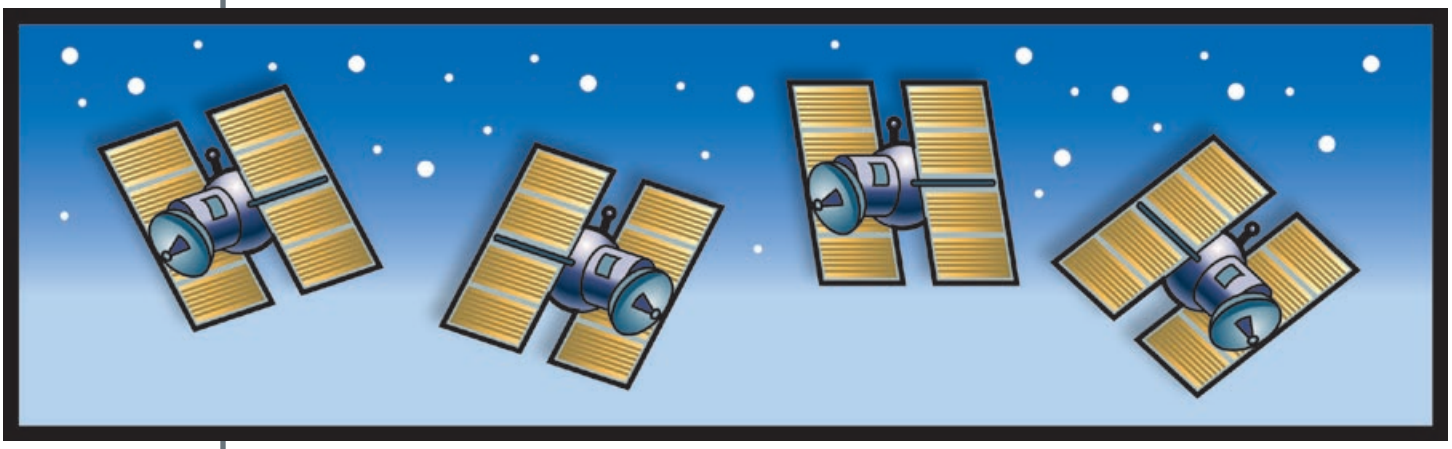
Assisted GPS



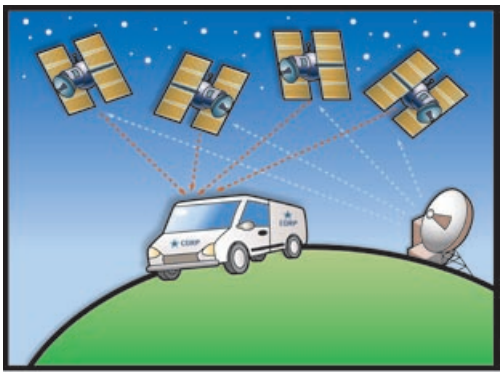
"Assisted GPS" (AGPS) describes a system that uses a terrestrial RF network to improve the performance of Global Positioning System (GPS) receivers by providing information about the satellite constellation directly to the GPS receiver.

Through its ReFLEX network, SkyTel provides Assisted GPS to its FleetHawk customers. This document provides an overview of GPS and Assisted GPS in general, and the SkyTel system of AGPS in particular.

What is GPS?

The Global Position System (GPS) was originally developed by the U.S. Department of Defense for use in precision weapon delivery. While the System is still funded and controlled by the DoD, it is also now used by thousands of civilians for location and tracking services.

Components of GPS:



A GPS receiver gathers data from satellites to pinpoint its location and time. Ground-based monitoring stations compute precise data and clock corrections and upload this data to the satellites. Ideal circumstances for receipt of GPS data include a clear view of the sky to receive satellite data and achieve a position fix.

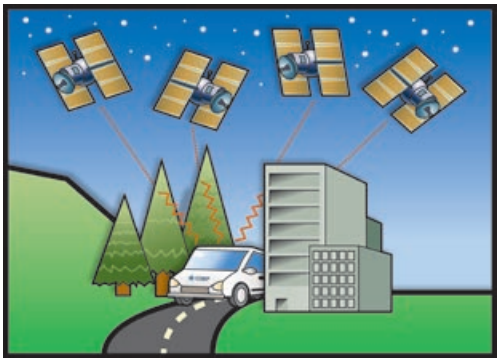
Satellites: The GPS Operational Constellation consists of a minimum of 24 satellites that orbit the earth every 12 hours. Frequently, there are more than 24 operational satellites, as new ones are periodically launched to replace older satellites or augment the constellation.

The satellites orbit the earth along six different orbital paths, or "planes," with four satellites equally spaced along each plane. The planes circle the earth at about fifty-five degrees with respect to the equatorial plane. This configuration puts between six and eleven satellites within line-of-sight from any point on earth. As they orbit, the satellites transmit their orbit information, plus a time code, to ground-based monitoring stations and to GPS receivers.

Monitoring Stations: Monitoring stations on the ground receive signals from the satellite and use that data to compute precise orbital data (ephemeris) and clock corrections for each satellite. The Master Control station uploads ephemeris and clock data to the satellite, which in turn sends subsets of this information to GPS receivers

GPS Receivers: GPS receivers obtain signals from the GPS satellites and use the data to calculate the location of the receiver. The receiver must locate four satellites to be able to obtain this position fix: three satellites to determine latitude, longitude and elevation, and one additional satellite to obtain the precise timing required to determine how much time it takes each GPS signal to travel from the satellite to the receiver. Under ideal circumstances, the typical receiver can determine its location with an accuracy of 10 meters or better.

Limitations of GPS



Under less than ideal circumstances, a GPS receiver may not be able to receive accurate or complete satellite data. This can occur when transmissions are blocked by buildings or natural obstructions such as heavy tree cover.

