal Regulations (CFR) Part 91, Paragraph H.2, Automatic Dependent Surveillance-Broadcast (ADS–B) Out Performance Requirements to Support ATC Service, is referred to as the "Final Rule".
FL	Flight Level
GA	General Aviation
GMT	Greenwich Mean Time
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GUI	Graphical User Interface
HAL	Horizontal Alert Limit
HFOM	Horizontal Figure of Merit
HPL	Horizontal Protection Limit
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICAO	International Civil Aviation Organization
ID	Identification
IDE	Integrated Development Environment
IP	Internet Protocol
IT	Information Technology
J2EE	Java 2 Platform, Enterprise Edition
KML	Keyhole Markup Language
LAAS	LAAS is an all-weather aircraft landing system based on real-time differential correction of the GPS signal. Local reference receivers located around the airport send data to a central location at the airport. The data are used to formulate a correction message, which is transmitted to users by VHF data link. A receiver on an aircraft uses this information to correct GPS signals, which then provide a standard ILS-style display to use while flying a precision approach.
LAN	Local Area Network

Term	Definition
Mask angle	The minimum acceptable satellite elevation above the horizon to avoid blockage of line-of-sight.
MHz	Megahertz
MOPS	Minimum Operational Performance Standards MSL
NACp	Navigation Accuracy Category for Position NACp specifies with 95 percent probability the accuracy limits for the horizontal position that is being broadcast.
NAS	National Airspace System
Navaids	Aids to navigation
NextGen	Next Generation Air Transportation System NFD
NIC	Navigation Integrity Category The NIC specifies the radius of containment for the aircraft's horizontal position.
NM	Nautical Miles
NOTAM	Notice to Airmen NOTAM or NoTAM are filed with an aviation authority to alert pilots of potential hazards along a flight route or at a location that could affect the safety of the flight. They are unclassified notices or advisories distributed by means of telecommunication that contain information about the establishment, conditions or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel and systems concerned with flight operations. NOTAMs are created and transmitted by government agencies and airport operators under guidelines specified by Annex 15: Aeronautical Information Services of the Convention on International Civil Aviation (CICA).
NPA	Non-Precision Approach
NSAL	No-Services Aircraft List
OpenGL ES	Open Graphics Library for Embedded Systems QRO
PIC	Pilot in Command
RADAR	Radio Detection and Ranging
RAIM	Receiver Autonomous Integrity Monitoring RNAV

Term	Definition
RNAV	RNAV is a method of air navigation that allows an aircraft to choose any course within a network of navigation beacons, rather than navigating directly to and from the beacons. It can conserve flight distance, reduce congestion, and allow instrument flight plans into airports without beacons.
RNP	Required Navigation Performance, Accuracy, Integrity, Continuity, Availability Rule Airspace Rule Airspace is defined in the published Final Rule on ADS–B (Docket No. FAA-2007-29305; Amdt. No. 91-314) as specified in 14 CFR § 91.225.
SA	Selective Availability A function in the GPS navigation system that deliberately introduced random errors for civilian receivers. It was implemented to prevent enemy troops on foreign soil from using the GPS system to their advantage, while allowing friendly troops to obtain the true signals in GPS receivers that supported military encryption. SA was disabled permanently in 2000.
SAPT	(ADS–B) Service Availability Prediction Tool
SBAS	Satellite-Based Augmentation System
SBS	Surveillance and Broadcast Services
SDK	Software Development Kit
SID	Standard Instrument Departure
SIL	The SIL defines the probability that the reported aircraft's position is outside the radius of containment defined by the NIC parameter, without alarms and/or alerts.
SSL	Secure Socket Layer
SSLPM	Satellite Service Level Prediction Model
SSR	SSR is used in Air Traffic Control to not only detect and measure the position of aircraft, i.e., range and bearing, but also to request additional information from the aircraft itself, such as its identity and altitude.
STAR	Standard Terminal Arrival
TCP/IP	Transfer Control Protocol/ Internet Protocol
TSC	Technologies Service Corporation
SVDD	Service Volume Definition Document
TLS	Transport Layer Security
TSO	Technical Standard Order A TSO is a minimum performance standard for specified materials, parts, and appliances used on civil aircraft. When authorized to manufacture a material, part, or appliances to a TSO standard, this is referred to as TSO authorization. A separate FAA approval is required to install the article on an aircraft.

