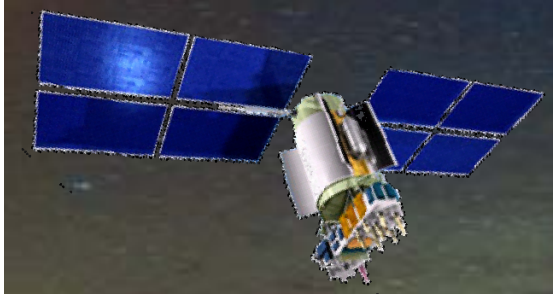
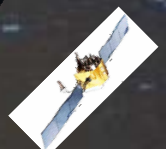
Seventh Meeting of the International Committee
on Global Navigation Satellite Systems
Beijing, China
4 – 9 November, 2012



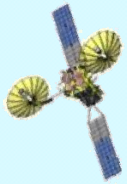


SDCM status and plans

Deputy Director General–Designer General
JSC «Russian Space Systems»,
Deputy Designer General of the GLONASS system
Prof. Dr. Grigory STUPAK

Composition of the System of Differential Correction and Monitoring (SDCM)

Data downlinks



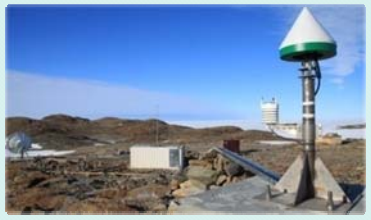
✓ *3 GEO relay satellites*

✓ *SiSnet server*

Reference stations network (RS)

19 RS in Russia

5 RS abroad



SDCM control centre (Moscow)

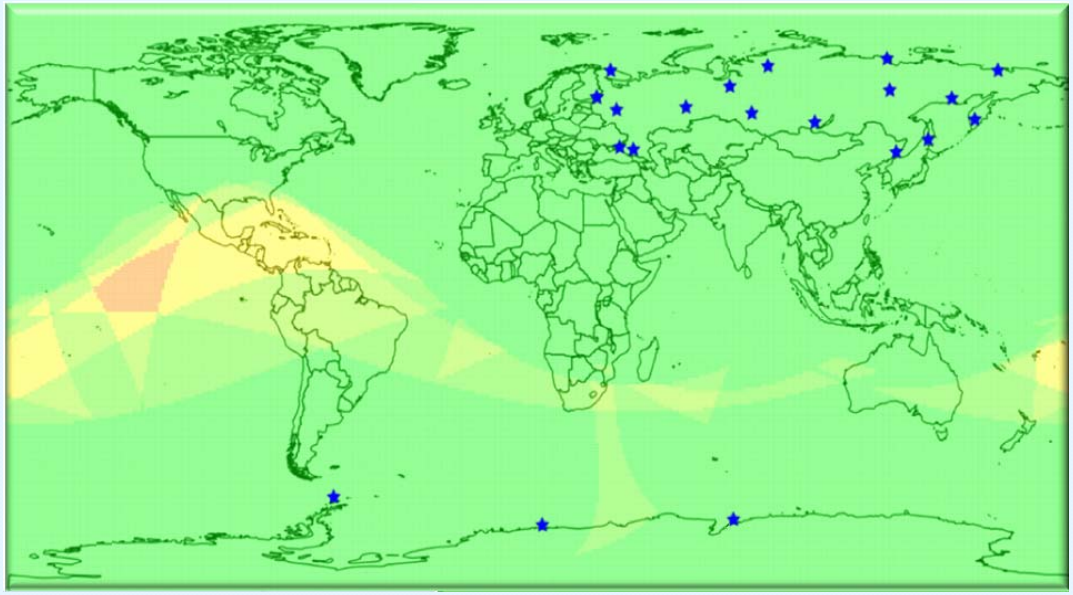
SDCM reference stations network

19 stations in the territory of the RF:

Pulkovo and Svetloe (Leningrad region), Mendeleevo, Gelendzhik, Kislovodsk, Novosibirsk, Irkutsk, Petropavlovsk-Kamchatski, Tiksi, Vladivostok, Magadan, Yuzhno-Sakhalinsk, Lovozero (Murmansk region),Yekaterinburg, Norilsk, Bilibino (Chukchi Peninsula), Noyabrsk (Tyumen region)

5 stations abroad:

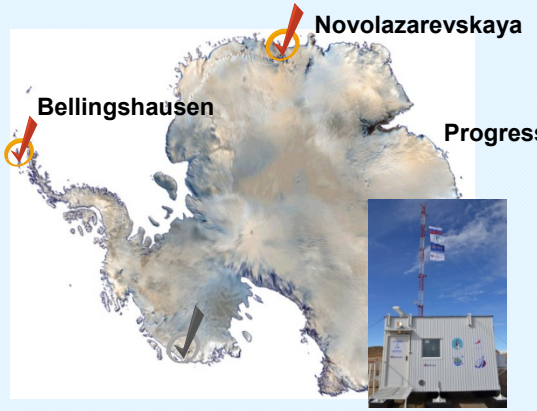
Sudak (Ukraine), Aktau (Kazakhstan)
«Bellingshausen» (Antarctica)
«Novolazarevskaya» (Antarctica)
«Progress» (Antarctica)



