STEINBEIS-TRANSFERZENTRUM RAUMFAHRT

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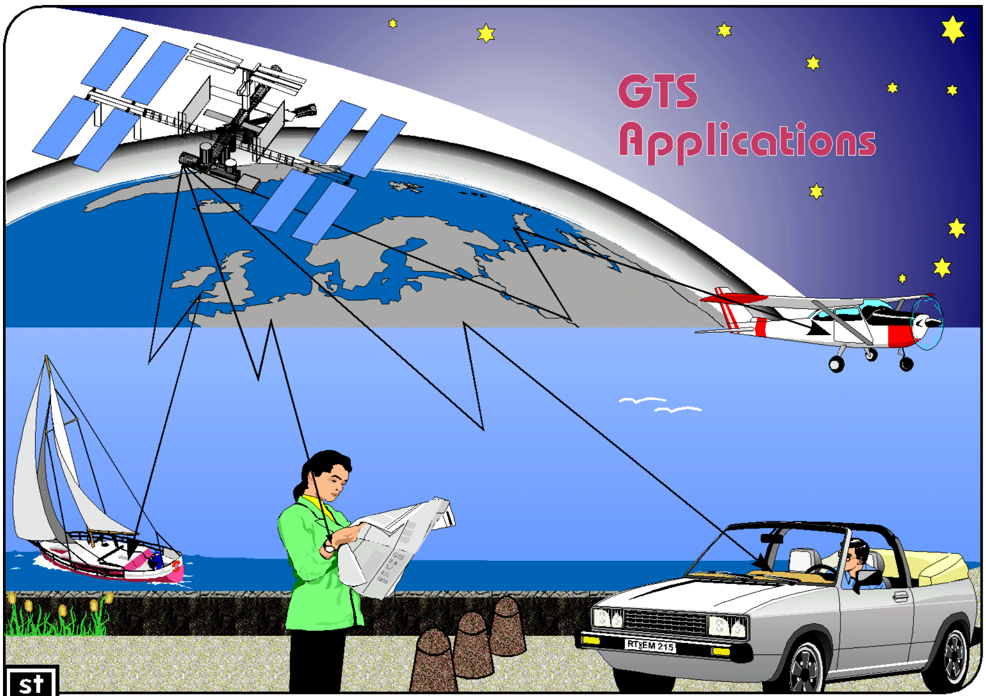
Information about GTS

Global Transmission Services
New Radio Services from Space

Global Transmission Services (GTS) is s new system for transferring radio signals from the International Space Station (ISS). It is currently being tested in the framework of a pilot project and will be offered as a new service in the near future. GTS is the first experiment on the new space station and at the same time the possibilities of future commercial uses of the space station as a space-born platform will be investigated. The experiment is being supported by Daimler-Chrysler, Fortis Swiss Watches as well as the German Aerospace Center (DLR) and the European Space Agency (ESA).

Two areas of applications will be investigated during the first phase of the experiment: the worldwide synchronization of watches and the deactivation of stolen vehicles.



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The new system consists of a computer system and a radio transmitter onboard the ISS. The system is controlled by a new ground control center located directly in Stuttgart. The monitoring and processing of the data take place in the control center on Earth. The data are then sent down to Earth from the transmitter in space.

The advantages of the ISS are:

- Compared to other satellites the ISS has a low flight altitude of 400 km and a high orbit inclination above the equator of 51.6° (see Figs. 1 and 2). This means that every point between 70°N and 70°S latitude can be reached by a radio signal five to seven times a day. Figure 3 shows the current reception area at the northernmost point of the ISS orbit. The station is, therefore, perfectly suited to emit a time or data signal with only 1 Watt of transmitting power and to distribute it to the entire Earth (except for the polar regions).
- The low orbit and the high orbit speed make it possible to create signals (Doppler effect, fast angle changes) that complement each other so that a rough navigation can be carried out.
- The ISS, the biggest space project of all time, is available on this advantageous orbit for the next 15-20 years (independent of any special service) and at the same time offers the possibility for the astronauts to exchange and maintain devices, as well as convenient transport possibilities approximately every three months.

