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ALFRED NOBELS VEJ 21C, 1.
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GOMX-3 Executive Summary

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1 Introduction

1.1 Purpose

The purpose of this document is to make an Executive Summary for the GOMX-3 In-Orbit Demonstration CubeSat Mission.

1.2 Scope

The scope of this document is to give an overview of the design of GOMX-3, and to highlight the results of the GOMX-3 mission.

1.3 Document Overview

Section 1 - Introduction (this section) provides the purpose, scope and this document's overview.

Section 2 - References provides the list of reference documents.

Section 3 - Glossary provides a list of acronyms and terms used throughout this document.

Section 4 – The executive summary

2 References

2.1 Applicable documents

Ref.	Document Title	Issue and Revision, Date
[AD-1]	IOD_CubeSat_ECSS_Eng_Tailoring_Iss_Rev1	26/03/13 Rev. 1

2.2 Reference documents

Ref.	Document Title	Issue and Revision, Date
[RD-1]		

3 Glossary

3.1 Acronyms

Acronyms	Description

3.2 Definition of Terms

Terms	Description

4 Executive Summary for the GOMX-3

4.1 Background

The objective of the GOMX-3 mission was to flight demonstrate a miniaturized technology payload to be carried on a 3-unit CubeSat nano-satellite platform to be deployed from the ISS during the ESA Short Duration Mission in 2015. The payload consists of a reconfigurable software-defined radio receiver operating in L-band, and a new 3-axis attitude determination and control subsystem for robust pointing of directional RF antennas. Additionally, the CubeSat platform shall be flight qualified to tailored ESA standards for CubeSats. The mission shall lead to the maturation of the technology payloads (reconfigurable SDR and 3-axis ADCS system) to high Technology Readiness Levels (TRL) such that they may be used in future missions with a lower technical risk.

The mission of the GOMX-3 satellite is to capitalize on a 2015 ISS launch opportunity by demonstrating advanced pointing while receiving both L-band and ADS-B signals.

In addition a X-Band transmitter from Syrlinks was integrated in order to test the transmitter over the ground stations in Kourou and Toulouse.

4.2 The timeline of the project.

The project was divided in 2 contracts

1. A contract for Phase A-C.
2. A contract for Phase D-F.

In Figure 1 the main milestones is the full project is shown.

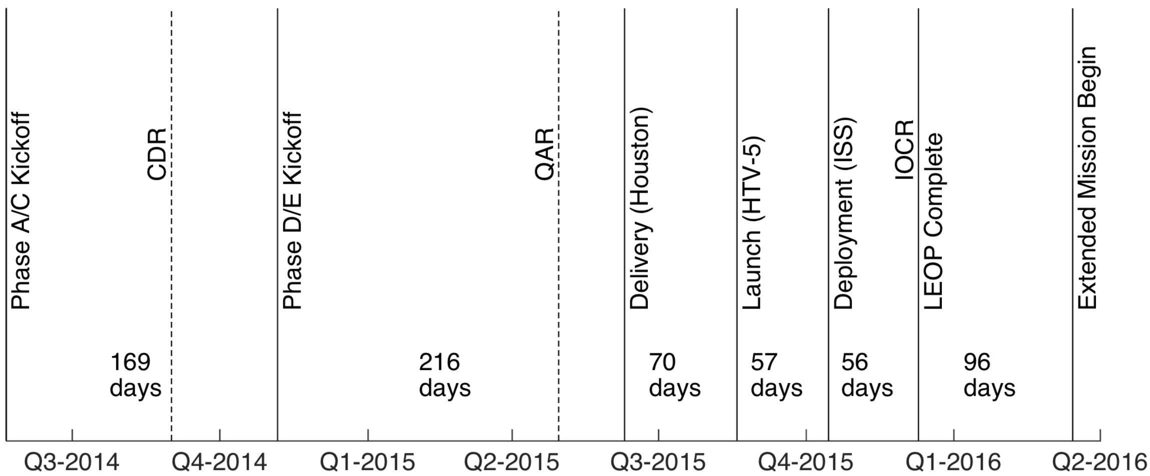

Figure 1 Overview of main milestones in GOMX-3

As it can be seen in Figure 1 the project had a very tight schedule with only 1 year from project kick off to the delivery of the FM.

The actual mission was commenced at the launch from ISS on the 5th of October 2015, and the mission was completed by the 7th of March 2016. GOMX-3 is expected to de-orbit in Q3 2016. The possibility to extent the mission by adding further in-orbit test is being investigated.

