

# **NEMO-HD – High-Definition Video and Multispectral Imaging in a Small Package**

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# Mission Overview

- Mission objectives
  - responsive multi-spectral imaging
  - real-time control
- Organizations
  - bus design and payload by SFL
  - experimental technologies by SPACE-SI
    - secondary X-band transmitter
    - image processing pipeline
    - real-time interactive ACS

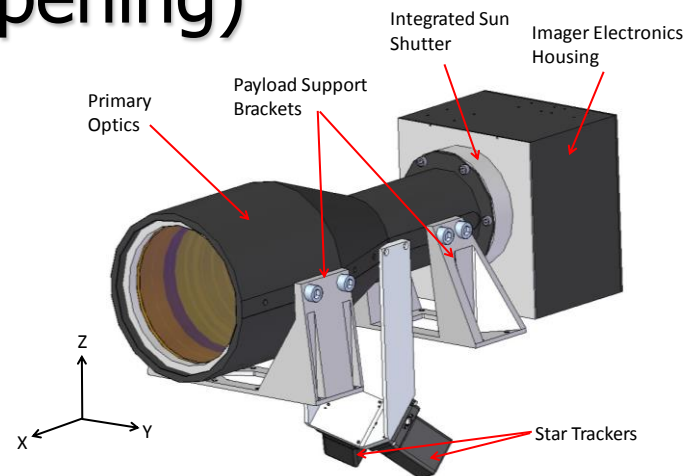


# Primary Payload

Primary instrument – high-resolution imaging

- fast 155 mm f/2.3 optics
- 300 lp/mm resolution at focal plane
- 5 still channels (with pan sharpening)

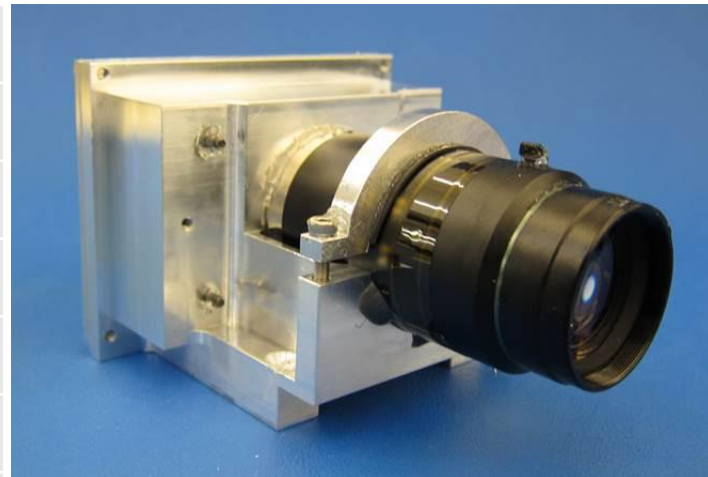
Channel	Band (nm)	GSD	Swath
PAN	400 – 900	2.8 m	10 km
Blue	420 – 520	5.8 m	
Green	535 – 607	5.8 m	
Red	634 – 686	5.8 m	
Near-IR	750 – 960	5.8 m	



