

# **TIM project progress presentation for the 9<sup>th</sup> RLS (SISSET)**

**The 9<sup>th</sup> Reginal Leader's Summit, Quebec, Canada  
2018.05**

# Overview

## ■ introduction

## ■ Progress for TIM Project

## ■ Products we provide and be interested

## ■ Suggestion.



# At a Glance

- Founded in 1966
- Over 1200 employees
- Headquarters: Yantai, Shandong Province
- Four research centers in Four cities: Yantai, Beijing, Xi'an, Changsha
- A space payload engineering center
- Joint laboratories with universities
- Total revenues(2017): 423M Dollars





# Facilities and Resources



Electronics assembly



Machining



EMC laboratory



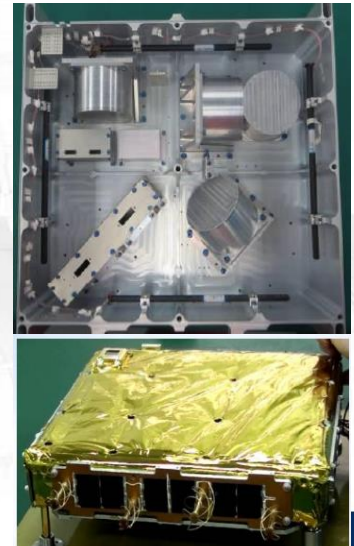
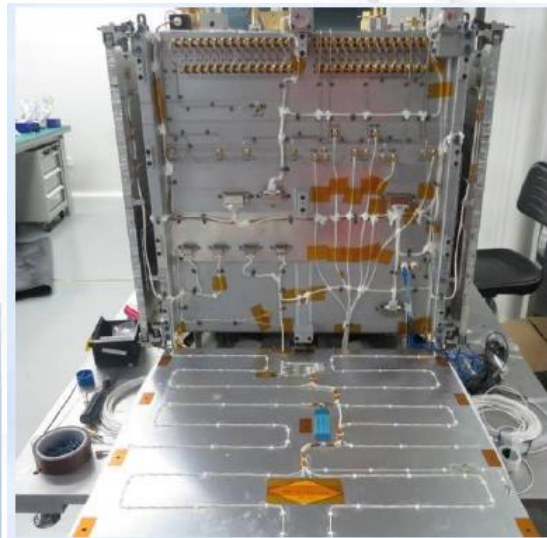
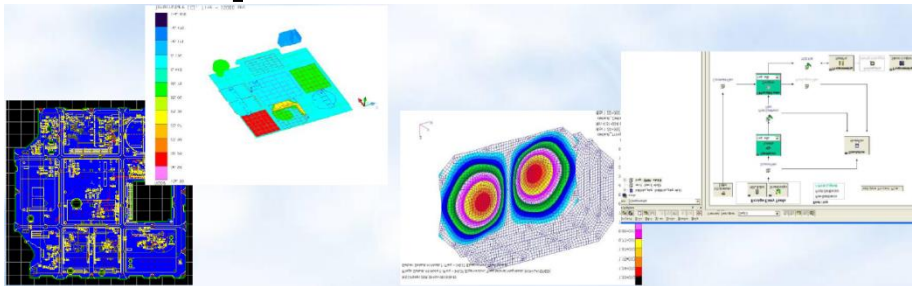
Environmental testing



Micro-electronics

# Satellite Services

- Design of Machine、Electric、Thermal
- Solution of Civil Component
- Manufacture of Structure in 1.5m×1.5m×1.5m
- Electronic Assembly of Satellite
- Integration of the Satellite under 200kg
- Experiment

