ncube
norwegian student satellite

NCUBE: The first Norwegian Student Satellite

22.05.2009

Participants

Norsk Romsenter
NORWEGIAN SPACE CENTRE

Initiative
Project funding

Andøya Rocket Range
- the cost effective entrance to space

Project management
Support & Test

NAROM

NTNU
Norwegian University of Science and Technology

Payload, Communications System
ADCS, OBDH:
- 8 students

NLH
Norwegian Agricultural University

Payload application
Orbit calculations:
- 6 students

University of Oslo

Mechanical structure, Solar Cells:
- 1 student

Narvik University College

Power Supply, Ground Segment:
- 6 students

Mission

Demonstrate ship traffic monitoring (Automatic Identification System) using a LEO satellite

Demonstrate reindeer herd monitoring from a LEO satellite using the AIS system

Objectives

1. Receive radio signals and telemetry from the satellite

2. Receive AIS-messages from a ship or a reindeer and forward it to the ground station.

3. Perform attitude control of the satellite

4. Allow radio amateurs to use the satellite as a digital repeater for digital packet communications (Digipeater operation)

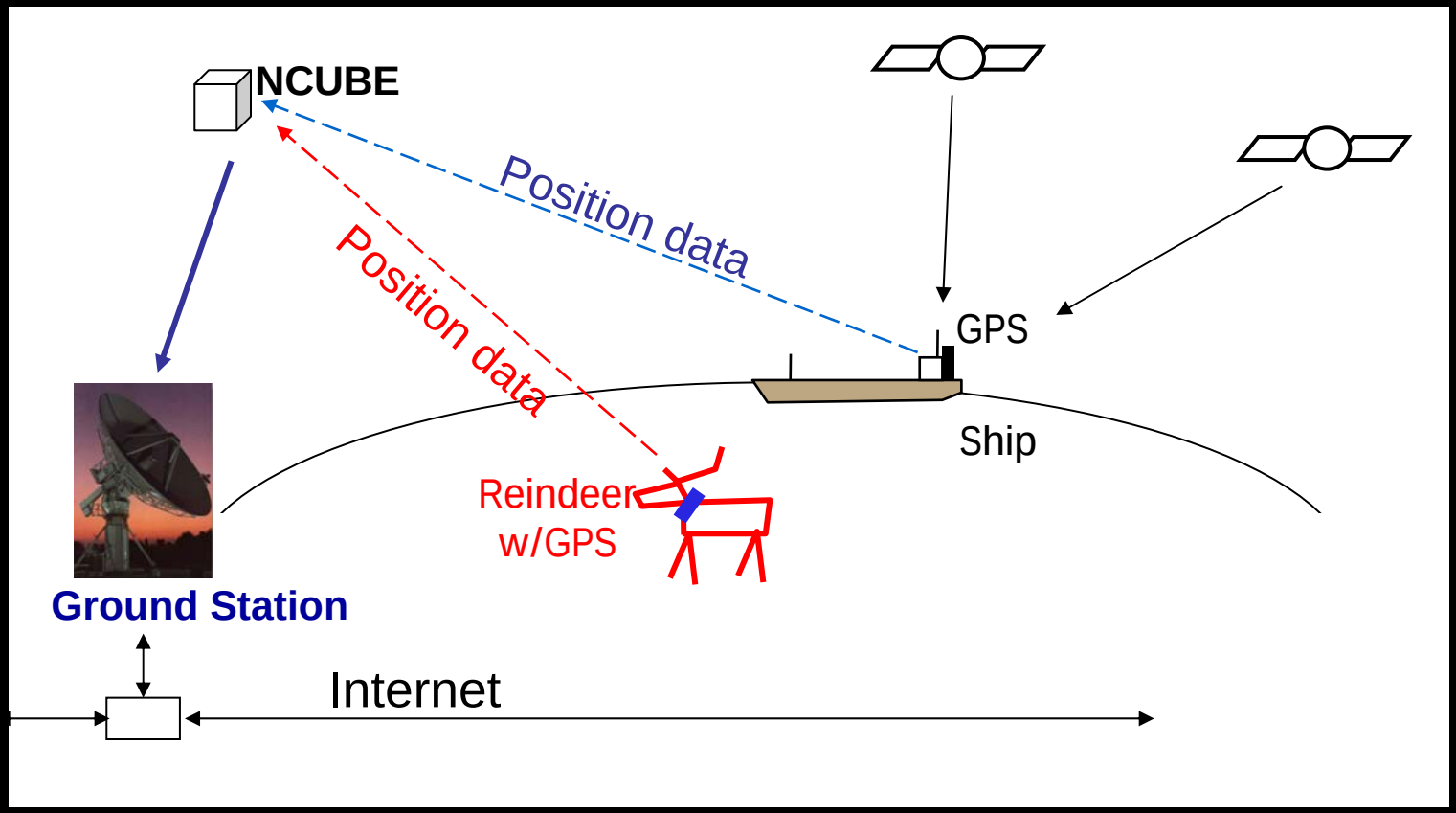
Payload

- AIS: Automatic Identification System
- Maritime information system for data exchange between ships
- Mandatory from 1 July 2002 for ships larger than 300 grt
- The ship broadcasts identity position, course, velocity at regular intervals

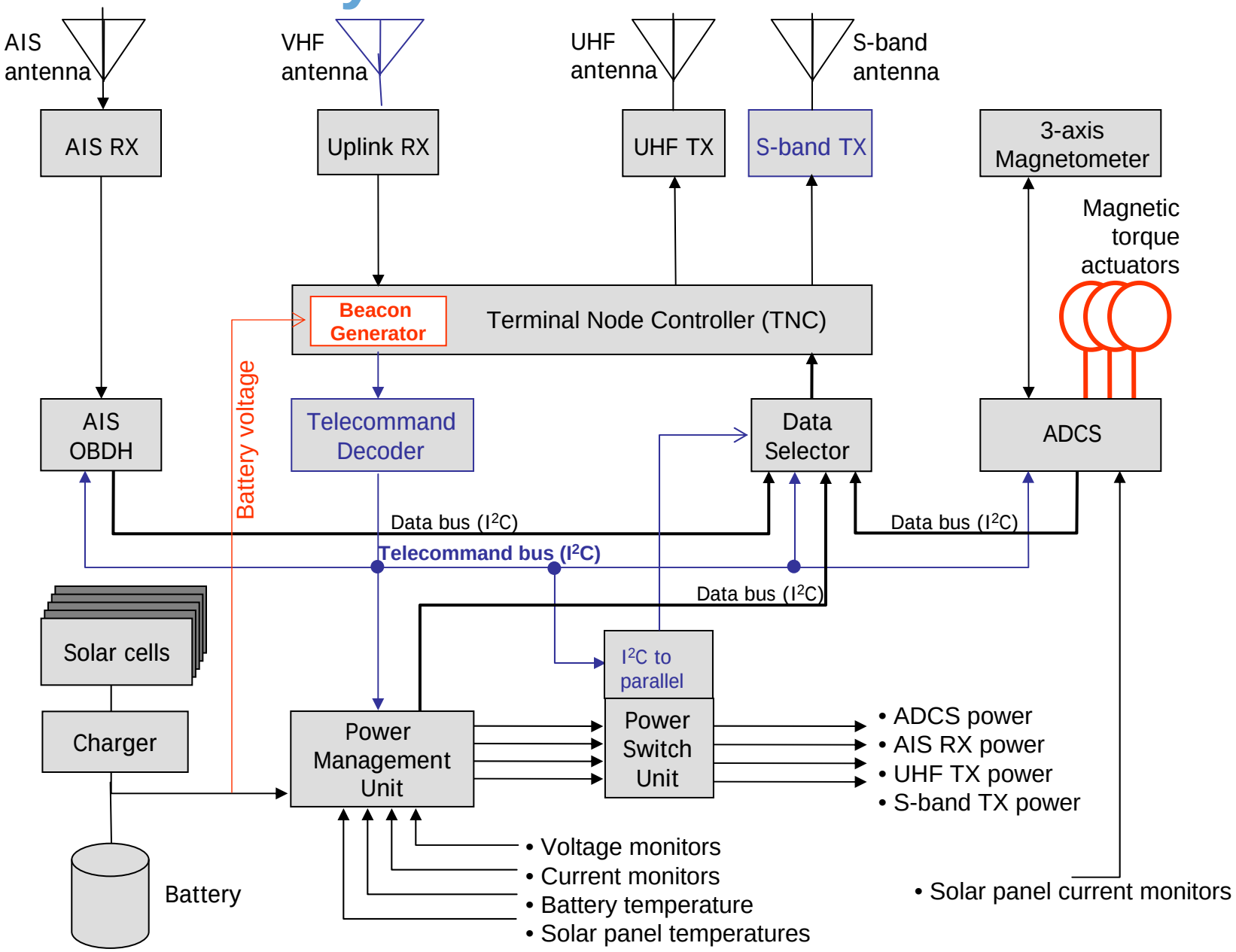
Technical specifications:
- 162 MHz maritime VHF band
- 9600 bps GMSK
- Messages transmitted in 27 milliseconds frames

