On development of scientific school on space engineering and technologies at al-Farabi KazNU

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SPACE DAYS IN KAZAKHSTAN. 21-22 NOVEMBER, 2016 ASTANA

Teaching on Specialty

2005 *– Kazakhstan started its own Space Program*

2010 *– KazNU has obtained the license for teaching on the specialty "Space engineering and technologies" for bachelor program (50)*

2012 *– for master program (6)*

2013 *– for PhD program (6)*

From ***2007*** *year we collaborate with professor of Tokyo University Shinichi Nakasuka, world known specialist on micro/nanosatellites development. 11 micro/nanostallites (5 on orbit, 6 are waiting for launch)*

In KazNU – 2PhD and 5 PhD students

Teaching on Specialty

*In **2015** the National Program of Innovative and Industrial Development (NPIID) of Republic of Kazakhstan had started.*
Profile master program, 1.5 year
***11** Universities including KazNU, which realize NPIID.*

*Enrollment **2015***
- *Information technologies of space monitoring system (on base of curriculum of TEMPUS – SESREMO)*

*Enrollment **2016***
- *Space monitoring*
- *Spacecraft development (for needs of our domestic enterprises)*

Development plan

At present al-Farabi KazNU creates the Center of Space Technologies and Remote Sensing.

The main goal is to train students in the satellite data processing.

The tasks , which we plan to solve:

- *understanding of the ecological factors , influencing on the man's health;*
- *control of energetic resources;*
- *decrease of losts from natural and technogenic disasters;*
- *etc.*

***International collaboration** :*

- *JSC "Sovzond" (Russia);*
- *Twente University (Netherlands) +PhD student;*
- *Tallinn Technical University (Estonia) +PhD student.*

Domestic enterprises:

- *National Center of Space Research and Technologies;*
- *Kazakhstan Garysh Sapary.*

Scientific projects

National grants:

2013 – 2015 *«Development and assembly of the program-technical complex and creating of the nanosatellite engineering model»;*

2015 – 2017 *«Development of attitude control system for small spacecrafts of remote sensing and scientific purpose»;*

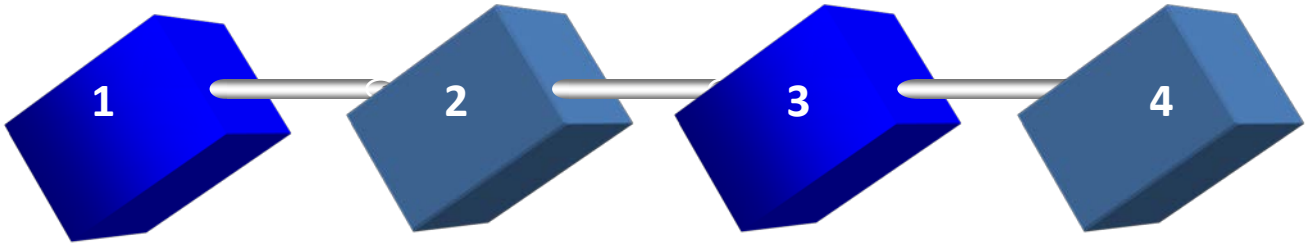
2015 – 2017 *«Establishment of the national scientific school on development of space engineering and technologies. Design, assembly and launch of the first nanosatellite of Kazakhstan».*

International projects:

- ***TEMPUS – SESREMO*** *(Strengthening education in space-based remote sensing for monitoring of eco systems in Israel, Azerbaijan, Kazakhstan 2013-2016)*
- ***APPLE*** *(applied curricula in space exploration and intelligent robotic systems)*

The mission of Al-Farabi series

Al-Farabi-1	• **type: 2U cubesat** • **mass: 2.3 kg** • **main mission: educational (testing of communication systems and power supply systems)**