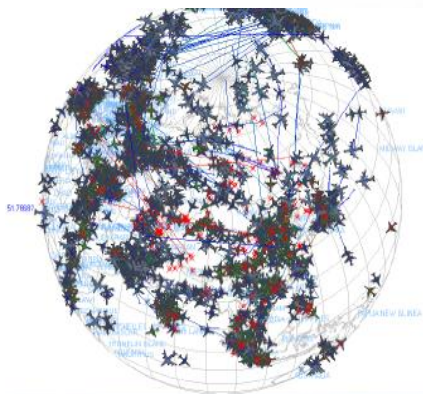






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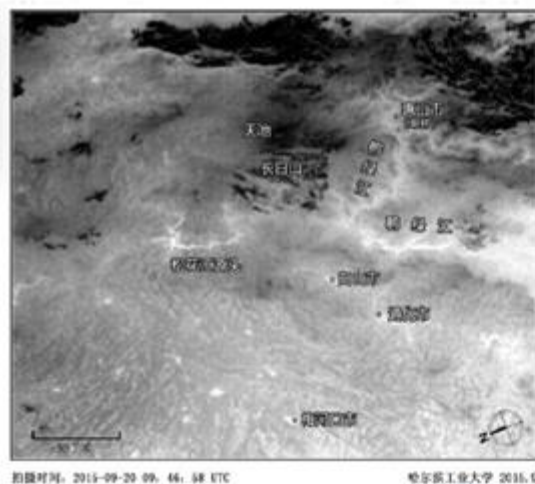
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# Micro Satellite Case



**SEPNet, launched in Sep,2014 ,  
132kg, the experiment of  
communication in the space**



**LilacSat-2, launched in Sep,2015 ,  
12kg, the Cube Satellite**

**Southgate Amateur Radio News**  
QRZ Callsign Search

Page last updated on: Thursday, September 24, 2015

**LilacSat-2 FM transponder tested**

The 2m to 70cm FM transponder on LilacSat-2 has been tested on low power, with many contacts being made.

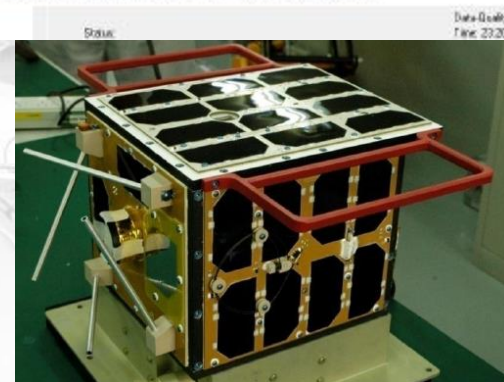
Wei Mingdhan, BG2BHC, writes:

Thank you very much for all the QSO reports via LilacSat-2! The repeater was turned on at about 2230 UTC [Sep 22] at 0.2W power. Not high but may hear good because of our special antenna design.

Due to some technical reasons, 437.200 is for TLM/FM/APRS and 437.225 is for TLM. No 144.390 use any more.

Please check the radio info page for updated frequency table and more information: [http://lilacsat.hit.edu.cn/?page\\_id=257](http://lilacsat.hit.edu.cn/?page_id=257)

LilacSat-2 is thought to be the first FM voice satellite to use sub-audible tones (< 300 Hz) on the transponder downlink to send telemetry data at the same time as speech. Software is now available to decode the telemetry, see <http://amsat-uk.org/satellites/communications/lilacsat-2/>





# Space Products

On Board Data  
Handling



- Satellite, Launcher and Spacecraft computer systems
- Thermal controller
- Vibration and shock monitoring unit

Communication  
Equipment



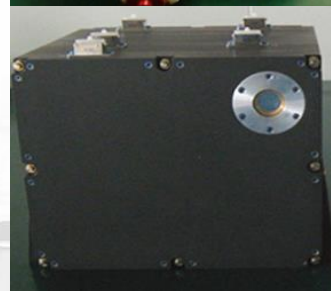
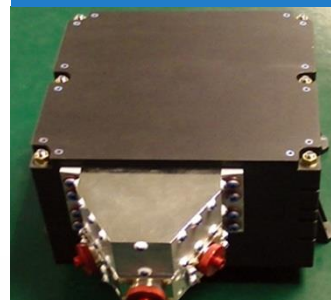
- S-band transceiver
- Inter-satellite transceiver

Power  
management



- Power condition Unit
- Power distribution Unit
- Li battery balancing management unit

Payload  
Instrument



- Massive storage unit
- Radiation effect testing unit
- Wireless voice communication equipment

Information system  
and Integrated  
Electronics



- Satellite Integrated electronics system
- Information system of Space station



# Overview

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# Progress for TIM project

## ■ got the Project Funds

Shandong province government financed 6 million RMB in the form of scientific and technological innovation project in Shandong and the other funds will be raised by Siset.

