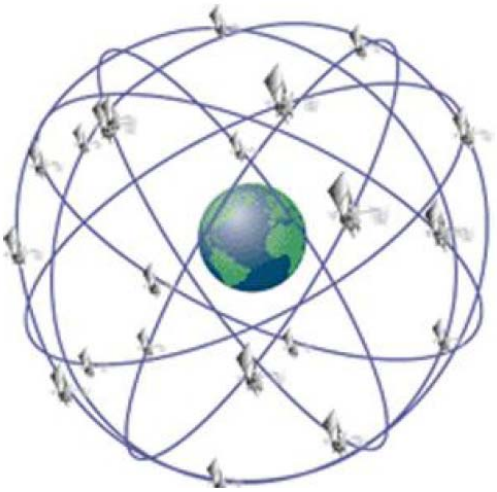
STARFIX.HP

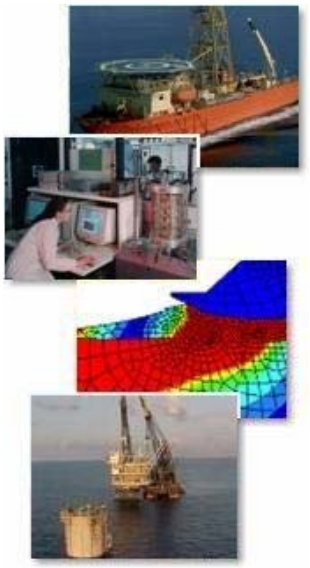
Starfix.HP High Precision

Starfix.HP (High Precision) is a dual frequency GPS carrier phase based service which offers sub-decimetre horizontal position accuracies (95%) at distances up to 500km and 10cm horizontal position accuracies up to 1000km from the closest reference station. Vertical accuracies are 15cm and 30 cm, respectively. Fugro operates an extensive network of over 100 high accuracy dual frequency reference stations world-wide. The network has 100% redundancy in both infrastructure and control.

Key Features:

- Capable of 10cm (95%) accuracy in horizontal and 15cm (95%) in vertical domain.
- HDOP < 2.5 (Within coverage areas)
- Dual delivery satellite beams – high power and low power
- Extensive QC monitoring in line with UKOOA standards
- Real-time system performance information available on-line
- Compatible with existing SkyFix hardware





Starfix.HP Technology

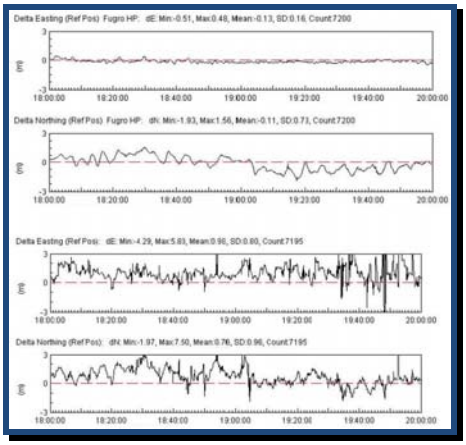
GPS user accuracy is limited by how well the different error sources are known at the user location. Standard DGPS techniques typically lump all errors (orbit, ionosphere, troposphere, clock, multi-path) into a single range (Prc) and range rate (Rrc) term. As long as the reference and user GPS receiver sees the same errors then the user position will be accurate to some level. As the distance between the user and reference station increases, the effects of error de-correlation become significant, increasing the position error observed by the user. As the solar activity has increased the effect of error de-correlation in the ionosphere is predominant compared to the other error sources.

By using dual frequency GPS receivers we can measure the true ionosphere at the reference and user locations, substantially eliminating this error. Using these iono-free measurements with information contained in the receiver carrier phase data, we are able to create wide area positioning results of unmatched accuracy and performance.

Starfix.HP uses proprietary algorithms to provide 10cm level accurate positioning solutions.

HP Performance

Improved performance of decimetre level phase based systems is seen in the difference between errors in Easting and Northing with HP (top) and VBS (bottom). Regular movement in HP northing is reflected in HP Northing as vessel was at harbour.



