



VZLUSAT-1 - Czech 2U Cubesat for IOD's

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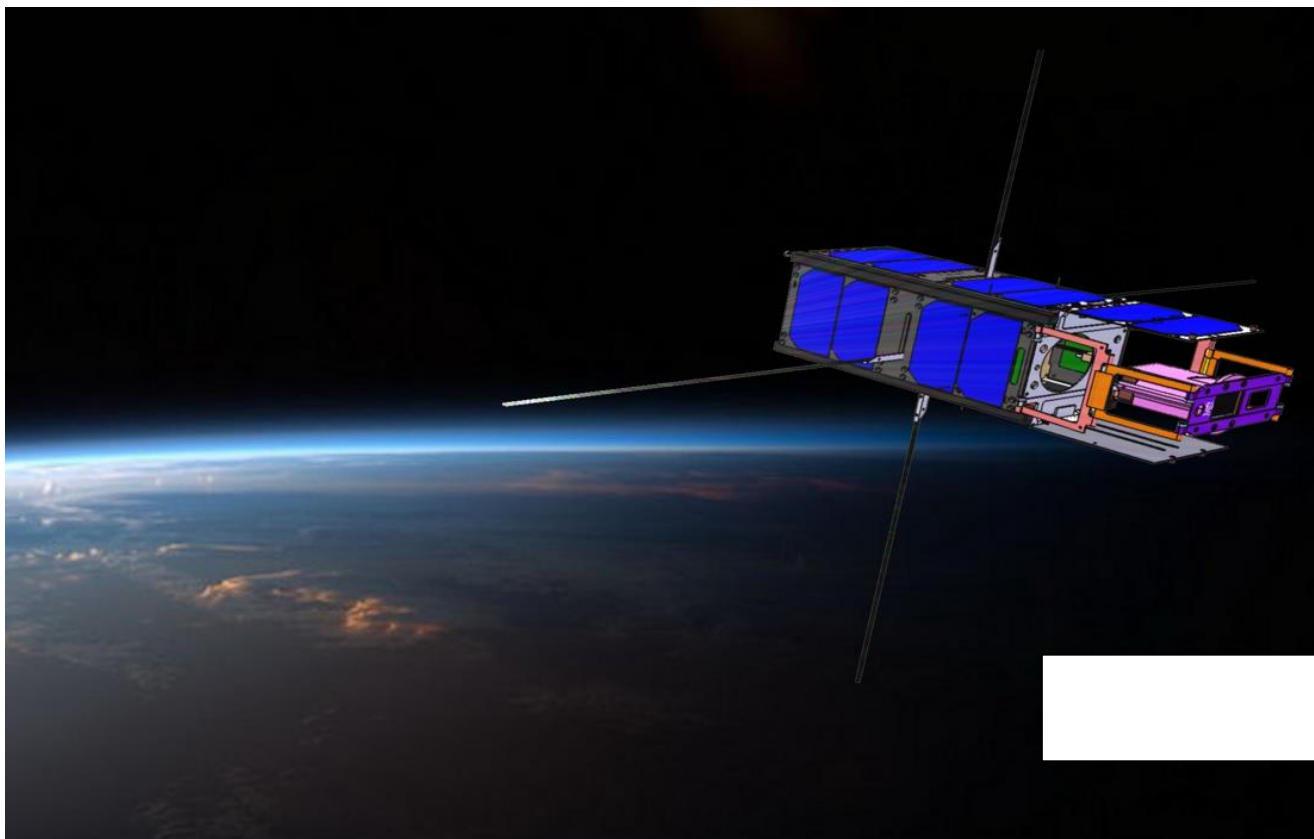
- Introduction
- VZLUSAT1 IOD's
- Miniaturized X-ray telescope
- Composites Health monitoring system
- VZLUSAT1 EQM assembly
- Communication system
 - Ground station
 - SW
 - COM testing
- Nanosatellite registration