4.3 GOMX-3 Design

GOMX-3 is a 3 unit cubesat, which mean that the size 10cmx10cmx30cm. The overall desiogn can be into 4 main functions, which are:

- The cubesat bus sub systems.

- ADCS subsystems.
- Payload for the mission.
- X-Band payload. The X-band payload is an additional 3rd party payload.

A more detailed overview of the different subsystem can be seen in Figure 2.

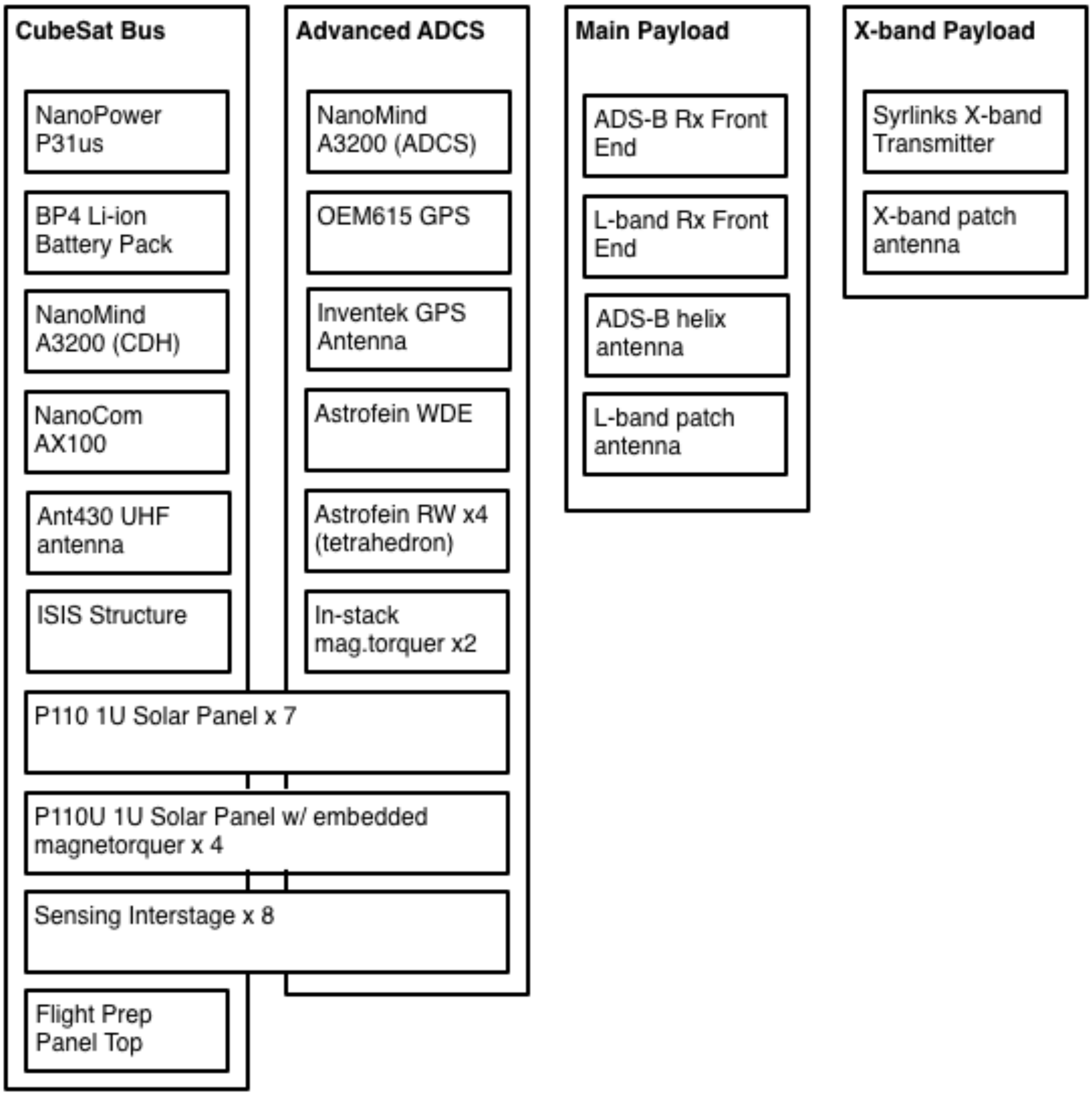

Figure 2 Sub system overview.

