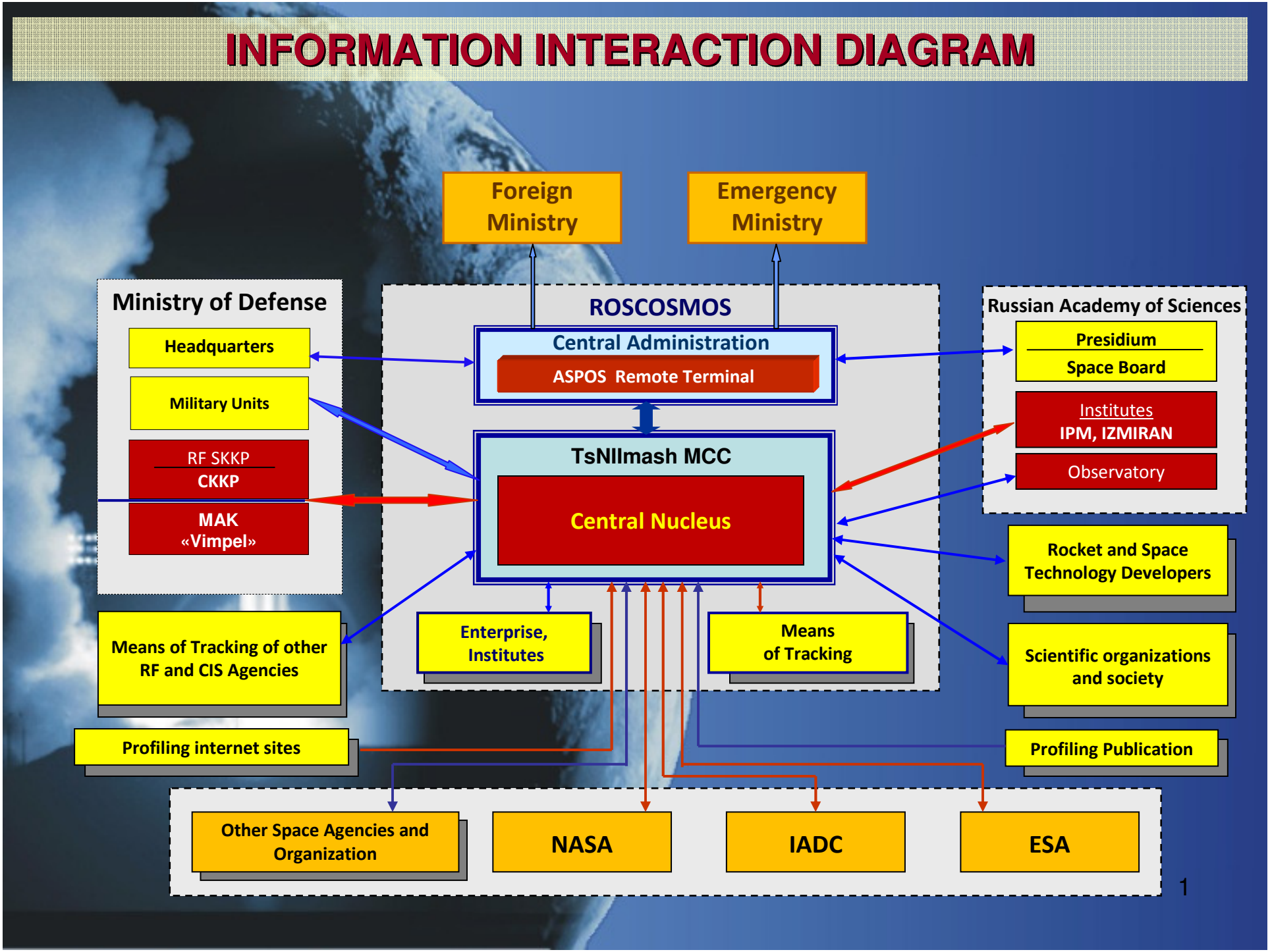
FEDERAL SPACE AGENCY
Federal State Unitary Enterprise
Central Research Institute for Machine Building
Mission Control Center

Detection and Warning Automated System of Hazardous Situations In near-Earth Space (NES). State and Perspective of Development.