CONTENT



VZLUSAT-1 2U Cubesat

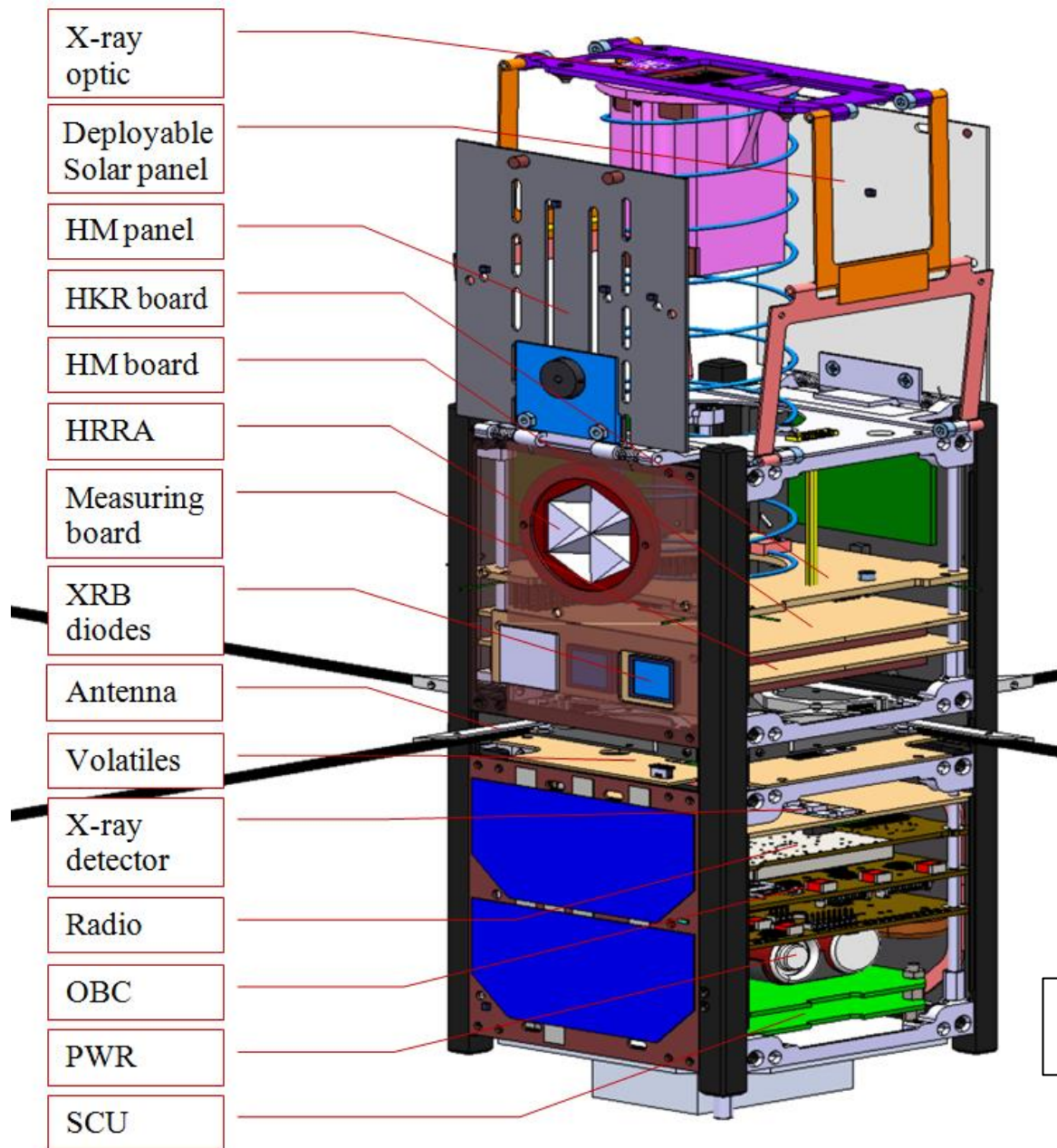
- QB50 participation
- Launch February 2016
- LEO 400km
- Radioamateur frequency
- Low download data
- Coarse attitude stab



VZLUSAT-1



IOD's onboard VZLUSAT1

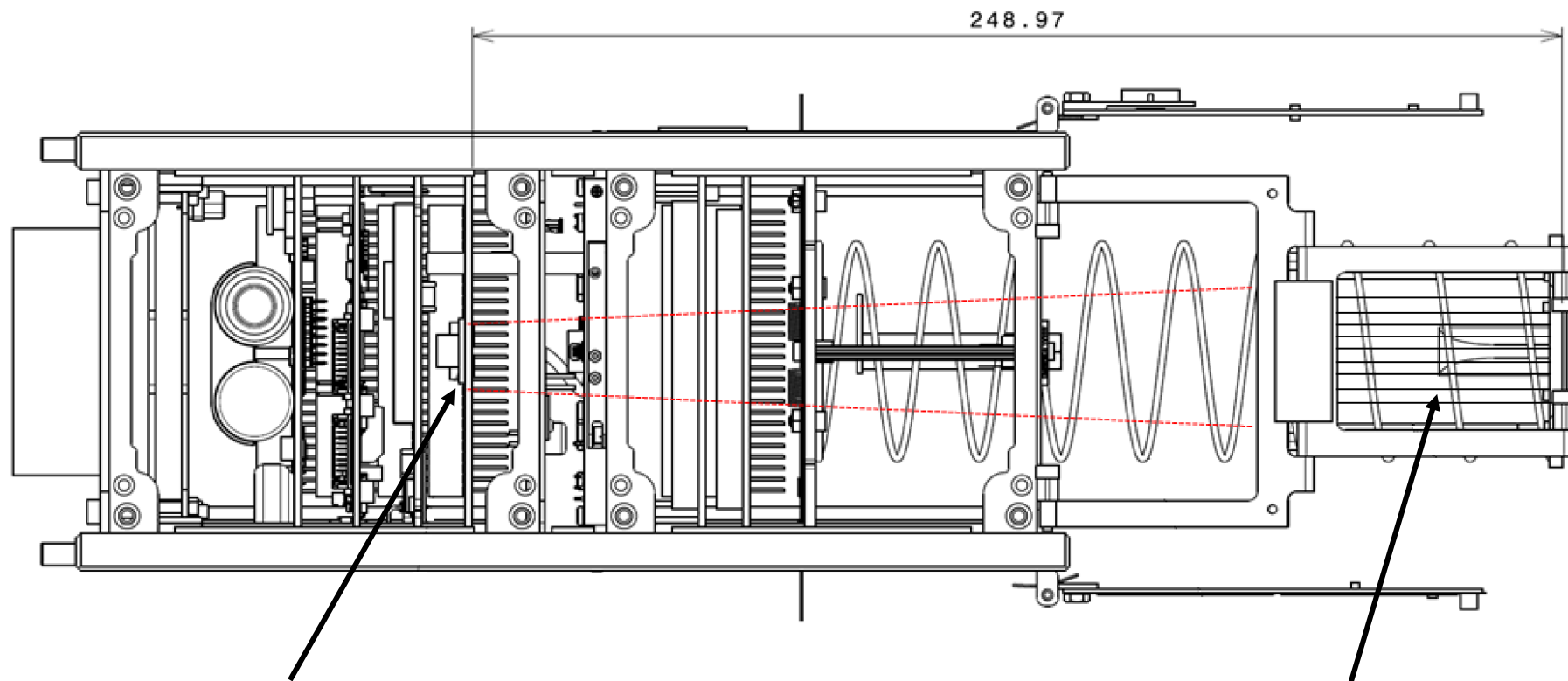


- Miniaturized X-ray telescope
- Radiation-hardened composite housing (RHCH) for electronics with increased thermal conductivity
- Solar panel on composite substrate
- Hollow retroreflector array based on composite
- Health monitoring of RHCH by sensors
 - Temperature (PT1000)
 - Volatiles (HYT, HAL2)
 - Radiation (XRB diodes, CdTe)
 - Vibration (piezo)
- QB50 Scientific unit - FIPEX

