MetroAir Virtual Airlines

NAVIGATION BASICS V 1.0

NOT FOR REAL WORLD AVIATION

GETTING STARTED

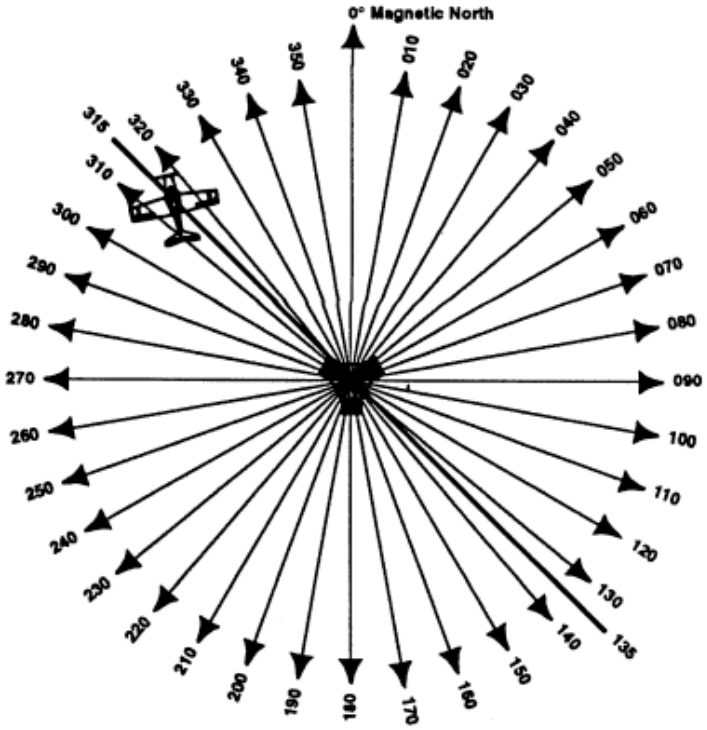
Having a good understanding of navigation is critical when you fly online the VATSIM network. ATC will expect that you know how to follow their directions as well as how to navigate the skies based on VORs, GPS, FMC, ILS etc. This lesson will give you a brief summary of what these acronyms stand for, and how they work.

VOR – VERY HIGH FREQUENCY OMNI RANGE

Very High Frequency Omni Range (**VOR**), is a type of short-range radio navigation system for aircraft, enabling aircraft to determine their position and stay on course by receiving radio signals transmitted by a network of fixed ground radio beacons, with a receiver unit. It uses radio frequencies in the very high frequency (VHF) band from 108 to 117.95 MHz. Developed in the US beginning in 1937 and deployed by 1946, VOR is the standard air navigational system in the world, used by both commercial and general aviation. There are about 3000 VOR stations around the world.

The basic principle of operation of the VOR is very simple: the VOR facility transmits two signals at the same time. One signal is constant in all directions as a reference phase. Another signal, it is variable-phase signal and it rotates through 360 degrees, like the beam from a lighthouse. Both signals are in phase when the variable signal passes 360 degrees (reference to magnetic north) and they are 180 degrees out of phase when the rotating signal passes 180 degrees The aircraft equipment receives both signals. The receiver will calculate the difference between the two signals, and interprets the result as a radial from the station to pilots on the aircraft.

RADIALS: The two signals from VOR transmitter generate 360 lines like spokes in a wheel. Each line is called a Radial. VOR navigation equipment on the airplane will determine which of those 360 radials the airplane is on.



There are 4 types of VORs in use in our air navigation system, two of which are utilized for civilian use. The other two types are used primarily by the military. VOR and VOR/DME are the two types of navigation that are used by civilians.

VOR: A VOR only gives you navigation information.

VOR/DME: A VOR/DME will give you direction, and distance information.

VORTAC: The VORTAC is a military version of the VOR with a collocated TACAN where the DME (Distance Measuring Equipment) is available to civilian aircraft.

TACAN: The TACAN is a more precision Military Version of the VOR with a military precision DME (Distance Measuring Equipment).