Term	Definition
UAT	Universal Access Transceiver
UML	Unified Modeling Language
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
WAAS	Wide Area Augmentation System WAAS provides horizontal and vertical navigation for approach operations for all users at all locations. WAAS provides service for all classes of aircraft in all phases of flight, including En Route navigation and airport departures and arrivals.
WAM	Wide Area Multilateration In this technique, several ground-receiving stations listen to signals from an aircraft and the aircraft location is mathematically calculated — typically in two dimensions, with the aircraft providing its altitude. Aircraft position, altitude and other data are ultimately transmitted, through an ATC automation system, to ATC for separation of aircraft. WAM provides performance that is comparable to secondary surveillance radar (SSR) in terms of accuracy, probability of detection, update rate and availability/reliability. Performance varies as a function of the location of aircraft in relation to the ground sensors.
WAN	Wide Area Network
WebGL	Web Graphics Library
WJHTC	William J. Hughes Technical Center WSDL
XML	eXtensible Markup Language

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Appendix B. Sample Email Responses to Deviation Requests

Sample email responses to pilots who submitted a deviation request are illustrated below.

For a request that was accepted:

Dear ADAPT User 5GMCKG8A5M6YS-1:

Thank you for using the Federal Aviation Administration's (FAA) ADS-B Deviation Authorization Pre-Flight Tool (ADAPT).

Keep this email in a safe place. It grants you a one-time deviation from the requirements of 14 CFR § 91.225 to operate on the proposed route of flight without ADS-B Out equipment installed or with equipment that does not meet the requirements of 14 CFR § 91.227.

Please Note:

- *If departure is not made within 2 hours of the proposed departure time, this authorization is canceled.*
- *This authorization does not relieve you of any flight plan filing requirements, nor does it substitute for an ATC clearance where required.*
- *Contact ATC on the appropriate frequency for all operational clearances.*

Details of your request are shown below:

ADS-B Rule Airspace Authorization Request Status = APPROVED

ADS-B Rule Airspace Authorization Request

ICAO	Tailnumber	Flight Classification	ADS-B Equipment Status	Operational Transponder w/Altitude
	N1AA	PART 135	Unequipped	Yes

Pilot in Command	PIC Phone Number
Joe Jones	555-555-1212
PIC Email Address	**Reason For Flight**
JoeJones@yahoo.com	Ferry Aircraft

Additional Comments

ATC Centers Impacted

Flight Planning Information

Aircraft ID	Aircraft Type	Nav Source TSO	ADS-B Link TSO	Mask Angle
ZZVCOS	GLF4	unequipped	2008	

Departs	Depart At	Arrives	Arrives At	Cruise Altitude	Airspeed
KCOS	11/01/2019 03:27	KDEN	11/01/2019 03:48	12000	392

Route of Flight	Disposition
KCOS.ELLZA.MASHD.TRAIN.KDEN	AlternateSurveillance

Link to SAPT Overview

https://saptest.faa.gov/outages.php?base=5GMCKG8A5M6YS1&outageType=1001060&outageResolution=0.125&router=1

If you have any questions, please visit our Frequently Asked Questions (FAQs). ***Please do not reply to this email.***

ADS-B Program Office,
Federal Aviation Administration
http://www.faa.gov/nextgen/equipadsb/ADAPT
Have questions? Get answers from our ADS-B Deviation Authorization Frequently Asked Questions: http://www.faa.gov/nextgen/equipadsb/ADAPT/faq
Read the Program Rules: http://www.faa.gov/nextgen/equipadsb/ADAPT/media/ADAPT_Program_Rules.pdf

For a request that was denied:

Dear ADAPT User 3PCKG8A4CJZK-1:

Thank you for using the Federal Aviation Administration's (FAA) ADS-B Deviation Authorization Pre-Flight Tool (ADAPT).

The FAA has denied your authorization request to operate on your proposed route of flight without ADS-B Out equipment.

The FAA's denial of your authorization request may be due to one or more of the following:

- *the departure or destination airport being capacity constrained*
- *lack of ATC surveillance along your route of flight*
- *lack of a functioning Mode C transponder*
- *the request being made less than one hour or more than twenty-four hours before the proposed departure*
- *or other reasons*

You may submit another request with a revised departure time, route, or destination airport. Each request will be evaluated independently.

