



# VOR to VOR Navigation Training

BY JOHN SHANKLAND

**W**hen I first started aviating with flight simulators, I would ascend into the virtual skies and simply fly around the airport from which I had taken off. I'd practice my takeoff and landing skills and "fly around the flagpole", but never much more than that. Oh, sure, I'd venture out further and would land at other airports, but the airports where I landed were hardly ever my intended destination. That's because I didn't know how to navigate.

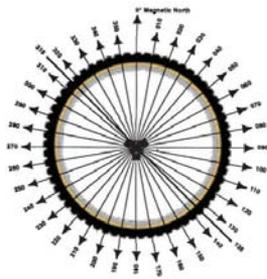
I tried reading some books on the subject (before Al Gore invented the internet), but I felt the books and articles I had read were written for people who already knew how to navigate. This was no help to me, whatsoever. I called my brother who had taken flying lessons and, with his help and considerable patience, I finally figured it out.

In this article, I will try to explain how to navigate through the virtual skies using VORs. I will use real sectional charts to show you how I create my flight plans. For me, using real sectional charts adds more realism to the flight sim experience. I realize that Microsoft Flight Sim incorporates a tool that creates a flight plan for you; however, in my opinion, that is far from fun. So sit back, relax, and enjoy this lesson... I have the airplane.

## What's What

VOR stands for Very High Frequency Omni-directional Range. Basically, it's a ground-based radio station that emits a precise signal in every direction. A VOR radio in your airplane picks up these signals and modifies a panel display that provides directional guidance while you are flying toward or away from the VOR transmitter.

This is how it works. Imagine the VOR transmitter is the hub of a bicycle wheel that has 360 spokes. These spokes are called “radials” and each radial represents one degree of a complete circle. With the NAV radio you tune in the frequency of the VOR that you want to fly toward or away from and then follow the specific radial of your choice.



THE VOR IN ALL IT'S GLORY

For purposes of this training I will be using the default Cessna 172 in FS2004. Also, I will be using real sectional charts for the area where I live. I must apologize because I live in the Midwest United States which means it's really flat... and boring. No magnificent mountains or other unique terrain features. Come to think of it... this is a perfect venue for this lesson because there are NO distinguishing features ANYWHERE! Because the landscape is so bland, it's easy to get off course, and this is where radio navigation becomes extremely useful.

### Cockpit Familiarization

As if it wasn't already hard enough to fly and keep track of the “Big Six” gauges on your panel while flying, I'm now going to add a few more. I took these screenshots in the 2D panel because it's easier to see; however, if you like flying with the virtual cockpit, these same gauges are there as well, although it might vary slightly from the 2D view. I've highlighted the instruments we are going to use in this lesson.



We will start with the radios; after all, we won't be flying to any VORs if we don't use these. On your radio stack you will have two communication radios and two Navigation radios. We'll call the navigation radios NAV1 and NAV2. You will see an “Ident” button on each radio. When a VOR is tuned into the NAV1 or NAV2 radios, you can identify the correct VOR by pulling this Ident knob and listening for a particular series of tones. In the real world, if you tune in the VOR and you don't hear anything when you pull the Ident knob there's a good chance that VOR is out of service. We won't run into this problem in FS2004.

Along with the VOR radios we'll be using Distance Measuring Equipment or “DME”. It's located at the top right corner of the 2D panel. This handy little display will help you a couple different ways -- it can show how far away you are from the VOR, and it can display your ground speed in knots. In some aircraft, it can also indicate the approximate flight time to arrive at the VOR. Since you will have two different VORs tuned into the NAV radios, there is a knob to switch the DME between the two radios.



THE DME DISPLAY. A VERY HANDY DISPLAY INDEED!

