X-PLANE

NAVIGATION DATA FOR NAVAIDS (USER_NAV.DAT & EARTH_NAV.DAT) FILE SPECIFICATION

VERSION 1100

REVISION HISTORY

7 May 2009	Spec converted to this new format to support new web site (http://data.x-plane.com).
8 Sept 2009	Error in usage of row type 13 fixed in "applicability" section below.
31 May 2010	Corrected error in specification of VOR and localizer radio frequencies. Added elevations to NDB spec. Corrected references to apt.dat.
29 July 2011	Fixed minor error in definition of navaid frequencies
27 Oct 2011	Fixed minor error in definition of glideslope approach angle
8 July 2012	Corrected error in definition of navaid ranges
10 Aug 2016	Spec updated for X-Plane 11
10 Oct 2016	Added encoding for SBAS service provider in LTP name

APPLICABILITY

This specification (XP NAV1100) is supported in X-Plane 11.00 and later. It is identified in the data files as "1100 Version" on the second row of the file.

The prior specification for navaid data was XP NAV810, which was compatible with X-Plane 8.10 – 10.99. Changes in the spec for XP NAV1100 were:

- New row codes for SBAS and GBAS path points (14,16)
- New row codes for GLS differential stations (15)
- New column for region identifier
- New column for terminal area identifier
- Markers must now use the parent localizer as ID

OVERVIEW & SCOPE

This specification defines all radio navigation data for X-Plane, including NDBs (DB-records), VORs (D-records, incl. VORTACs and VOR-DMEs), ILS components (PI- and PM-records, localizers, glideslopes, marker beacons), GBAS correction stations and SBAS/GBAS approach path point data (PP-, PQ-, and PT-records). The effect of this data is to:

- Allow these radio navigation facilities to be used when flying in X-Plane.
- Display the navigation facilities on X-Plane's chart.
- Render objects in the X-Plane scenery system to represent each physical facility.
- Allow these navaids to be selected in X-Plane's GPS and FMC systems.
- Allow path points be used by X-Plane's GPS and FMC systems.

BASIC CONCEPTS

- Latitudes and longitudes are described in a decimal notation (e.g. 20.12345678).
    - A latitude of 50 degrees 30 minutes south would be defined as -50.50000000
- North latitudes and east longitudes are positive. South latitudes and west longitudes are negative.
- All headings are referenced to true north (not magnetic north). X-Plane has an internal model of magnetic variation.
- Terminal NDBs, ILS components and approach path points must specify the airport whose terminal area they belong to
- Enroute navaids must specify the ICAO region code according to ICAO document No. 7910

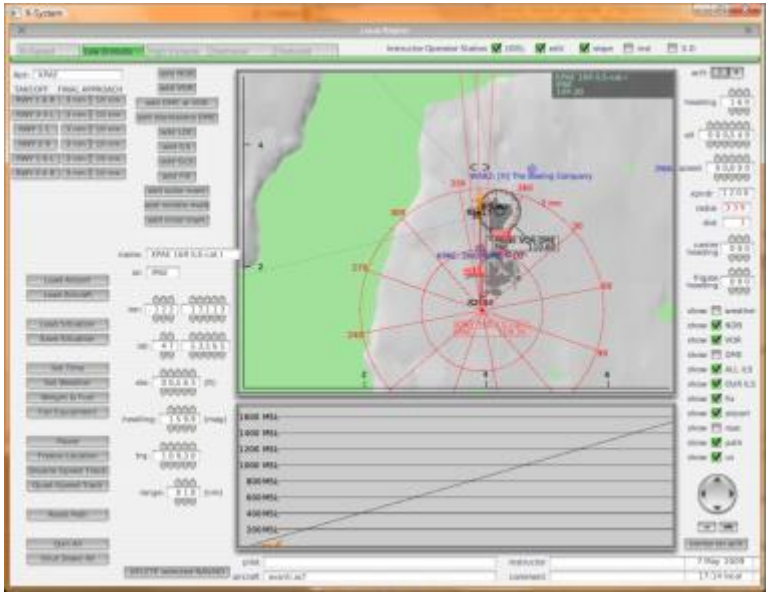
FILE CHARACTERISTICS

The earth_nav.dat (and nav.dat) files are plain text files:

- Fields in the data can be separated by one or more white space (space, tab) characters.
- By default, the files are generated so that columns of data are consistently aligned, but this is not required.
- Glideslope records must come later in the file than their associated localizer
- LTP/FTP records must come later in the file than their associated FPAP
- Paired DME records must come later in the file than their associated VOR or TACAN
- The above can also be achieved by sorting the file strictly using the first column

FILE STRUCTURE

The navigation data can be edited in X-Plane in the "Location | Local Map" view, and by clicking on the "edit" button at the top of the screen.



If data is changed here, then X-Plane will ask for confirmation that the new data should be saved when quitting X-Plane. This will ensure that all structural requirements listed here for airport data are met. Manually edited data is dumped into the user_nav.dat file and kept separate from data supplied by providers. On load, navaids in the user_nav.dat file override navaids in the global earth_nav.dat file.

[Note that X-Plane displays headings for an ILS in magnetic degrees on this screen, but that this data is converted to a true heading when the data is saved to earth_nav.dat.]

In common with most other X-Plane data file specification, header rows of data define the origin ("I" = Intel byte order or "A" = Motorola byte order) of a particular copy of a file, and define the file specification version. The file specification must include the four-digit AIRAC cycle date (e.g. 1602 for the AIRAC cycle effective 4-Feb-16, refer to https://www.nm.eurocontrol.int/RAD/common/airac_dates.html for cycle dates), an 8-digit build date and the reference to this document. A copyright message may be added, while the total length of this line is not to exceed 1024 characters:

```
I
1100 Version - data cycle 1602, build 20160204, metadata NavXP1100. Copyright © 2016, Robin A. Peel (robin@xsquawkbox.net)...
```

Subsequent rows of data define each navaid. Sequence is not important.

The file is terminated by a '99':

```
99
```

ROW CODES

Each row of data begins with an integer code that defines the type of data:

Row Code	Meaning	Comment
2	NDB (Non-Directional Beacon)	Includes NDB component of Locator Outer Markers (LOM)
3	VOR (including VOR-DME and VORTACs)	Includes VORs, VOR-DMEs, TACANs and VORTACs
4	Localizer component of an ILS (Instrument Landing System)	
5	Localizer component of a localizer-only approach	Includes for LDAs and SDFs
6	Glideslope component of an ILS	Frequency shown is paired frequency, not the DME channel
7	Outer markers (OM) for an ILS	Includes outer maker component of LOMs
8	Middle markers (MM) for an ILS	
9	Inner markers (IM) for an ILS	
12	DME, including the DME component of an ILS, VORTAC or VOR-DME	Paired frequency display suppressed on X-Plane's charts
13	Stand-alone DME, or the DME component of an NDB-DME	Paired frequency will be displayed on X-Plane's charts
14	Final approach path alignment point of an SBAS or GBAS approach path	Will not appear in X-Plane's charts
15	GBAS differential ground station of a GLS	Will not appear in X-Plane's charts
16	Landing threshold point or fictitious threshold point of an SBAS/GBAS approach	Will not appear in X-Plane's charts