Payload

- AIS: Automatic Identification System



System Overview



ADCS

Attitude Determination and Control System

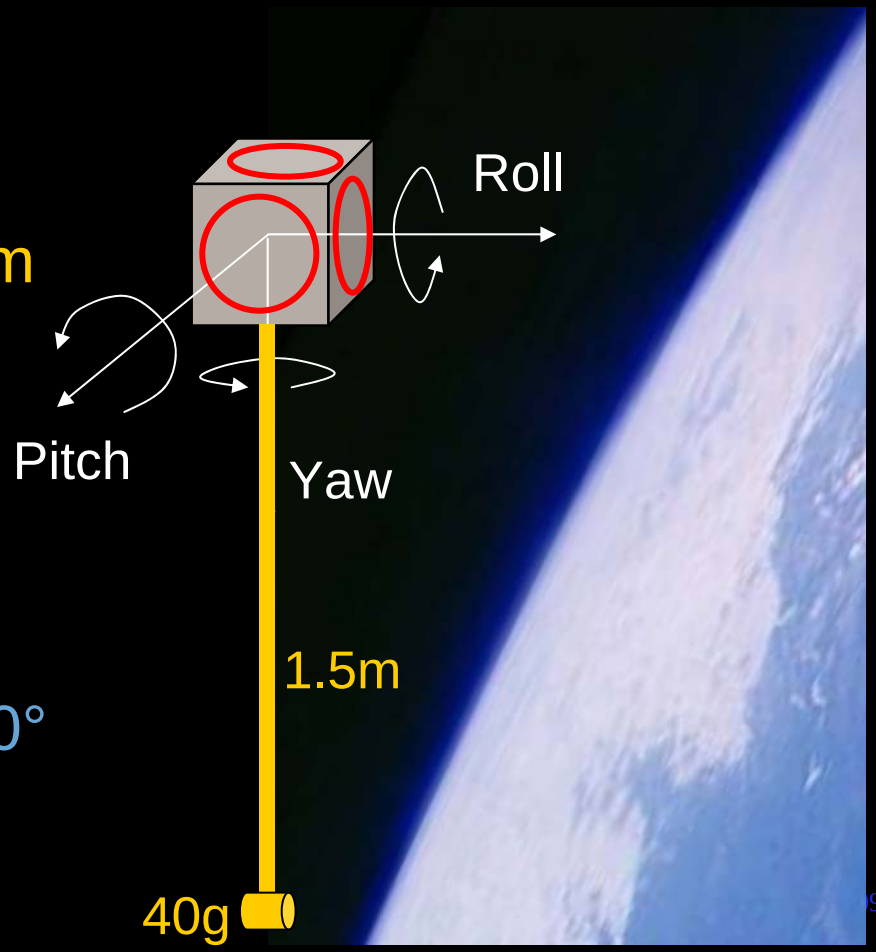
Actuators:

Passive: Gravity gradient boom

Active: Magnetic torque coils

Regulation methods:

- Detumbling
- Stabilize Roll/Pitch within ±10°



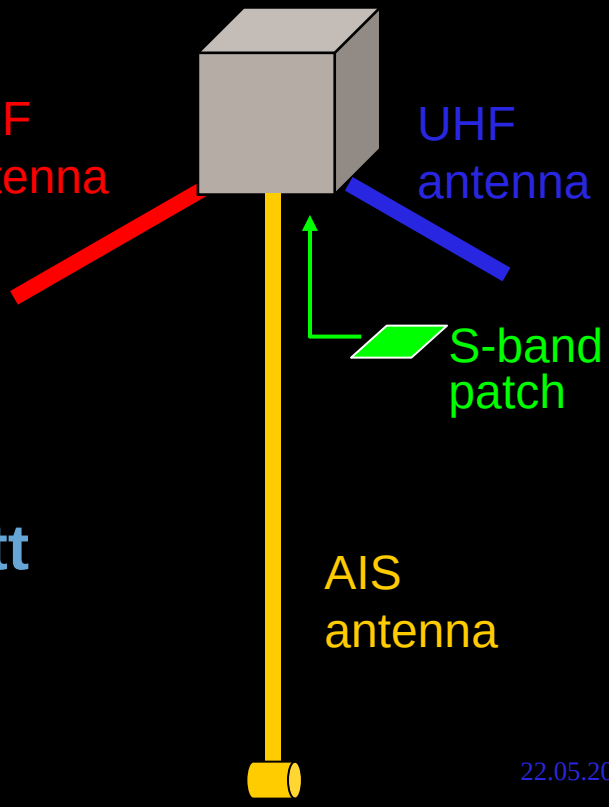
Communications System

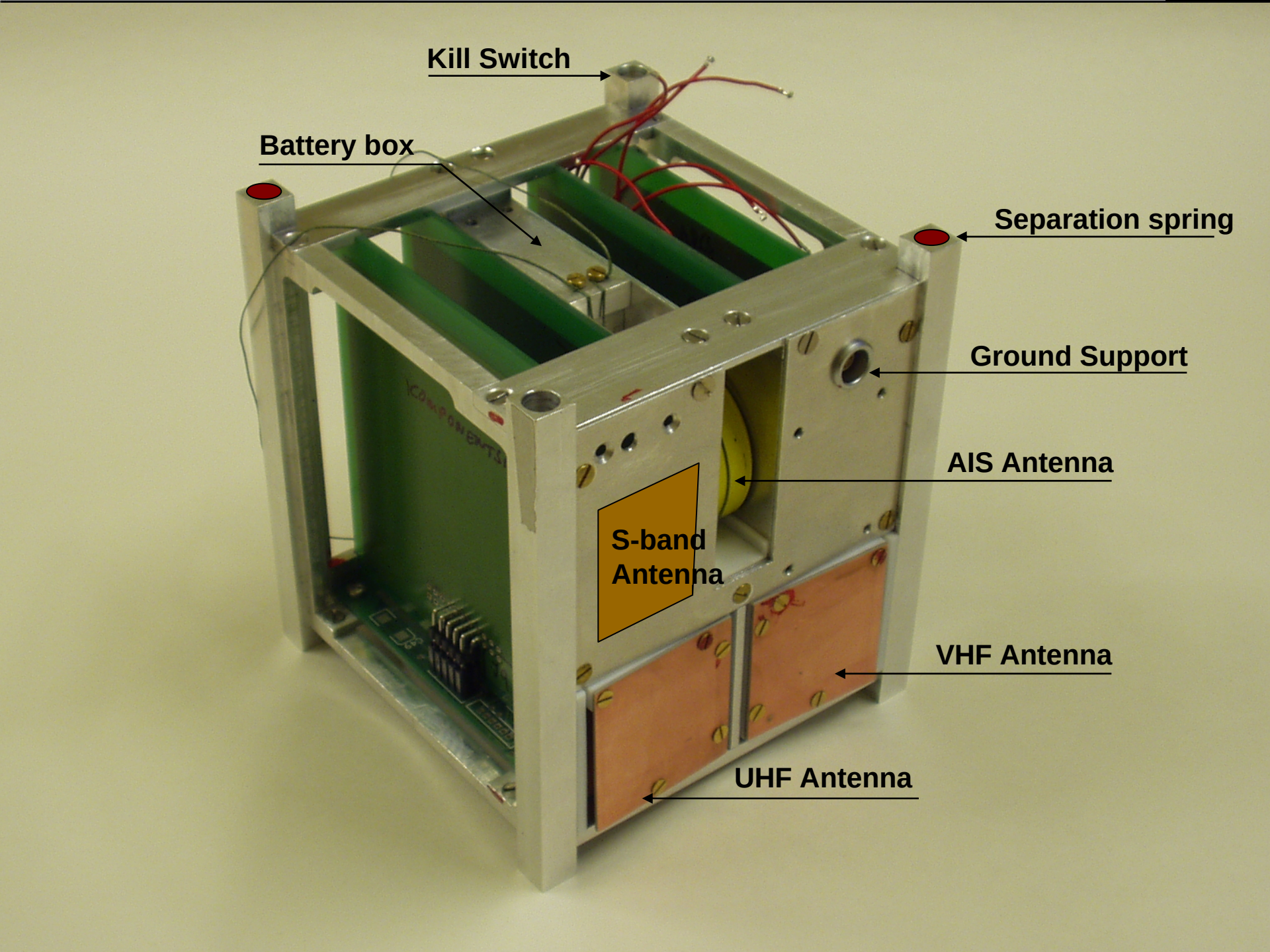
Amateur radio equipment:

Uplink: 145.980 MHz
Downlink: 437.305 MHz
Downlink: 2407.250 MHz

AX.25 protocol: 9600 bps GMSK

Satellite transmitter power: ~0.8 Watt
Antennas: Monopoles (VHF/UHF)
Patch (S-band)




Kill Switch
Battery box
Separation spring
Ground Support
AIS Antenna
S-band Antenna
VHF Antenna
UHF Antenna

Transmitters:

-UHF: 435MHz amateur band

-Homemade

-Output power: ~800mW

-S-band: 2.4GHz amateur band

-Modified telemetry transceiver from ARS

Receivers:

-AIS - 162MHz maritime VHF band

-VHF, 144MHz amateur band

- -Common design eases implementation
- -Double superheterodynes, 10.7MHz and 455kHz IF
- -SA606, PLL and TXCO:
  - -Excellent dynamic range
  - -Ditto frequency stability
  - -Cheap, standard filters.

Why AX.25?

-Large knowledge base worldwide.

-Cheap hardware (Ebay: TNC2, $7).

-Thousands of ground stations worldwide.

-Valuable asset to the amateur radio community.

How?

-Hardware built from scratch.

-Atmel microcontrollers used throughout the design.

-Useful advice and feedback from the amateur community.

AX.25 in a nutshell:

-Data link layer protocol, packet based.

-Flow control, error detection, automatic retransmission of corrupted frames.

-Suitable both for half and full duplex communications.

Ground Station

- LINUX based software
- Internet access via FGN (Federated Ground Station Network)