GPS – GLOBAL POSITIONING SYSTEM

The **Global Positioning System** (**GPS**) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

One of the newer concepts is Area Navigation, which allows aircraft to fly user-preferred routes from one way point to another, where way points don't depend on ground infrastructure. Newer procedures have been developed so that this system could be used for all phases of flight, particularly those that lack advanced navigation aids or surveillance equipment. Also, new and more efficient air routes are currently being expanded so they can be used with GPS. This saves both time and money. Often airplanes fly over areas like oceans which lack sufficient data. Here comes the role of GPS that allows more favorable and well-organized routes for flights, thereby saving time and fuel as well as raising the cargo revenue. For greater precision, satellite signals are augmented to allow for landing in minimal visibility conditions.

FMC - FLIGHT MANAGEMENT COMPUTER

The **Flight Management Computer** (FMC) also known as a Flight Management System (FMS) or Multi Control Display Unit (MCDU) is a fundamental part of a modern commercial aircraft's avionics systems. An FMS is a specialized computer system that automates a wide variety of in-flight tasks, reducing the workload on the flight crew to the point that modern aircraft no longer carry flight engineers or navigators.

A primary function is in-flight management of the flight plan. Using various sensors (such as GPS and INS often backed up by radio navigation) to determine the aircraft's position, the FMC can guide the aircraft along the flight plan. From the cockpit, the FMC is normally controlled through a Control Display Unit (CDU) which incorporates a small screen and keyboard or touchscreen. The FMC sends the flight plan for display on the EFIS, Navigation Display (ND) or Multifunction Display (MFD).

All FMCs contain a navigation database. The navigation database contains the elements from which the flight plan is constructed. These are defined via the ARINC 424 standard. The navigation database (NDB) is normally updated every 28 days, in order to ensure that its contents are current. Each FMC contains only a subset of the ARINC data, relevant to the capabilities of the FMC.

The NDB contains all of the information required for building a flight plan, consisting of:

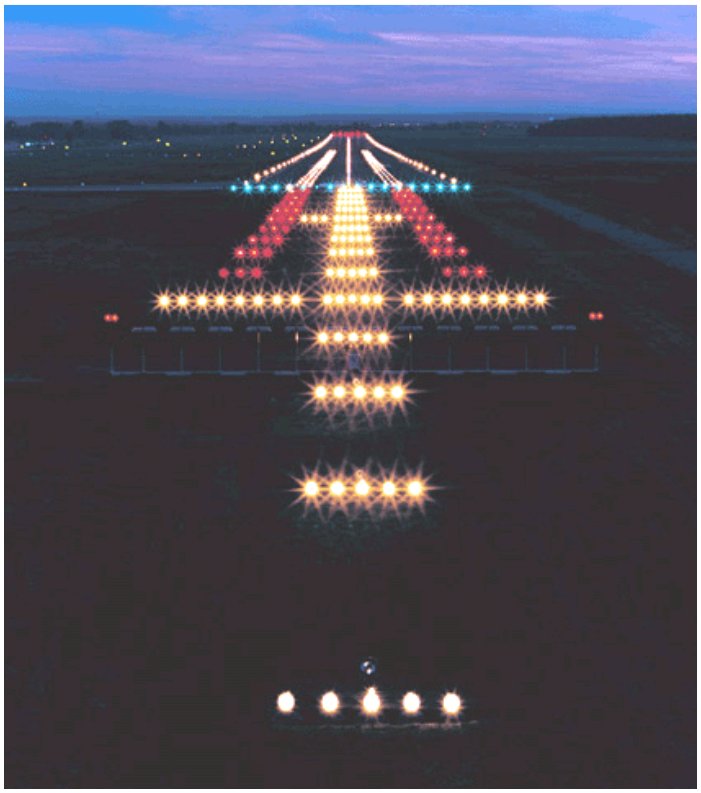
- Waypoints/Intersection
- Airways (highways in the sky)
- Radio navigation aids including distance measuring equipment (DME), VHF omnidirectional range (VOR), non-directional beacons (NDBs) and instrument landing systems (ILSs).
- Airports
- Runways
- Standard instrument departure (SID)
- Standard terminal arrival (STAR)
- Holding patterns (only as part of IAPs-although can be entered by command of ATC or at pilot's discretion)
- Instrument approach procedure (IAP)

Waypoints can also be defined by the pilot(s) along the route or by reference to other waypoints with entry of a place in the form of a waypoint (e.g. a VOR, NDB, ILS, airport or waypoint/intersection)

In Flight Simulator, FMCs are typically found on payware Aircraft.