A block diagram shown the overall design of GOMX-3 can be seen in Figure 3.

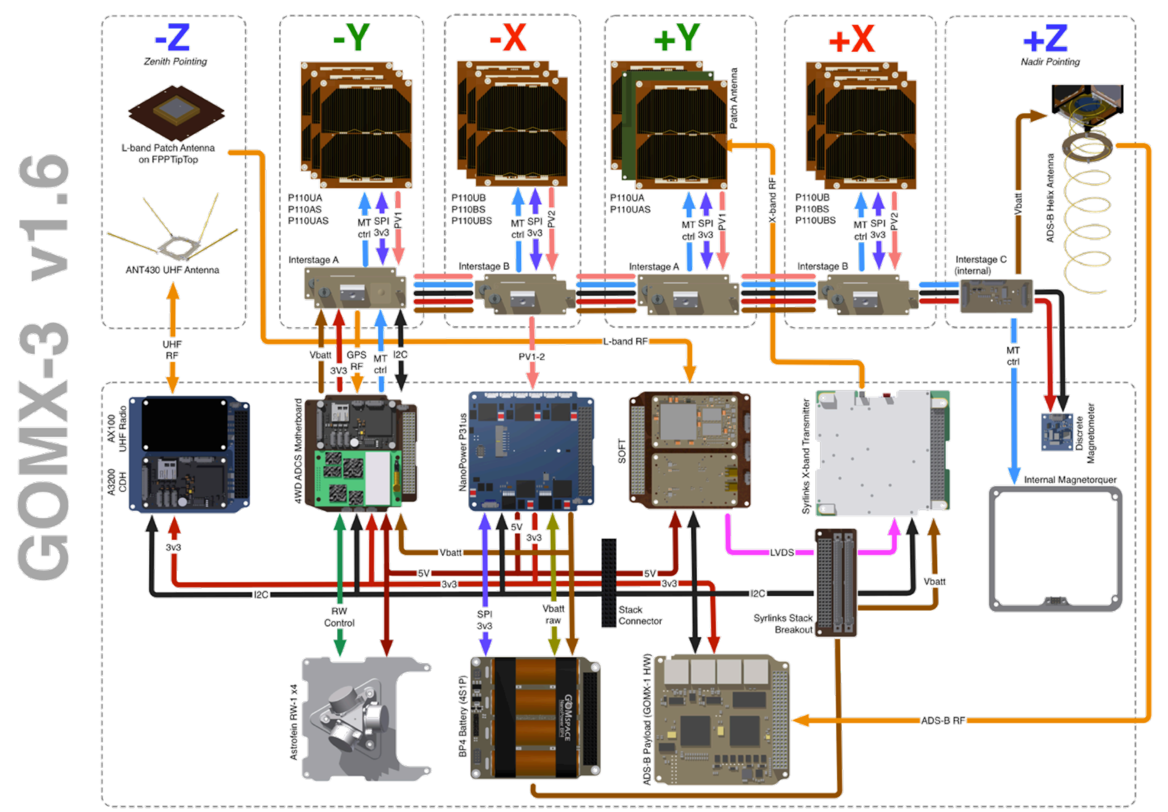

Figure 3 Block diagram showing the GOMX-3 design

4.3.1 ADCS performance

The ADCS performance on GOMX-3 is a pre-condition for the performance of the other payloads on-board.

The ADCS configuration consists of:

- The ADCS motherboard with GPS plug-in and on-board:
- Magnetometer
- Rate-gyros
- Coarse sun-sensors integrated on solar panels
- GomSpace digital fine sun sensors (0.5 degree accuracy, 120 degree FOV)
- Coarse IR sensors for horizon tracking while in eclipse
- Reaction wheel assembly from AstroFein
- Magnetorquers integrated in solar panels

The main ADCS requirement is a pointing accuracy of 2 degrees. An example of the measured quaternion alignment error when pointing Nadir can be seen in Figure 4. As can be seen in the figure the ADCS fulfils the requirement of a pointing accuracy of 2 degress.