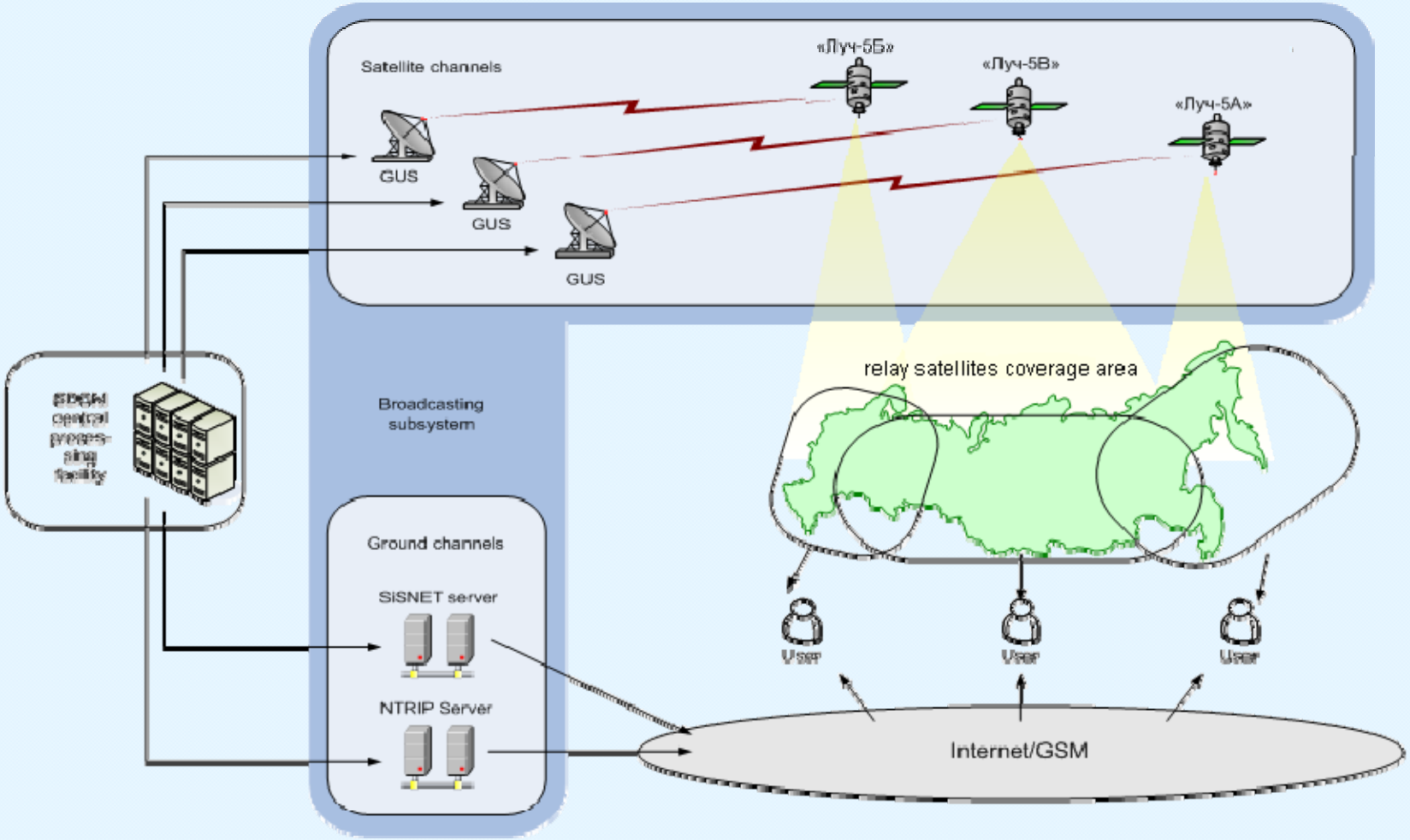
Several stations simultaneously track one satellite