IOD'S ONBOARD VZLUSAT1



Miniaturized X-ray telescope



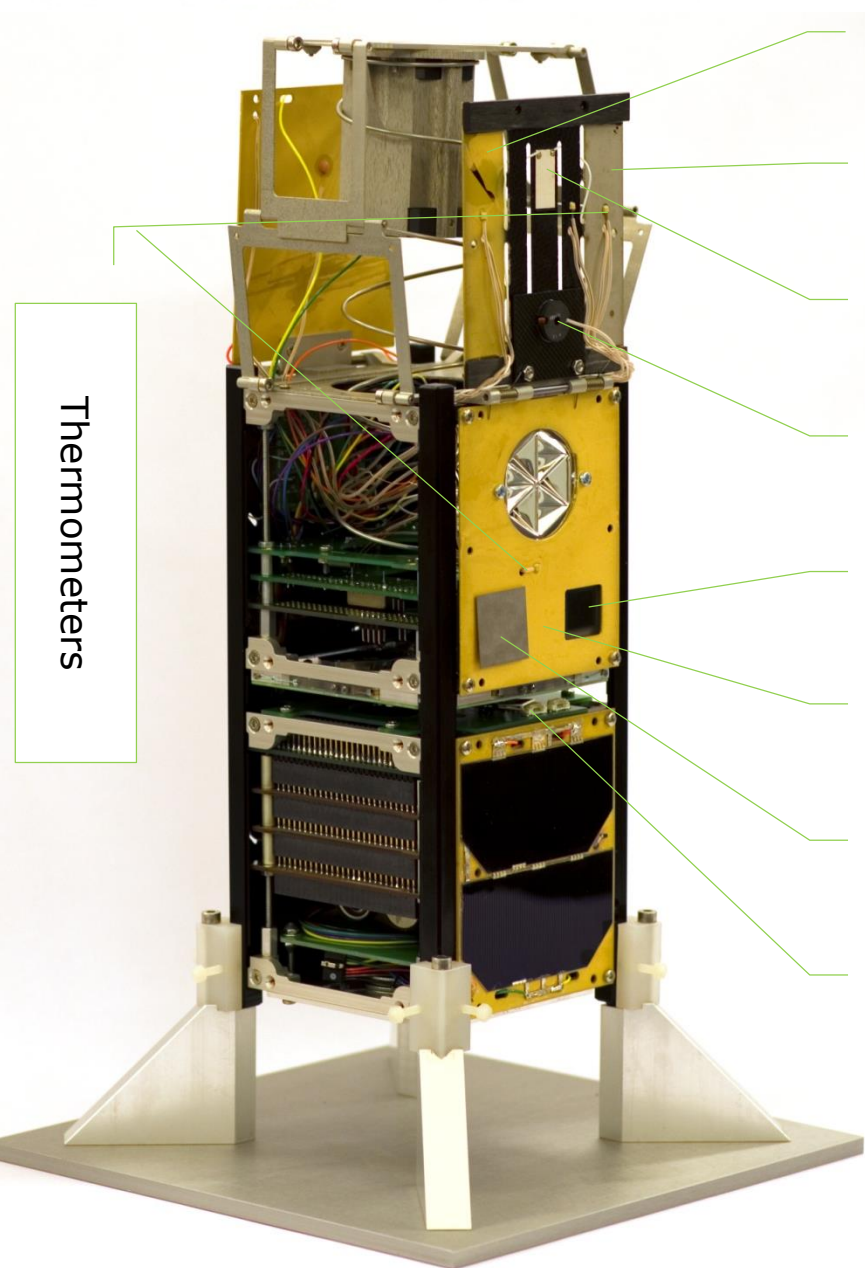
This pixel detectors Timepix for X-rays images in energy range 3-50 keV is used 256×256 pixels and pixel size of 55 microns. Detection area is 14×14 mm².

1D Lobster eye optic (LE) system is used for the soft X-ray region (5 – 20keV) For hard X-ray region above 35 keV behaves as a collimator (Soller slit).

MINIATURIZED X-RAY TELESCOPE INTEGRATION



HM of Radiation hardened composites



Thermometers

Reflexive surface
gold

Reflexive surface
nickel

Piezo for mechanic
oscillation measurement

Coil for mechanic
pulse generation

XRB diode not covered

XRB diode covered
by RHCH

XRB diode covered
by RHCH and tungsten

Volatiles sensors

The Radiation-hardened composite (RHCH) is designed to shield a broad spectrum of energies.