## ■ Project Progress

- ✓ Accomplish the primary design of the satellite platform initially;
- ✓ Survey the Selection of payloads





# Progress for TIM project

The satellite is tentatively defined as a 3U cube satellite including structure, power(PCU, storage battery, solar arrays), computer, communication, attitude control system(mems gyroscope, sun sensor, magnetometer, momentum wheel, magnetic torque).

NO.	Name of the component	Specifications	Supplier
1	structure	$\leq 1\text{Kg}$	Self-developed
2	OBC	Processor: ARM-Cortex@120MHz	Self-developed
3	UHF/VHF	Frequency band: VHF(uplink)/UHF (downlink) Modulation mode : AFSK/FM(uplink) ; BPSK (downlink) Rates: 1200bps (uplink) , 9600bps (downlink)	Self-developed
4	GNSS Receiver	Positioning accuracy: 20m ( $3\sigma$ )	Self-developed

# Progress for TIM project

NO.	Name of the component	Specifications	Supplier
5	inter-satellite communication	Undetermined	
6	data transmitter	X band, 1M-4M bps	Self-developed
7	propulsion	Undetermined	
8	PCU	Battery charging current: 0.15A Input voltage: 2.6V Bus voltage: 7~8.4V, current(2A) Secondary power: 3.3V/5V, current(2A)	Self-developed
9	Battery	Capacity: 5Ah; Topology: (18650 battery) two parallels and two serials;	Self-developed
10	Solar Array	Area: 714cm <sup>2</sup> Output power: ~20W(direct sunshine)	Self-developed
11	Mems gyroscope ( MPU-3300 )	Power consumption: < 12.5 mW Random noise: < 0.015 °/s Constant shift: 0.004 °/s	COTS



# Progress for TIM project

NO.	Name of the component	Specifications	Supplier
12	sun sensor (SSBV CubeSat)	Power consumption: $\leq 50\text{mW}$ Mass: $\leq 5\text{g}$ Field of view: $\pm 57^\circ$ Measuring accuracy: $< 0.5^\circ$	COTS
13	magnetometer (HMC5883L)	Power consumption: work mode: $< 1\text{mW}$ ; sleep mode: $< 1\text{mW}$ Range: $\pm 2\text{ Gauss}$ ( $0.0002\text{ T}$ ) Resolution: $146\text{ nT}$	COTS
14	magnetic torque	Magnetic moments: $0.15\text{ Am}^2$ Power consumption: $< 0.045\text{W}$ Mass: $30\text{ g}$ Resistance: $30\ \Omega$	Self-developed
15	momentum wheel	$3\text{mNm}@9000\text{rpm}$ $0.45\text{mNm}, 45\text{g}$ $32*32*17\text{mm}$	Self-developed
16	On-board software	Software for the satellite formation flying control	

# Progress for TIM project

## ■ Survey the Selection of payloads

### (1) Gomspace – nanocam

#### Specifications:

- ✓ Image sensor: 3M CMOS sensor
- ✓ Spatial resolution: 22.9m (@500Km)
- ✓ Swath: 46km (@500Km)
- ✓ Image storage: 2GB
- ✓ Image output format: RAW/BMP/JPEG
- ✓ Data interface: CSP-enabled CAN/I2C/TTL
- ✓ Standard size: 96\*90mm;
- ✓ Mass: 277g (70mm camera lens)



NanoCam  
C1U



Figure 1. Gomspace – nanocam



# Progress for TIM project

## ■ Survey the Selection of payloads

### (2)SCS Gecko imager Specifications:

- ✓ Spatial resolution: 39m (@500km)
- ✓ Swath: 80km (@500km)
- ✓ Image sensor: 2.2M RGB
- ✓ Data format: 8bit RAW、10bit raw or thumbnail
- ✓ Frame rate: 5 full frame/s
- ✓ Data storage: 128G
- ✓ Additional function: JPEG2000 image compression、ground support equipment, increase the frame rates or storage
- ✓ Data interface: LVDS, SPI, I2C
- ✓ Size:  $<97\text{mm} \times 96\text{mm} \times 60\text{mm}$
- ✓ Mass:  $<480\text{g}$
- ✓ Operating temperature range:  $+10^{\circ} \sim +30^{\circ}$
- ✓ Storage temperature:  $-20^{\circ} \sim +50^{\circ}$
- ✓ TID:  $<30\text{krad}$