Disadvantage of the ISS:

- Contrary to the mobile radio satellite constellations like Iridium, Globalstar and ICO, a real time operation is not possible. This means that a time critical operation can not be supported.

In the near future, GTS should make it possible to distribute commercial data packages to any miniature **mobile** receivers worldwide. This includes

- Global clock synchronisation
- Paging
- Datentransmission to smartcards with polymerdisplays
- Theft protection for cars, credit cards, mobile phone etc.
- Emergency / repair calls for car
- Remote controlling
- Container tracking
- Fleet management

By miniaturizing the receiver, it will be possible to protect smaller items such as watches, mobile phones, electronic car keys and chip cards from misuse in the future. The experiment will also investigate the possibility of locating the position of these or larger mobile items which are stolen (containers, semi-truck trailers) to within at least a few square kilometers. This would be possible with a transmitting power of a few hundred mW from miniature receivers with a return channel to the space station.

Start of experimental operations was in 2002. After a two-year trial phase, the new services will be marketed commercially. The marketing company is in the process of being founded and is still accepting additional partners interested in the above mentioned applications. TZR is currently developing a new, fully digital receiver for a desk top clock. The receiver can also be utilized in the other devices. Uon completion of the experimental phase, the prototype circuit will be directly converted into a generic microchip which can perform all of the functions mentioned. The use of a generic chip form, which will be conditioned for each individual application, allows for mass production which results in lower prices.

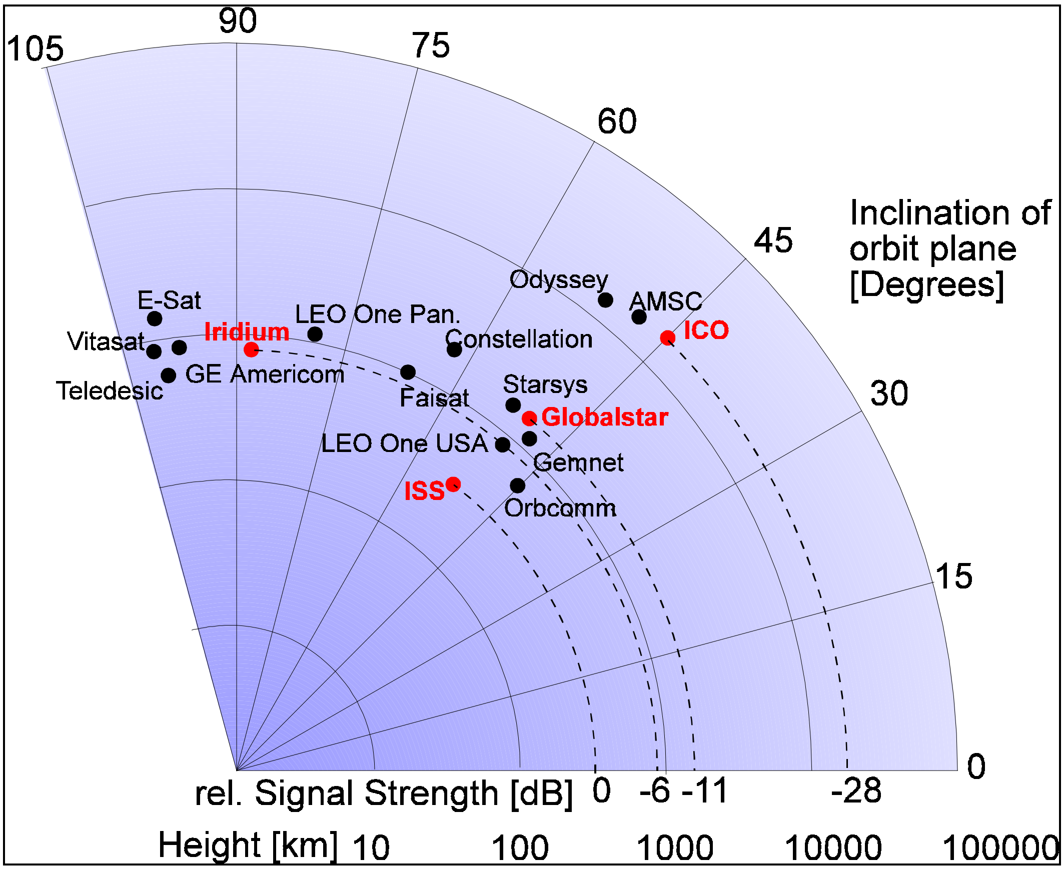

Figure 1: orbit altitude and inclination of mobile radio satellite constellations (S-PCN systems) and their relative signal strengths compared to the ISS