EXAMPLE DATA

Here is some example data for the Seattle, Washington, USA area (note the separate data row for the DME component of the Seattle VORTAC):

```
 2  47.632522222 -122.389516667        0      362    25       0.000   BF  ENRT K1 NOLLA/KBFI LMM RW13R NDB
 3  47.435372222 -122.309616667        0    11680   130      19.000  SEA  ENRT K1 SEATTLE VORTAC
12  47.435372222 -122.309616667        0    11680   130       0.000  SEA  ENRT K1 SEATTLE VORTAC DME
 4  47.428408333 -122.308063889      425    11030    25     180.343 ISNQ  KSEA K1 16L ILS-cat-III
 6  47.460816667 -122.309394444      425    11030    25  300180.343 ISNQ  KSEA K1 16L GS
 9  47.466013889 -122.307733333        0        0     0       0.000 ISNQ  KSEA K1 16L IM
12  47.434333333 -122.306300000      369    11030    25       0.000 ISNQ  KSEA K1 SEATTLE RW16L DME-ILS
14  47.437969722 -122.311211111      429    61010   0.0     180.339 R16CY KSEA K1 16C LPV
16  47.463809028 -122.310985000      429    61010  56.6  300180.339 R16CY KSEA K1 16C WAAS
```

DEFINITION OF DATA FIELDS

Each column in each row is defined below, using the example data from Seattle shown above. Note that:

- Some row codes store data in an identical specification, and these have been grouped together in the table below (eg. the marker beacons).
- The specification aims to be internally consistent. For example, the format or latitudes and longitudes is always the same, and all headings/orientations are defined as true (not magnetic) degrees.

Row	Meaning *Example value*	Comment *Explanation*	*Valid values*
2	NDB	Non-directional beacon	
	2	Row code for an NDB	2
	47.63252778	Latitude of NDB in decimal degrees	Eight decimal places supported
	-122.38952778	Longitude of NDB in decimal degrees	Eight decimal places supported
	0	Elevation in feet above MSL	Integer. Used to calculate service volumes.
	362	Frequency in KHz	Integer. Decimal frequencies not supported.
	50	Maximum reception range in nautical miles	Integer
	0.0	Not used for NDBs	0.0
	BF	NDB identifier	Up to four characters. Unique within ICAO region
	ENRT	NDB terminal region identifier or ENRT for enroute NDBs	Airport code for terminal NDBs, ENRT otherwise
	K1	ICAO region code of enroute NDB or terminal area airport	Must be region code according to ICAO document No. 7910 For terminal NDBs, the region code of the airport is used
	NOLLA NDB	NDB name	Text, suffix with "NDB"
3	VOR	Includes VOR-DMEs and VORTACs	
	3	Row code for a VOR	3
	47.43538889	Latitude of VOR in decimal degrees	Eight decimal places supported
	-122.30961111	Longitude of VOR in decimal degrees	Eight decimal places supported
	354	Elevation in feet above MSL	Integer. Used to calculate service volumes.
	11680	Frequency in MHZ (multiplied by 100)	Integer - MHz multiplied by 100 (e.g. 123.45MHz = 12345)
	130	Maximum reception range in nautical miles	Integer
	19.0	Slaved variation for VOR, i.e. direction of the 0 radial measured in true degrees	Up to three decimal places supported
	SEA	VOR identifier	Up to four characters. Unique within ICAO region
	ENRT	ENRT for all VORs	Always ENRT
	K1	ICAO region code	Must be region code according to ICAO document No. 7910
	SEATTLE VORTAC	VOR name	Text, suffix with "VOR", "VORTAC", "TACAN" or "VOR-DME"