ILS – INSTRUMENT LANDING SYSTEM

An **Instrument Landing System** (**ILS**) is a ground-based instrument approach system that provides precision guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and, in many cases, high-intensity lighting arrays to enable a safe landing during instrument meteorological conditions (IMC), such as low ceilings or reduced visibility due to fog, rain, or blowing snow. There are three kinds of ILS approach with the CAT-III being the one with the lowest minimums typically allowing the approach to be flown even with no visibility.



There are three main components to an ILS:

Localizer - A localizer is an electronic beam which transmits a specific signal and a VOR receiver can determine left/right (horizontal) reference to the beam. Think of it as a single radial off a VOR. It is typically (but not always) aligned with the runway centerline.

Glideslope - A glideslope is an electronic beam which is vertically as opposed to horizontally oriented. As a result, a glideslope receiver can determine above/below (vertical) reference. A glideslope signal is typically aligned with a localizer beam.

Approach Lighting System - The approach lighting system (ALS) assists the pilot in transitioning from instrument to visual flight, and to align the aircraft visually with the runway centerline. Pilot observation of the approach lighting system at the Decision Altitude allows the pilot to continue descending towards the runway, even if the runway or runway lights cannot be seen, since the ALS counts as runway end environment.

VFR OUT THE WINDOW

Visual flight rules (VFR) are a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minimums, i.e. in visual meteorological conditions (VMC), or when the ceiling and/or visibility are 3SM and 1000 AGL. The pilot must be able to operate the aircraft with visual reference to the ground, and by visually avoiding obstructions and other aircraft.

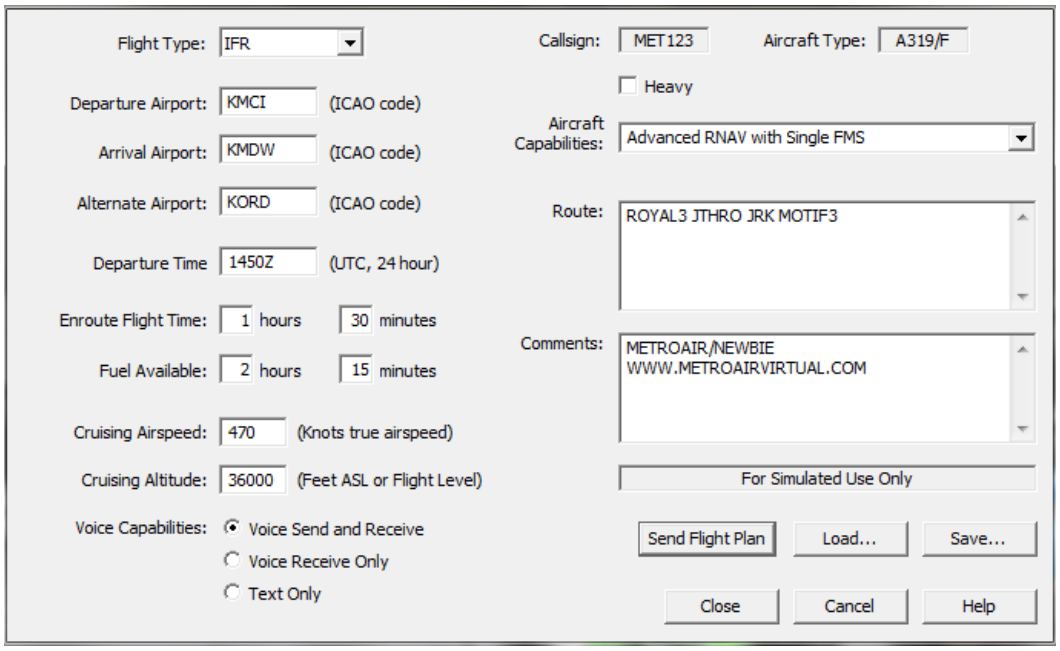
If the weather is below VMC, pilots are required to use instrument flight rules, and operation of the aircraft will primarily be through referencing the instruments rather than visual reference. In a control zone a VFR flight may obtain a clearance from air traffic control to operate as Special VFR.