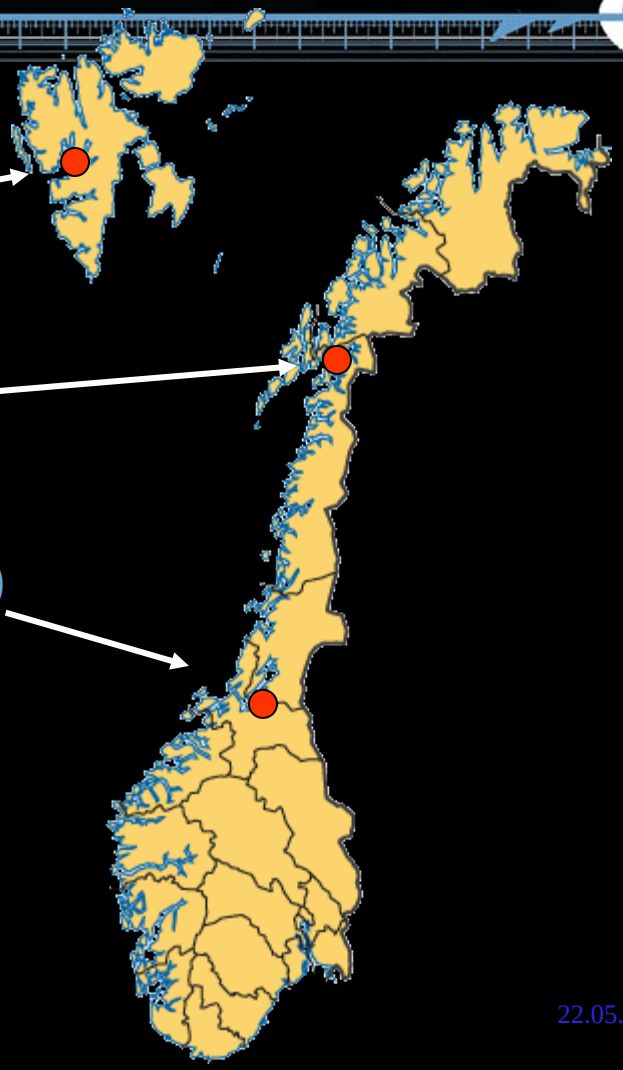
[J. Cutler, Stanford University]

Ground Stations

Svalbard (SvalSat)

Narvik University College

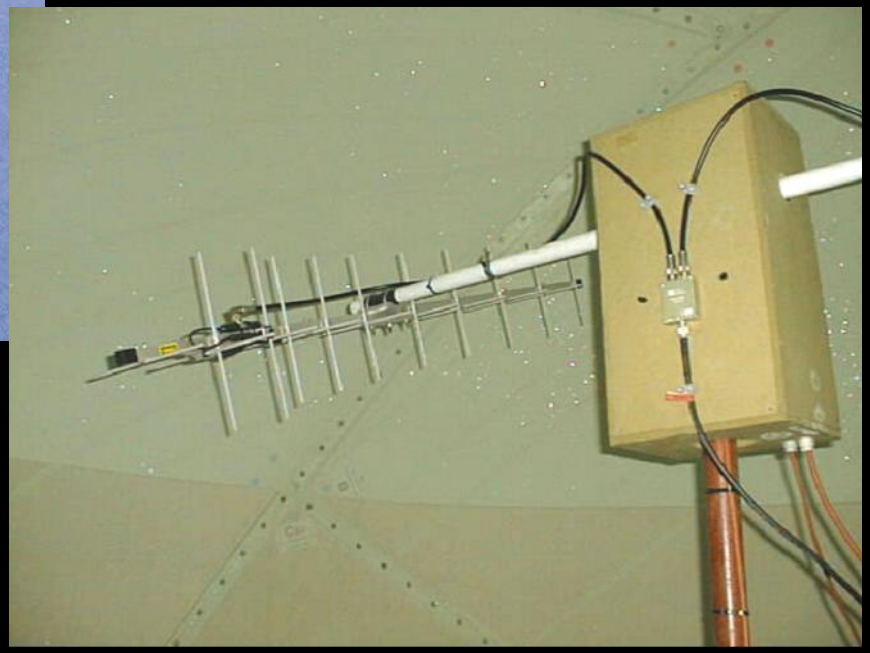
Trondheim, Akademisk Radioklubb (LA1K)



SvalSat

Latitude: 78º N

4 meter radome with antennas and rotator available



Owned and operated by Kongsberg Satellite Services AS, Norway

Supporting Partners

Kongsberg Defence and Aerospace

Kongsberg Seatex

Norwegian Defence Research Establishment

www.thor-satellites.no

Summary

- Project period 2001 - 2005
- Initial phase: 26 students from 4 universities
- Implementation: 16 students from 4 universities
- CubeSat ideally suited for university education
- Support and administration is important
- NCUBE-2 is in preliminary development phase