Parameter	ISS	Iridium	Globalstar	ICO
Orbit Height	ca. 400km (LEO)	785 km (LEO)	1414 km (LEO)	10355 km (MEO)
Number of Satellites	1	66 (+ 6 spare)	48 (+ 8 spare)	10 (+ 2 spare)
Rel. Signal Strength	1	26%	8%	0.15%
in dB	0	-6	-11	-28

Figure 2: comparative data of the most important satellite personal communications networks compared to the ISS

GTS Timetable

	1998	1999	2000	2001	2002	2003	2004	2005
Space segment								
Developement and building of the electronic unit (EU)	████████	████						
Developement and building of the transmitters	████████	████						
Developement and building of the antenna unit (AU)	██████							
Mounting of the AU on the Service Module (Dec 98)	▼							
Launch of Service Module (Summer 2000)			▼					
Launch of the EU (Autumn 2001)				▼				
Start of orbit tests					▼			
Experimental phase						███████	████████	....
Ground segment								
Development of receiver prototypes						████████		
First ground receiving (March 2002)					▼			
Miniaturisation of the receiver chips							████	
Finish of the experimental phase								████████
Commercial use								
Foundation of service company								▼
commercial use								.......███

The "Steinbeis Transferzentrum Raumfahrt" is responsible for the project management and the development of the space segment; the development of the ground segment will be handled by an industrial partner.

The experiment's antenna platform was mounted on the Russian Service Module (SM) in December 1998. A proton rocket was carrying it into space in summer 2000.

The transmitter hardware followed on a progress transporter shortly thereafter and was installed by the astronauts onboard. The experiment was scheduled to begin functioning in the year 2002.

Functional Principle

The transmitter onboard the ISS periodically sends time signals and the user signals which are received from the ground control center. The Earth's rotation and the high orbit inclination of the space station make it possible in the course of the flight to cover a ground area of approximately ±70 degrees of latitude several times in one day. This means that almost the entire inhabited area on Earth is covered. Watches on Earth will be set to the correct time by the special form of the signals. In the case of user data, a special code, which cannot be copied by other senders, verifies the authenticity of the data. This guarantees that the data can be transmitted securely.

The GTS system transmits the correct local time for the different time zones taking into account daylight savings time so that the clocks and watches on Earth automatically have the correct time. Each ground receiver has its own identification (ID) through which information can be sent to individual users.

If the GTS system is used as theft protection, it sends coded messages to the receiver chip which in turn blocks the electronics. The chip can be installed in either vehicles or in the appropriate keys. This option ensures that even if a thief has an original, stolen car key he cannot steal the car because the key will become ineffective within a very short time. This counteracts the increased threat car owners face when they are violently forced to hand over their car keys.

For more information please contact:

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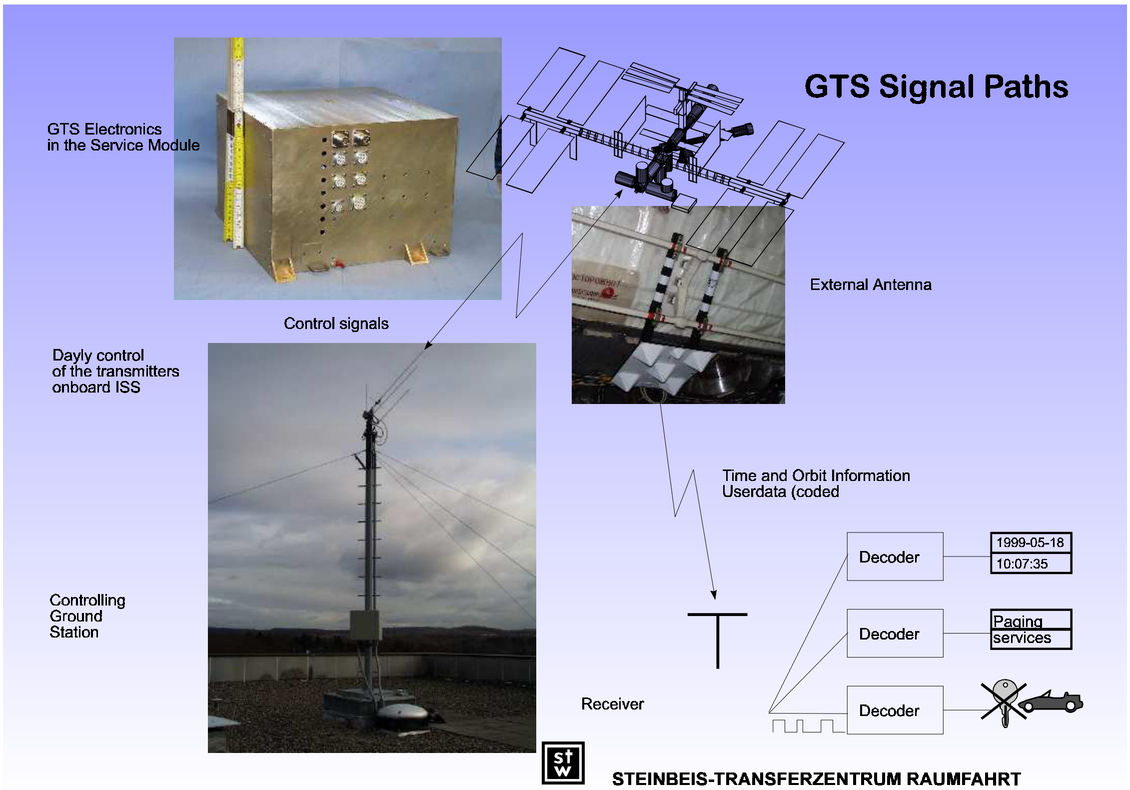