FLIGHT PLAN EQUIPMENT CODES

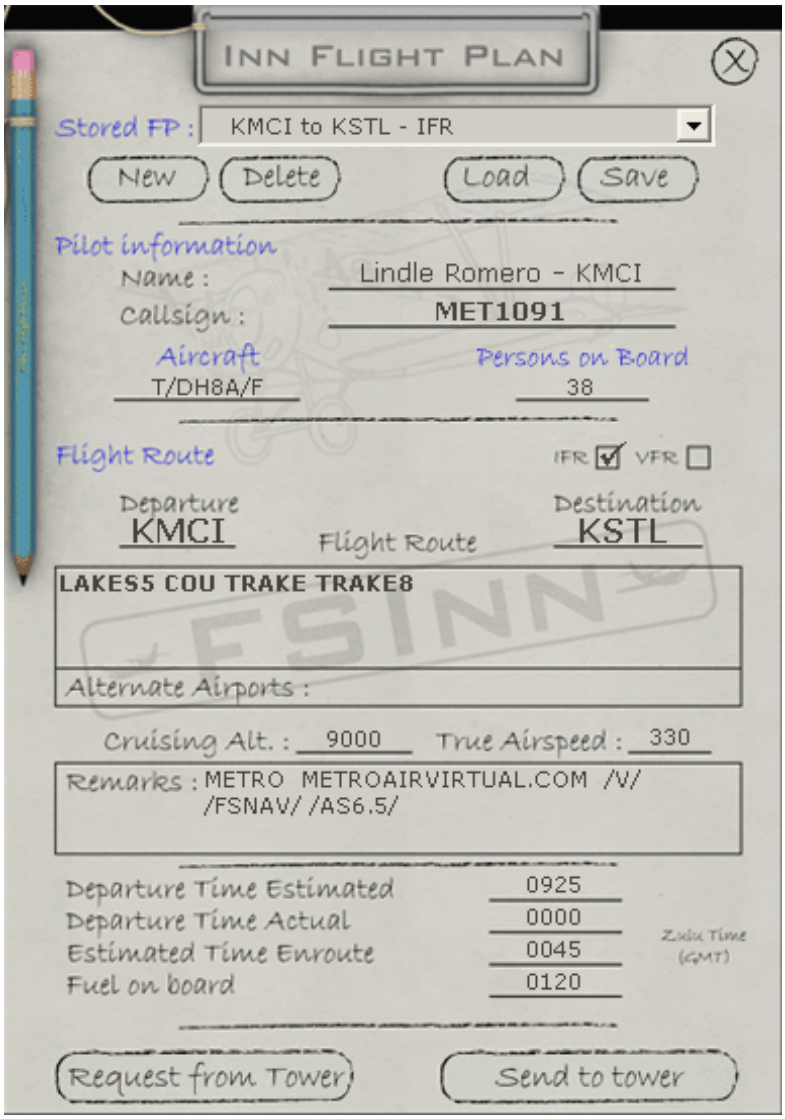
Including an aircraft equipment code in your flight plan is important to both you and ATC. The controller needs to know what navigational equipment is on board your aircraft. If you want to fly in RVSM airspace (FL290 - FL410) you must file your equipment code correctly. Equipment codes describe the transponder and/or navigation capability of your aircraft. Equipment Codes assist ATC in issuing you your flight plan clearance; therefore you need to understand the use of the appropriate equipment suffix. Depending on the pilot client you are using whether it is SquawkBox or FSInn, the aircraft capabilities are entered differently from one another.

SquawkBox:

In SquawkBox, the aircraft capabilities are determined from two (2) different places from your flight plan, the *Heavy* checkbox and the *Aircraft Capabilities* dropdown list.



FSInn: Typically if you load up your aircraft at the gate then load FSInn, the aircraft code will be loaded for the aircraft as seen below. If the aircraft code is not set, you will have to enter all details manually in the Inn Flight Plan form. There are no checkboxes and or drop down lists for Aircraft Capabilities; therefore you will need to enter the codes yourself using the Aircraft Equipment Code Suffix which is added to the end of the Aircraft Type code.



Aircraft Equipment Codes & Suffixes When providing an aircraft type on a flight plan, you are required to include information about the on-board, certified equipment using an identifier code as a suffix to the equipment type. It is recommended that you file the maximum capability of your aircraft. For a list of the available suffixes and what each means, visit http://flightaware.com/about/faq_aircraft_flight_plan_suffix.rvt.