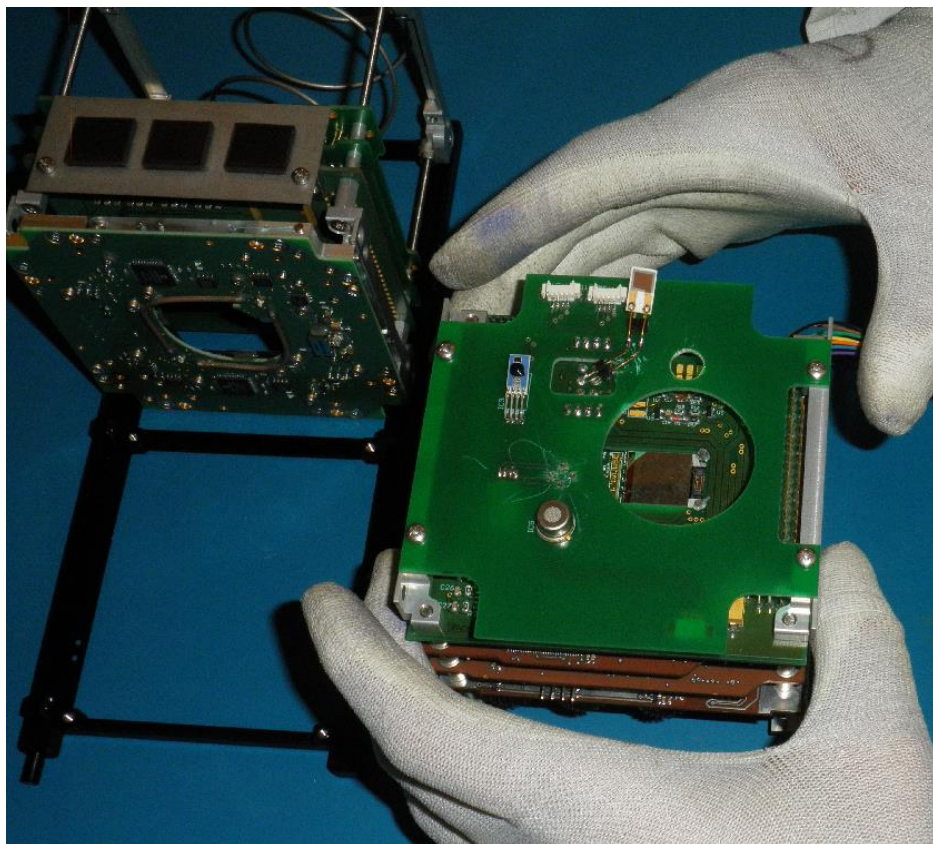
Health monitoring of RHCH is implemented by sensors:

- Temperature (PT1000)
- Volatiles (HYT, HAL2)
- Radiation (XRB diodes)
- Mechanical (piezo)

HEALTH MONITORING SYSTEM



X-ray telescope integration



HKR board, HM board, Measuring board, Antenna board and Volatiles board has hole in the way of optical beam. Except Antenna all board must be in-house designed.



X-RAY TELESCOPE INTEGRATION



Nanosatellite Communication system

Location: Pilsen, Czech Republic
GPS: 49°43'25.778"N,
13°20'58.626"E
LOC: JN69QR
400 m above sea
20 m above terrain
min. el. 5 deg

145 MHz ... MSQUARE cross YAGI
2MCP14 10,2 dBdc
435 MHz ... MSQUARE cross YAGI
436CP30 14,1 dBdc
2400 MHz ... RFHAMDESIGN grid
dish 1,9 m + helix feed



PILSENCUBE GROUND STATION



Nanosatellite Communication system

Radio (145 / 435 / 1200)

... ICOM IC910H

... USRP N-210 for 2400 MHz

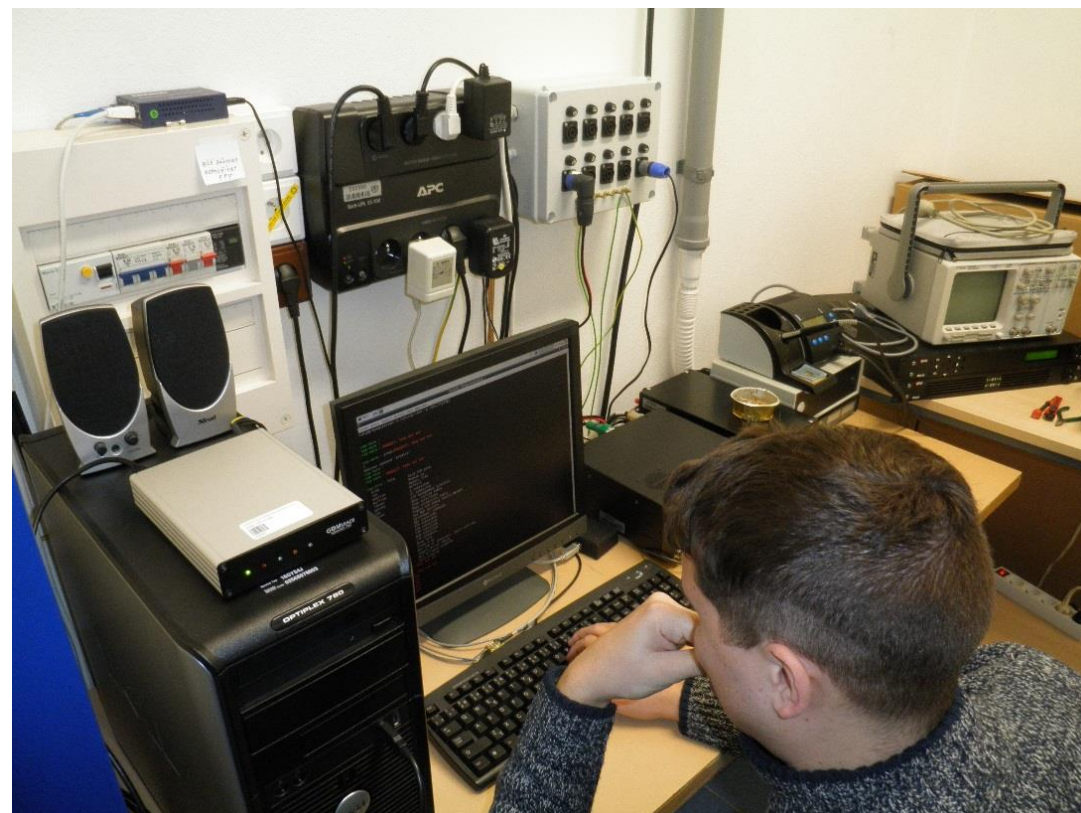
Positioner (azim. + elev.)