EDUCATIONAL

Preparation of experts for the Kazakhstan space industry

SCIENTIFIC

The study of near-Earth space using a small satellite

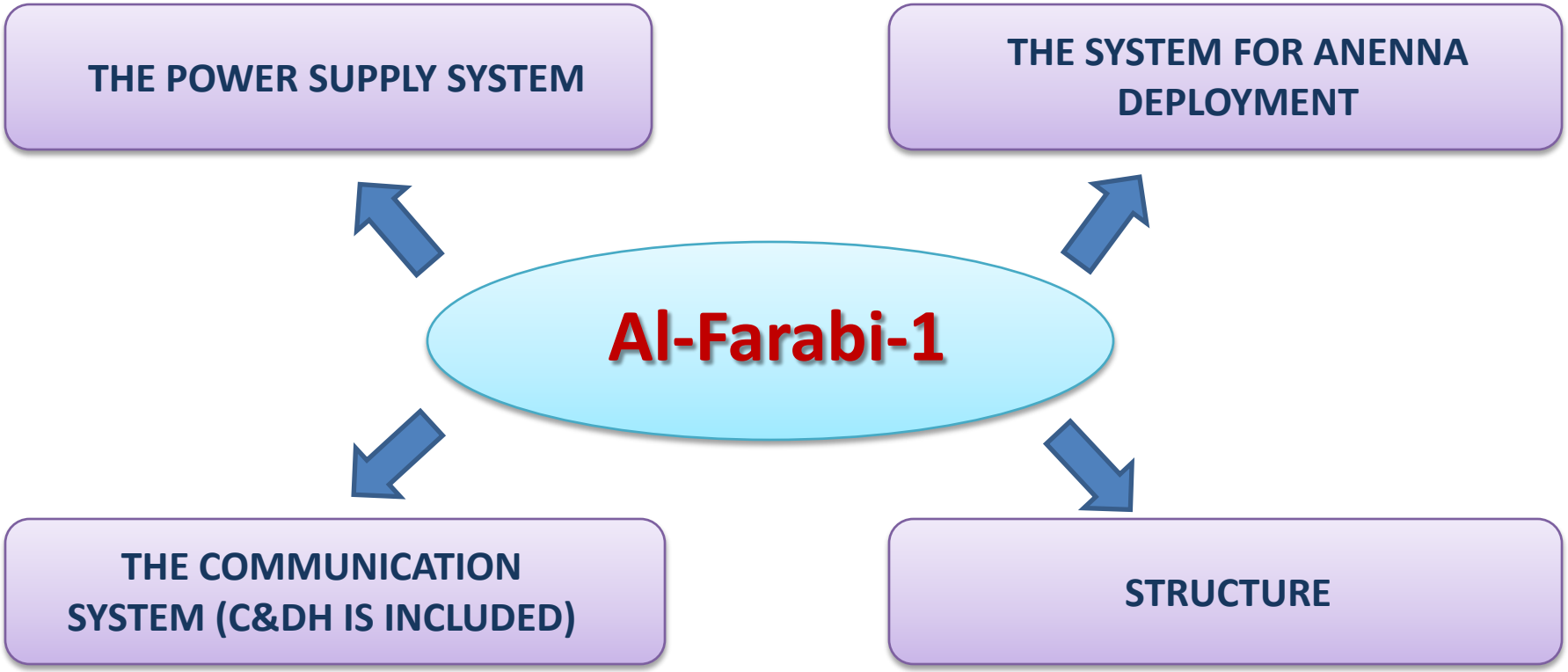
TECHNOLOGICAL

Obtaining technologies of assembling, integration & testing of small satellite

EDUCATIONAL-METHODICAL

Development and improvement of study programs for future space engineers

Subsystems of Al-Farabi-1



The power supply system

The power supply system (PSS) of the nanosatellite Al-Farabi-1 is divided into four parts:

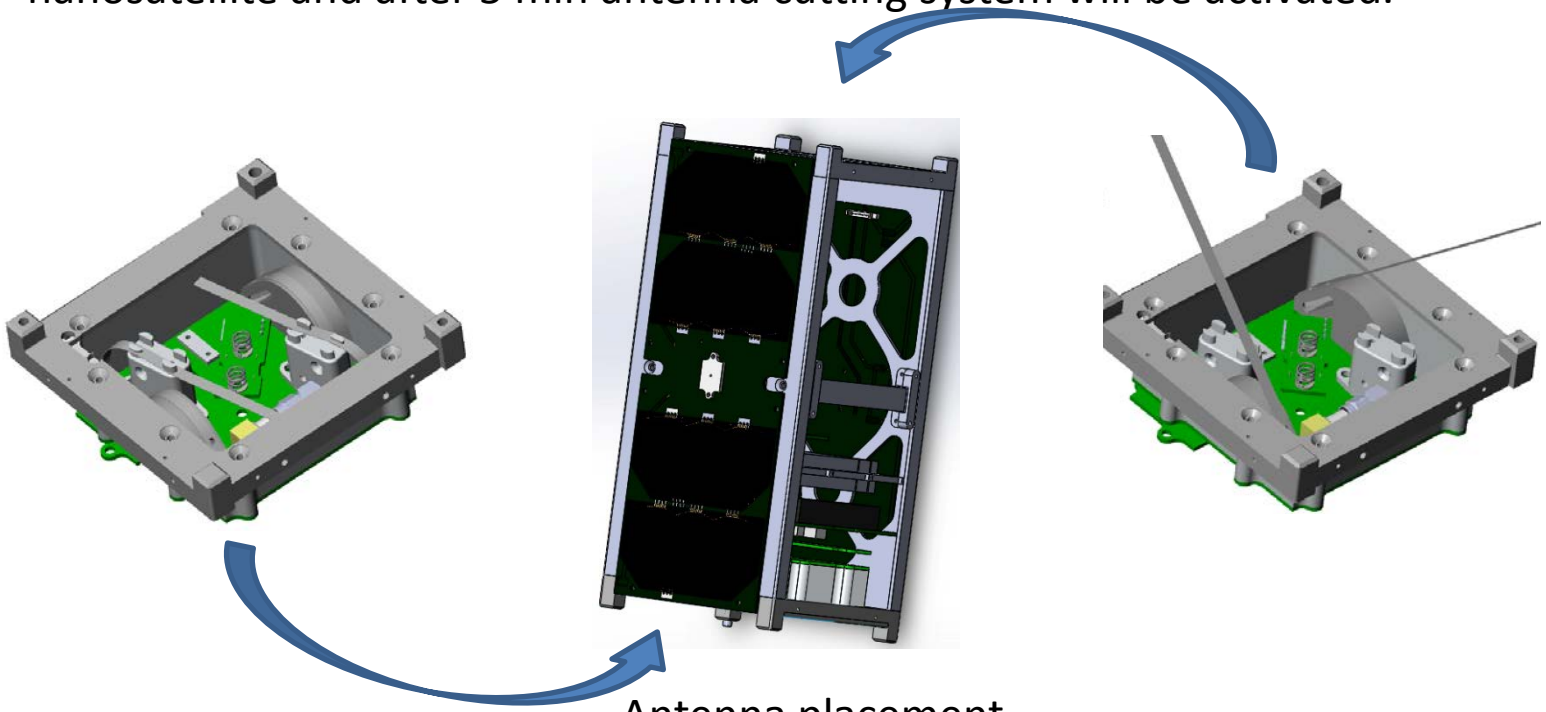
- **solar cells**
- **battery and its charging system**
- **power control unit**
- **power distribution unit**

Solar cells	**4 x 4 sides**
Battery	**1 lithium-polymer**
Total capacity of bat	**19 Whr**

Depending on control algorithms of PSS there are several ports which electricity distribution is implemented to provide power to **a)antenna deployment device; b) for communication system.**

Antenna deployment system

- Antennas(two steel tapes) stowed by nylon wire which cut by electric current.
- The dual burnout system was installed for redundancy.
- After the separating of nanosatellite from the rocket, kill switch turn on nanosatellite and after 5 min antenna cutting system will be activated.



