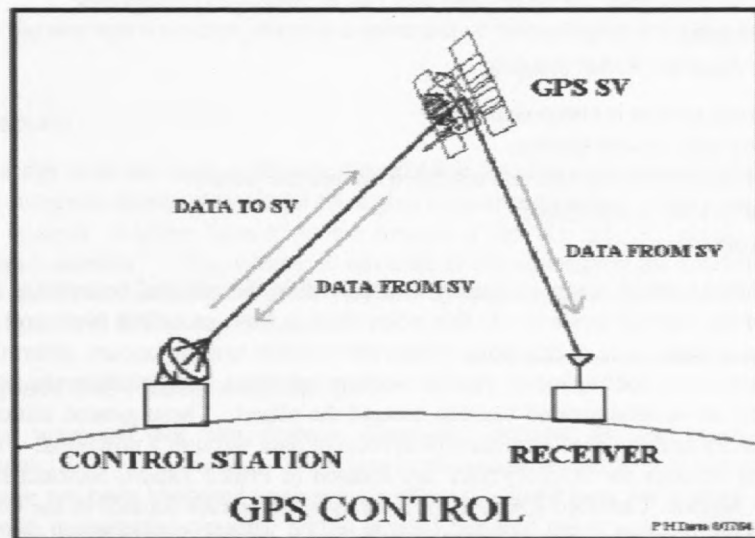


GPS USER SEGMENT⁶³



The GLONASS constellation is owned and operated by the Russian Federation⁶⁴ and has a similar tripartite functional architecture to the GPS constellation with a space segment,⁶⁵ a ground segment⁶⁶, and receivers. GLONASS is also a dual use space asset.⁶⁷

⁶³ http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html.

⁶⁴ The GLONASS system is managed for the Russian Federation Government by the Russian Space Forces, system operator, providing significant benefits to the civil users community through a variety of applications. The GLONASS system has two types of navigation signal: standard precision navigation signal (SP) and high precision navigation signal (HP). SP positioning and timing services are available to all GLONASS civil users on a continuous, worldwide basis and provide the capability to obtain horizontal positioning accuracy within 57-70 meters (99.7% probability), vertical positioning accuracy within 70 meters (99.7% probability), velocity vector components measuring accuracy within 15 cm/s (99.7% probability) and timing accuracy within 1 mks (99.7% probability). These characteristics may be significantly increased using differential mode of navigation and special methods of measurements (e.g. carrier phase etc.) see <http://www.rssi.ru/SFCSIC/english.html>.

⁶⁵ Fully deployed GLONASS Constellation is composed of 24 satellites in three orbital planes whose ascending nodes are 120 degrees apart. 8 satellites are equally spaced in each plane with argument of latitude displacement of 45 degrees. Besides the planes themselves have 15 degrees argument of latitude displacement. Each GLONASS satellite operates in circular 19,100 km orbits at an inclination angle of 64.8 degrees and each satellite completes an orbit in approximately 11 hours 15 minutes. The spacing of satellites in orbits is arranged so that a minimum of 5 satellites are in view to users world-wide, with adequate geometry, i.e. GLONASS Constellation allows to provide continuous and global navigation coverage for performing of successful navigation observations. Each GLONASS satellite transmits radio frequency navigation signal containing navigation message for users <http://www.rssi.ru/SFCSIC/english.html>.

⁶⁶ GROUND-BASED CONTROL COMPLEX

The GLONASS Constellation is operated by Ground-based Control Complex (GCS). It consists of the System Control Center (Golitsyno-2, Moscow region) and a several Command Tracking Stations (CTS) are placed over a wide area of Russia. The CTSs track the GLONASS satellites in view and accumulate ranging data and telemetry from the satellites signals. The information from CTSs is processed at the SCC to determine satellite clock and orbit states and to update the navigation message of each satellite. This updated information is transmitted to the satellites via the CTSs, which also used for transmitting of control information. The CTSs ranging data is periodically calibrated using a laser ranging devices at the Quantum Optical Tracking Stations which are within GCS. Each GLONASS satellite specially carries laser reflectors for this purpose.

The synchronization of all the processes in the GLONASS system is very important for its proper operability. There is the Central Synchronizer within GCS to meet this requirement. The Central Synchronizer is high-precise hydrogen atomic clock which forms the GLONASS system time scale. The onboard time scales (on a basis of satellite cesium atomic clocks) of all the GLONASS satellites are synchronized with the State Etalon UTC(CIS) in Mendeleevo, Moscow region, through the GLONASS System Time scale. <http://www.rssi.ru/SFCSIC/english.html>.

⁶⁷ See Decree of the President of the Russian Federation at <http://www.rssi.ru/SFCSIC/english.html>. GLONASS is used for Air and naval traffic management, safety increasing; Geodesy and cartography; Ground transport monitoring;

- Time scale synchronization of the remote from each other objects;
- Ecological monitoring, search and rescue operation organization. See <http://www.rssi.ru/SFCSIC/english.html>