... AlfaSpid BigRAS

+ MD-01 extended unit

Other ... UPS, optical network connection, PC, 13,5V PSU

LNAs for 145 / 435 MHz with bypass relay



GROUND STATION EQUIPMENT



Nanosatellite Communication system

Linux Debian 7

Predict / GPredict satellite pass prediction, positioning and Doppler shift compensation

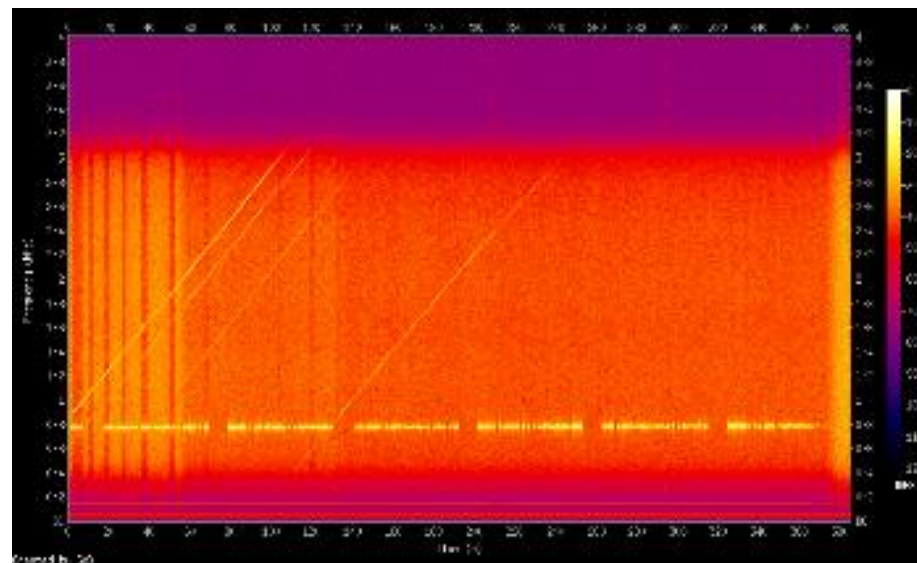
Hamlib interface for positioner and TRX

SoundModem for AX.25

GomSpace NanoCom TNC

Remote control, remote audio, automatic recording and data processing, web and sftp interface

Online camera



GROUND STATION SOFTWARE



Nanosatellite Communication system

Waiting for elevation $>$ min

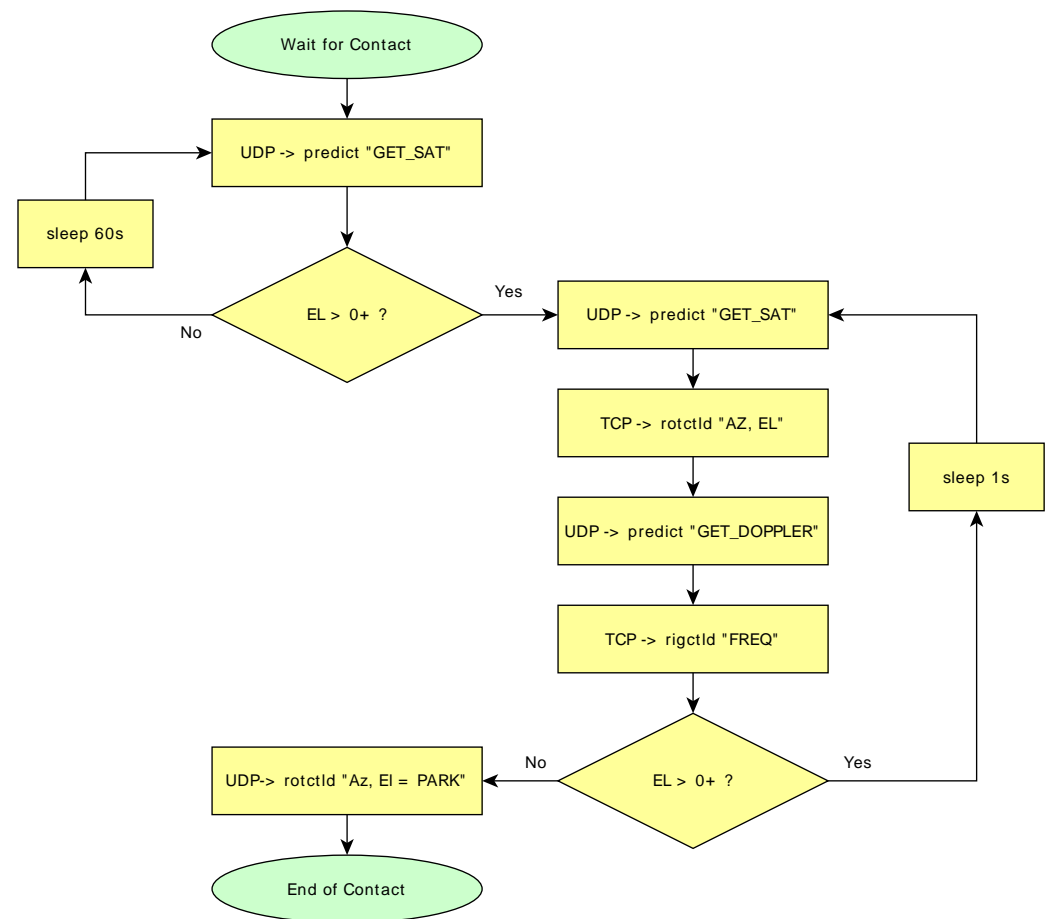
Query the Predict server
Azimuth + Elevation