≥3	2	1

1. IP telephone
2. VPN module
3. Controller
4. Computer
5. GLONASS/GPS receiver
6. Hydrogen Mazer
7. UPS module

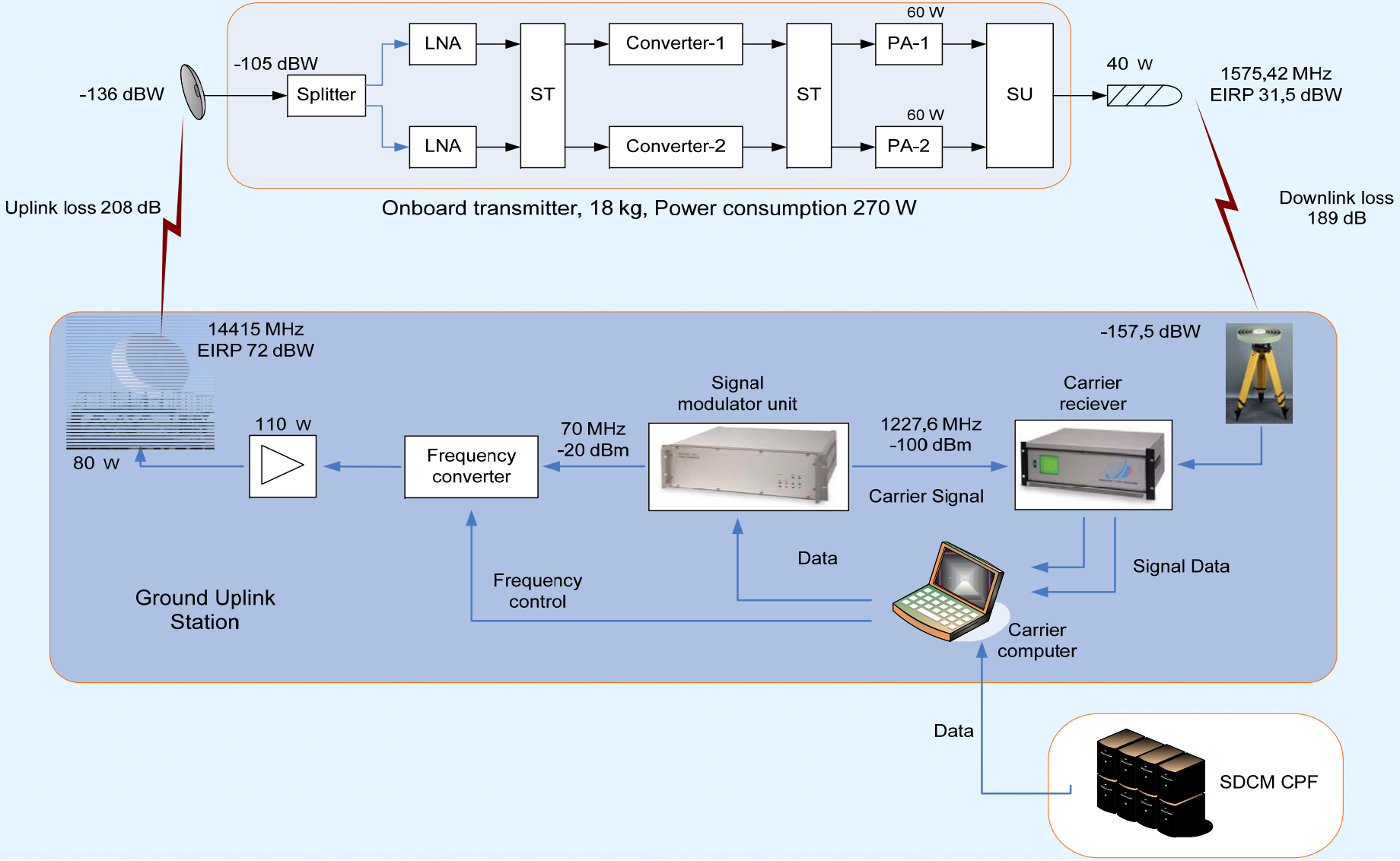


SDCM data dissemination system



IP: 79.104.19.214 port: 5555

Channel to disseminate the SDCM information through a multifunctional relay system of the Luch satellite



SDCM PRN Codes

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER (AFSPC)
LOS ANGELES AIR FORCE BASE, CALIFORNIA

20 DEC 2011

MEMORANDUM FOR RUSSIAN SPACE AGENCY
ATTN: MR VICTOR VASILIEVICH ASHURKOV
RUSSIAN SPACE AGENCY
42 SHEPKINA STREET
MOSCOW 107996
RUSSIA

FROM: SMC/GP
483 N Aviation Blvd
El Segundo, CA 90245-2808

SUBJECT: SDCM Pseudorandom Noise (PRN) Code Assignments

1. The purpose of this memorandum is to assign the Russia Space Agency three L1 C/A PRN codes for the System of Differential Corrections and Monitoring (SDCM). These assignments follow discussions between technical representatives from Russia and the United States during a bilateral meeting on 8 June 2011. The bilateral meeting was in conjunction with a Working Group-A meeting of the International Committee on Global Navigation Satellite Systems.

2. Please note that, per the Global Positioning Systems Directorate ("Directorate") PRN code assignment process, these PRN code assignments expire in ten years unless a renewal application is filed. As such, PRN code assignments to the Russia Space Agency, as described in item 3 below, will expire ten years from 1 Dec 2011.

3. The following PRN codes have been assigned the Russia Space Agency:

L1 C/A:

PRN Signal Number	G2 Delay (Chips)	Initial G2 Setting (Octal)	PRN Allocations	Orbital Slot	Effective Date
125	235	1076	SDCM (Luch-5A)	16W	Active 12/11
140	456	1653	SDCM (Luch-5B)	95E	Active 12/11
141	499	1411	SDCM (Luch-4)	167E	Active 12/11

4. Technical description of these codes can be found in IS-GPS-200 and IS-GPS-705 located at the following website address:

http://www.losangeles.af.mil/library/factsheets/factsheet.asp?id=9364

5. Although the Directorate conducts an analysis on PRN number requests with respect to potential interference issues, the issuance of a PRN number does not convey legal authority to radiate in the band and does not indicate that coordination under Article 9 of ITU-R Radio

INTEGRITY, SERVICE, EXCELLENCE

L1 PRN codes assignments (PRN 125, 140 and 141) for SDCM took place on the 20th of December, 2011

Regulations has been completed. In addition, in order to radiate in the GPS L1 or L5 band, the applicant should obtain a frequency assignment and transmission authorization from their own radio regulatory authority.

6. The Directorate assumes no responsibility for ensuring systems using these spreading codes follow international and domestic radio frequency regulations or other applicable laws or regulations, or for ensuring that systems using Directorate PRN codes do not cause harmful radio frequency interference.

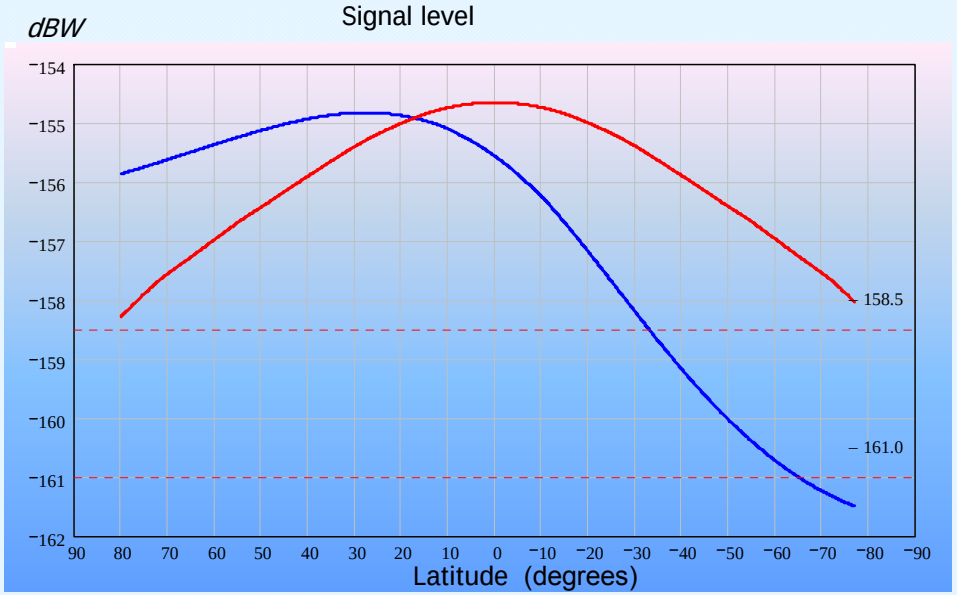
7. The PRN code assignments will be posted to the following website:

http://www.losangeles.af.mil/library/factsheets/factsheet.asp?id=8618

8. If you have any questions or need further assistance, please contact Captain C. Nathan Howard at +1-310-653-3253 or email at carl.howard@losangeles.af.mil.

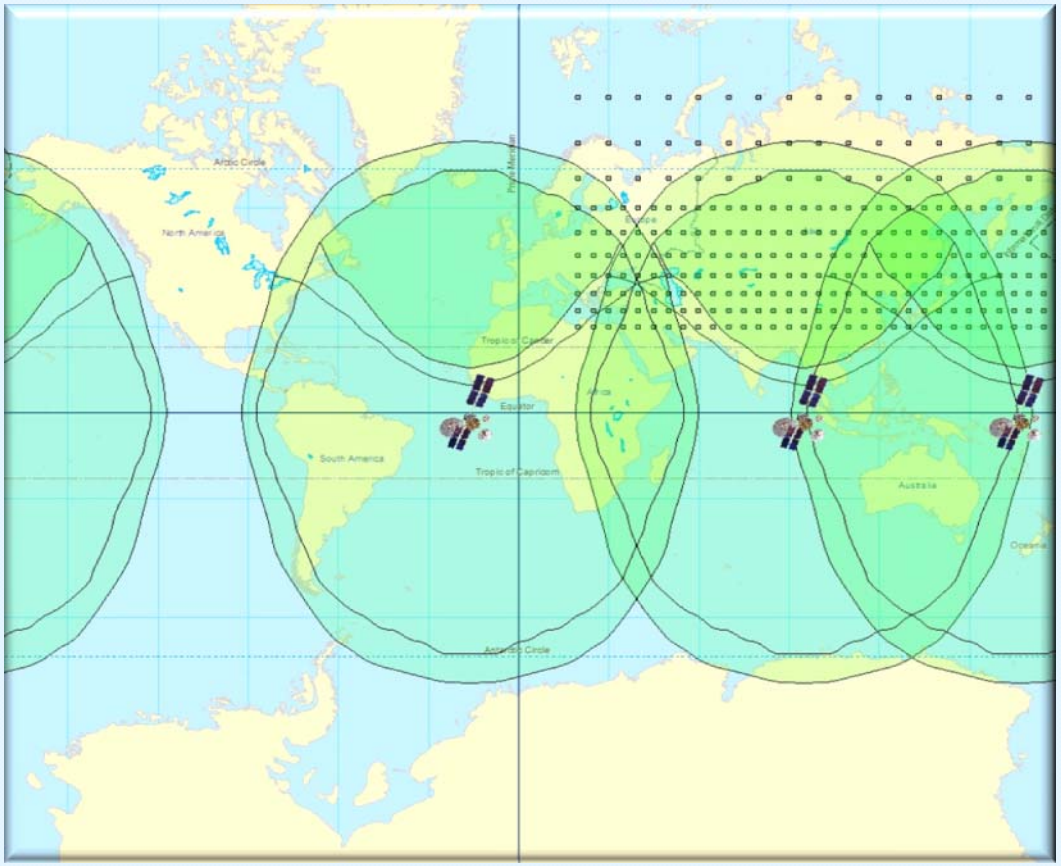
ROBERT W. ERICKSON, Lt Col, USAF
Chief Engineer
Global Positioning Systems Directorate

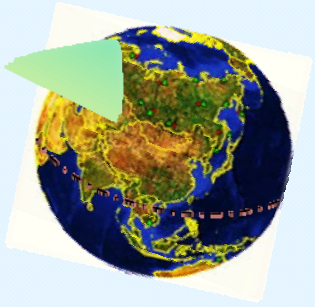
SDCM coverage area



Signal level in case of standard antenna pointing

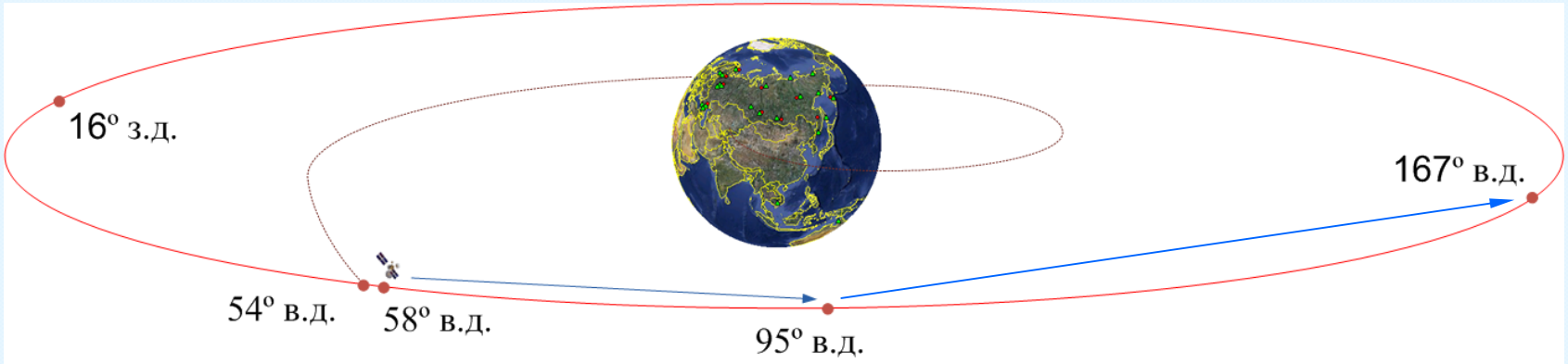
Signal level in case of deflecting antenna pointing to 7 degrees north