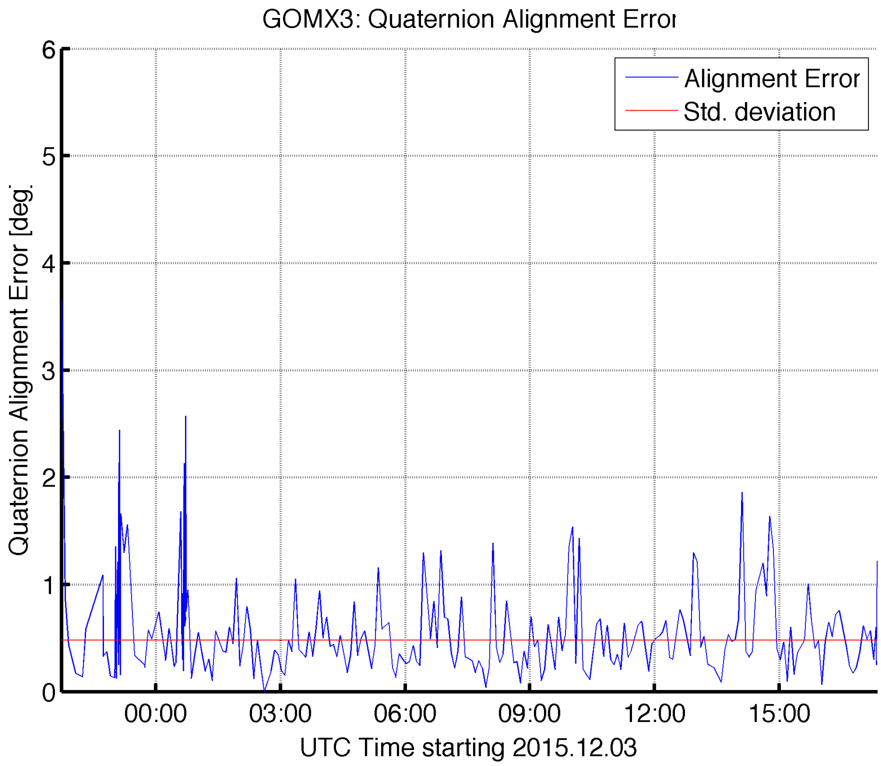

Figure 4 Quaternion Alignment Errors.

During the mission the ADCS Demonstrated its Capability within:

- Detumbling
- 3-axis pointing
- On-orbit calibration
- On-orbit software upload
- Momentum dumping
- Nadir Pointing
- Ram Pointing
- ECEF Tracking
  - Earth Ground Station (Kourou)
  - Earth Ground Station (Toulouse)
  - Geostationary Satellite (Inmarsat 3F2)

4.3.2 ADS-B Payload results

Based on the results of the GOMX-1 mission a number of potential improvements to the signal pre-processing and decoding algorithms have been included in the ADS-B payload.

On day 2 in the LEOP phase the SDS-B antenna was deployed and the ADS-B payload was activated. Immediately after the payload was activated the first ADS-B signals were recorded. During the mission millions of ADS-B signals have recorded. In Figure 5 an example of aeroplane positions recorded by the ADS-B payload can be seen.