Set the antenna position

Query the Predict server
Doppler Shift
Calculate the shifted frequency

Set the frequency on TRX

Low elevation $<$ min terminate
the tracking

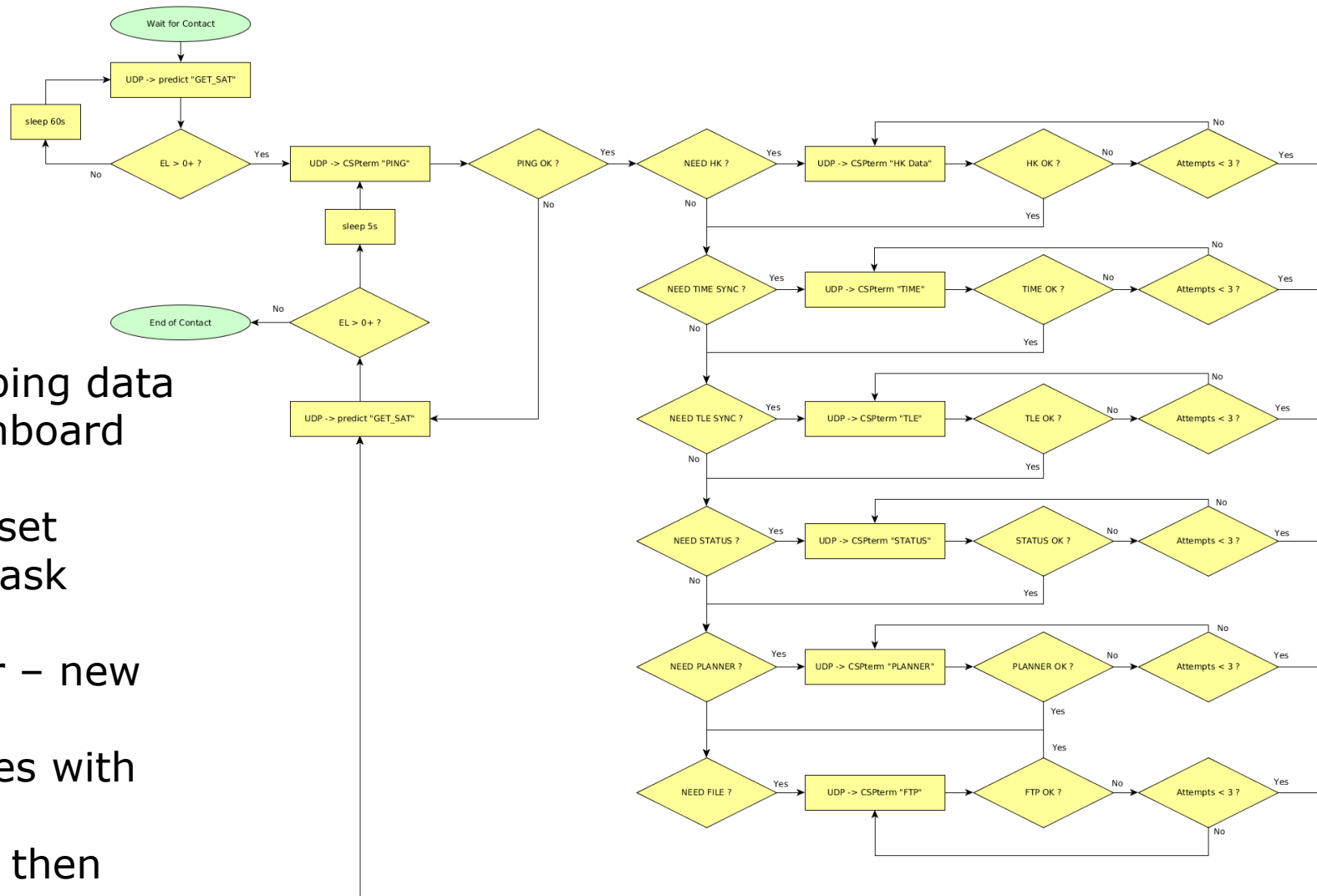


SATELLITE TRACKING ALGORITHM



Nanosatellite Communication system

- Waiting for elevation $> \text{min}$
- Try to contact the satellite using PING
- When succeed, then download data
 - Get the HouseKeeping data
 - Synchronize the onboard time
 - Upload actual TLE set
 - Get the storage / task status
 - Upload the Planner – new task list
 - Download some files with results
- When fail, try 3 times, then return to PING loop
- If the elevation $< \text{min}$, the contact terminates