Row	Meaning *Example value*	Comment *Explanation*	*Valid values*
4, 5	LOC	Includes localizers (incl. LOC-only), LDAs and SDFs	
	4	Row code for a localizer associated with an ILS	4=ILS localizer, 5=stand-alone localizer (incl. LOC, LDA & SDF)
	47.42939200	Latitude of localizer in decimal degrees	Eight decimal places supported.
	-122.30805600	Longitude of localizer in decimal degrees	Eight decimal places supported.
	338	Elevation in feet above MSL	Integer.
	11030	Frequency in MHZ (multiplied by 100)	Integer - MHz multiplied by 100 (e.g. 123.45MHz = 12345)
	18	Maximum reception range in nautical miles	Integer
	180.343	Localizer bearing in true degrees	Up to three decimal places supported
	ISNQ	Localizer identifier	Up to four characters. Usually start with "I". Unique within airport terminal area
	KSEA	Airport ICAO code	Up to four characters. Must be valid airport code
	K1	Airport ICAO region code	Must be region code according to ICAO document No. 7910
	16L	Associated runway number	Up to three characters
	ILS-cat-III	Localizer name	Use "ILS-cat-I", "ILS-cat-II", "ILS-cat-III", "LOC", "LDA" or "SDF"
6	Glideslope	Glideslope associated with an ILS	
	6	Row code for a glideslope	6
	47.46081700	Latitude of glideslope aerial in decimal degrees	Eight decimal places supported
	-122.30939400	Longitude of glideslope aerial in decimal degrees	Eight decimal places supported
	425	Elevation in feet above MSL	Integer.
	11030	Frequency in MHZ (multiplied by 100) (paired frequency, not channel)	Integer - MHz multiplied by 100 (e.g. 123.45MHz = 12345)
	10	Maximum reception range in nautical miles	Integer
	300180.343	Associated localizer bearing in true degrees prefixed by glideslope angle	Up to three decimal places supported. Glideslope angle multiplied by 100,000 and added (e.g. Glideslope of 3.25 degrees on heading of 123.456 becomes 325123.456)
	ISNQ	Glideslope identifier	Up to four characters. Usually start with "I". Unique within airport terminal area
	KSEA	Airport ICAO code	Up to four characters. Must be valid airport code
	K1	Airport ICAO region code	Must be region code according to ICAO document No. 7910
	16L	Associated runway number	Up to three characters
	GS	Name	"GS"

Row	Meaning *Example value*	Comment *Explanation*	*Valid values*
7, 8, 9	Marker beacons	Outer (OM), Middle (MM) and Inner (IM) Markers	
	8	Row code for a middle marker	7=OM, 8=MM, 9=IM
	47.47223300	Latitude of marker in decimal degrees	Eight decimal places supported
	-122.31102500	Longitude of marker in decimal degrees	Eight decimal places supported
	433	Elevation in feet above MSL	Integer
	0	Not used	0
	0	Not used	0
	180.343	Associated localizer bearing in true degrees (also known as "minor axis")	Up to three decimal places supported
	ISNQ	Associated approach identifier	Identifier of localizer or ILS approach associated with marker
	KSEA	Airport ICAO code	Up to four characters. Must be valid airport code
	K1	Airport ICAO region code	Must be region code according to ICAO document No. 7910
	16L	Associated runway number	Up to three characters
	MM	Name	"OM", "MM" or "IM"
12, 13	DME	Distance Measuring Equipment	
	12	Row code for a DME	12=Suppress frequency in charts. Used for paired DMEs, 13=display frequency in charts. Used for NDB/DMEs and unpaired DMEs
	47.43433300	Latitude of DME in decimal degrees	Eight decimal places supported
	-122.30630000	Longitude of DME in decimal degrees	Eight decimal places supported
	369	Elevation in feet above MSL	Integer
	11030	Frequency in MHZ (multiplied by 100) (paired frequency, not channel)	Integer - MHz multiplied by 100 (e.g. 123.45MHz = 12345)
	10	Minimum reception range in nautical miles	Integer
	0.000	DME bias in nautical miles.	Default is 0.000
	ISNQ	Identifier	Up to four characters. Unique within terminal or ICAO region.
	KSEA	Airport ICAO code (for DMEs associated with an ILS) ENRT for DMEs associated with VORs, VORTACs, NDBs or standalone DMEs	Up to four characters. Must be valid ICAO code ENRT otherwise
	K1	ICAO region code of enroute DME or terminal area airport	Must be region code according to ICAO document No. 7910 For terminal DMEs, the region code of the airport is used
	16L	Associated runway number (for DMEs associated with an ILS)	Only used for DMEs associated with an ILS. Up to three characters
	DME-ILS	DME name (all DMEs)	"DME-ILS" if associated with ILS Suffix "DME" to navaid name for VOR-DMEs, VORTACs & NDB-DMEs (eg. "SEATTLE VORTAC DME" in example data) For standalone DMEs just use DME name

