Picosat Systems

Development of OzQube-1

Stuart McAndrew

1st Asian PocketQube Workshop

5th Nov 2018

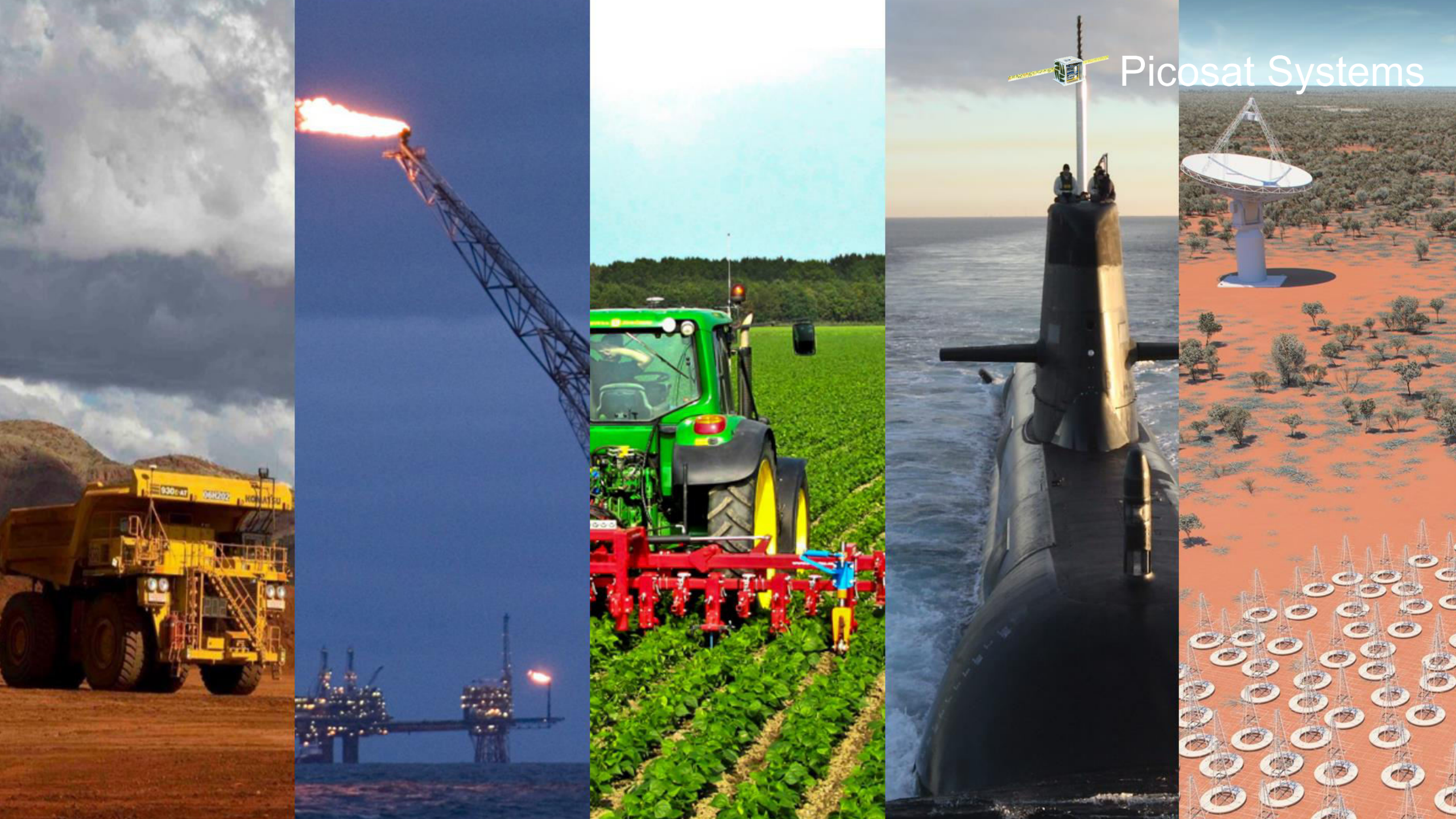
WESTERN AUSTRALIA Innovator of the Year 2017
WOODSIDE OIL AND GAS ENCOURAGEMENT AWARD WINNER

Image credit: Youtube channel Beautiful Earth

Who are we?