2011

INFORMATION INTERACTION DIAGRAM



NES ASPOS MAIN TASKS

- Earth Space Global Monitoring of Technogenic Environment
- Identification, Forecasting, Issuing Warnings about the Dangerous Approach of a Controlled Spacecraft and Space Debris
- Forecasting of Entry into the Atmosphere and Fall to Earth of Uncontrolled Risk Objects
- Providing of Roskosmos with Information and Analytical Data regarding the Technogenic Environment in NES and RF Participation in International Activities of Space Debris Problems

NES ASPOS APPLICATION RESULTS (2009 - 2011)

- Were Identified more than 200 Dangerous Approaches of ISS with Space Debris. In 9 Cases Were Identified Violation of the Security Zone Station. Were Performed 3 Escape Maneuver.
- Were Identified more than 500 Space Debris Approaches with the Russian Spacecrafts “Resurs-DK”, “Koronas-Foton”, “Sterh”, GLONASS Spacecrafts and Geostationary Orbit Spacecrafts.
- Was Completed Operational Ballistic and Information Support of De-orbit more than 100 Space Objects Including Time and Fall Area Determination.
- Was Provided RF Participation in 2 International Test Campaigns to Support “Falling" Space Objects De-orbit.

ISS and SPACE DEBRIS DANGEROUS APPROACHES (2009-2011)

Were Registered more than 200 Dangerous Approaches at a Distance of less than 6 km

Is Identified 7–10 Dangerous Approaches Monthly

December, 2010 Data

Date	Time	Space Debris Name	Expected Minimum Distance	Collision Probability
06.12	17:39:19	Fengyun (China)	4,4 km	$3,3_{10}$-9
14.12	01:09:58	Fengyun (China)	4.8 km	$2,1_{10}$-9
20.12	22:29:33	UARS (USA)	4,85 km	$2,0_{10}$-9
23.12	11:12:45	SL-12 (RF)	1,92 km	$1,2_{10}$-7
24.12	11:40:23	Fengyun (China)	5,3 km	$6,1_{10}$-10
26.12	12:44:26	WIRE (USA)	5,6 km	$2,7_{10}$-10
27.12	08:14:12	UARS (USA)	4,5 km	$3,6_{10}$-9

ISS AND SPACE DEBRIS DANGEROUS APPROACHES (2009-2011)

In 9 cases Were Identified Violation of the Security Zone Station.

Were Performed 3 Escape Maneuver

Date	Time	Space Debris Name	Expected Minimum Distance	Comment
12.03.09	16:39:41	Booster Fragment (USA)	$2,34_{10}$-4	Crew Was Evacuated to "Soyuz"
17.03.09	07:14:11	Spacecraft Fragment (RF)	$2,63_{10}$-4	Threshold
23.03.09	19:25:03	Chend Zhend (China)	$1,7_{10}$-4	Avoidance
21.05.09	12:11:18	Fengyun (China)	$4,7_{10}$-4	Threshold
18.07.09	09:11:25	Not Cataloged	$7,5_{10}$-4	Avoidance
19.09.09	17:27:58	Kosmos 2251 (RF)	$1,47_{10}$-4	Threshold
07.11.09	02:17:35	Not Cataloged	$7,1_{10}$-3	Threshold
30.04.10	04:02:09	Fengyun (China)	$1,85_{10}$-4	Threshold
26.10.10	12:41:43	Uars (USA)	$2,64_{10}$-4	Avoidance

SPACECRAFT AND SPACE DEBRIS DANGEROUS APPROACHES (2009-2011)

Were Identified more than 500 Space Debris Approaches with the Russian Spacecrafts "Resurs-DK", "Koronas-Foton", "Sterh", GLONASS Spacecrafts and Geostationary Orbit Spacecrafts.

"Resurs-DK" and Space Debris Dangerous Approaches Data, late December

Date	Time	Space Debris Name	Expected Minimum Distance	Comment
21.12	08:23:35	Thorad (USA)	3,19 km	$2,0_{10}$-8
21.12	17:22:42	Kosmos 1536 (RF)	2,5 km	$2,7_{10}$-8
23.12	07:19:32	Fengyun (China)	1,23 km	$4,1_{10}$-7
23.12	11:13:09	PSLV (India)	3,37 km	$1,5_{10}$-8
28.12	13:34:07	Genesis (USA)	1,93 km	$1,2_{10}$-7
29.12	19:08:46	Kosmos 1606 (RF)	3,84 km	$1,0_{10}$-8
31.12	05:51:02	SL-3 (RF)	1,54 km	$2,8_{10}$-7

FALLING SPACE OBJECT DE-ORBIT CONTROL (2009-2011)

Was Completed Ballistic and Information Support of De-orbit more than 100 Space Objects Including Time and Fall Area Determination.

