

55 degrees relative to the equator. The orbital radius (i.e. distance from the center of mass of the earth to the satellite) is approximately 26,600 km.

With the baseline satellite constellation, users with a clear view of the sky have a minimum of four satellites in view. It is more likely that a user would see six to eight satellites. The satellites broadcast ranging signals and navigation data allowing users to measure their pseudoranges in order to estimate their position, velocity and time, in a passive, listen-only mode. The receiver uses data from a minimum of four satellites above the mask angle (the lowest angle above the horizon at which a receiver can use a satellite). The exact number of satellites operating at any one particular time varies depending on the number of satellite outages and operational spares in orbit. For current status of the GPS constellation, please visit <http://tycho.usno.navy.mil/gpscurr.html>. [Figure 16-40]

VFR Use of GPS

GPS navigation has become a great asset to VFR pilots providing increased navigation capability and enhanced situational awareness while reducing operating costs due to greater ease in flying direct routes. While GPS has many benefits to the VFR pilot, care must be exercised to ensure that system capabilities are not exceeded.

Types of receivers used for GPS navigation under VFR are varied from a full IFR installation being used to support a VFR flight to a VFR only installation (in either a VFR or IFR capable aircraft) to a hand-held receiver. The limitations of

each type of receiver installation or use must be understood by the pilot to avoid misusing navigation information. In all cases, VFR pilots should never rely solely on one system of navigation. GPS navigation must be integrated with other forms of electronic navigation, as well as pilotage and dead reckoning. Only through the integration of these techniques can the VFR pilot ensure accuracy in navigation. Some critical concerns in VFR use of GPS include RAIM capability, database currency, and antenna location.

RAIM Capability

Many VFR GPS receivers and all hand-held units are not equipped with RAIM alerting capability. Loss of the required number of satellites in view, or the detection of a position error, cannot be displayed to the pilot by such receivers. In receivers with no RAIM capability, no alert would be provided to the pilot that the navigation solution had deteriorated and an undetected navigation error could occur. A systematic cross-check with other navigation techniques would identify this failure and prevent a serious deviation.

In many receivers, an updatable database is used for navigation fixes, airports, and instrument procedures. These databases must be maintained to the current update for IFR operation, but no such requirement exists for VFR use. However, in many cases, the database drives a moving map display that indicates Special Use Airspace and the various classes of airspace in addition to other operational information. Without a current database, the moving map display may be outdated and offer erroneous information to VFR pilots wishing to fly around critical airspace areas, such as a Restricted Area or a Class B airspace segment. Numerous pilots have ventured into airspace they were trying to avoid by using an outdated database. If there is not a current database in the receiver, disregard the moving map display when making critical navigation decisions.

In addition, waypoints are added, removed, relocated, or renamed as required to meet operational needs. When using GPS to navigate relative to a named fix, a current database must be used to properly locate a named waypoint. Without the update, it is the pilot's responsibility to verify the waypoint location referencing to an official current source, such as the Chart Supplement U.S., sectional chart, or en route chart.

In many VFR installations of GPS receivers, antenna location is more a matter of convenience than performance. In IFR installations, care is exercised to ensure that an adequate clear view is provided for the antenna to communicate with satellites. If an alternate location is used, some portion of the aircraft may block the view of the antenna increasing the possibility of losing navigation signal.

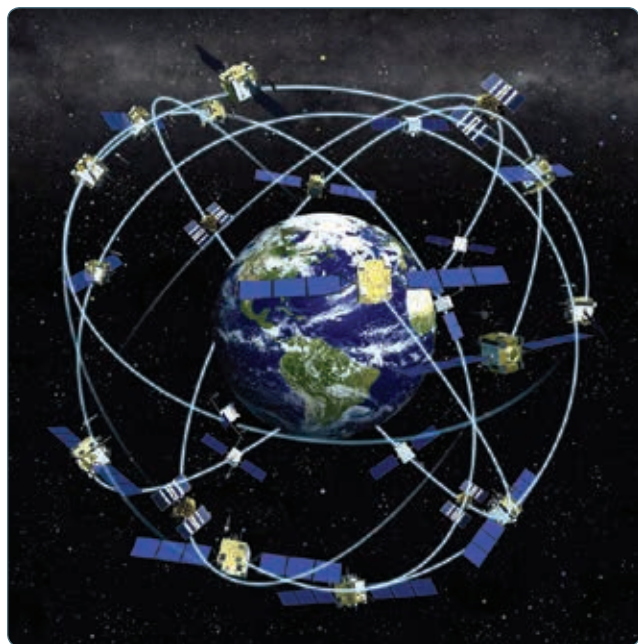


Figure 16-40. *Satellite constellation.*