Al-Farabi Kazakh National University

The 7th Nano-Satellite Symposium

Development of a first Kazakhstan student nanosatellite Al-Farabi-1

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Almaty, Kazakhstan

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Introduction – Al-Farabi-1 background information

2005 *– Kazakhstan started its own Space Program*

KazSat-2, KazSat-3, KazEOSat-1, KazEOSat-2

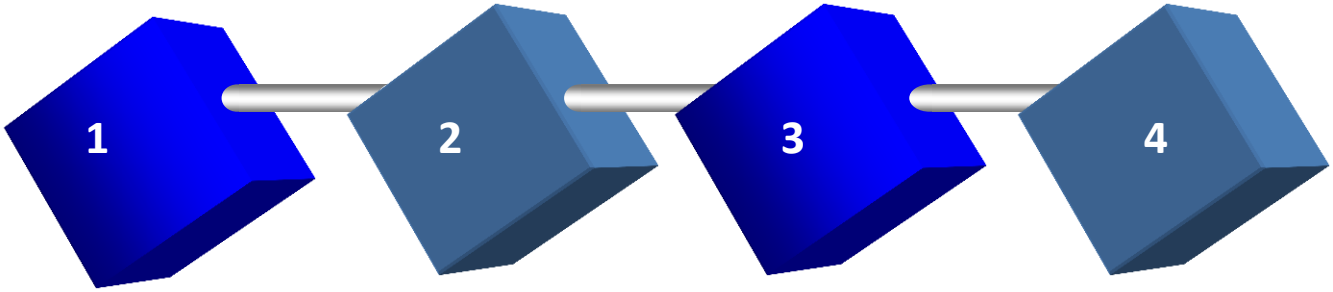
2010 *– KazNU has obtained the license for teaching on the specialty "Space engineering and technologies"*

2013 *– KazNU started a project to develop the first student nanosatellite. The main goal of the project is an educational mission, allowing students and young scientists of KazNU to participate in all stages of the nanosatellite design.*

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

The mission of Al-Farabi series

The main mission of the project is to establish the national research school on development of space techniques and technologies