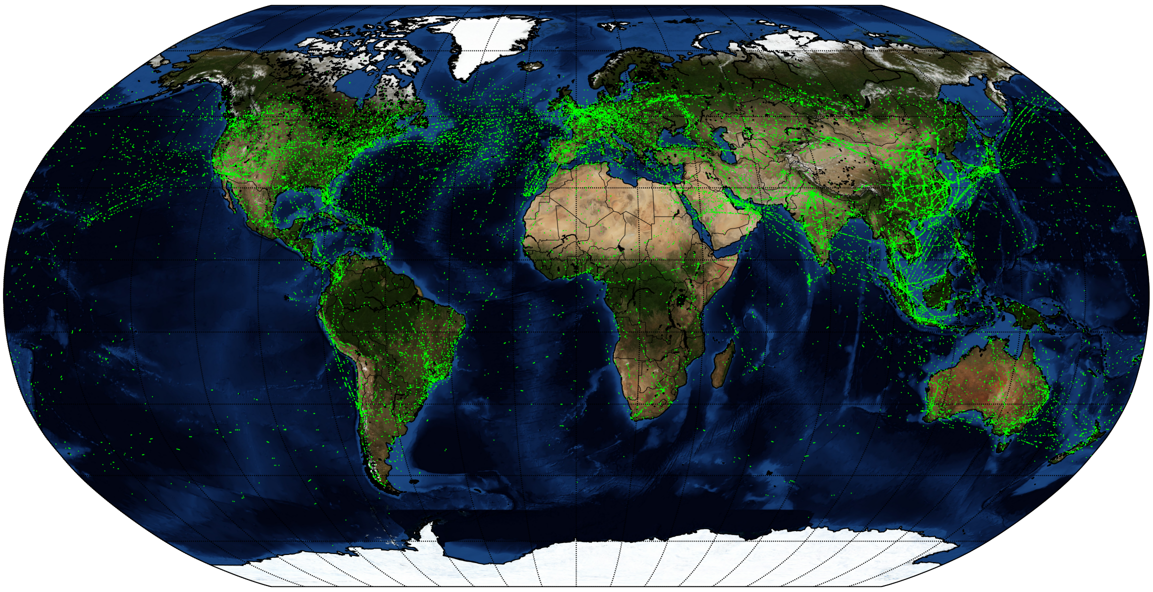

Figure 5 Example of Aeroplane positions recorded by the ADS-B payload.

A test has been performed over New Zealand in cooperation with Airways New Zealand. The purpose of the test was to verify if all known aeroplanes in an area during a pass of GOMX-3 was captured. The conclusion was that all planes during the test where recorded.

4.3.3 Spot-Beam Characterization in L-Band

The purpose of the L-Band payload is to verify the possibility to record the spectrum of an Inmarsat satellite while tracking the satellite. During the test the spectrum of the BGAN signal was recorded. In Figure 6 an example a spectrum monitoring during an orbit is shown.

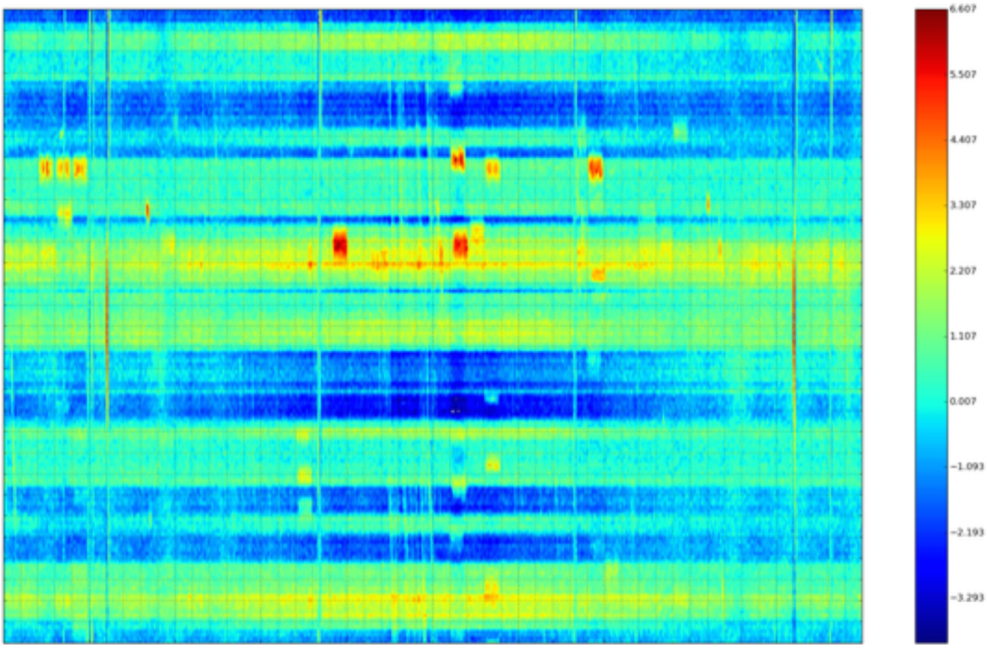

Figure 6 Example of spectrum monitoring results during an orbit.

4.3.4 X-Band payload.

The X-band transmitter from Syrlinks was included in the GOMX-3 S/C as a 3rd party payload. The X-Band transmitter was tested on 2 different ground stations (Kourou & Toulouse). The test was performed be sending a known test file from the X-Band transmitter.

The test over Kourou was done during 7 passes, and the signal was weaker than expected. During a typical pass only a few good frames and bad frames where received. The conclusion of the test over Kourou is the antenna beam is too narrow. This combined with a TLE that was not precise enough gave a too weak signal during this test.

The test over Toulouse was tested with an antenna with a wider beam with, and this test was very successful. During a pass the following results where obtained:

- The signal power was [-16;-23]dBm.
- The number of good frames where 89150 and the number of bad frames where 32.
- In total 115,5 MB was received during the pass.