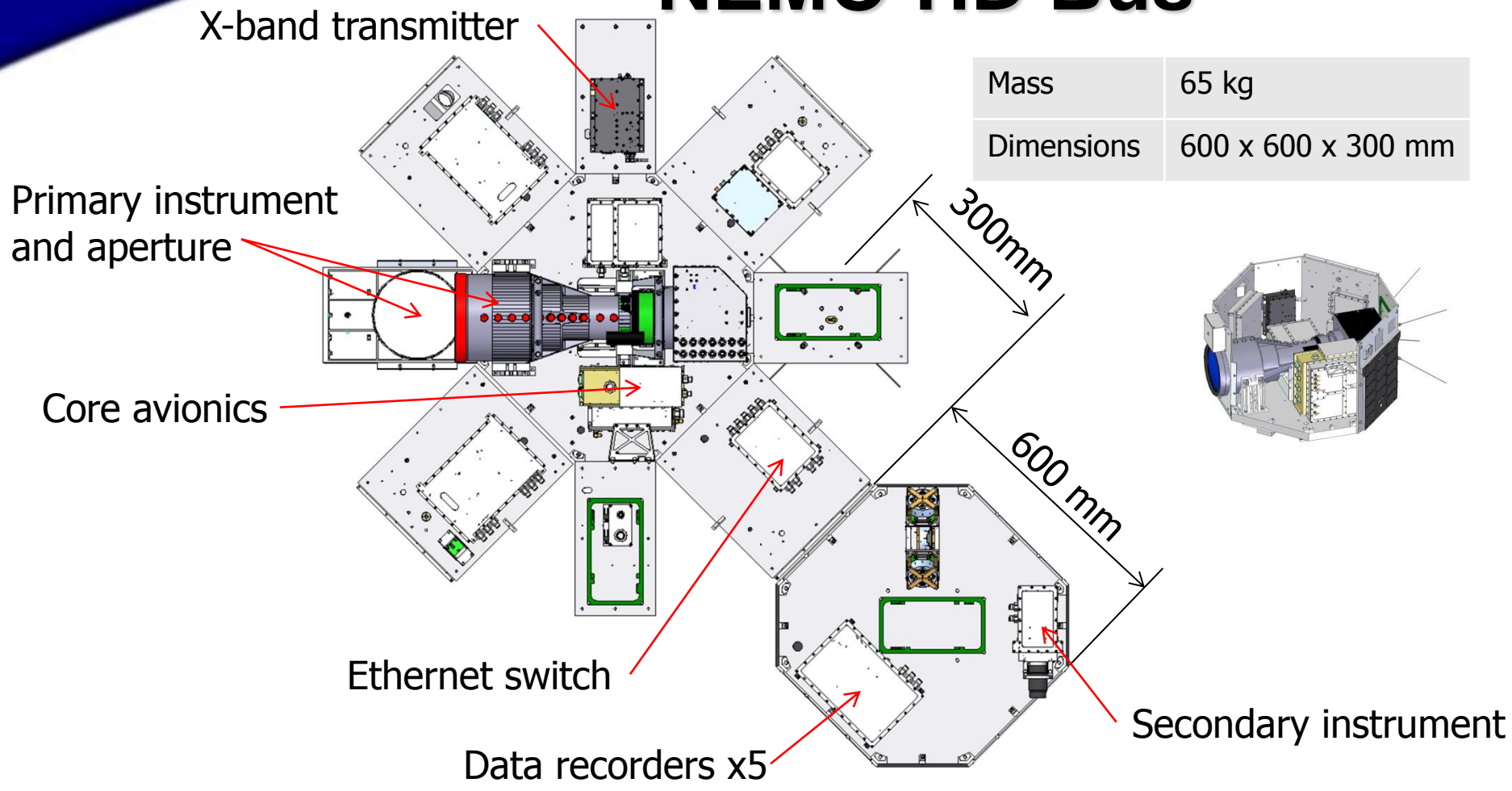
# Video Payload

- High-resolution video shares primary optics
- Secondary video for wide-angle context
- Dual real-time or recorded video streams

	<b>Primary</b>	<b>Secondary</b>
GSD	2.8 m	40 m
Swath	5.4 km	76.8 km
Resolution (pixels)	1920 x 1080 (full HD)	
Encoding	H.264	
Data rate	Up to 25 Mb/s per channel	
Chroma	RGB (PAN pass-band)	