Picosat Systems

- Small early-stage startup based in Perth, Western Australia
- Co-founders: Stuart McAndrew and Conrad Pires
- Aim to develop space industry in Australia
- Focussing on new, small form factor satellites, including PocketQubes and Cubesats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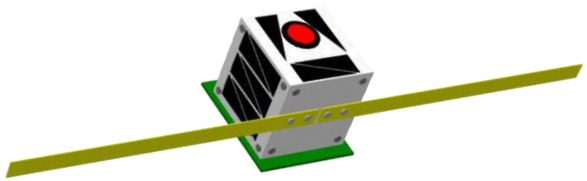
Concept



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Engineering

Flight

OzQube-1

Tech Demonstrator

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A 1P PocketQube designed and built in (Western) Australia.

Main Mission Objectives:

- Validate core PocketQube subsystems (CDH, Comms, EPS)
- Capture colour images of Australia from space
- Transmit the images to people around the world

OzQube-1

Pico-satellite Technology Demonstrator

Mission: Capture colour images of Australia

Size: 5cm x 5cm x 5cm (excluding antenna)

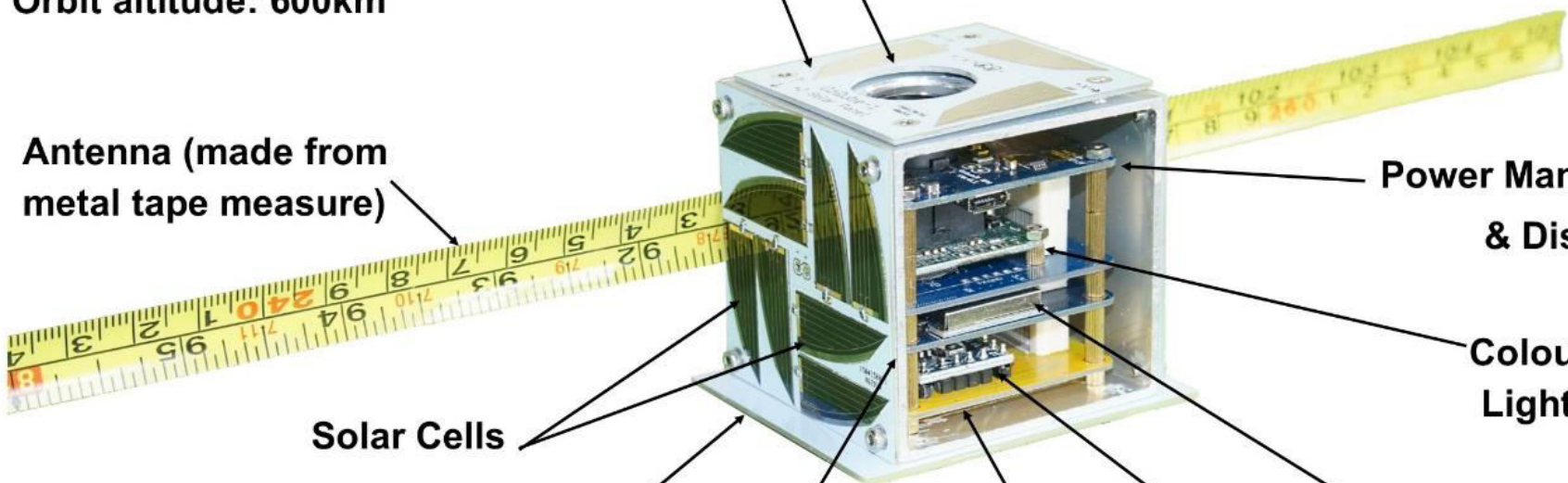
Mass: 150 grams (approx.)

Format: PocketQube

Launch: 2019 (est.)