HP vs. VBS

Starfix Subscription

In 2005 the Starfix network introduced Starfix subscription, it is now possible to subscribe to the Starfix network only when required, providing a pay-for-use system that is enabled and disabled without the need to remove hardware.

HP Position Calculation

Starfix.HP is one of Fugro's high precision GNSS services. GNSS stands for Global Navigation Satellite System, which includes GPS, the Russian Glonass and European Galileo systems. HP is currently based on GPS only, but Glonass and Galileo are in the process of being implemented.

Starfix.HP is based on differential techniques, using a network of reference stations to reduce or eliminate biases due to the troposphere, satellites orbits and clocks. Ionospheric effects are eliminated by forming linear combinations of L1 and L2 observations (the ionospheric effects are frequency-dependent). Data from the reference stations is transmitted to mobile users using geostationary (communication) satellites, like Easat, Amsat, etc. Fugro's Starfix Satellite uplink yard. Fugro's global network of reference stations (together with the areas covered by the geostationary satellites), provide the reference station data to users. Some stations are used for services other than HP, such as standard DGPS, which provide accuracies at the metre level.

In the picture opposite an example of a convergence period for a moving receiver is shown (HP).

The initial precision is comparable to the one obtained from absolute positioning using code observations only. After a while, the precision improves, due to the increased weight of the carrier observations. RTK (Real-Time Kinematic) techniques take advantage of the integer nature of the carrier ambiguities, but can be applied to relatively short baselines only.

For HP, the baselines are in general too long to resolve the integer ambiguities. As a result, the convergence takes a long time.

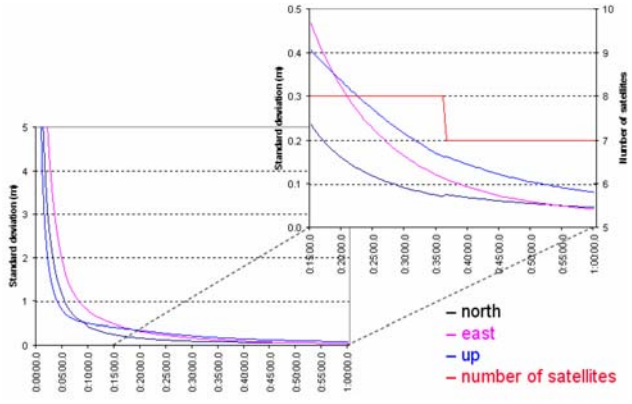
In general, a 45-60 minutes convergence period is acceptable for HP users. However, sometimes lock to the GNSS signal's is lost due to obstructions or interference. In those cases, users don't like to wait another hour before to reach decimetre accuracy.

Fugro has developed and implemented a technique for fast re-convergence, which makes it possible to bridge gaps in GNSS signal reception of up to 60-90 seconds. Once the satellite signals are re-acquired after a gap, positioning will almost instantaneously revert to the high precisions available before the gap.

Note: HP will start a convergence after each GPS interruption.

Today precise (10-20 cm standard deviation) orbits and clocks are available in real-time. For long baselines or when large height differences are involved, tropospheric effects have to be estimated, whereas ionospheric effects are eliminated, not by using a differential set-up, but by forming linear combinations of observations. Another reason for applying differential techniques is that convergence time can be reduced, since it allows for the resolution of the integer ambiguities; however, this will work only for relatively short baselines.

The State Space corrections consist of the differences between precise satellite positions and clock offsets, and those computed using the parameters, transmitted by the satellites in their navigation messages. Starfix.HP corrections are added to the parameters computed using the broadcast navigation messages, resulting in precise satellite positions and clock offsets.



Example of the convergence period for a moving receiver (example for HP not using XP corrections).

Specifications

Class: D
Signal(s) tracked: (types/bands/codes): L1-C/A, P1, P2
Single/Dual frequency: Dual
Number of channels/Tracking mode: 12, Parallel
Max no. satellites tracked: 12
Time to first fix (C/W/R) © [sec. sec. sec]: 900/60/60 sec