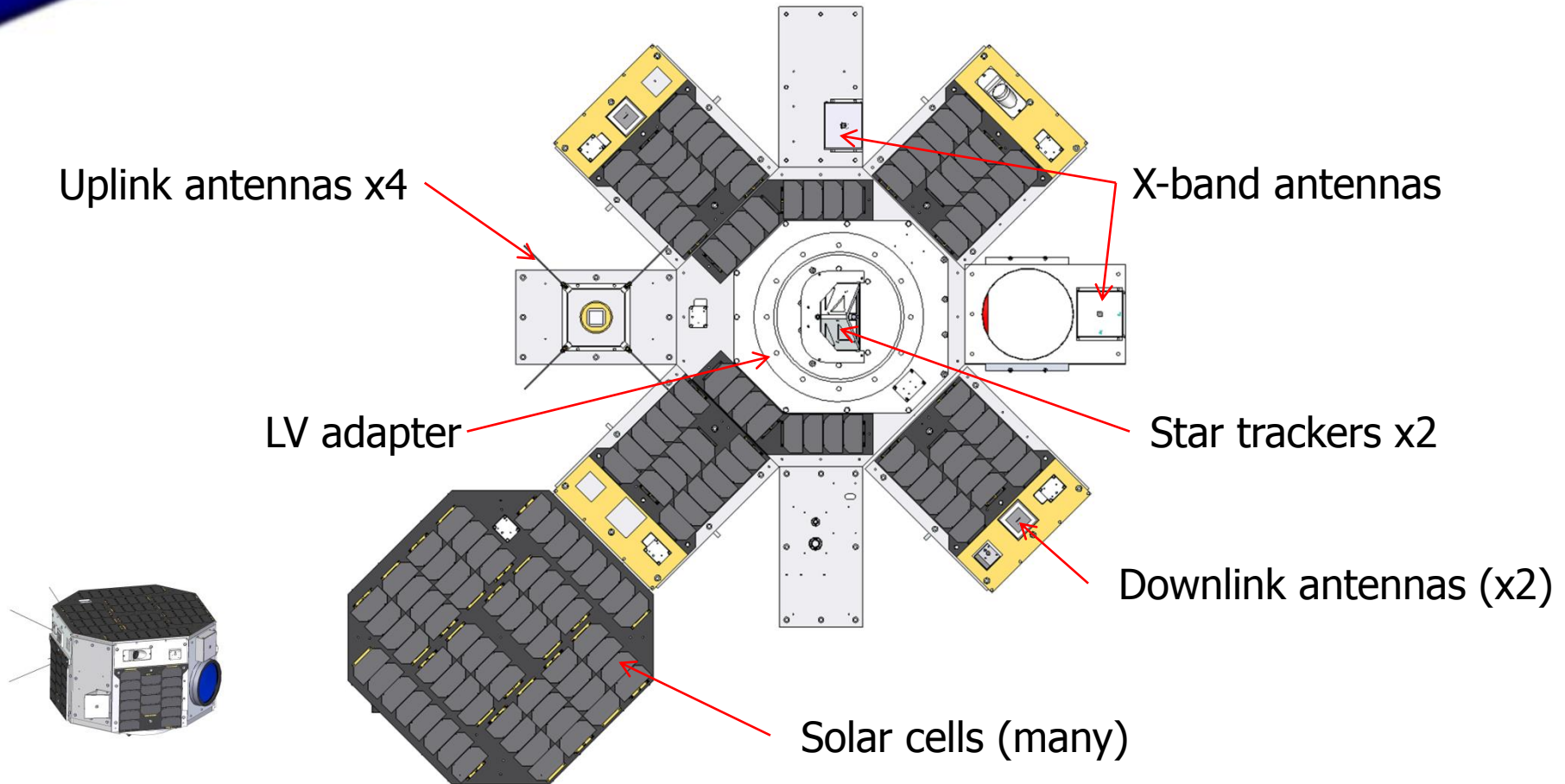


# NEMO-HD Bus



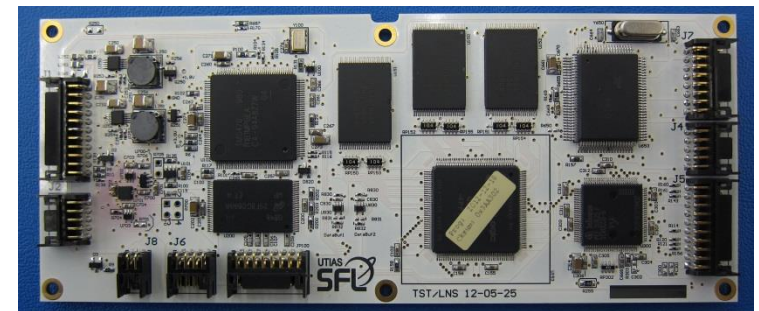
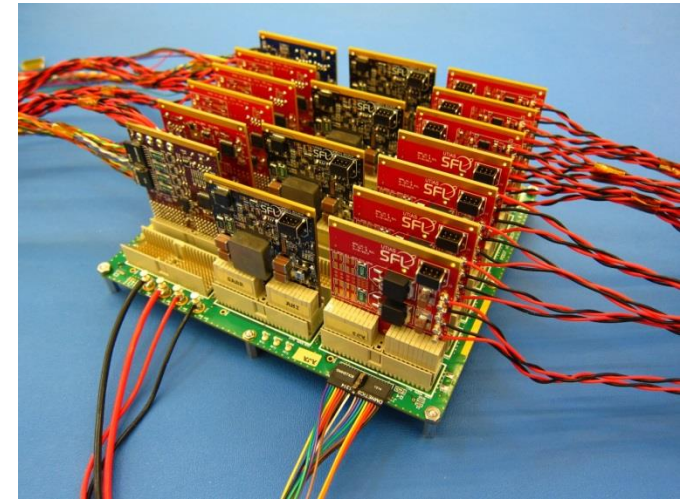


# NEMO-HD Bus



# NEMO-HD Power, C&DH

- Modular Power System
  - 5 W keep-alive
  - 215 W peak
  - (not shown) 5.8 Ah battery
- Housekeeping and Attitude Computers
  - SFL flight heritage
  - some cross-strapping for redundancy

