# Doppler Processing

The Cospas-Sarsat System calculates the location of distress beacons using Doppler processing techniques. Simply stated the Doppler effect is a term used to describe the phenomena that the frequency of a signal "as heard" by a receiving device is affected by the magnitude of the relative velocity between the transmitter and the receiver. If the distance between the transmitter and the receiver is reducing, the frequency as heard by the receiver is raised by the Doppler effect. If the distance is increasing, the Doppler effect reduces the frequency as heard by the receiver. If there is no relative velocity, the frequency heard by the receiver is exactly the transmitted frequency.
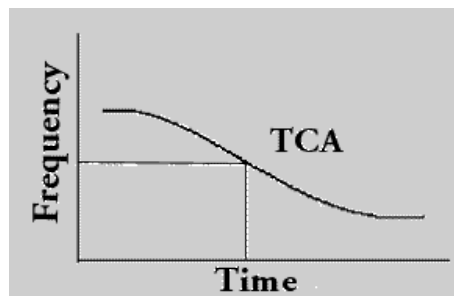
The frequency time plot to the left is representative of a signal heard by a LEO satellite passing over a stationary transmitter on the surface of the Earth. The point of inflection of the curve represents the point in time where the satellite was closest to the transmitter (TCA - Time of Closest Approach). The slope of the curve at TCA determines the distance of the transmitter from the satellite track.
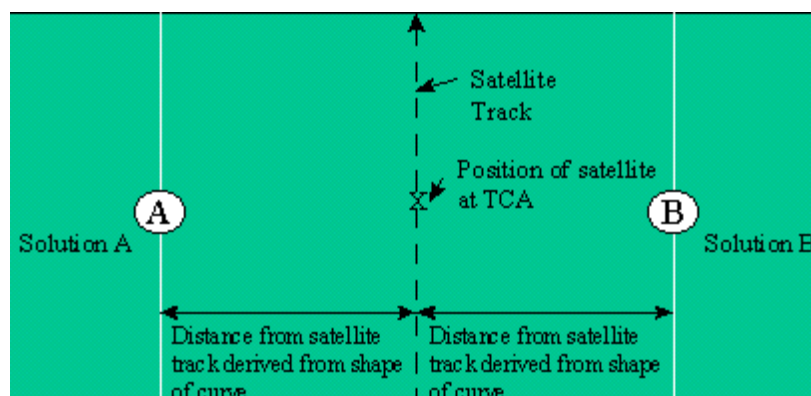
Using this information, and by knowing where the satellite was at all times during the pass, it is possible to plot two lines which represent the distance from the satellite track where the transmitter could have been. Then knowing the time of closest approach of the satellite, it is a simple matter of drawing a perpendicular line from the point on the satellite track at TCA to the lines representing the distance between the transmitter and the satellite track. Where these lines intersect represent two possible locations for the transmitter, one being the actual location and the other being its mirror image. A subsequent satellite pass on a different satellite track can be used to resolve the ambiguity. An estimate of the true and image location can also be calculated by taking into account the Earth rotation when computing the Doppler solutions. However, this ambiguity resolution technique is dependent upon the stability of the transmitted frequency and can only be used reliably with 406 MHz distress alerts.