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## HSR DemoSat and Ground Station

### Development of a demo satellite and establishment of communication with earth-orbiting satellites



Satellites surrounding the earth (Source: European Space Agency ESA)

**Introduction:** Since 1957, thousands of satellites have been launched into orbit. They are used for a large number of purposes such as observing the earth and its movements, broadcasting radio and television, sending navigation signals, watching weather conditions, transmitting phone calls and much more. The HSR, which is involved in the CubeETH project, is newly in possession of a ground station to track and communicate with those satellites. But it is not yet comfortable to use due to lack of tracking automation.

#### Objective:

- The HSR ground station, consisting of antennas, radio equipment, a motor controller and other hardware, is to be extended and optimized. A satellite is to be automatically tracked to communicate with it.
- In addition, a small demo satellite (10×10×10 cm) must be developed. Similar to the ongoing project CubETH, a transceiver that is capable of modulating and demodulating FSK and AFSK should be used. The demo satellite is used to test the new ground station and therefore must be able to send packets to and receive commands from the ground station.

#### Result:

- The ground station is able to follow satellites with its two motors automatically. A software application is used to calculate the azimuth and elevation angles into motor movements. Also, the Doppler shift is taken into account, so the user can fully concentrate on his or her activities, such as listening to the ISS astronauts. There is the option to use the station as an internet gateway for the Automatic Packet Reporting System (APRS).
- The developed demo satellite is able to send AFSK modulated data. Due to its integrated GPS module, the HSR DemoSat is traceable over APRS. The hardware has been designed to the point that the functionality of the satellite can be easily extended by software.



HSR ground station antenna mast with two x-quad and one multiband monopole antenna



Developed HSR DemoSat with receive, transmit and GPS antenna