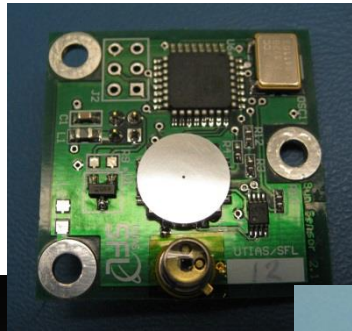


# NEMO-HD ADCS

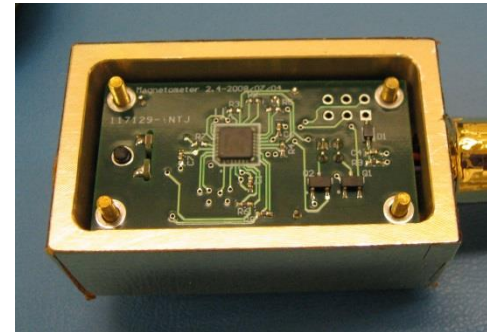
Star trackers



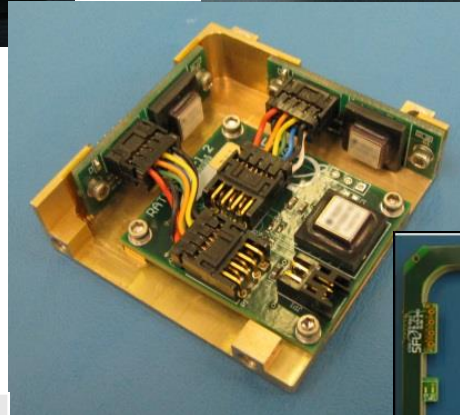
Sun sensors



Magnetometer

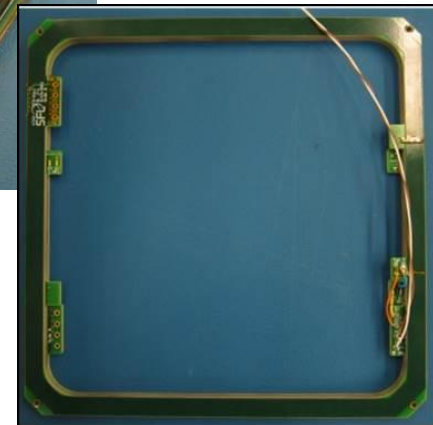


Reaction wheels



Rate sensor

Magnetic torquer



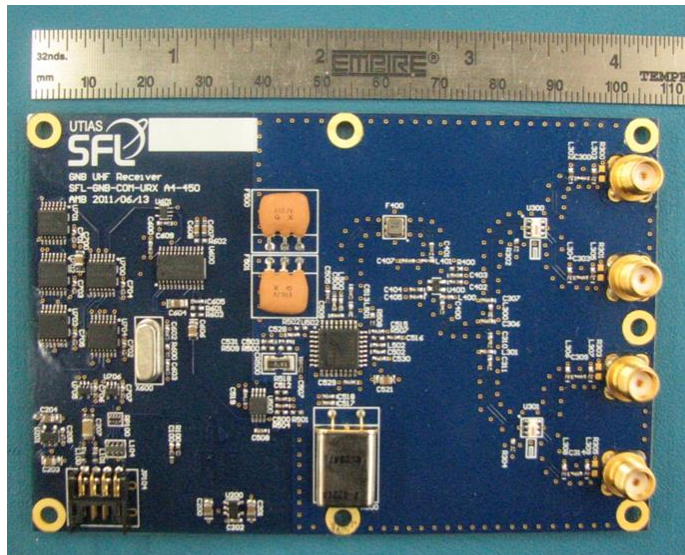
Determination	Pointing	Slew rates