Orbit altitude: 600km

Cut-away View



Solar Cells

Camera Lens

Antenna (made from metal tape measure)

Power Management & Distribution

Colour Visible Light Camera

Solar Cells

Radio Transceiver

Aluminium Chassis

On-board Computer

Passive Magnetic Attitude Stabilisation (inside)

Points camera downward over Australia

Rechargeable Battery

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Key Features

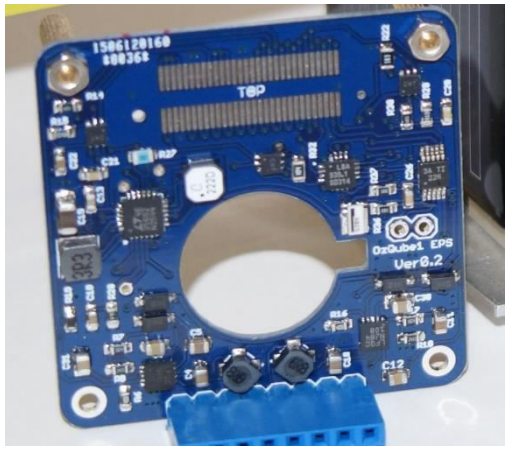
- PQ60(ish) inside
- Separate PCB’s for each subsystem (EPS, CDH, Comms, Camera payload)
- Simplified robust design
- Single Li-ion 800mAh (ish) cell (sandwiched between PCB’s)
- Tape measure antenna

Command & Data Handling

- ATmega1284P Microcontroller (Was ATmega328p but needed more!)
- µSD and FRAM Data storage
- 9-Axis IMU (Only 6 useful in orbit!)
- External Watchdog
- RTC
- Connects to comms via SPI + GPIO, EPS via I2C + direct GPIO

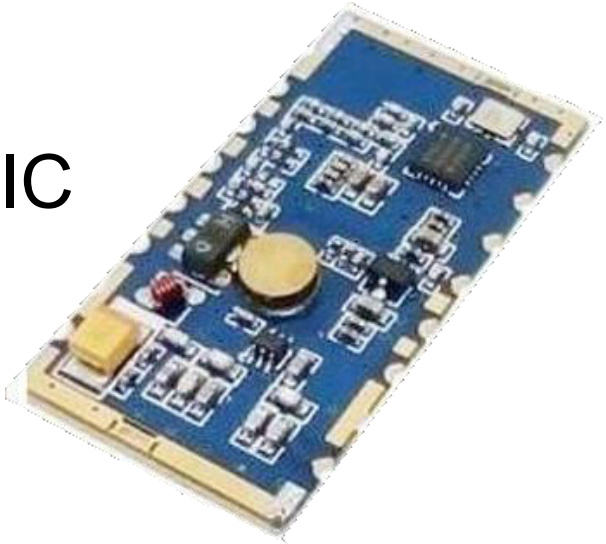
EPS

- Hole in the middle for camera lens
- 4 channel MPPT(+X, -X, -Y separate, +Z and –Z on single channel with blocking diodes on each panel)
- Single BCR (Battery Charge Regulator)
- Temp controlled Battery charging
- PowerPath for battery bus (Maintains 3.6V if battery failed or low)
- 3.3V Bus and 1 switched 3.3v circuit for payload (that's why PQ60ish)
- All power circuits have current limiting and overload protection
- V + I telemetry from Bat and BCR output (not per panel as board space is limited!)



EPS Prototype

Comms



- Radio based on Silicon Labs Si4463 transceiver IC
- 70cm Amateur band
- Half-wave dipole tape measure antenna
- 1W / 30dBm output
- FSK 9600bps / 19200kbps
- Custom packet format (to be released before launch)
- Open uplink commands available to HAM operators (such as RSSI report, Telemetry dump)
- Reception with Arduino and Si4463 based radio (eg, RFM26W) Software based on RadioHead driver.

Camera

- Off-the-shelf UART camera – Slightly modified
- Originally planned 2Mp, but 5Mp version now available!
- OV5642 + STM32 Micro
- Adapted to PQ60 board
- 25mm M12 Lens
- GSD
  - ➢34m @ 600km
  - ➢17m @ 300km
- JPEG images

ADCS

- Passive Magnetic Stabilisation
- Dual magnets to provide improved stability around roll axis
- Pointing downwards over southern hemisphere & Nadir over Australia
- No active control (Yet…..)
- Photodiode based sun sensor for basic solar angle determination
- Will experiment with images of stars to determine position

Lessons Learnt (so far)

- Easy to get scope creep (Try and stick to the plan)
- Lots and lots of little things matter
- There’s always more to learn
- Radios are black holes of knowledge
- Some things are more expensive than you think (I’m talking about you conductive epoxy…..)