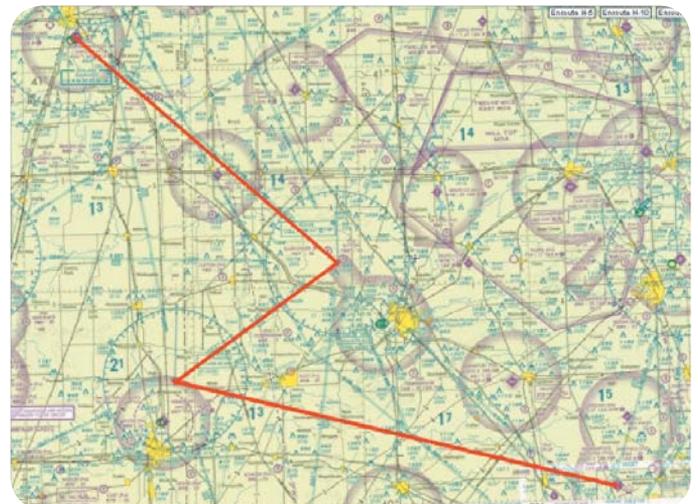
The VOR1 and VOR2 gauges are located on the right side of the panel. As denoted by the illustration, a bearing ring is mounted around the outside of the gauge. This bearing ring is not to be confused with a Heading Indicator gauge! The purpose of the bearing ring is to select a particular radial from the VOR transmitter, and this selection can be adjusted with the Omni-directional Bearing Selector (OBS) knob on each receiver.



CHECK THE LOCATION OF THE VOR RECEIVERS IN RELATION TO THE “BIG SIX”

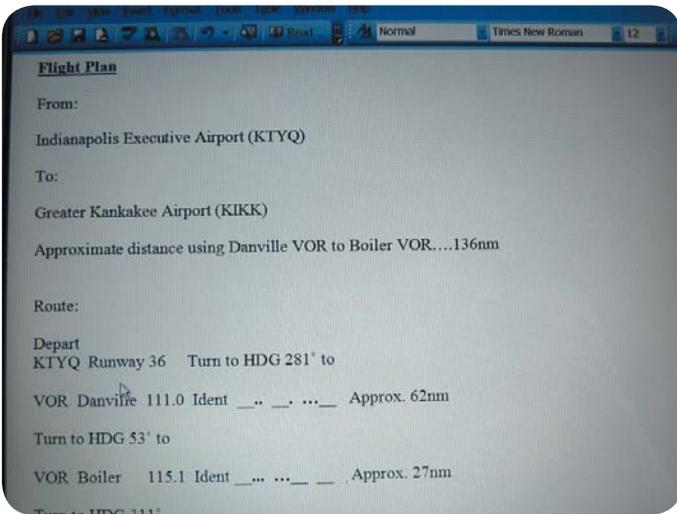
### Creating a flight plan

The flight plan I created for this lesson was made using real sectional charts. We'll be taking off from a small airport north of Indianapolis (KTYQ) and landing at an airport south of Chicago (KIKK). In real life, it's pretty much a straight shot, but I threw a little jog into the flight plan to spice it up.



I create my flight plans on my laptop and then set it next to me as I fly. This does two things for me... one, it provides all the information I need at a glance and, two, makes me feel high tech!

If you'd like to create your flight plans as I do, you can purchase sectional charts and other planning and navigation aids from your local municipal airport.



**I HAVE HEADINGS, VOR RADIO FREQUENCIES AND IDENTIFYING CODES, AND DISTANCES AT THE READY**

I laid out my sectional and my navigation plotting ruler and went to work. The first leg of my flight was from Indianapolis Executive (KTYQ) Runway 36 to the Danville VOR. According to the sectional, I should be flying a heading of 281°. From there, I would backtrack a little to the Boiler VOR. Notice that there is a route already established on the chart between these two VORs. These routes are called “Victor Airways” (VA) and you can see numerous VAs on a sectional connecting various VORs. The VA in this case told me that I needed to fly a heading of 053° from the Danville VOR to the Boiler VOR. The final leg of our flight will take us from the Boiler VOR to Greater Kankakee Airport (KIKK)... which happens to have a VOR smack dab in the middle of the airport! We will be landing on Runway 34.

**Let’s go flying!**



**LINED UP AND READY TO GO!**

After completing a thorough preflight check, we release the parking brakes and taxi to Runway 36. At the “Hold Short” marker, we go through the takeoff checklist and note that everything seems to be good with the airplane. We tune the NAV1 radio to a frequency of 111.0 and set the OBS to a bearing of 281°. This is for the Danville VOR. Next, we set the NAV2 radio to 115.1 and the OBS to a bearing of 053° for the Boiler VOR.

Nothing happens! Why? Well, we’re sitting on the ground. Once we get airborne and gain some altitude, the VOR receivers will spring to life... I promise! We now have clearance for departure on Runway 36 heading west. We check to ensure the pattern is clear, ease out onto the runway, get lined up, ease the throttle forward, and off we go!