EDUCATIONAL

Preparation of experts for the Kazakhstan space industry

SCIENTIFIC

The study of near-Earth space using a small satellite

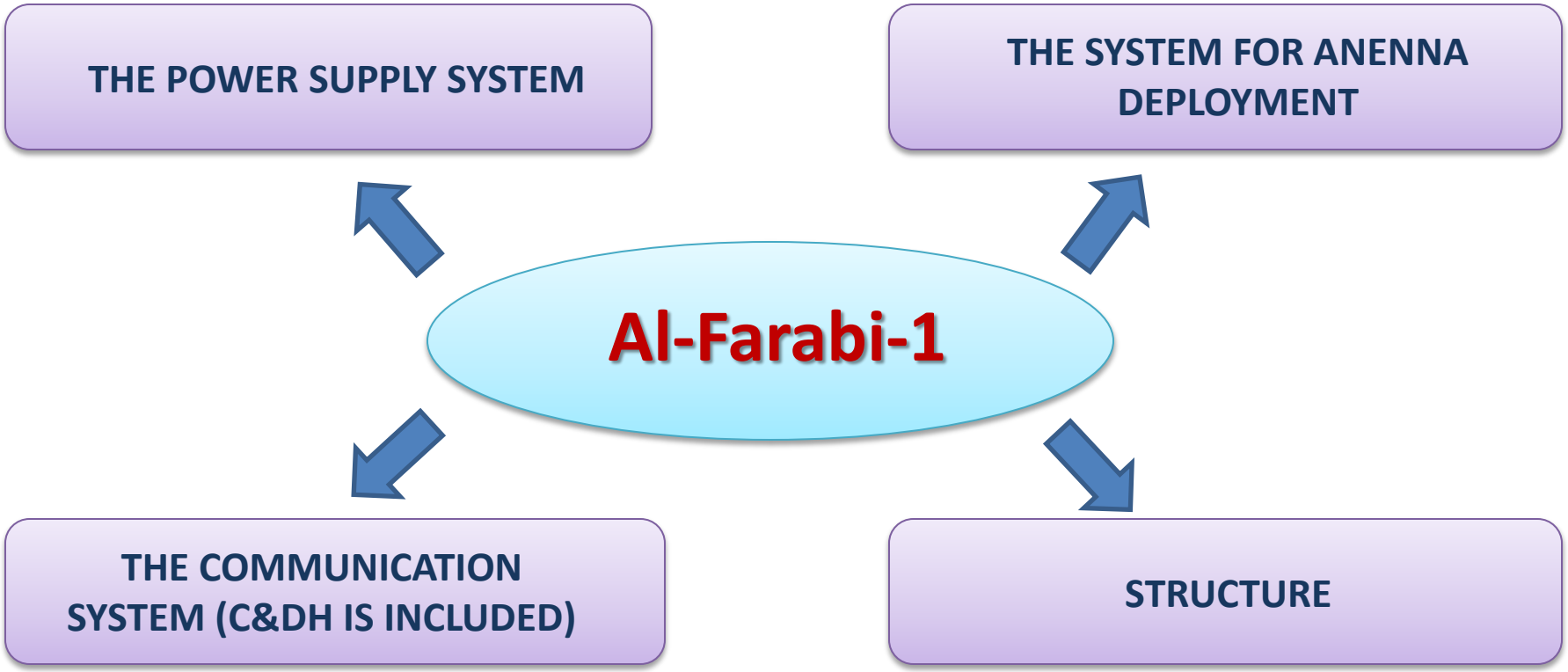
TECHNOLOGICAL

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**

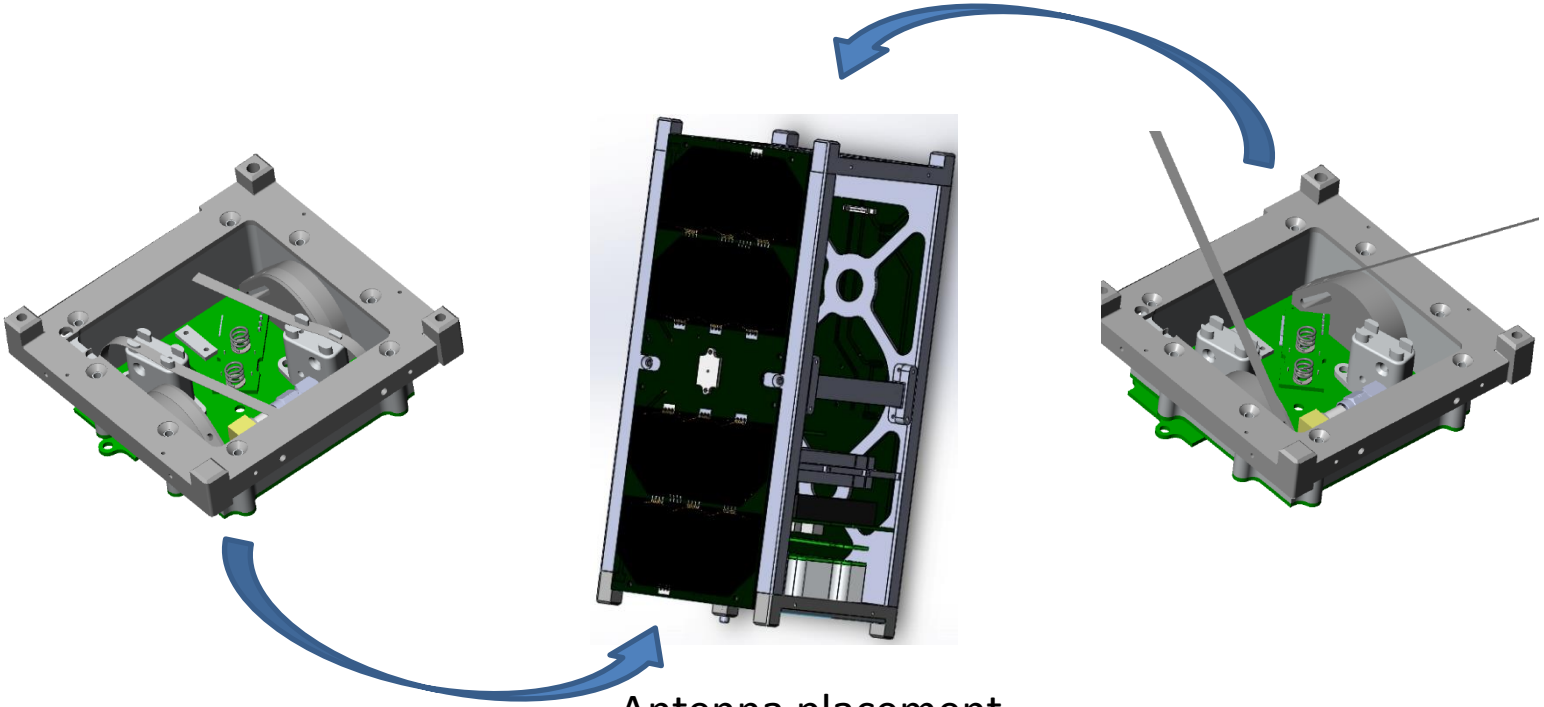
Solar cells	**4 x 4 sides**
Battery	**1 lithium-polymer**
Total capacity of bat	**19 Whr**