Launch of the «Luch-5A» satellite

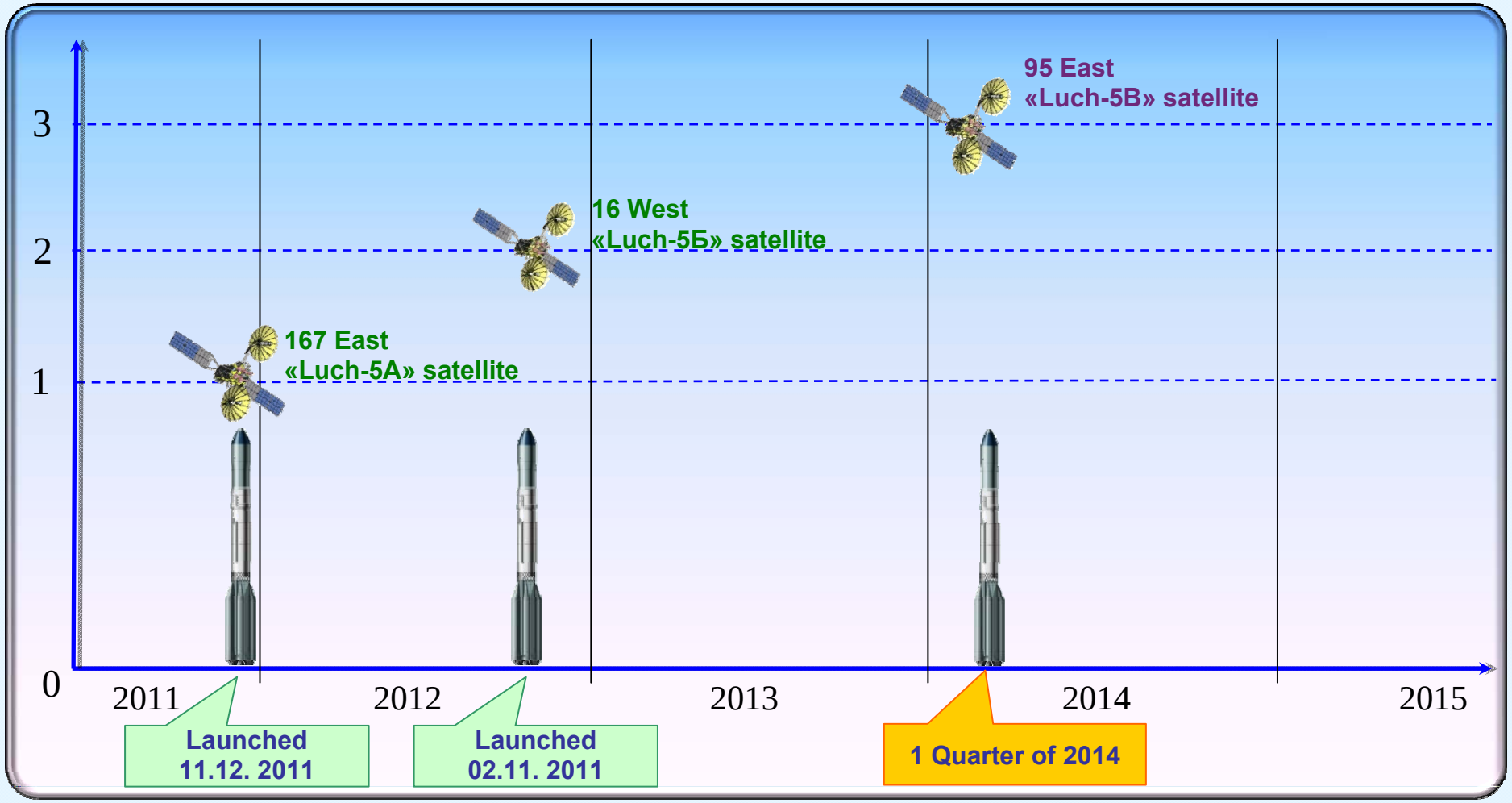
On the 11th of December, 2011 the «Luch-5A» satellite was successfully put into geostationary orbit