Row	Meaning *Example value*	Comment *Explanation*	*Valid values*
14	FPAP	Final Approach Course Alignment point of SBAS or GBAS path point	
	14	Row code for FPAP	14
	47.437969722	Latitude of FPAP in decimal degrees	Eight decimal places supported
	-122.311211111	Longitude of FPAP in decimal degrees	Eight decimal places supported
	429	Orthometric height of FPAP in feet. Use 4.1.28.2/4.1.35.2 continuation record. If unavailable, use EGM2008 geoid to convert from WGS84 ellipsoid height	Integer, Feet
	61010	WAAS channel (SBAS) or GLS channel (GBAS)	Integer
	0.0	Length Offset in meters, from stop end of runway to FPAP	Up to one decimal place supported, meters
	180.339	Final approach course in true degrees	Up to three decimal places supported
	R16CY	Approach procedure identifier	Up to five characters
	KSEA	Airport ICAO code	Up to four characters. Must be valid airport code
	K1	Airport ICAO region code	Must be region code according to ICAO document No. 7910
	16C	Associated runway number	Up to three characters
	LPV	Approach performance indicator	Currently supported are "LP", "LPV", "APV-II" and "GLS"
16	LTP/FTP	Landing threshold point or fictitious threshold point of GBAS or SBAS path point	
	16	Row code for LTP/FTP	16
	47.463809028	Latitude of LTP/FTP in decimal degrees	Eight decimal places supported
	-122.310985000	Longitude of LTP/FTP in decimal degrees	Eight decimal places supported
	429	Orthometric height of LTP in feet. Use 4.1.28.2/4.1.35.2 continuation record. If unavailable, use EGM2008 geoid to convert from WGS84 ellipsoid height	Integer
	61010	WAAS channel (SBAS) or GLS channel (GBAS)	Integer
	56.6	Path point threshold crossing height, feet	Up to one decimal place supported, Feet
	300180.339	Associated final approach course in true degrees prefixed by glidepath angle	Up to three decimal places supported. Glidepath angle multiplied by 100,000 and added (e.g. Glidepath of 3.25 degrees on heading of 123.456 becomes 325123.456)
	R16CY	Approach procedure identifier	Up to five characters
	KSEA	Airport ICAO code	Up to four characters. Must be valid airport code
	K1	Airport ICAO region code	Must be region code according to ICAO document No. 7910
	16C	Associated runway number	Up to three characters
	WAAS	Provider	Provider of the SBAS service can be "WAAS", "EGNOS", "MSAS". If no provider is specified, or this belongs to a GLS approach, use "GP"

Row	Meaning *Example value*	Comment *Explanation*	*Valid values*
15	GLS	Ground station of differential GPS used for GLS approaches	
	15	Row code for GLS	15
	-33.964605556	Latitude for differential GPS ground station in decimal degrees	Eight decimal places supported
	151.184791667	Longitude for differential GPS ground station in decimal degrees	Eight decimal places supported
	21	Elevation of differential GPS ground station in feet	Integer
	22790	GLS GBAS channel number	Integer
	0	Unused	0
	300074.656	Associated final approach course in true degrees prefixed by glidepath angle	Up to three decimal places supported. Glidepath angle multiplied by 100,000 and added (e.g. Glidepath of 3.25 degrees on heading of 123.456 becomes 325123.456)
	G07A	Approach procedure identifier	Up to five characters
	YSSY	Airport ICAO code	Up to four characters. Must be valid airport code
	YM	Airport ICAO region code	Must be region code according to ICAO document No. 7910
	07	Associated runway number	Up to three characters
	GLS	Name	"GLS"

FURTHER INFORMATION

Resources are available for airport designers at the X-Plane Scenery Gateway at http://gateway.x-plane.com/