



JEPPESSEN ELECTRONIC CHART CLINIC SECOND IN A SERIES

By JAMES E. TERPSTRA
SR. CORPORATE VICE PRESIDENT, JEPPESSEN

DIGITAL BRIEFING

Details, details, details. In the world of aeronautical charts you know the magnitude of details to get the content and the image just right. And now - add on top of that the world of bits and bytes to those charts. For every little piece of information that shows up in print, there is an additional world to make that information show up in the digital world.

Some of that electronic data has no intelligence - we say it has just a pretty face. Raster charts are like that. To go one step higher in the intellectual chain, enter into the world of vector.

Vector Images

For those of us in the world of aviation, we know the term "vector" as something ATC gives us mostly in the terminal environment to efficiently move airplanes. If you ask controllers, they will tell you vectors are the simplest and earliest versions of RNAV. Controllers can place you anywhere without having to fly over a navaid.

To draw a parallel between the controller's vector and how the term "vector" is used in creating graphic images, imagine the controller's vector as a place where you began your particular flight path. At the point where the vector began, that is a point on the ground. The controller's vector then began as a heading which took you in a direction. That heading is compared to the line on a chart. When the controller gives you a change in your heading, the point at which the heading changed can also be defined as a point on the ground.

Looking back on those clearances, you had two points on the ground connected by a heading which created a track over the ground. That is exactly how vector charts and images are drawn.

When a graphic artist wants to define a line on a chart in vector format, he or she defines the starting point and the ending point. Once the beginning and ending points have been defined, then the line connecting those two points is defined.

For aeronautical charts, the beginning and ending points are typically defined as points of latitude and longitude. As an example, the line on a chart can connect a VOR and an intersection. The VOR and the intersection are both defined in

the database each with a latitude and longitude. The line connecting the VOR and the intersection is then described with a number of attributes. The attributes usually include a description that says the line is solid (no dashes), it has a width, and it has a color. The attributes may even have a link (or connection) to a field in the database that describes additional information such as the minimum altitude, the aeronautical description of the line such as an initial approach segment, etc.

Defining the Ends of the Legs

For each line on a vector chart, the beginning and ending points are defined as a specific latitude and longitude. This allows each point on the chart to be precisely geo-referenced so that each point may be linked with GPS signals for moving map displays. Since each point is defined as a latitude and longitude location, the point will precisely match the latitude and longitude of the GPS signals. With charts based on vector formats, the airplane symbol generated by the GPS signal will be depicted *exactly* at the location on the chart that matches the airplane's location. Raster charts have the geo-referencing correct at many locations on the chart, but the points in between the geo-referenced spots will be inaccurate by the amount of stretching of the paper or the inexact plotting by the cartographer who originally drew the chart by hand.

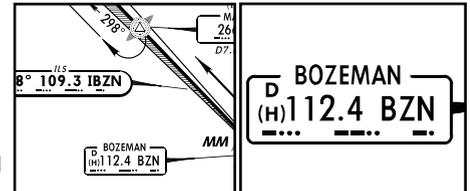
If the beginning point of a line is defined as a VORTAC, the automated cartography (or computer graphics system) that drew the vector chart used a "call" to access the VORTAC symbol out of a graphics symbol file. Each of the symbols in a vector chart is also drawn as a vector symbol.

So What Does This Vector Chart Mean for Me?

Assuming the GPS you are using has RAIM and other means to ensure its accuracy and integrity, the GPS signal that is used to overlay your airplane's position on a chart will be very precise. But if you are using that signal over a raster chart, the signal will be more accurate than the chart you are using. You might be lined up perfectly on the extended centerline of a runway on a Sectional Chart or WAC and find when you match that up with the outside world, you are not on the same path. That is because the geo-referencing is averaged and not precise over the entire chart.

On vector charts, when your airplane is lined up on the extended centerline, you can look outside and you will also see your airplane lined up exactly on the real extended centerline. On vector charts, when you pass over a fix or navaid on the chart, you are also precisely passing over that same fix or navaid in the real world.

Vector charts provide other advantages also. When you zoom close in to make the images and chart content larger, the lines and symbols are redrawn from the vector descriptions. Since they are redrawn, the larger images will be as crisp and clean as when viewed in their original size. This allows all images to be easily read at any zoom level.



In the illustration, note that the small navaid facility box for the Bozeman VOR is crisp in its regular size as it appears in vector format in JeppView. When zoomed into the maximum, the facility box for Bozeman remains just as crisp. This is because the image is regenerated from the vector points when zooming in closely. The "crispness" applies to text as well as lines.

Does File Size Matter?

In the previous article, the statement was made that the electronic sectional or WAC chart files were incredibly large at 7 to 12 megabytes. Is that really large with today's computers? Yes. The size by itself is not particularly large for ground-based computers, but when placed into an airplane, that size for a complete coverage of charts usually requires a CD. As you remember from training days, anything that spins wants to stay in its own plane of rotation. Can you imagine a CD not wanting to change its plane of rotation as you change the pitch and bank of your airplane? Files that are smaller fit on fixed media that don't rotate.

Also, with raster charts, the millions of pixels need to change location very fast on a moving map display in an airplane moving 200 to 300 knots. In order to get the raster pixels to move smoothly, it takes a lot of processing power. That's also expensive in an airplane when you consider certification.

Vector images can be stored in substantially smaller files. Vector files generally consume only 10% to 50% of the file size for an equivalent image, depending on the type of aeronautical chart.

In the next issue, we'll discuss charts that are generated out of a database "on the fly" without an image that has been previously composed by a graphic artist sitting on the ground.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: jim.terpstra@jeppesen.com