Flight tests of on-board Luch-5A SDCM equipment are in progress since July 2012

Phased relocation of the Luch-5A satellite into a slot of 167 deg. East

Luch satellite launching program



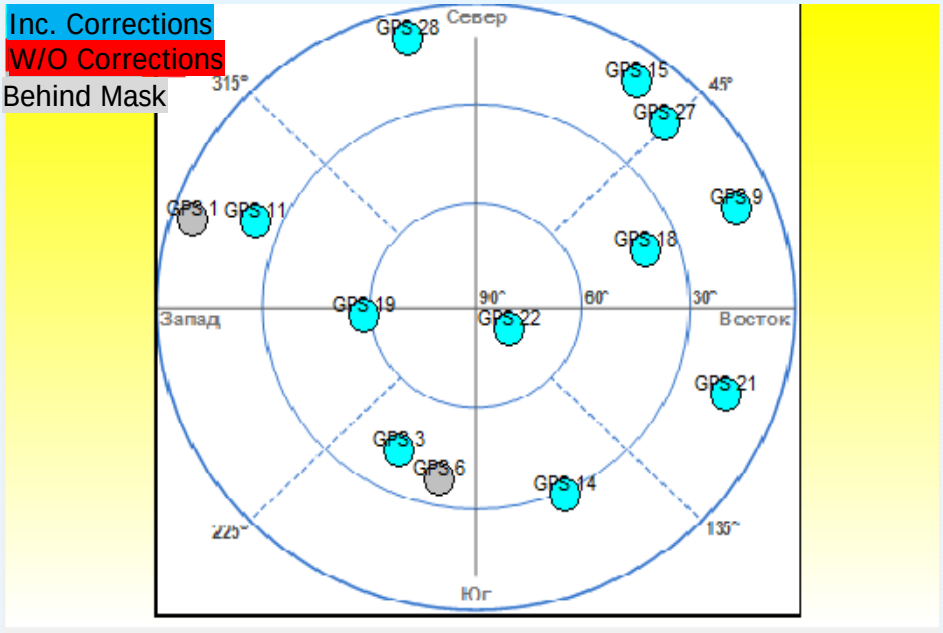
SDCM accuracy characteristics

Moscow, April 16, 2012 (Δt = 24 hours), (0.95)

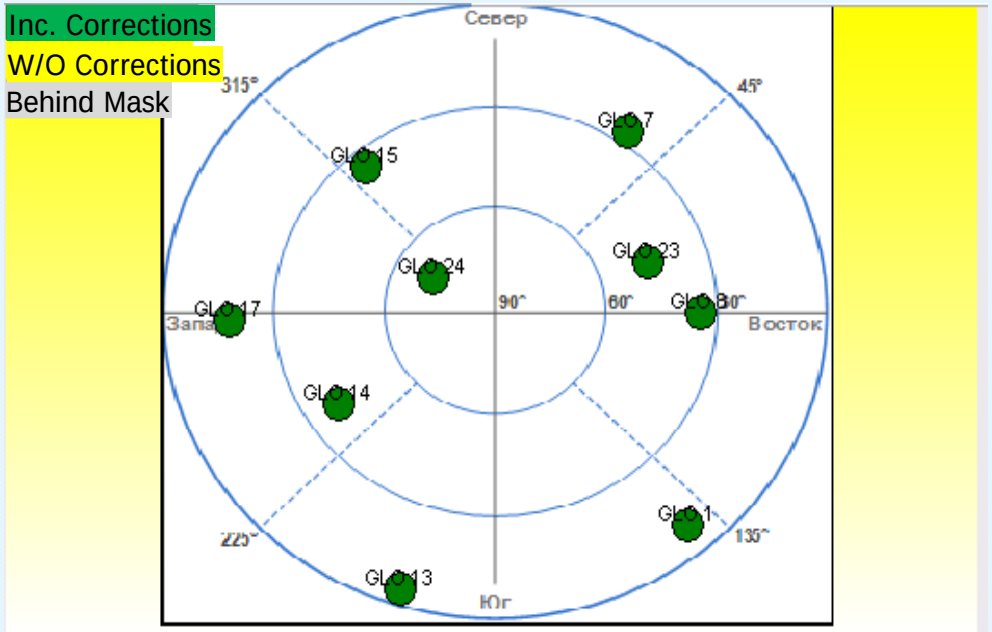
Functional mode	Absolute mode	GPS+SDCM
Planimetric coordinates (m)	3,5	1,0
Altitude (m)	6	2,5

Functional mode	Absolute mode	GLONASS+SDCM
Planimetric coordinates (m)	8,8	0,98
Altitude (m)	13,2	1,7