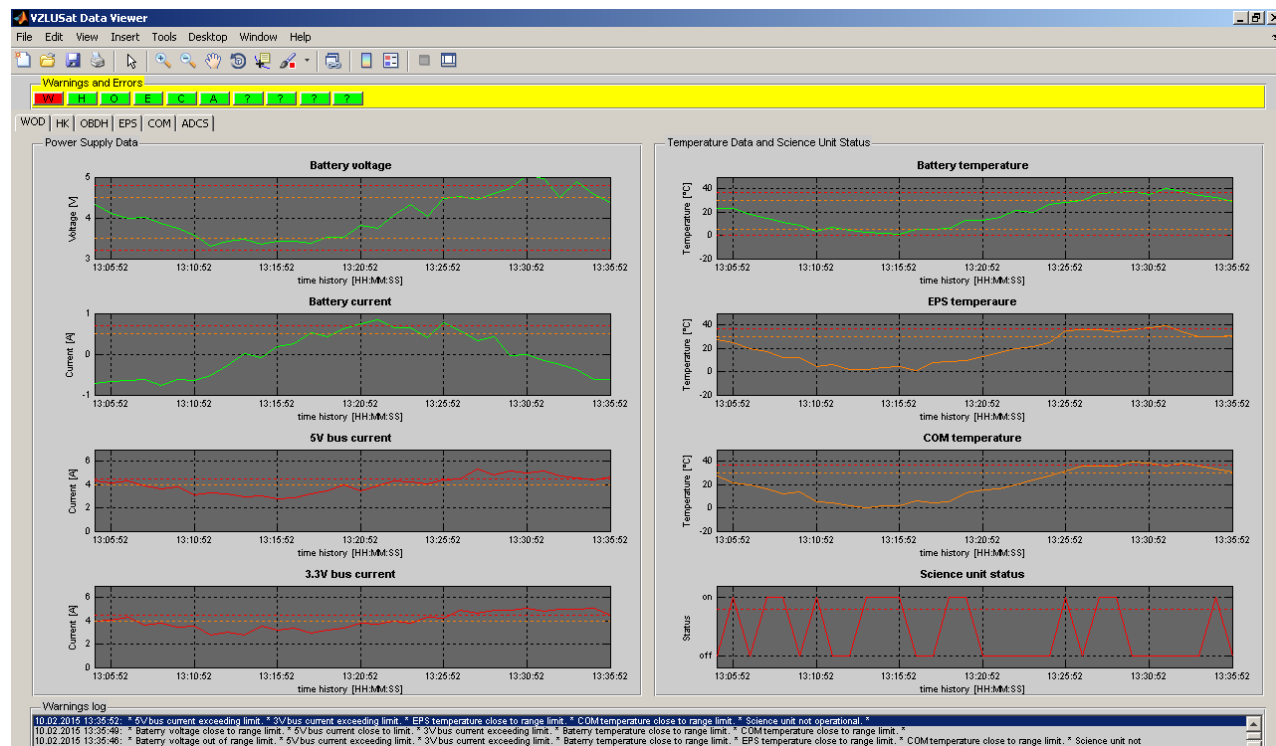


SATELLITE CONTACT ALGORITHM



Nanosatellite Communication system

- Satellite data are downloaded to Database server
- Based on Matlab Graphical User Interface to database server
- Data presented in the form of graphs, tables, statute indicators
- Main window splits to several customized tabs
 - Whole orbit data
 - HouseKeeping data
 - OBDH system data
 - EPS system data
 - COM system data
 - ADCS system data
 - Payloads data
- Automatic checking of data and generating of warnings
- Automatic logging of warnings and errors