< 15" 1- $\sigma$	< 120" 2- $\sigma$	1.5 °/s

*Wheel, star tracker photos courtesy of Sinclair Interplanetary*



# NEMO-HD T&C

UHF receiver



S-band transmitter



Uplink	UHF	4 kb/s
T&C downlink	S-band	up to 1 Mb/s
Payload downlink	X-band	50 Mb/s



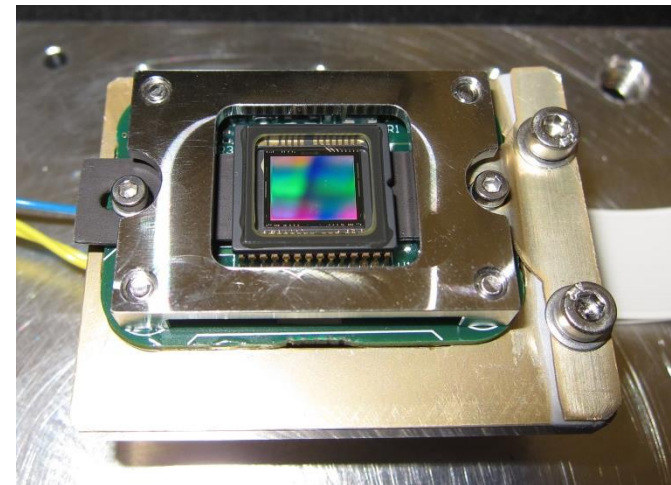
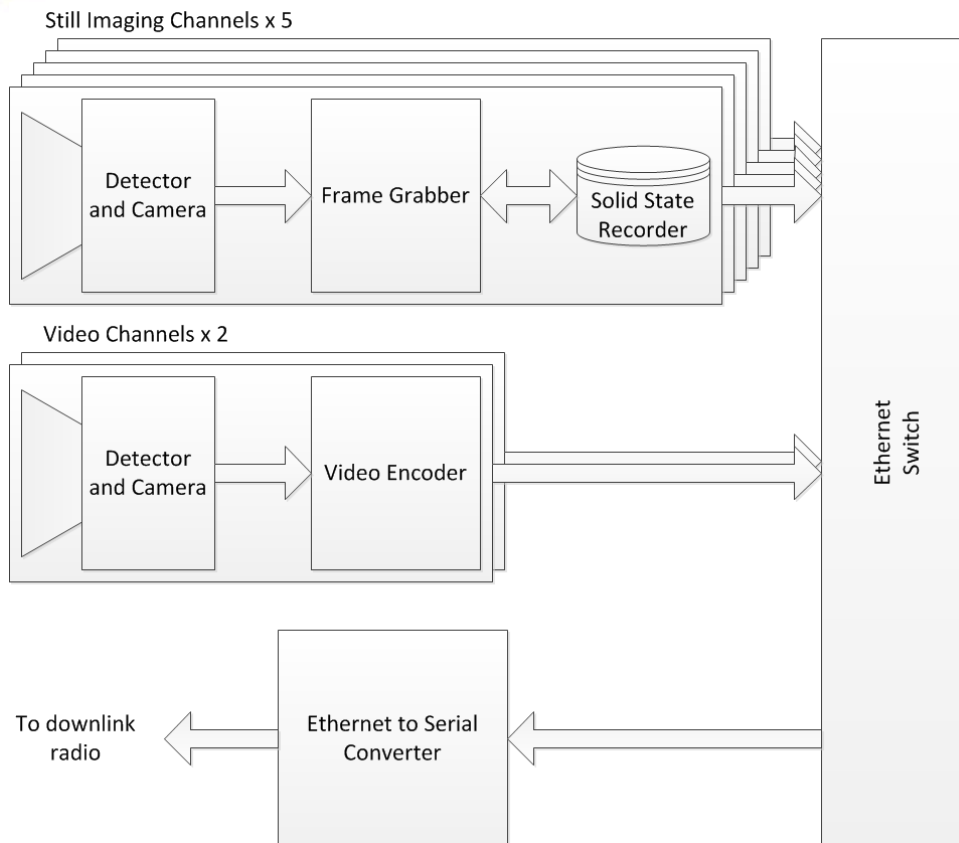
X-band transmitter