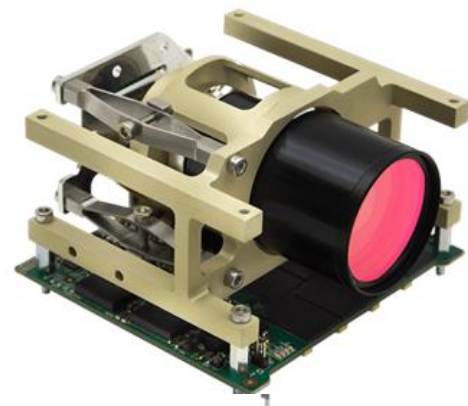


Figure 2. SCS Gecko imager

# Progress for TIM project

## ■ Survey the Selection of payloads

### (3) AIS Receiver Specifications:

- ✓ Collect, store and transmit the AIS message
- ✓ Band; 156.8~163MHz;
- ✓ Channel band: 25kHz;
- ✓ modulation: GMSK;
- ✓ sensitivity:  $\leq -112\text{dBm}$ ;
- ✓ platform bus: CAN\UART\SPI
- ✓ storage:  $\geq 1\text{Gbyte}$
- ✓ power:  $\leq 2.0\text{W}$ ;
- ✓ mass:  $\leq 200\text{g}$ ;

### Antenna specification:

- ✓ antenna:  $\geq -3\text{dB}$  Beam bandwidth:  $\leq \pm 55^\circ$ ;
- ✓ total mass:  $\leq 500\text{g}$