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

- In case that the current value exceeds the permissible limit, the PSS will cut the power supply.
- The system has a real time clock with which power control is carried out in real time reference.
- The setting of the system can be changed by sending commands from the ground.

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

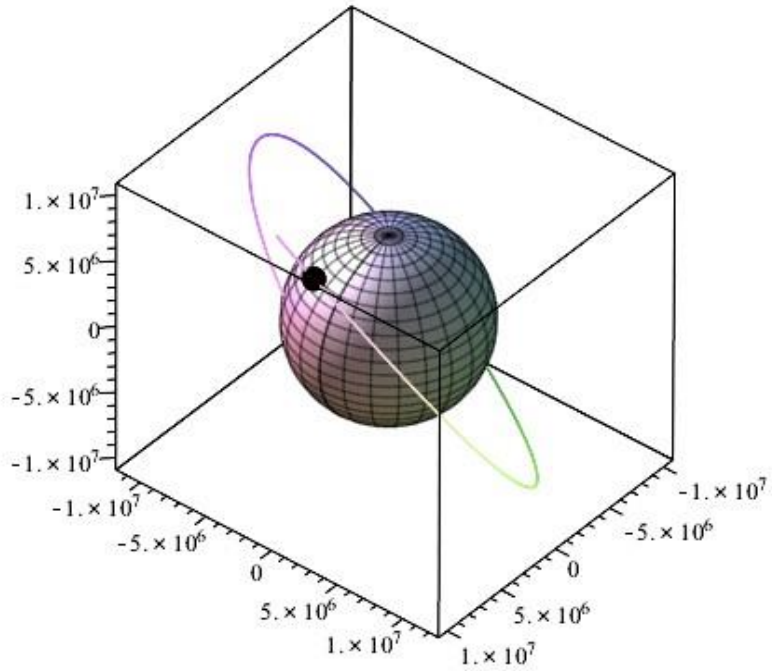
The communication system

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*:**

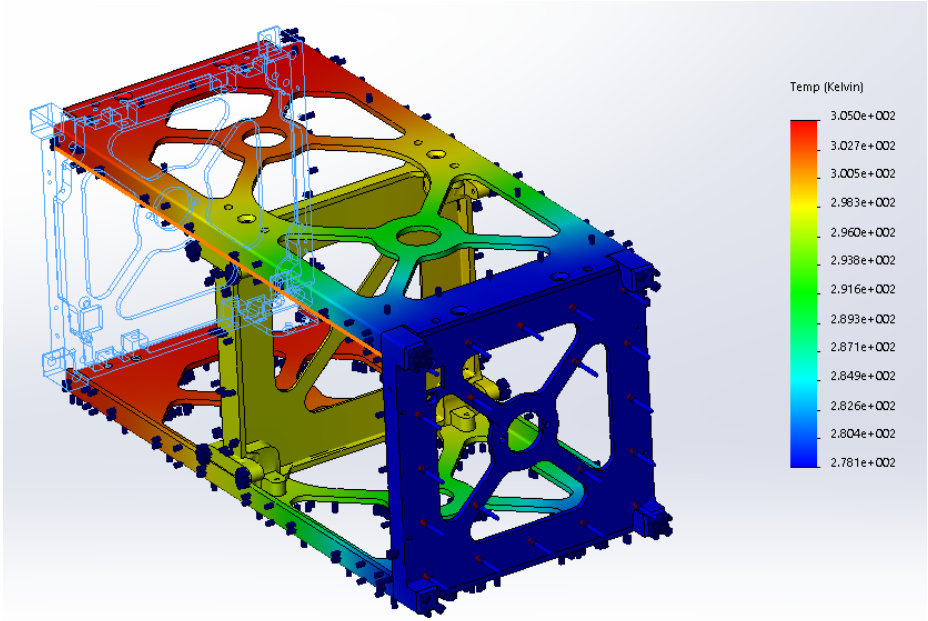
- Orbit is SSO
- altitude is 580 km
- 4-5 times operations per day
- 6-8 min active session

- 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.