# Payload Electronics

Very short development timeline

- flight-hardened COTS assemblies
- open-source software
- standard interfaces and protocols
  - Ethernet (100 Mb/s and 1000 Mb/s)
  - Linux
  - H.264 video
  - RTSP
  - GigE Vision
  - SATA

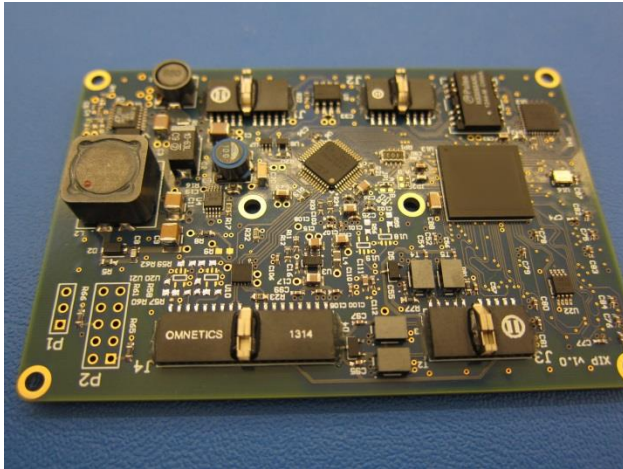
# Payload Electronics



Multispectral camera

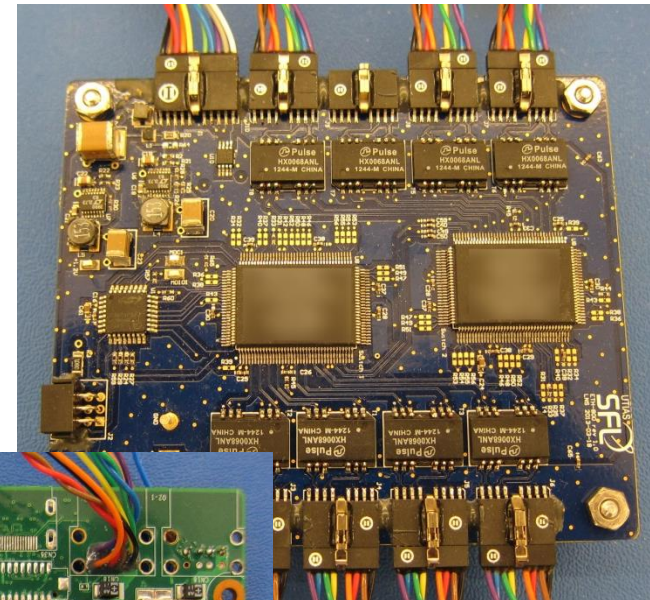


# Payload Electronics

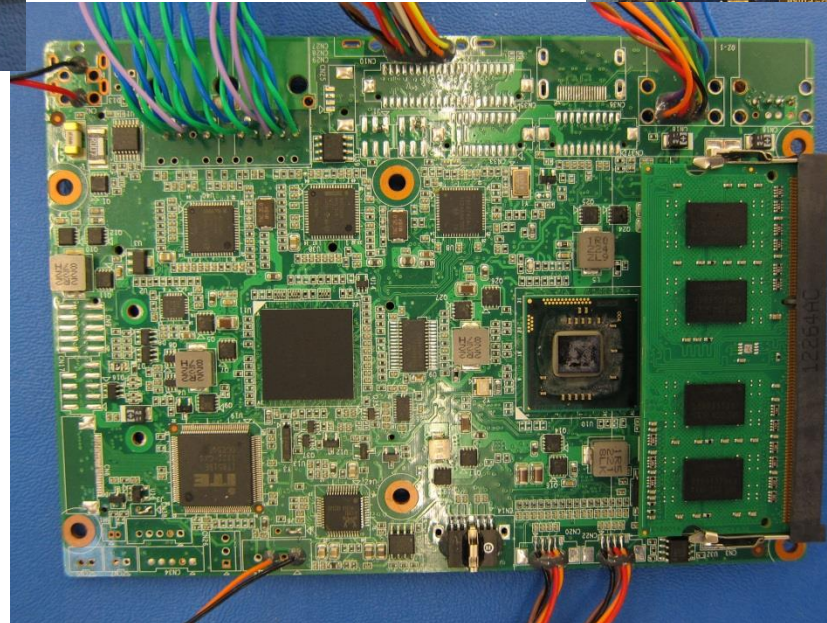


Ethernet-serial converter

Payload recorder



Ethernet switch





# Concept of Operations

Action	Real-time	Real-time (auto)	Time-tagged
Select channels	yes	yes	yes
View video	yes	yes	no
Record video	opt	opt	opt
ACS	user	target-based	commanded
Frame/swath acquisition	on command	on command	timed