After establishing a positive rate of climb and retracting the flaps, we climb out to 1500 ft. Upon reaching altitude, we turn to a heading of 281°. Soon we will see the DME display showing a readout for the Danville VOR.



**CLIMBING OUT ON A HEADING OF 281°**

This is when we use the Ident button on the Nav1 radio. When the Ident button is activated, we will hear a series of Morse Code tones. According to our flight plan, it should be “dash dot dot pause dash dot dot pause dot dot dot dash”. If that’s what we hear, then we’re tuned into the correct VOR. If not, we need to re-check our frequency settings.

As VOR1 becomes active, we can see that we’re on a heading of 281° and tracking the 281° radial toward the Danville VOR. In other words, we are flying TO the VOR. We know this by looking at the gauge itself. Notice that there is a small arrow pointing up at the bottom of the gauge. We can fly either toward or away from a VOR. The key is to make sure that we have the correct radial selected with the OBS.



**THINGS LOOK A LITTLE DIFFERENT IN THE VIRTUAL COCKPIT VIEW.**

If you have MS Flight Simulator create your flight plans for you, it automatically selects the headings for you, but if you create flight plans as I do, you have to be wary of which radial you select. Many times I would put my straight edge in the center of the VOR of the departure airport and use that radial. If you look at the route earlier in the article, the red line from KTYQ to the center of the Danville VOR looks like it lies on the 99° radial. Well, it is... IF I'm flying FROM that particular VOR. However, if I'm flying TO a VOR, I need to use the reciprocal of the 099° radial, or 281°. If you look at the VOR diagram earlier in the article, you'll see that the reciprocal heading for 270° is 090°. Likewise, the reciprocal for 360° is 180°.

When we took off, we assumed a heading of 281° and pretty much hit right on the radial that we were supposed to be on. What happens when we aren't lined up exactly on the radial and we need to find it? As long as we are flying TO the VOR, we need to "fly to the line" in order to intercept the radial we need. To illustrate this, I took a little detour to the left to get off course. The needle in the middle of the VOR1 gauge moved to the right, indicating that we are to the left of the 281 radial and we need to turn right to intercept it. As we get closer to the 281 radial, the needle swings back to the center as the illustrations show.



**COMMENCING A RIGHT TURN TO "FLY TO THE LINE" TO GET BACK ON COURSE**



**STARTING MY LEFT TURN**



**ONCE THE NEEDLE HITS CENTER, ROLL BACK TO A HEADING OF 281°. ROLL OUT OF YOUR TURN A LITTLE EARLY SO YOU DON'T OVERTHOOT THE RADIAL**



**NOTICE THE NEEDLE ON VOR 1 HAS MOVED TO THE RIGHT OF CENTER**



**GETTING READY TO TURN ONTO THE 053 RADIAL FOR THE BOILER VOR. NOTICE THE HEADING INDICATOR AND THE BEARING RING ON THE VOR 2 RECEIVER. AFTER THE TURN, THEY'LL BOTH READ THE SAME**

We stay on the 281 radial until about 1.5 nautical miles from the Danville VOR, and then we turn to a heading of 053°. Since we were so close to the Danville VOR and are now following the Victor Airway for the Boiler VOR when we roll out of our turn, we are exactly on the 053 radial. We switch the DME over so it starts picking up the Boiler VOR. With a quick pull of the Ident knob, we confirm that we have the correct VOR frequency dialed into the NAV2 radio.



**RESETTING THE NAV 1 RADIO TO 111.60 AS WELL AS SETTING THE VOR 1 OBS SO IT WILL TRACK THE 311 RADIAL OUT OF KANKAKEE**

At the conclusion of the turn, it's time to reset the NAV1 radio to the Kankakee VOR. We dial in the frequency of 111.60 and the needle quickly swings into action. We know from our flight plan that we need to fly a heading of 311° from the Boiler VOR all the way to Kankakee, so we set the OBS to a bearing of 311°.

It's relatively a short little jaunt from the Danville VOR to the Boiler VOR. So far, everything is going according to plan.

At this point, we're flying in fair weather conditions, but if it were bad weather, we may have to change our destination airport. When I've done that in the past, I would get out my sectionals and re-route my trip on the fly (no pun intended!). That is always a challenge, but very rewarding when a potential disaster can be avoided with some quick and cool-headed thinking.