Figure 3: GTS Transmission Paths

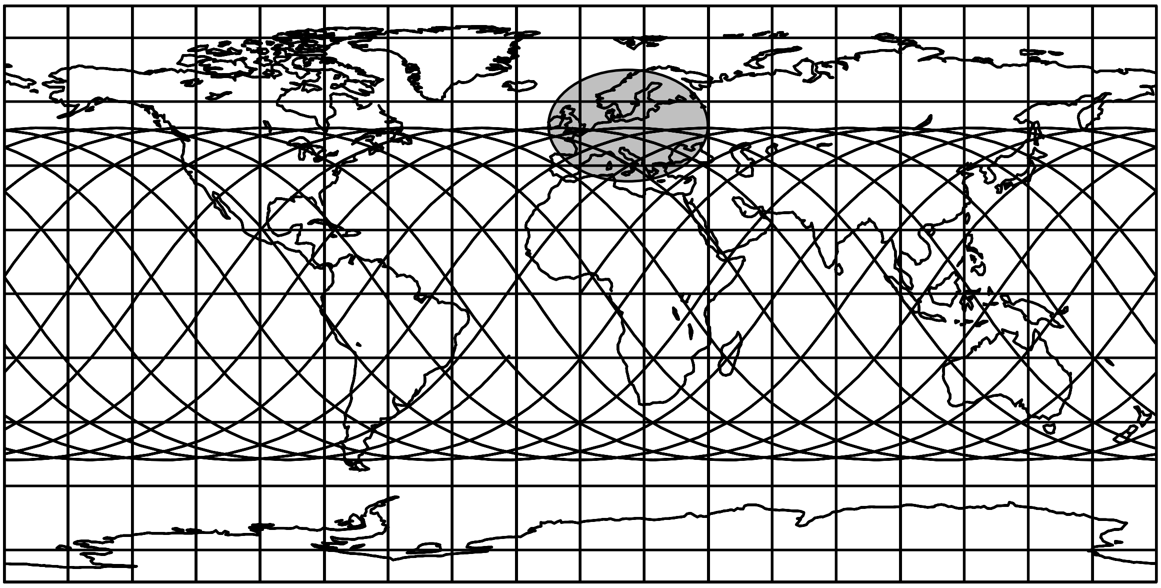