Upon activation, the GPS receiver scans for signals from the GPS satellites. The unit must locate and receive signals from at least four satellites to be able to determine its location. With unassisted GPS, this process of locating the satellites, receiving the data and achieving a position fix can take several minutes. This delay can be problematic for many GPS applications.

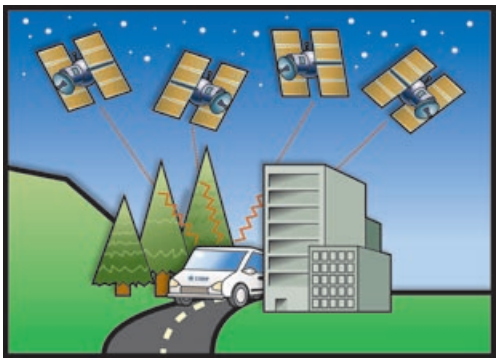
A second limitation of GPS is that the receiver needs a clear view of the sky to successfully receive signals from the satellites. Under unfriendly RF conditions, such as in a building, in urban "canyons" or other RF-shadowed environments, accuracy of the position fix can be compromised. In some cases, it can be impossible to achieve a position fix.

AGPS Advantages

With AGPS, a wireless network sends information directly to the GPS receiver,

which allows the receiver to quickly locate the four satellites and process the data contained in their signals.

The AGPS information includes identification of the visible satellites. Because the receiver is now searching only for specific signals, the amount of time it takes for a GPS receiver to obtain its first location or time-to-first-fix (TTFF) is reduced from minutes to seconds.



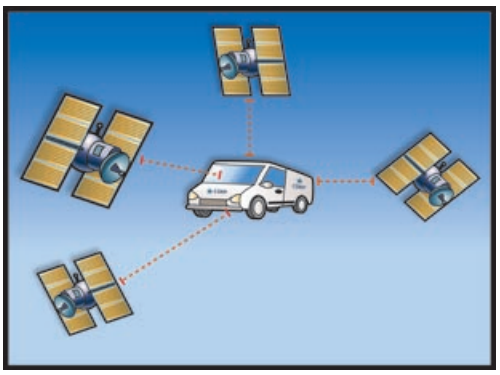
With SkyTel Assisted GPS, ground receivers, placed in optimal, clear-sky locations, also receive the GPS satellite signals. Those signals are retransmitted to SkyTel FleetHawk receivers to compensate for any interference that may occur. Consequently, FleetHawk receivers are able to obtain quick, accurate location and time fixes under less than ideal circumstances.

Assistance is also provided to the GPS receiver by sending the ephemeris data for each satellite so that this data does not have to be decoded from the GPS signals. The receiver must still obtain signals from at least four satellites to determine the time it took each signal to arrive at the receiver; however, it does not have to decode the entire signal.

Assisted GPS effectively increases the sensitivity of the receiver so that it is able to obtain and demodulate the satellite signals in areas where unassisted GPS could not. Further, since the ephemeris data is already provided to the receiver, it can determine position more quickly than if unassisted, even in clear view of the sky.

It is important to note that these advantages will be seen primarily under circumstances present when the device is in an unfriendly RF environment. The most obvious situation is when the device is first powered. When first powered, there is no valid ephemeris data on the GPS receiver, so the positions of the satellites in the sky are unknown. In this circumstance, the Assistance information enables the receiver to obtain a fix more quickly than an unassisted device and in some cases, obtain a position fix where an unassisted device could not obtain one at all.

If a GPS receiver has been functioning and has been demodulating the satellite signals prior to entering an unfriendly RF environment, the assistance data is initially unnecessary and offers no advantage. However, if the receiver remains in this unfriendly RF environment for a period of time, the satellites viewable over its position will change. In addition, the ephemeris data of each satellite will also change, as corrections are made to its orbit on a regular basis. For these reasons, ephemeris data becomes stale and needs to be updated on the GPS receiver. Regular updates of ephemeris data to the receiver enable the device to continue to operate in conditions where an unassisted device would cease to operate.



GPS receivers must locate and gather data from four GPS satellites to obtain a position fix: three satellites determine latitude, longitude and elevation, and the fourth provides the element of time.

SkyTel AGPS Technology

The SkyTel AGPS system allows FleetHawk devices to operate more quickly and under adverse RF conditions. The SkyTel AGPS system consists of the following components:

- GPS reference network
- AGPS Server
- ReFLEX transmitters and receivers, and
- FleetHawk devices

A network of GPS receivers across the United States is used to obtain the most up-to-date ephemeris data from all

satellites visible in the United States. The AGPS server is constantly obtaining the ephemeris data from the reference network and determining the satellites visible in each region of the United States. For each region, assistance messages are constructed that include ephemeris data for the visible satellites. The assistance messages are broadcast in each zone region on a periodic basis to ensure the data does not become stale.

FleetHawk devices are configured to receive the Assistance messages as they are broadcast and use the ephemeris data to obtain a position fix. Broadcasting ephemeris data at a regular interval ensures that the FleetHawk devices can operate and obtain position fixes where ordinary unassisted GPS receivers cannot.

Even with the broadcast, however, it is sometimes possible for a device to miss the periodic broadcast of ephemeris data needed for a position fix. This may occur when the device is first powered and has not yet received an Assistance message, or if the device has been without power for an extended period of time and upon power-up recognizes that its ephemeris data is stale. Under these conditions, the device may request immediate assistance data from the SkyTel network. Upon receiving a request, the AGPS Server creates an assistance message optimized for the requesting device and sends it to that device.

With SkyTel's proprietary system of reference GPS receivers, transmitters, and devices, FleetHawk customers will realize all the advantages of Assisted GPS.

Assisted GPS

SkyTel Corp.

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