Antenna placement

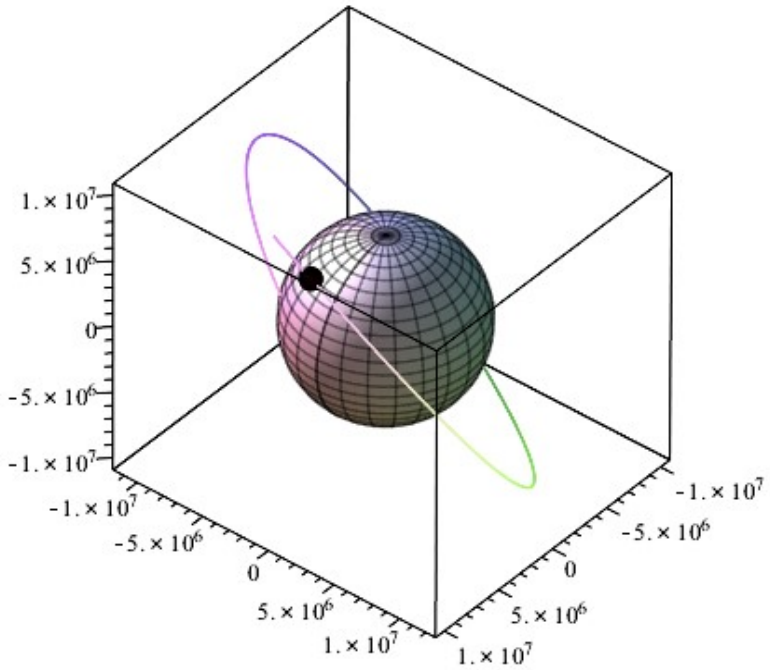
The communication system

The communication system	2 VHF transceivers
Telecommunication module modulation	GMSK (Gaussian Minimum Shift Keying)
The frequency	435.5 MHz
Speed	4800 bps

- Software of communication system of nanosatellite with a ground segment has been developed.
- To communicate with the ground segment Mobitex protocol was used.
- 6-10 synchronization bytes is sufficient for connection

VHF transceiver

The simulation of motion of Al-farabi-1



***Orbital characteristics*:**

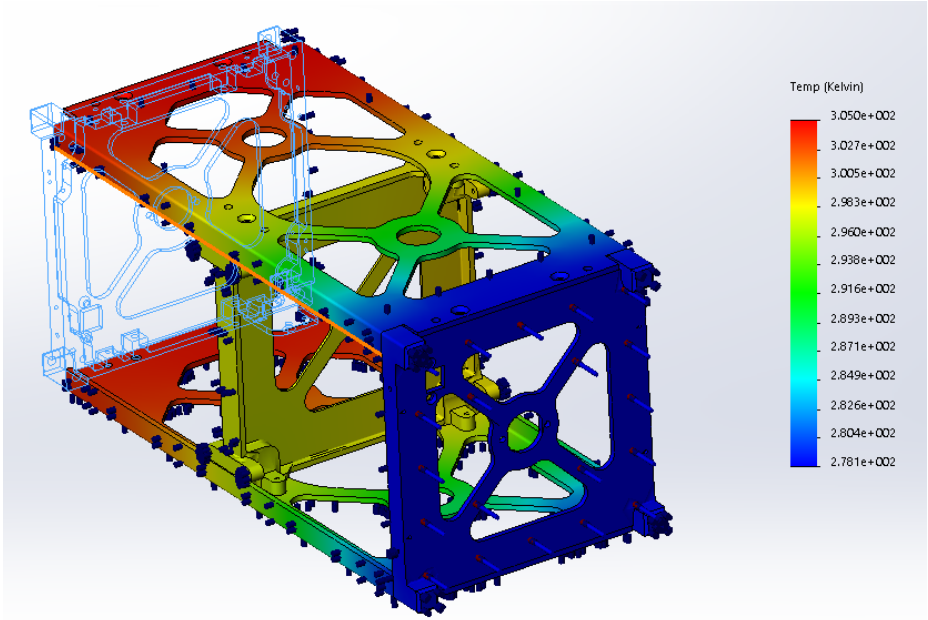
- Orbit is SSO
- altitude is 580 km
- 4-5 times operations per day
- 6-8 min active session

- Coordinates of GS (Almaty) are
  43° 13'28.25“ N
  76° 55'25.04“ E

Thermal and mechanical analyzes of Al-farabi-1

The value of heat fluxes:

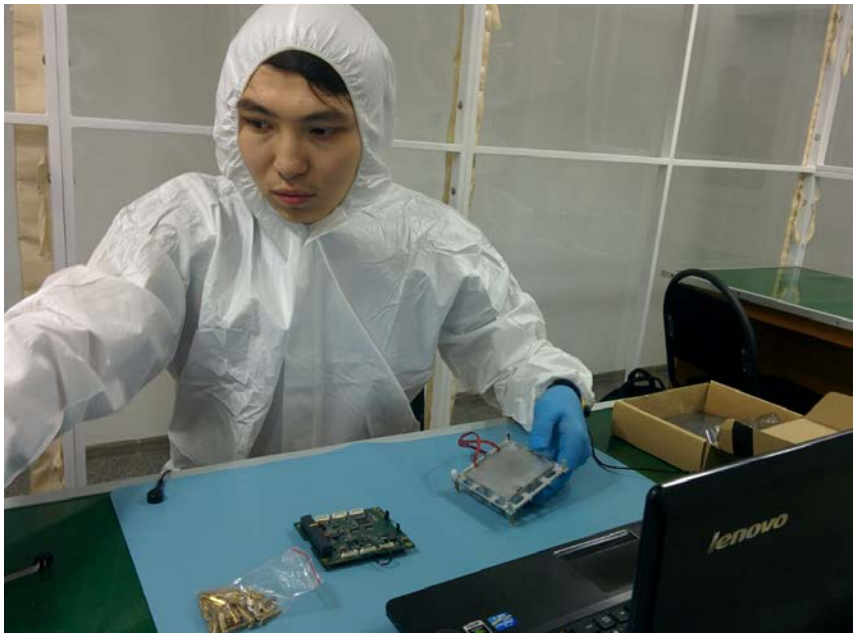
- **Day time 47 W;**
- **Night time 4 W.**



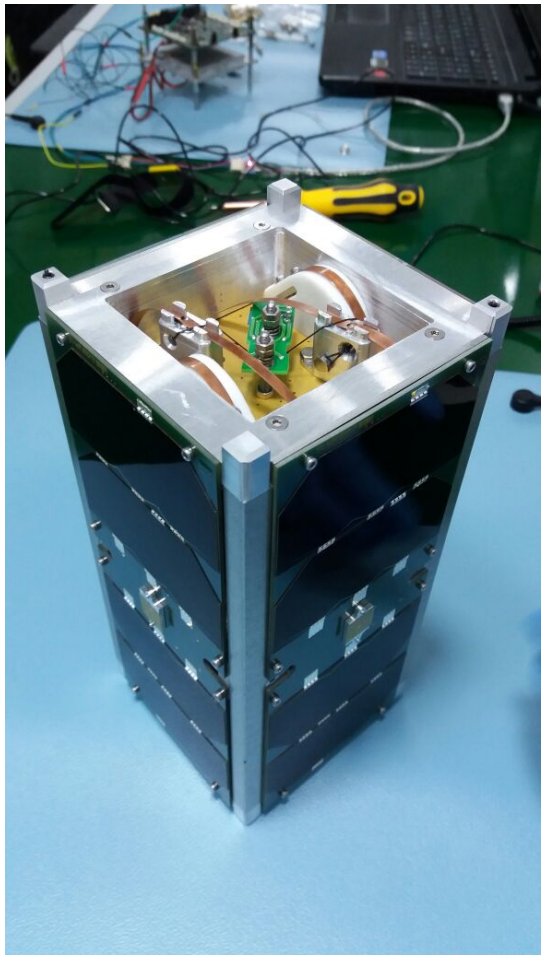
- Structure strength is already assuming Dnepr rocket.
- Dnepr was changed to PSLV.

Clean room for Al-farabi series

Students are assembling Al-farabi-1 nanosatellite



Al-farabi-1 nanosatellite flight model



Conclusion

The following designs already completed:

- Requirements for the nanosatellite;
- Software of PSS, Communication system(C&DH);
- CAD model.

The followings are already fabricated:

- Structure;
- Communication system(C&DH);
- Antenna deployment system.