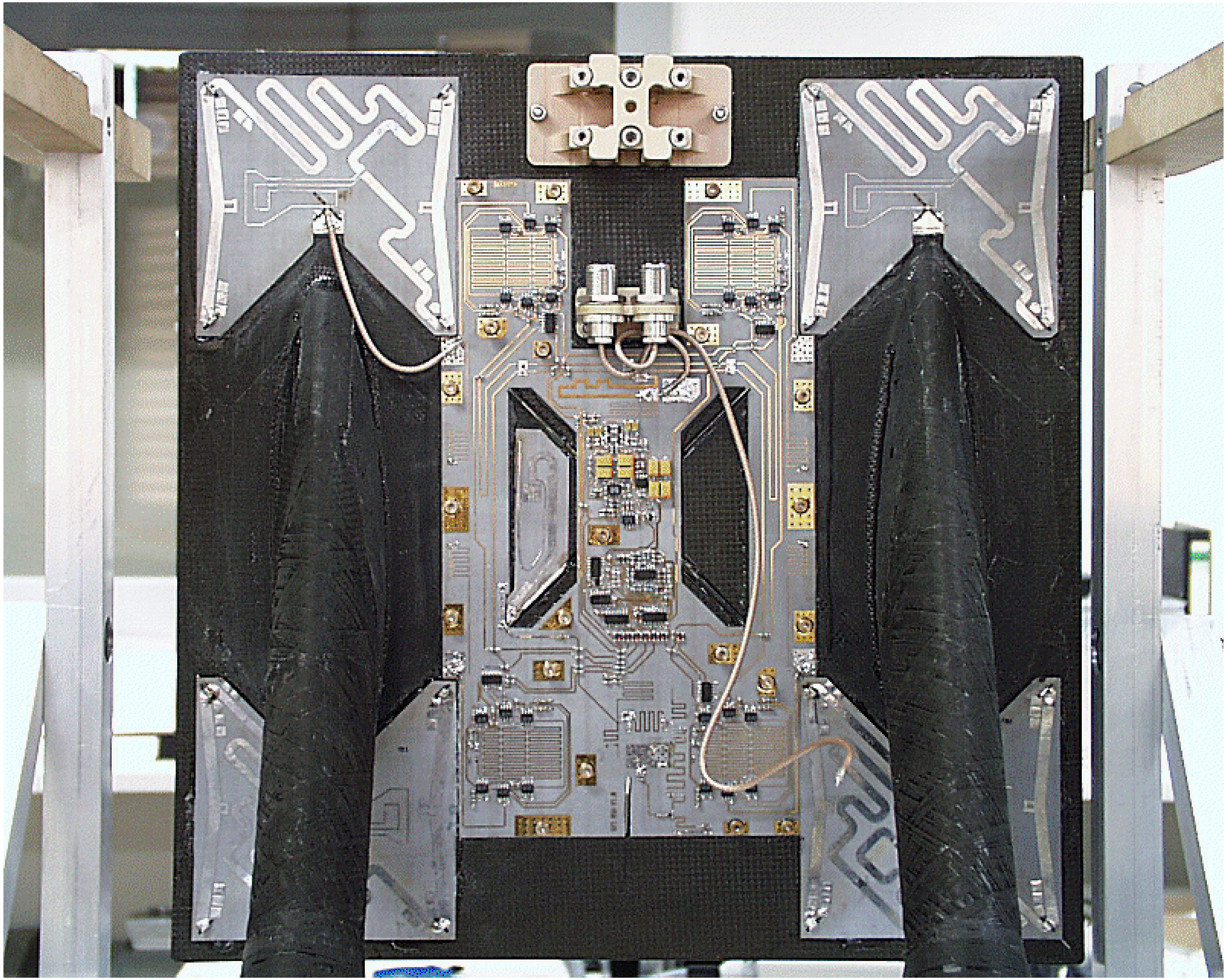
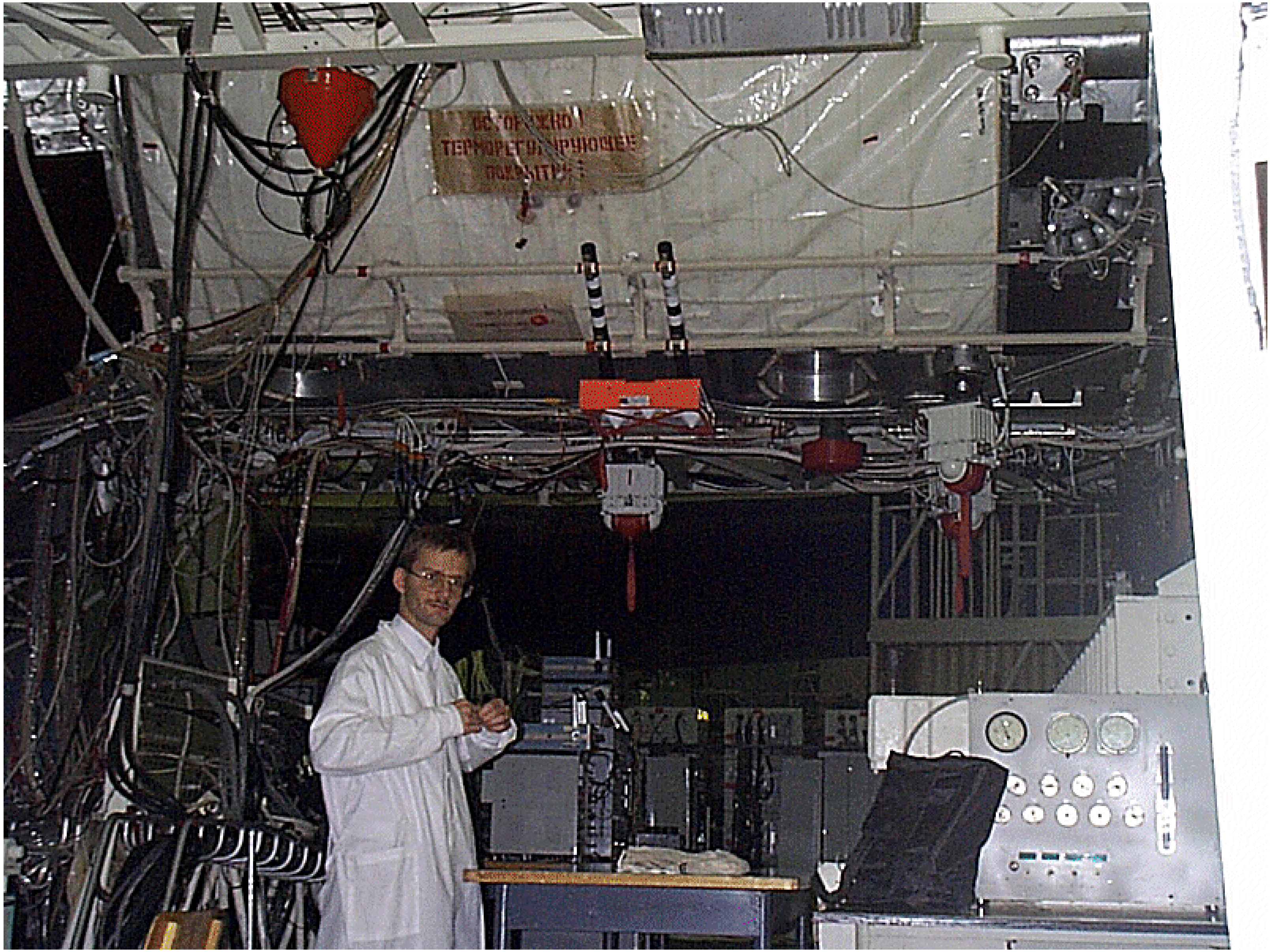