Details of your request are shown below:

ADS-B Rule Airspace Authorization Request Status = DENIED

ADS-B Rule Airspace Authorization Request

ICAO	Tailnumber	Flight Classification	ADS-B Equipment Status	Operational Transponder w/Altitude
	N1AA	PART 129	Unequipped	Yes

Pilot in Command	PIC Phone Number
Cally Perry	555-555-1212
PIC Email Address	**Reason For Flight**
"pilotXYZ@*****.com	Other (Explain in Comments Box)

Additional Comments
[Please enter your comment here.]
ATC Centers Impacted

Flight Planning Information

Aircaft ID	Aircraft Type	Nav Source TSO	ADS-B Link TSO	Mask Angle
ZZVAIB	A321	unequipped	260B	

Departs	Depart At	Arrives	Arrives At	Cruise Altitude	Airspeed
KBOS	11/01/2019 05:15	KPHX	11/01/2019 15:19	38000	450

Route of Flight	Disposition
KBOS.BOS.STELA.JHW.GIJ.JOT.LOAMY.IRK.SLN.SJN.CAMVI.KPHX	AlternateSurveillance

Link to SAPT Overview
https://sapttest.faa.gov/outages.php?hid=3PCKG8A4CJZK&outageType=1011000&outageResolution=0,125&route=1

If you have any questions, please visit our Frequently Asked Questions (FAQs). ***Please do not reply to this email.***

ADS-B Program Office,
Federal Aviation Administration
http://www.faa.gov/nextgen/equipadsb/ADAPT
Have questions? Get answers from our ADS-B Deviation Authorization Frequently Asked Questions: http://www.faa.gov/nextgen/equipadsb/ADAPT/faq
Read the Program Rules: http://www.faa.gov/nextgen/equipadsb/ADAPT/media/ADAPT_Program_Rules.pdf

For a request that is awaiting adjudication:

Dear ADAPT User 3PCKG8A4CJZK-1:

Thank you for using the Federal Aviation Administration's (FAA) ADS-B Deviation Authorization Pre-Flight Tool (ADAPT).

Your authorization request has been placed in pending status for review. When the review is complete, you will receive an email with a final determination. If you have not received email notification of final decision 30 minutes prior to the proposed departure time, consider the request denied.

If the request is denied, you may submit another request with a revised departure time, route, or destination airport. Each request will be evaluated independently.

Details of your request are shown below:

ADS-B Rule Airspace Authorization Request Status = PENDING

ADS-B Rule Airspace Authorization Request

ICAO	Tailnumber	Flight Classification	ADS-B Equipment Status	Operational Transponder w/Altitude
	N1AA	PART 129	Unequipped	Yes

Pilot in Command	PIC Phone Number
Martin Fitzgerald	555-555-1212
PIC Email Address	**Reason For Flight**
mfitzgerald22@hotmail.com	Other (Explain in Comments Box)

Additional Comments
[Please enter your comment here.]
ATC Centers Impacted

Flight Planning Information

Aircraft ID	Aircraft Type	Nav Source TSO	ADS-B Link TSO	Mask Angle
ZZVAIB	A321	unequipped	260B	

Departs	Depart At	Arrives	Arrives At	Cruise Altitude	Airspeed
KBOS	11/01/2019 06:15	KPHX	11/01/2019 15:19	38000	450

Route of Flight	Disposition
KBOS.BOS.STELA.JHW.GIJ.JOT.LOAMY.IRK.SLN.SJN.CAMVI.KPHX	AlternateSurveillance

Link to SAPT Overview
https://sapttest.faa.gov/outages.php?bid=3PCKG8A4CJZK&outageType=1011050&outageResolution=0.125&route=1

If you have any questions, please visit our Frequently Asked Questions (FAQs). ***Please do not reply to this email.***

ADS-B Program Office,
Federal Aviation Administration
http://www.faa.gov/nextgen/equipadsb/ADAPT
Have questions? Get answers from our ADS-B Deviation Authorization Frequently Asked Questions: http://www.faa.gov/nextgen/equipadsb/ADAPT/faq
Read the Program Rules: http://www.faa.gov/nextgen/equipadsb/ADAPT/media/ADAPT_Program_Rules.pdf