FUGRO
STARFIX®

Fugro’s Starfix products and services provide vessels and rigs around the world with precise offshore positioning systems, the reliability, availability and coverage of which, help deliver safer operations.

OFFSHORE APPLICATIONS
Fugro is a market leader in satellite positioning, providing:

- Worldwide solutions, using a small omnidirectional antenna or Inmarsat terminal
- Highest levels of signal reliability to ensure continuous signal reception
- Dual independent links in all Inmarsat ocean regions
- Centimetre and decimetre level of positioning accuracies
- Global Navigation Satellite Systems (GNSS) capability using GPS, GLONASS, BeiDou and Galileo

STARFIX.G4
Satellite-based systems rely on an unobstructed “view” of satellites, but when operating close to large structures, signals can easily be obscured, leading to reduced performance, just when it is needed most.

The more satellites are available, the more options the positioning system has, which means a higher probability of achieving a reliable positioning solution.

Using its worldwide network of reference stations, Fugro is able to calculate corrections to orbit and satellite clock values, for all available GNSS systems (GPS, GLONASS, BeiDou and Galileo).
**STARFIX SERVICES**

Fugro provides a number of services within the Starfix brand as follows.

**Starfix.G2+**
Starfix.G2+ is an enhancement of Fugro’s G2 service and utilises advanced GNSS augmentation algorithms developed in-house. This service will be particularly beneficial when seeking to measure latitude, longitude and elevation with ultra-high accuracy in real time. Ultra-precise (3 cm) GPS and GLONASS Global Positioning Service, using clock and orbit corrections enhanced with carrier-phase corrections from the Fugro G2 Network.

**Starfix.G4**
An extension of the Starfix.G2 service which utilises the Chinese BeiDou and European Galileo GNSS systems in addition to GPS and GLONASS.

**Starfix.XP2**
A precise (decimetre) GPS and GLONASS positioning system which is 100% independent of Starfix.G2. Although based on orbit and clock PPP technology, the corrections are procured via an independent third party corrections supplier.

**Starfix.HP**
A high precision GPS-only system, based on differential techniques. It uses Fugro’s network of reference stations to reduce or eliminate biases due to the troposphere, and the orbits and clocks of satellites. Ionospheric effects are eliminated by forming linear combinations of L1 and L2 observations (the ionospheric effects are frequency-dependent). Corrections calculated at the reference stations are transmitted to mobile users using geostationary communication satellites.

**Starfix.L1**
The Starfix.L1 system uses single frequency code correction data from Fugro’s network of reference stations. These corrections, combined with a single frequency GPS receiver, are used to produce a high accuracy position. This system can provide a positional accuracy of better than 1.5 m (95%) horizontally at a distance of 500 km from the closest reference station.

**REFERENCE STATION NETWORK**
Fugro operates a fully duplicated network for the production and delivery of high performance Global Navigation Satellite System (GNSS) augmentation services.

- Independent Network Control Centres (NCC) in Australia and USA
- Back up NCC in Australia and USA
- Dual satellite broadcast data links covering all ocean regions

Fugro Satellite Positioning DGNSS services are delivered over dual independent L-band delivery paths. To complement the standard satellite broadcast delivery channels, we also offer internet / online delivery of correction data using the NTRIP protocol. (Network Transport of RTCM over Internet Protocol).
STARFIX SYSTEMS

StarPack GNSS Receiver:
The Fugro StarPack is a high precision positioning system. The unit provides single and dual frequency GPS, GLONASS, Galileo and BeiDou positioning, using corrections generated by the global Fugro Starfix network of reference stations, broadcast via geostationary communication satellites. The unit contains a multichannel and multifrequency GNSS card (NovAtel or Trimble) and a Linux based operating system. The system is operated and configured via a user-friendly web interface, which also provides QC functions.

MultiFix 6 Software:
MultiFix 6 is a Fugro sixth generation differential GNSS real-time position computation and QC package. MultiFix 6 has been enhanced with the introduction of G2/XP2 GPS + GLONASS functionality.

AD-492 GNSS & L-band Antenna:
This is a multifrequency GNSS antenna with L-band reception for receiving corrections signals. In addition to signal reception, this antenna has an Inmarsat C-band filter to minimise interference from a vessel’s Global Maritime Distress and Safety System (GMDSS).

STARFIX INDEPENDENCY

The Fugro correction data are transmitted in a compressed and encrypted proprietary format known as SCF (Super Compressed Format). These corrections are available via high power satellite transmissions and via an NTRIP internet link (via the vessel’s VSAT system).

Fugro’s correction networks, Network Control Centres, uplink stations and correction satellites are combined with independent vessel hardware and software to provide fully independent Starfix positioning solutions. This combination ensures that there is no single point of failure that could cause both systems to fail.

Independency diagram.
The combination of our unique purpose-built L-band antenna for low elevation satellites (AD-493 receives corrections up to 75° North) and our NTRIP solution delivered over VSAT, delivers the right corrections for maintaining reliable and safe operations in the Arctic.

IRIDIUM

In order to further improve the delivery of Starfix corrections in high latitudes and polar regions, Fugro has developed a service to deliver these corrections via the Iridium OpenPort® broadband service. Iridium is a satellite communications system comprising more than 60 satellites in low-Earth polar orbit (LEO), at an altitude of approximately 800 km. In order to deliver these corrections Fugro, has created a dedicated NTRIP Service optimised for communications systems with limited bandwidth. This service contains optimised Starfix.G2 orbit and clock corrections to allow vessels to obtain a precise GNSS PPP position.

Fugro’s high performance satellite navigation augmentation services can be delivered beyond normal coverage limits.