Finally following things should be done:

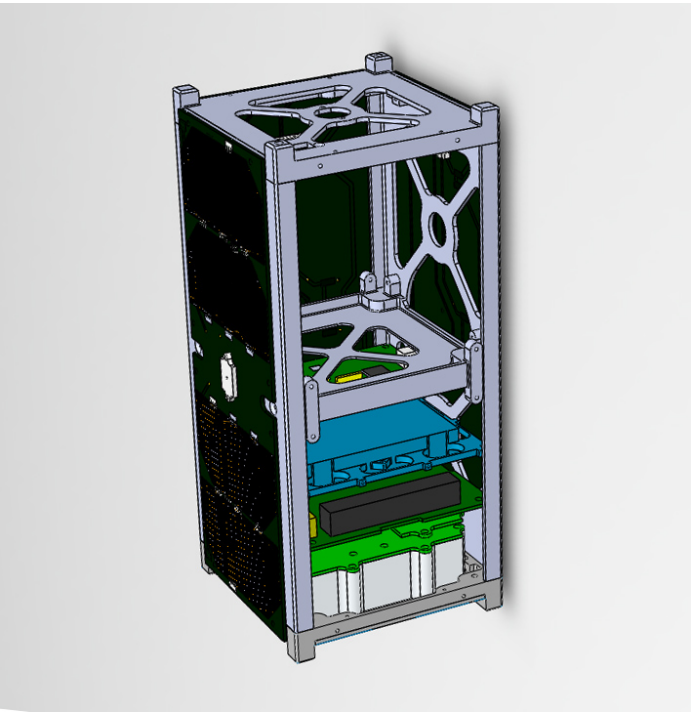
- Analysis of the orbit for PSLV;
- FM environmental testing;
- Operation practice.

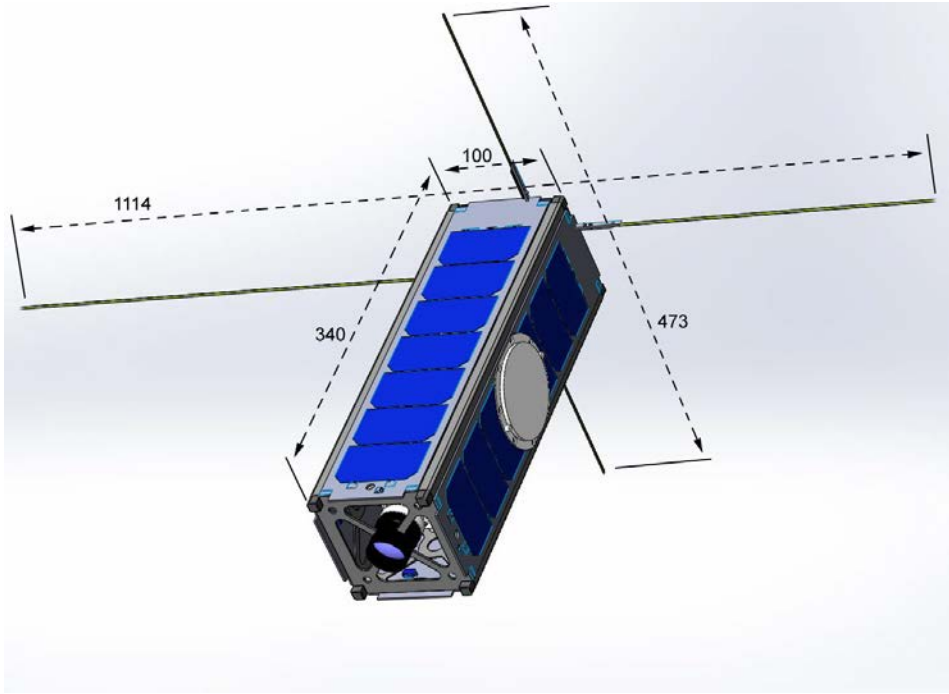
Lessons learned

Important things are:

- Project management;
- Domestic environmental testing would be required(in Kazakhstan);
- Choosing the launch vehicle is very important!

Our future plan





3 U CubeSat Al-Farabi-2

Thank you for your attention!