In January, 2011 Was Implemented Fall Control of the next Falling Space Objects:

Space Object Name	De-orbit Date and Time		De-orbit Coordinates Latitude	Longitude
Aerocube 3 (USA)	06.01	04:55 (± 2 h)	35,3 n	146,9 w
QBX 1 (USA)	06.01	20:19 (± 3 h)	25,2 n	60,9 w
SMDC ONE (USA)	12.01	16:07 (± 2 m)	5,3 s	126,2 w
QBX 2 (USA)	16.01	17:13 (± 9 h)	8,8 n	56,2 e
ATLAS AGENA (USA)	18.01	09:07 (± 1 m)	45,0 n	273,0 e
Launch Vehicle Stage 3 «Soyuz-U»	31.01	08:21 (± 7 h)	51,1 s	145,1 e

INTERNATIONAL TEST CAMPAIGN PARTICIPATION

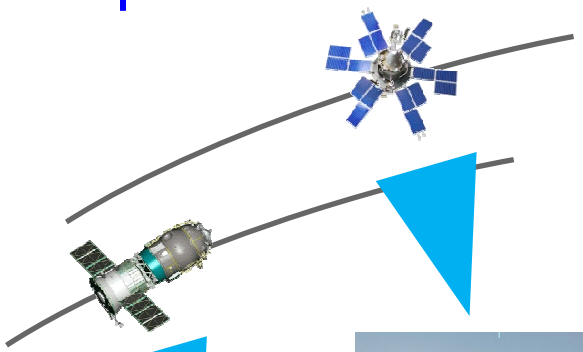
IADC Test Campaign 2010-1. Launch Vehicle "Vostok-2M" Space Tug De-orbit Conduct

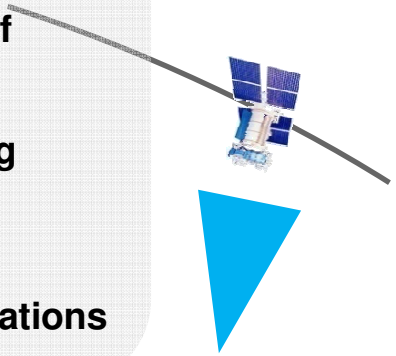
№	Participations	Measurement Number	Decision Number		Prediction Error (minutes)
			Total	Last Day	
1.	England/BNSC	-	11	4	+44
2.	Germany/DLR	-	7	4	+11
3.	ESA	4	11	4	+9
4.	India/ISRO	-	17	6	+6
5.	Italy/ASI	-	22	7	+5
6.	China/CNSA	-	25	4	-54
7.	Russia/Roscosmos	93	22	9	+2
8.	USA/NASA	117	7	4	+10
9.	France/CNES	1	7	3	-24
10	Japan/JAXA	4	7	1	+37

Fall: 30.04.2010г., 16:54 UTC. φ = 10,4°s, λ=219,3°e

NES ASPOS and SPACECRAFT CHIEF OPERATOR INTERACTION PERSPECTIVE

1. Collection and Analysis of Information about NES Condition
2. Identification, Analysis and Prediction of Possible Hazardous Situations
3. Coordination and Planning of Monitoring Facilities Work. Correction of Approach Parameter
4. Outputting of Warning and Recommendations to Parry Hazardous Situations





Spacecraft Chief Operator

Near-earth Space ASPOS Segment

PERSPECTIVE DEVELOPMENT of INTERNATIONAL COOPERATION

- Information-Ballistic Support Providing of Special-Purpose Information Spacecraft Operators to Identify Dangerous Approaches with Space Debris and Escape Maneuvers Conducting
- Situational Analysis, Coordination and Planning of Work of Russian and Foreign Tracking Station for the NES in order to Ensure Safety of Spacecraft Control
- Develop Proposals on the Principles and Organizational Procedures of Interaction NES ASPOS with International Organizations
- Develop Regulations to limit the Technogenic Pollution of NES, as the Phases of the Development of Spacecraft, as well as during their Operation