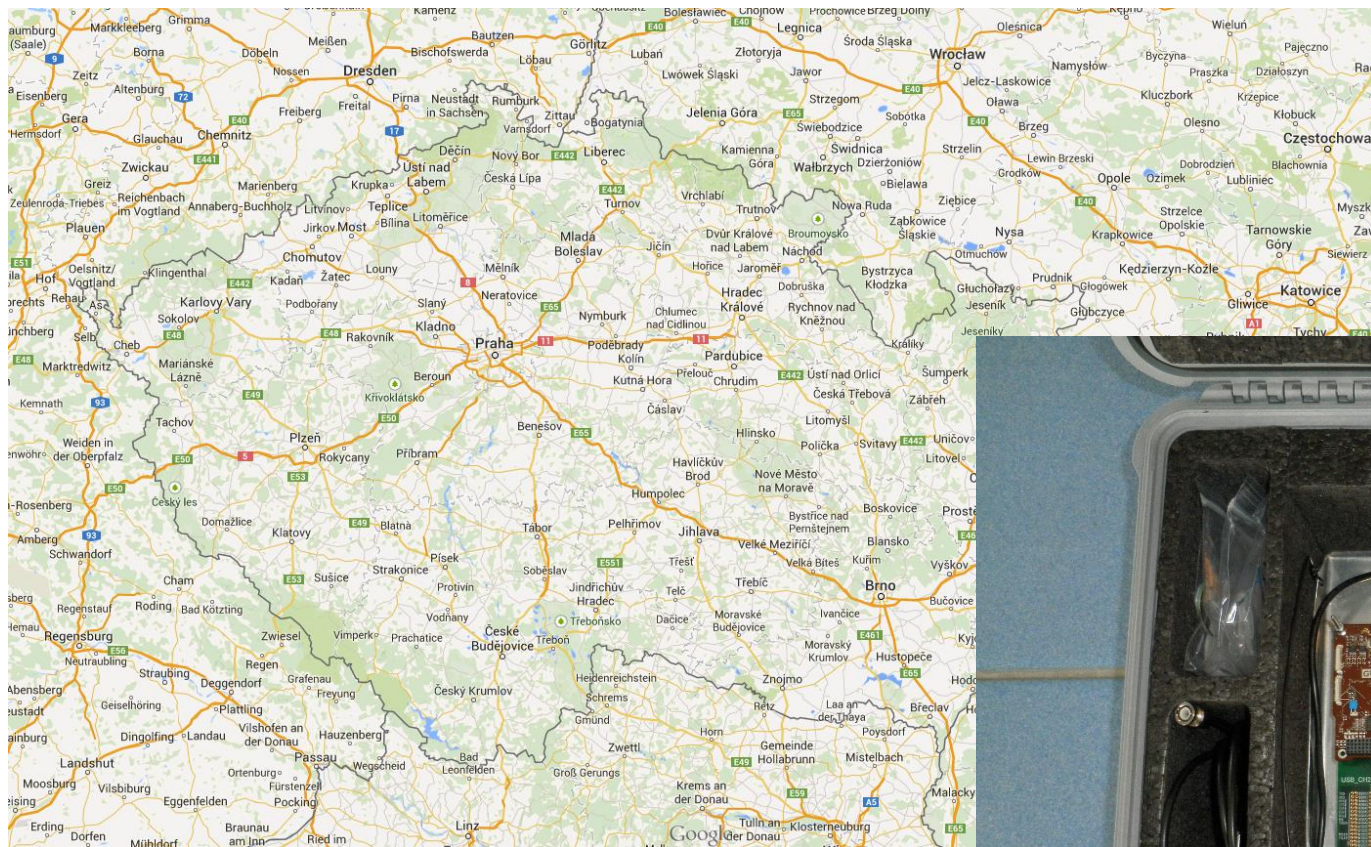


DATA VIEWER

2-4 March 2015
Prague

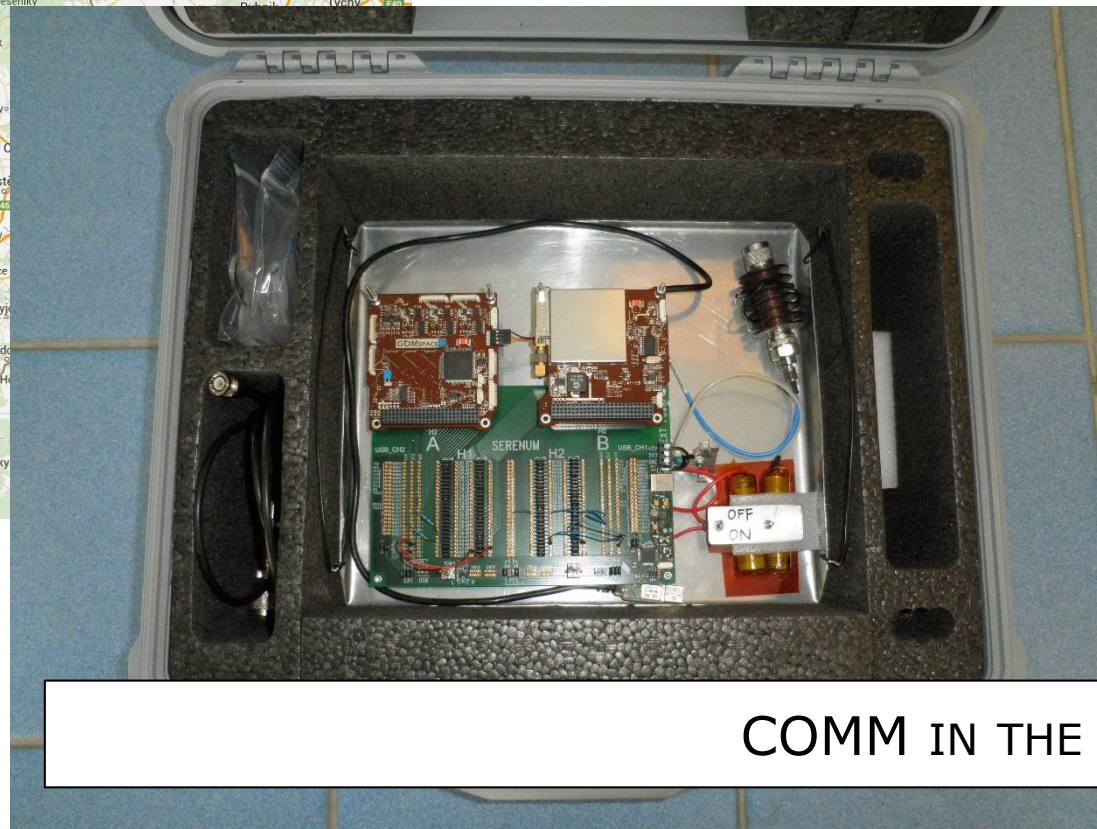


Nanosatellite Communication testing



The VZLUSAT-1 COMM in the case for test simple movement and testing.

The OBC and COMM is integrated with the batteries. Attenuator for antenna is necessary.



COMM IN THE CASE

2-4 March 2015
Prague



Nanosatellite Communication testing



The COMM of the VZLUSAT1 was tested from car for about 10 km successfully.

CAR COMM TEST



Nanosatellite Registration

- VZLUSAT-1 takes part in QB50 mission
- Radiofrequency coordination
 - IARU registration
 - ČTÚ – Czech Telecommunication Office
- Space object registration
 - Statement with regard to legal and regulatory aspects related to the participation in the QB50 Project
 - MD – Czech Ministry of Transportation

30.9.2014

IARU Sat Coordinator



The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

IARU Amateur Satellite Frequency Coordination

TELEFAX

68245



Český telekomunikační úřad
Czech Telecommunication Office

VZLUSAT-1

Supporting Organisation

Contact Person

Headline Details:
qualification and e
Orbit Demonstrati
VZLUSAT1 takes
experiment FIPEX
data.Planning to us
Application
Date:

The IARU Amate

Odesílatel / Sender

ČESKÝ TE

P.O.Box 0;

225 02 Pr

Czech Rep

Telefon / Phon

Telefax

Adresát / Addressee

ČESKÝ TE

P.O.Box 0;

225 02 Pr

Czech Rep

Telefon / Phon

Telefax

Kroky při registraci umělého kosmického tělesa:

- 1) spolupráce s odpovědným subjektem za notifikace vypouštěných umělých kosmických těles (Na základě usnesení vlády č. 326 ze dne 5. května 2014 je k vedení rejstříku kosmických objektů gesčně příslušné Ministerstvo dopravy.)
- 2) Mezinárodní Telekomunikační Unie (ITU) - registrace frekvence před vypuštěním umělého kosmického tělesa za účelem získání licence na využití dané frekvence (více zde: <http://www.itu.int/ITU-R/go/space/en>).
- 3) V případě registrace umělého kosmického tělesa typu CubeSat koordinace užití frekvence s IARU (The International Amateur Radio Union), více zde: <http://www.iaru.org/amateur-radio-satellite-frequency-coordination.html>
- 4) COSPAR (výbor pro kosmický výzkum) - registrace před vypuštěním umělého kosmického tělesa a získání jeho unikátního mezinárodního označení.
- 5) Ministerstvo dopravy notifikuje věcně příslušný úřad OSN o vypuštění umělého kosmického tělesa. Notifikace vyžaduje dodání potřebných orbitálních/letových parametrů umělého kosmického tělesa. Pro forma vyžadovaných parametrů pak zde: <http://www.unoosa.org/docs/misc/reg/regformE1.doc>. Národní rejstřík kosmických objektů je pak pro informaci dostupný zde: <http://www.czechspaceportal.cz/5-sekce/rejstrik-kosmickych-objektu/>.

REGISTRATION

2-4 March 2015

Prague



Thank you for your attention

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