GPS

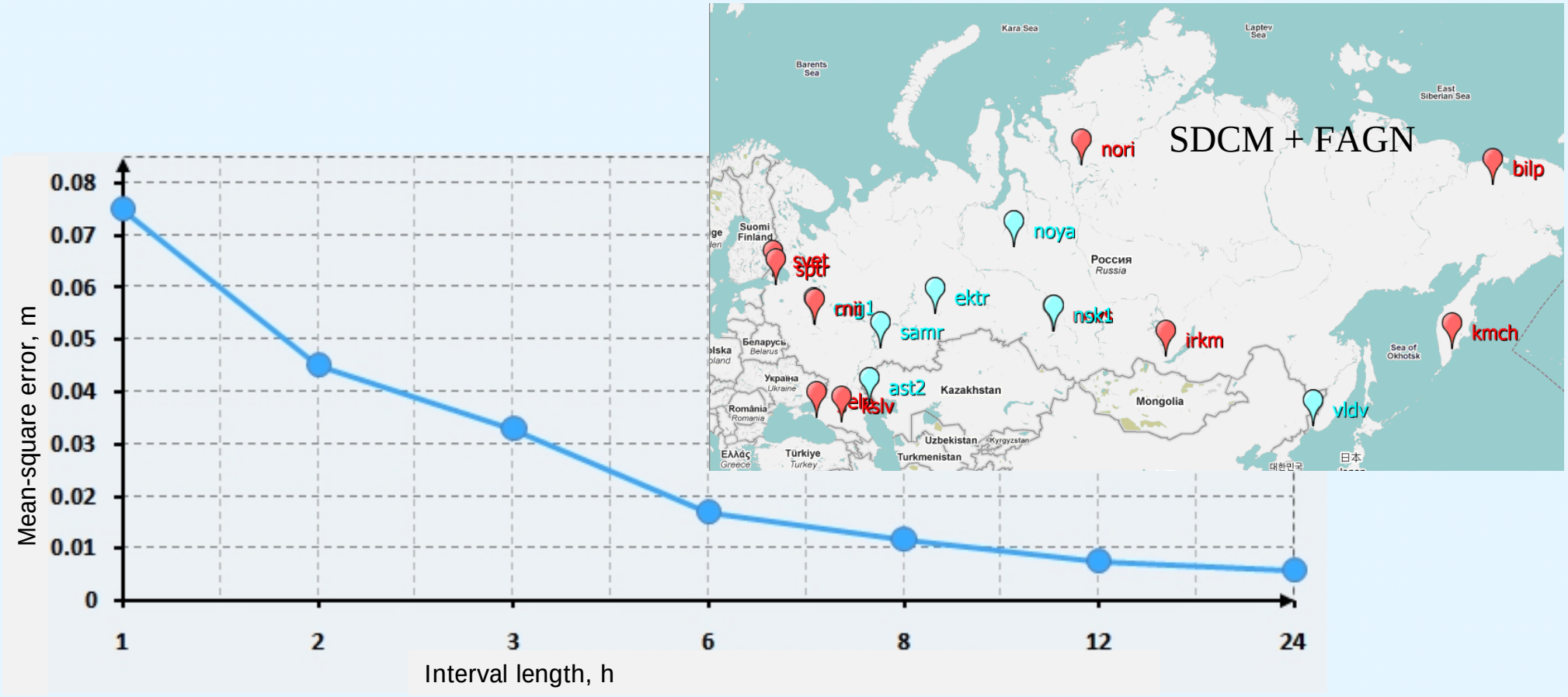


GLONASS



April 16, 2012 (t = 06 h. 25 min. Moscow time)

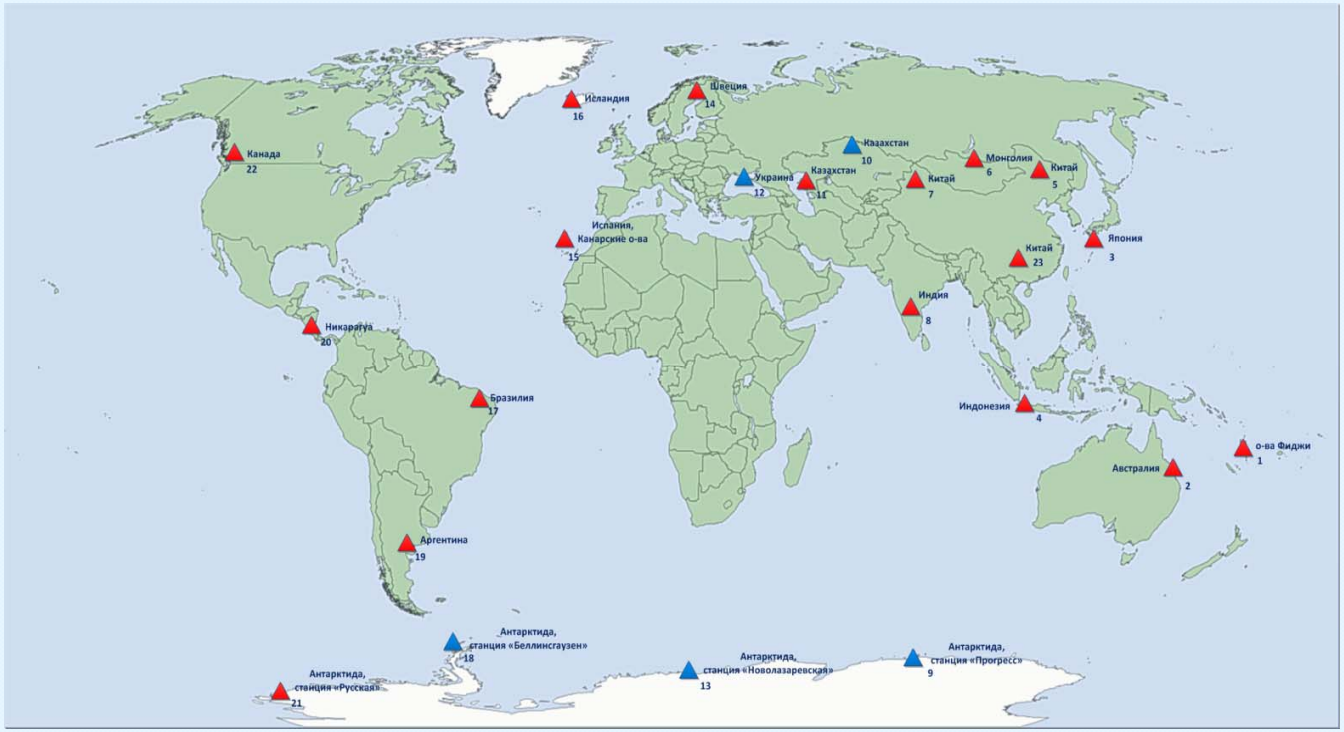
Estimation of user positioning accuracy at various length of observation intervals



Experimental study used pseudorange and pseudophase measurements of the GLONASS and GPS signals on L1 and L2 bands

SDCM reference stations network in Russia

Global SDCM reference stations network (planned)



Deployed SDCM Stations

Planned SDCM Stations (~ 18 stations)