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;
- Start build clean room before (if not exist);
- Domestic environmental testing would be required(in Kazakhstan);
- Choosing the launch vehicle is very important!

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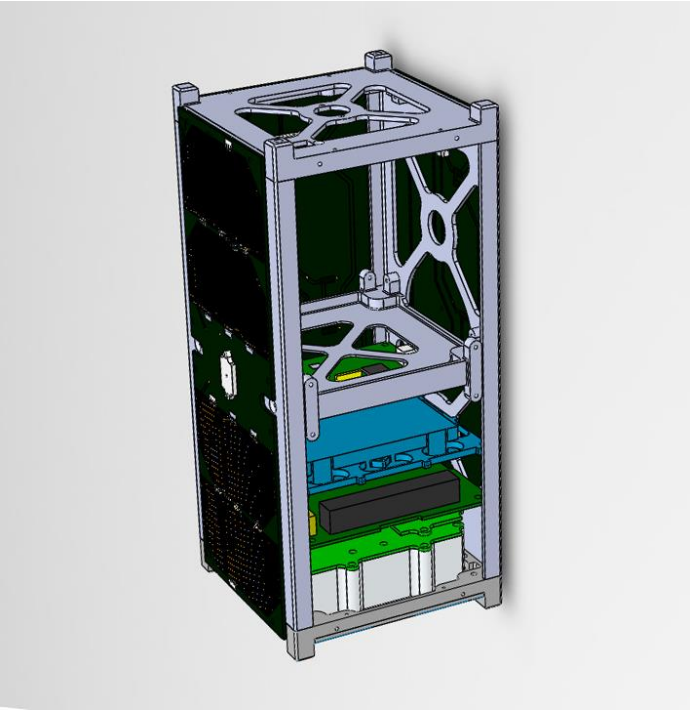
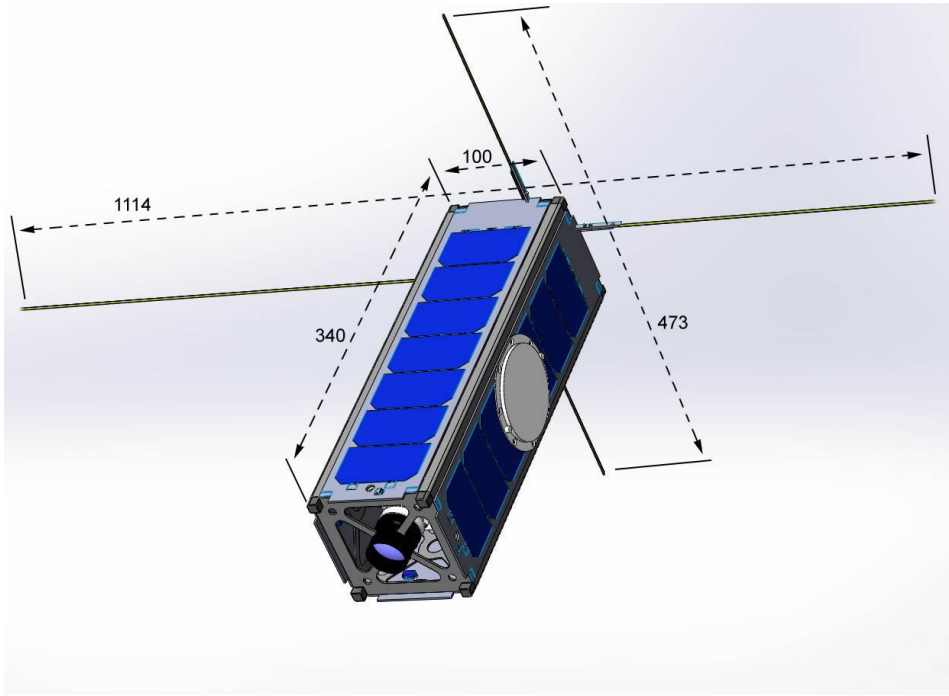
Our future plan





3 U CubeSat Al-Farabi-2

Thank you for your attention!

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