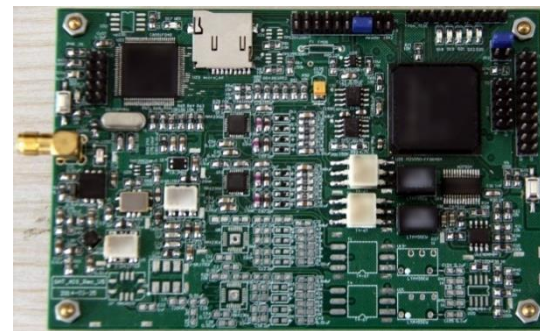


Figure 3. AIS Receiver

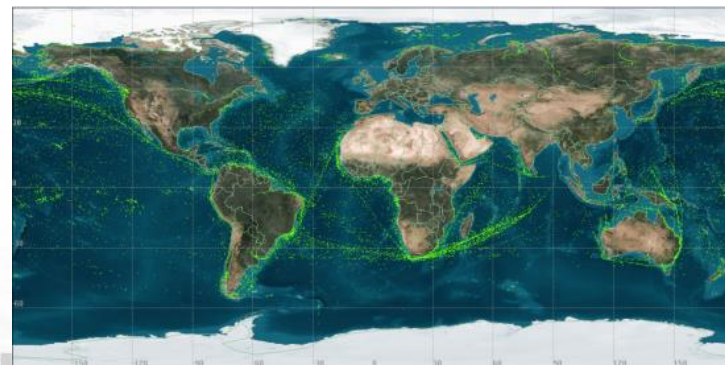


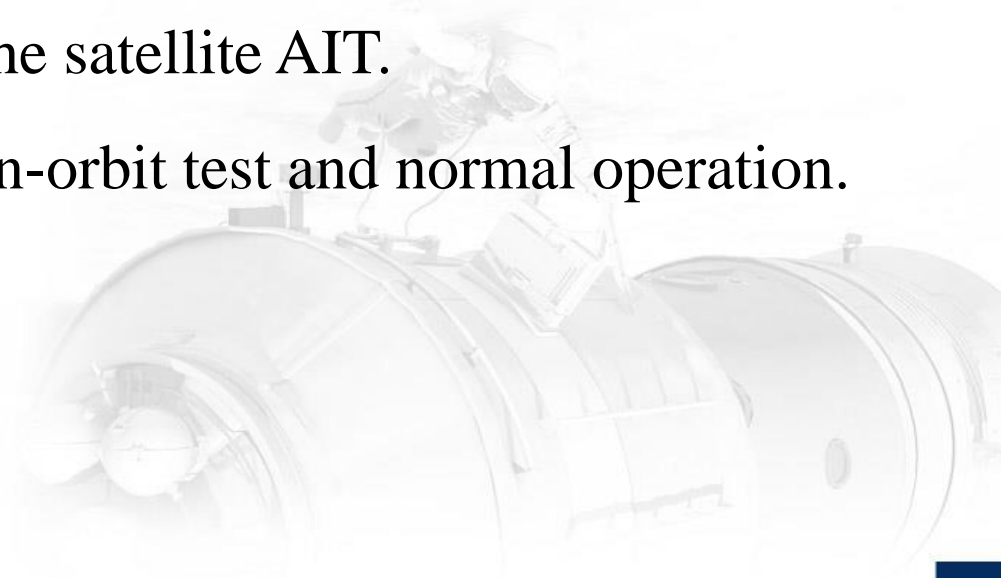
Figure 4. Data collected by TT-1



# Progress for TIM project

## ■ Satellite Development Plan

- ✓ May 2018, attend the TIM meeting and clear the overall mission requirements.
- ✓ December 2018, accomplish the detail design of the satellite.
- ✓ may 2019, accomplish the products development .
- ✓ December 2019, accomplish the satellite AIT.
- ✓ 2020, launch the satellite, do in-orbit test and normal operation.



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- Suggestions



# Products that we can provide

## ■ OBC

The OBC board uses an ARM-based 32-bit MCU, which works at 128MHz. It has a 64Mbits SPI flash memory chip and two TF card socket. So it can do OBDH and also payload processing. Furthermore, it integrates H-bridge, 3-axis magnetometer and a 3-axis MEMS gyroscope. WDT and power reset circuits are used to monitor and protect the software. Fly with the LilacSat-2 for more than 3 years.

### Specifications:

- (1) Mass: <0.3Kg
- (2) Power consumption: < 0.25W
- (3) Dimensions: 90mm×90mm×20mm
- (4) Processor: ARM@128MHz
- (5) program flash: 1MB
- (6) SRAM: 196KB
- (7) Data Flash: 8MB
- (9) Interface: 2 UARTs、2 I2C、1PPS、3 H-bridge、4 DACs
- (10) OC command: 4
- (11) Power distribution: 4 3.3V@2A
- (12) Integrated magnetometer, range is  $\pm 1.3\text{Gauss}$ , resolution is 92nT,
- (13) Integrated gyroscope, resolution is 6.9mdps/digit



Figure 5. OBC



# Products that we can provide

## ■ PCU

PCU provides 9 MPPT(Maximum Power Point Tracking) channels, Li-ion battery chargers, DC-DC converters, antenna deploy drivers. Also, the temperature, current and voltage sensors are integrated。

Specifications:

- (1) Battery charging current: 0.15A
- (2) Input voltage: 2.6V
- (3) Bus voltage: 7.0~8.4V, current(2A)
- (4) Secondary power: 3.3V/5V, current(2A)
- (5) antenna deploy drivers: 2, 1.5A per channel
- (6) Processor: low-power MCU
- (7) Temperature sensor resolution:  $\pm 0.5^{\circ}\text{C}$
- (8) Current monitor: range(0~12.8A), resolution(0.4mA)
- (9) Voltage monitor: range(0~32V), resolution(4mV)
- (10) Power consumption: 0.1W
- (11) Mass: 200g



Figure 6. PCU

# Products that we can provide

## ■ U/V transceiver

U/V transceiver provides command and telemetry links and payload links. It has a VHF receiver and a UHF transmitter. The antennas for VHF/UHF are deployable monopole wire antennas.

### Receiver Specifications:

- (1) Frequency: 145.8~146MHz (VHF)
- (2) Noise figure:  $\leq 8\text{dB}$
- (3) Dynamic range:  $\geq 50\text{dB}$
- (4) sensitivity:  $-110\text{dBm}$

### Transmitter Specifications:

- (5) Frequency: 435~438MHz (UHF)
- (6) Output power:  $\geq 23\text{dB}$
- (7) Spurious emission restriction:  $\geq 50\text{dB}$
- (8) Forward link: 1200bps, FSK/FM, AX.25
- (9) Backward link: 9600bps, BPSK, AX.25
- (10) Mass:  $<0.6\text{Kg}$
- (11) Power Consumption: 0.7W(Receive only), 3.2W(full duplex)



Figure 7. U/V transceiver

# Service that we can provide

## ■ Ground Station

We can provide S-band ground-station.