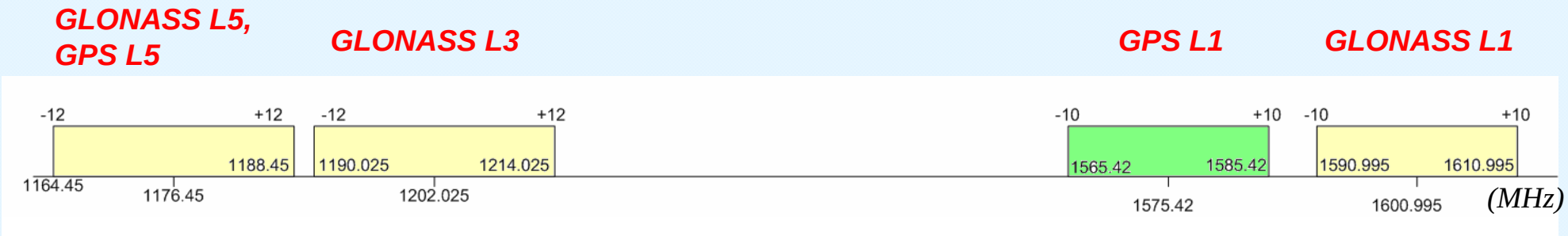
№	Country	City
1	Fiji Islands	Suwa'
2	Australia	Brisbane
3	Japan	Okinawa
4	Indonesia	Djakarta
5	China	Changchun’
6	Mongolia	Ulan Bator
7	China	Urumqi
8	India	Bangalore
9	Antarctica	«Progress station»
10	Kazakhstan	Akkol’
11	Kazakhstan	Atyrau
12	Ukraine	Sudak
13	Antarctica	«Novolazarevskaya» station
14	Sweden	Kiruna
15	Spain	Canary Islands
16	Iceland	Reykjavik
17	Brazil	Brasilia
18	Antarctica	«Bellingshausen» station
19	Argentina	Falda-del Carmen
20	Nicaragua	Managua
21	Antarctica	«Russkaya» station
22	Canada	Victoria
23	China	Kunming

Main avenues of SDCM development

Priority tasks of SDCM development:

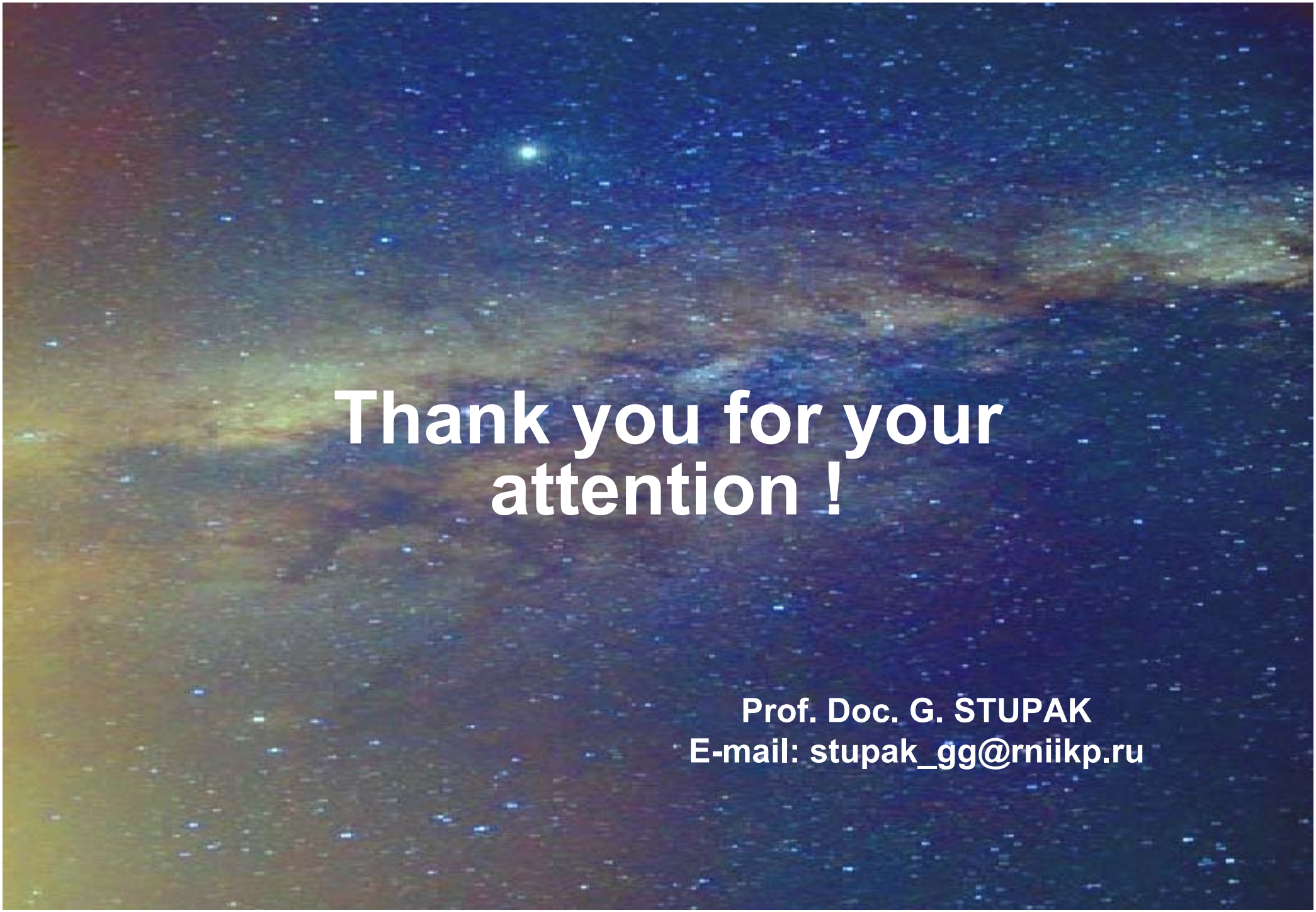
- ✓ Full deployment of the SDCM space segment on the basis of the Luch satellite family;
- ✓ Establishment of regional SDCM data processing centers;
- ✓ Enlargement of the number of SDCM reference stations network in Russia and globally;
- ✓ SDCM certification;
- ✓ Enlargement of SDCM transferred data composition.

Frequency bands of SDCM signals



– *applied frequency band of SDCM signals*

– *discussed frequency band of SDCM signals*



Prof. Doc. G. STUPAK
E-mail: stupak_gg@rniikp.ru