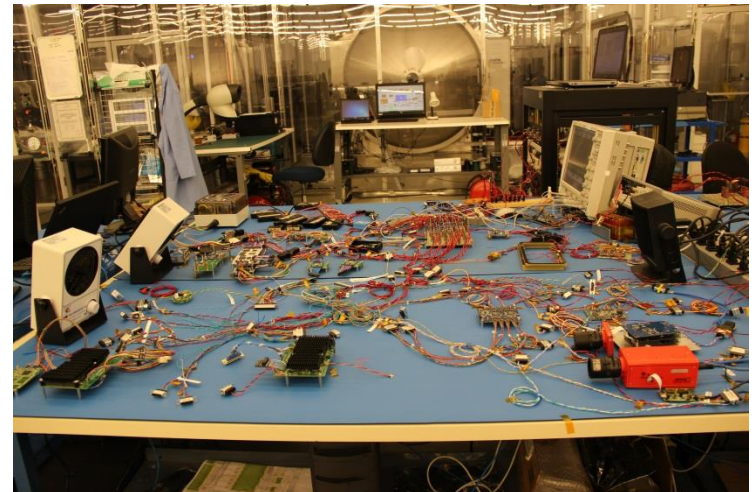
- Payload data can be downlinked at any point
- Automatic slew to sun point when idle

# A Flexible EO Platform

- NEMO-HD bus driven by payload size
- Heavy optics driven by
  - channel count
  - resolution
- Change instrument specs for a smaller spacecraft
- Flexible multi-channel architecture easy to adapt to other missions
- Power systems scales  $2\text{ W} < P_{\text{max}} < 1\text{ kW}$

# Current Status

- Structure in manufacturing
- Bus avionics complete and accepted
- Payload electronics mostly accepted
  - will be introduced to optics late 2013
- “Flatsat” integration
- Final assembly 1-2Q2014







[www.utias-sfl.net](http://www.utias-sfl.net)