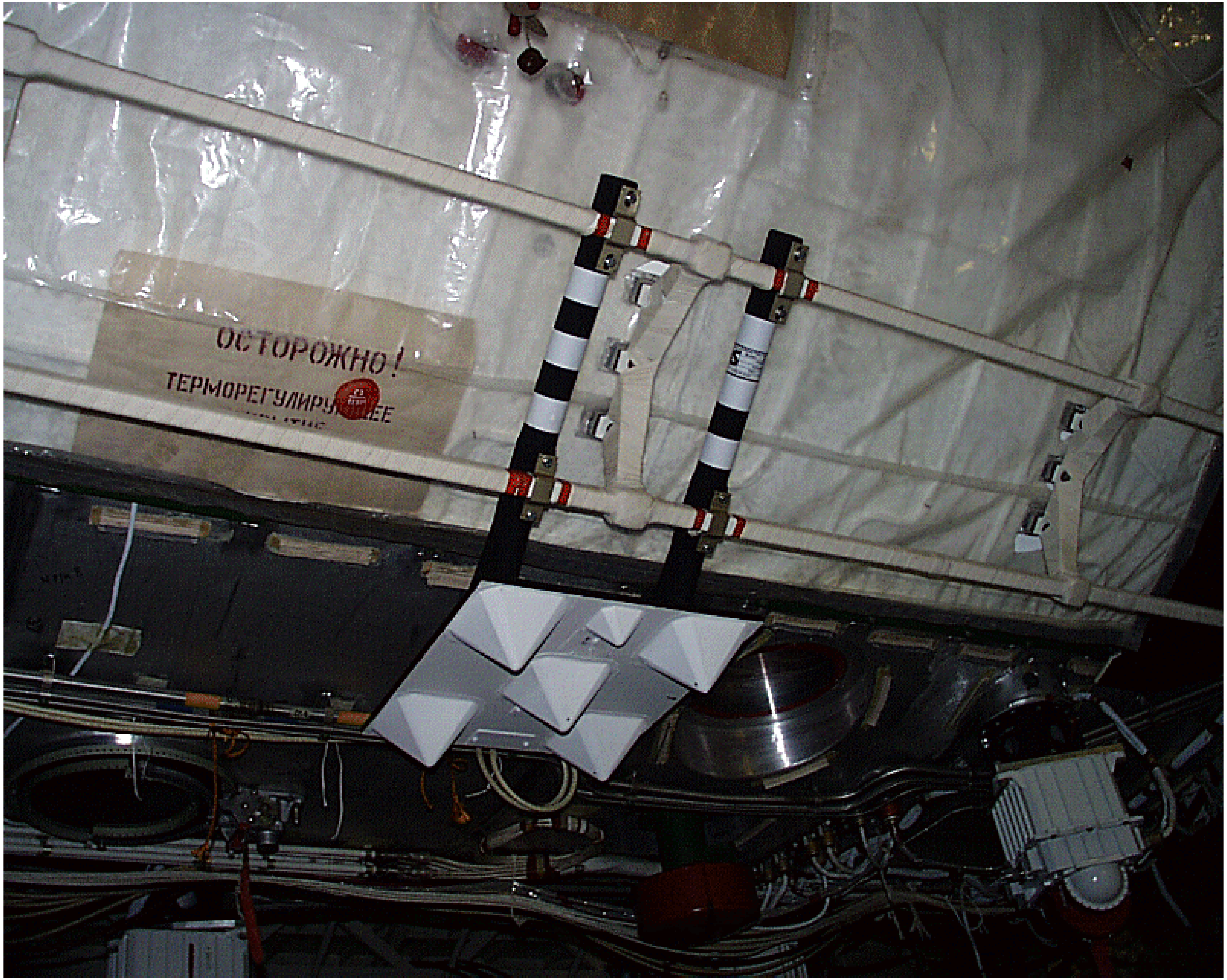
Figure 4: Groundtrack of the ISS with a typical reception area



The antenna electronics during final assembly



Mounting of the GTS antenna on the Service Module



GTS Antenna mounted on the Service Module