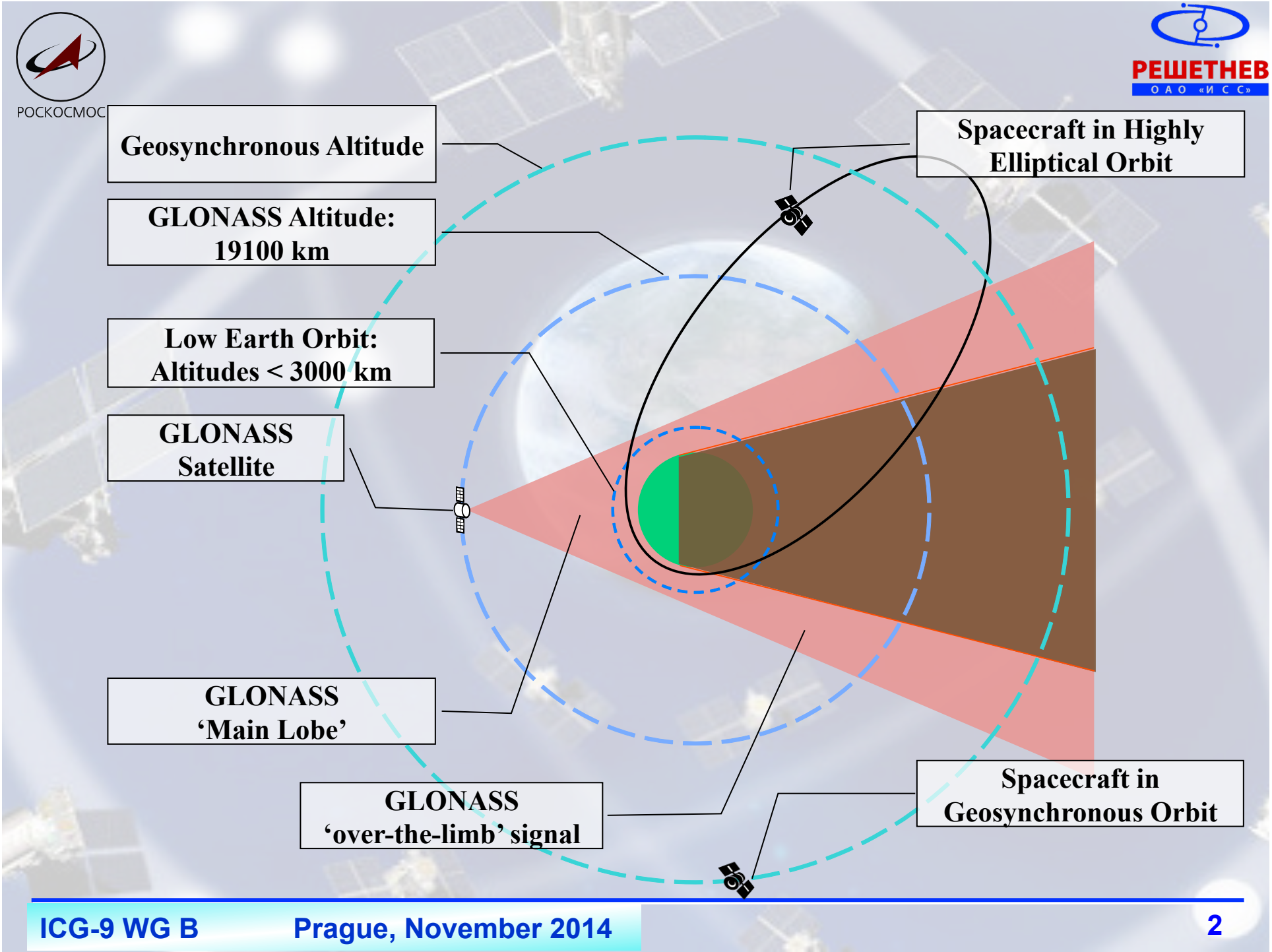
GLONASS space service volume

JSC "Academician M.F.Reshetnev" Information Satellite Systems"

V. Kosenko, A. Grechkoseev, M. Sanzharov

ICG-9 WG-B, Prague, Czech Republic– November 2014


РОСКОСМОС
РЕШЕТНЕВ
ОАО «ИСС»
Geosynchronous Altitude
GLONASS Altitude: 19100 km
Low Earth Orbit: Altitudes < 3000 km
GLONASS Satellite
GLONASS 'Main Lobe'
GLONASS 'over-the-limb' signal
Spacecraft in Highly Elliptical Orbit
Spacecraft in Geosynchronous Orbit

Definitions	Notes
Lower Space Service Volume (also known as 'MEO altitudes'): 3000 to 8000 km altitude	Four GLONASS signals available simultaneously a majority of the time but GLONASS signals over the limb of the Earth become increasingly important. One-meter orbit accuracies are feasible (post processed).
Upper Space Service Volume (GEO and HEO with the exception of the perigee area): 8000 to 36000 km altitude	Nearly all GLONASS signals received over the limb of the Earth. Accuracies ranging from 20 to 200 meters are feasible (post-processed) depending on receiver sensitivity and local oscillator stability.

Parameters	Value	
User range error	1.4 meters	
Minimum Received Civilian Signal Power (GEO)	**With account of the GLONASS satellite's transmitter antenna gain pattern**	**Reference Off-Boresite Angle**
L1[1,2]	-180 ÷ -185 dBW	14 – 20 deg
L2	-177 ÷ -184.4 dBW	14 – 28 deg
L3	-176 ÷ -184 dBW	14 – 28 deg
Signal availability[3]		
MEO at 8000 km	**At least 1 signal**	**4 or more signals**
L1	81%	64%
L2, L3	100%	66%
Upper Space Service Volume (HEO/ GEO)	**At least 1 signal**	**4 or more signals**
L1	70%	2.7%
L2, L3	100%	29%

Note 1 – FDMA signals in L1 and L2 bands and CDMA signals in L3

Note 2 – L1, L2 signals are transmitted by GLONASS-M and GLONASS-K satellites. At present, the L3 signal is transmitted by the GLONASS-K satellite and by the GLONASS-M No. 55 satellite (flight tests). Furthermore, the final 6 GLONASS-M satellites will also transmit L3 signal.

Note 3 – Assumes that the high-orbit SV has at least one GLONASS satellite in line-of-sight.

Experience in the application of GLONASS and GPS for the GEO spacecraft navigation

- The radionavigation equipment has been used successfully on board of several geostationary spacecraft since 2008
- The possibility of reception and measurement of GLONASS/GPS signals as well as the possibility of positioning in GEO is confirmed
- Orbit accuracies ranging from 20 to 200 m are feasible *(a posteriori data)*
- The possibility of keeping of a geostationary spacecraft in an orbital slot with a required accuracy (±0,05°) is realized without ground control segment
- The Elektro-L meteorological satellite which will be launched in 2015 is equipped with radionavigation equipment

Possible GNSS development to improve the high orbit spacecraft navigation

- *Supplementary antenna installation to transmit navigational signals in the opposite direction*
- *Navigational signal coincides with one of the signals transmitted towards the Earth;*
- *The HEO and GEO spacecraft navigation accuracy can be increased up to 30 m if a navigational signal in the opposite direction is transmitted*
- *A stable navigation on the line Earth-Moon with accuracies ranging from 250 to 2500 m will become possible with a navigational signal in the opposite direction*


ГЛОБАЛЬНАЯ НАВИГАЦИОННАЯ СПУТНИКОВАЯ СИСТЕМА
GLONASS
RESHETNEV
COMPANY
Thank You for attention