### (1) S-band ground station

- a. uplink –frequency: 2025MHz~2120MHz, 100kHz one step adjustable.
- b. downlink-frequency: 2200MHz~2300MHz, 100kHz one step adjustable.
- c.  $G/T \geq 11.6\text{dBK}$
- d.  $\text{EIRP} \geq 44.0\text{dBW}$

### (2) U/V ground station

Our local partner HIT, has a U/V ground-station, we can use their ground station for the TIM satellites operation management.



# Service that we can provide

## ■ Ground Station

We can provide S-band ground-station.

### (1) S-band ground station

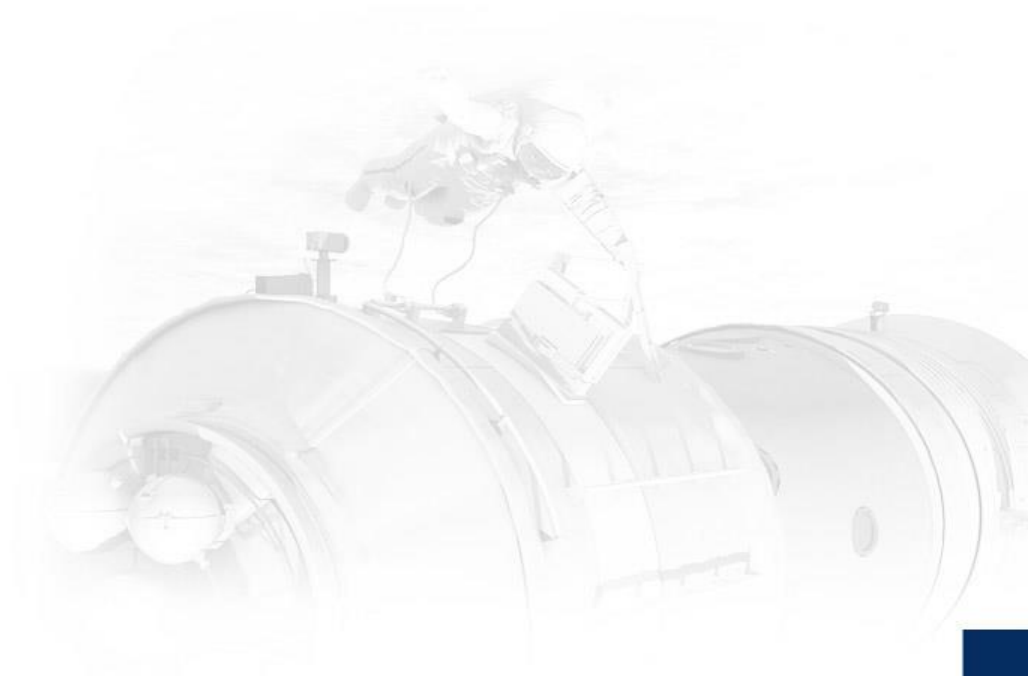
- a. uplink –frequency: 2025MHz~2120MHz, 100kHz one step adjustable.
- b. downlink-frequency: 2200MHz~2300MHz, 100kHz one step adjustable.
- c.  $G/T \geq 11.6\text{dBK}$
- d.  $\text{EIRP} \geq 44.0\text{dBW}$

### (2) U/V ground station

Our local partner HIT, has a U/V ground-station, we can use their ground station for the TIM satellites operation management.

# Products that we are interested

- inter-satellite communication
- Propulsion system
- Satellite formation flying control software
- Other products...



# Suggestions

- Clear the requests of the overall mission of the satellite formation, the orbit, and the inter-satellite link requirements, so that we can redesign our satellite primary design;
- Start the application of the frequency resources that we need including VHF, UHF, X bands.





**Let's work together, and make it better!**

**Thank you for your listening !**