## Bringing It In



**ROLLING OUT ONTO THE 311 RADIAL. NOTICE THE DME IS STILL SET TO THE BOILER VOR. THE HEADING INDICATOR AND THE VOR 1 BEARING WILL READ THE SAME AT THE COMPLETION OF THE TURN.**

When we are about one and a half nautical miles from the Boiler VOR, we roll into a left turn and roll out onto the 311 radial for the Kankakee VOR.

As you can see from the screenshots, this is a VERY FLAT place. There are no landmarks, mountains, hills, rivers, or anything else for that matter that might help us determine where we're at. This is why learning how to navigate using the VOR system can be so helpful and fun!

About twenty miles from the Kankakee airport we make a left turn and intercept the 340 radial. We do this because the VOR sits smack dab in the middle of the airport and we're looking to land on Runway 34. This will give us our best chance of making a straight-in approach. We intercept the 340 radial and follow it in to the Greater Kankakee Airport and, sure enough, the runway lies dead ahead! Having done the landing checklist before, it's just a matter of a few small adjustments here and there and we can set this puppy on the ground!

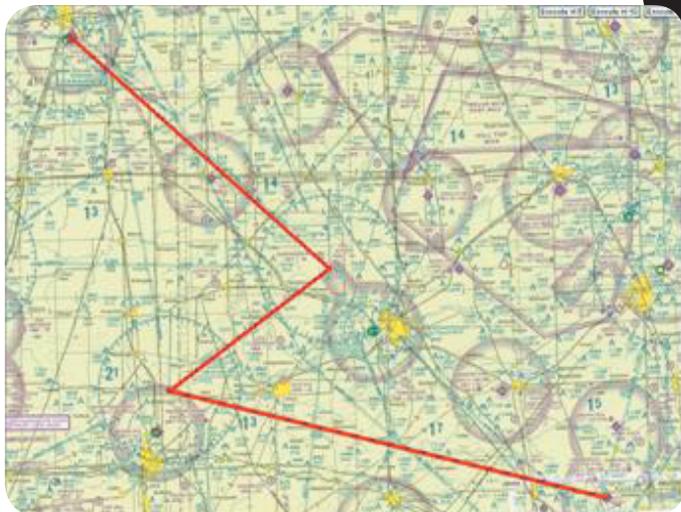


**LINED UP ON FINAL!**

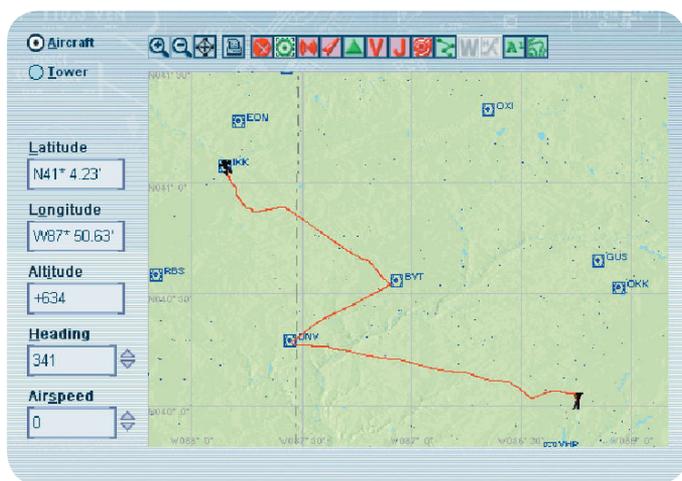


**TOUCHDOWN!**

## Debrief



**PROPOSED ROUTE**



**ACTUAL ROUTE**

Now that we're safely on the ground, we can compare our flight plan with the actual route we flew. It's important to keep in mind that I veered off course on purpose to show you how to find the radial we were looking for. It's almost a mirror image!

I'm pleased with the results of this flight. It's always fun to sit back and review your flight and say, "I did a good job on that one!" or "Where the heck is this place? This airport wasn't on the flight plan!" Either way, just have fun doing it!

With everything these days moving towards new-fangled GPS systems and so forth, I find it very exciting and rewarding to plan my flights using real world sectionals and navigation aids. I admit that, when I first started, I didn't think I would be able to do it; however, I stuck with it and now I fly all over the place using the VOR system.

I hope you enjoyed this lesson and want to continue to hone your navigation skills. If you have questions, the flight sim community is full of helpful individuals who will gladly take the time to assist you. The internet is also a great place to find resources on the subject

Happy flying! →