What’s Next?

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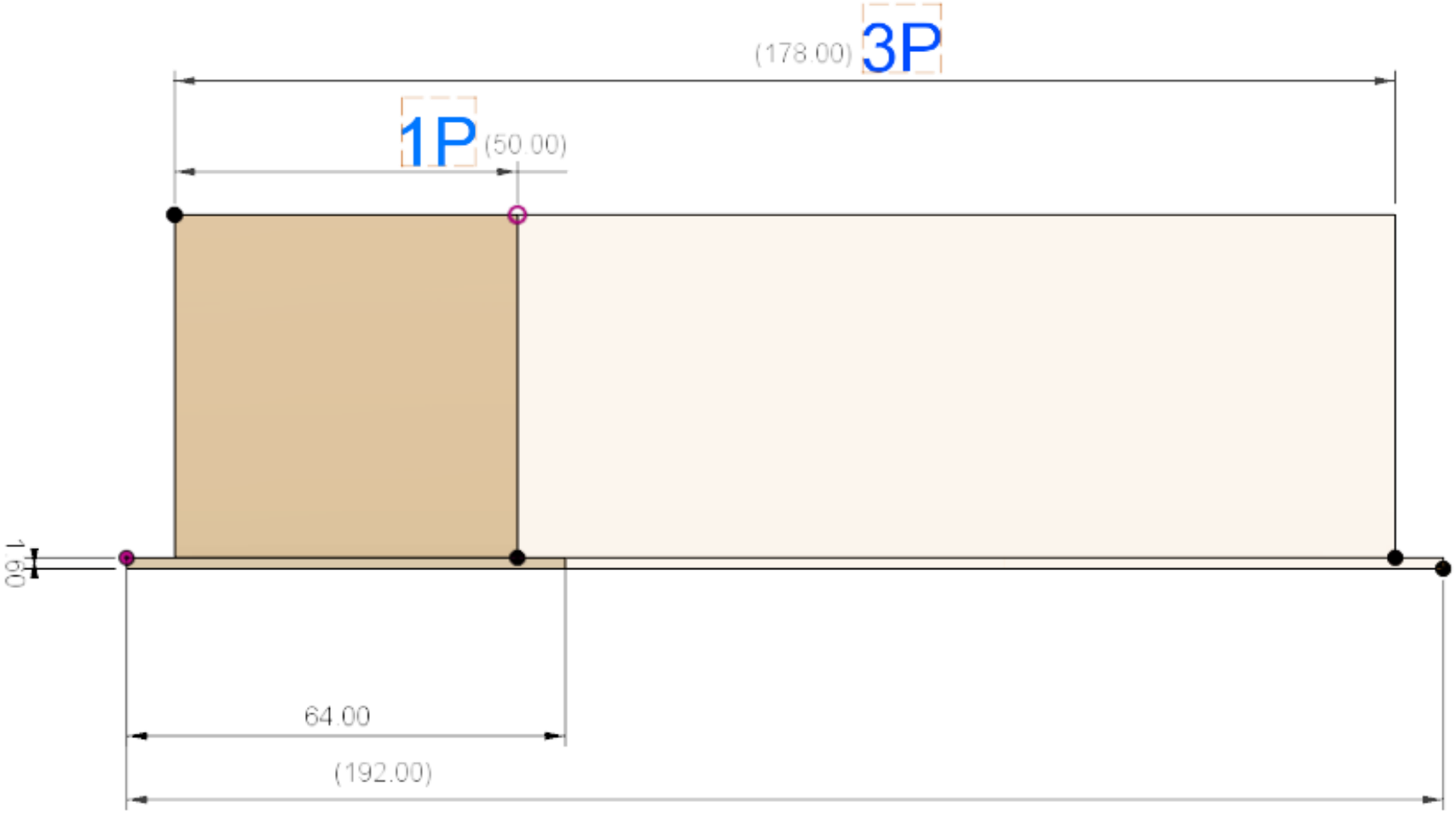
Platform Evolution



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Technology Evolution

Deployable Solar (15 W, ~10W OAP)

High Power EPS

S-band 2Mbps

Mesh and Delay Tolerant networking

Evolved Star Tracker

Reflectarray Antenna

Optical Comms

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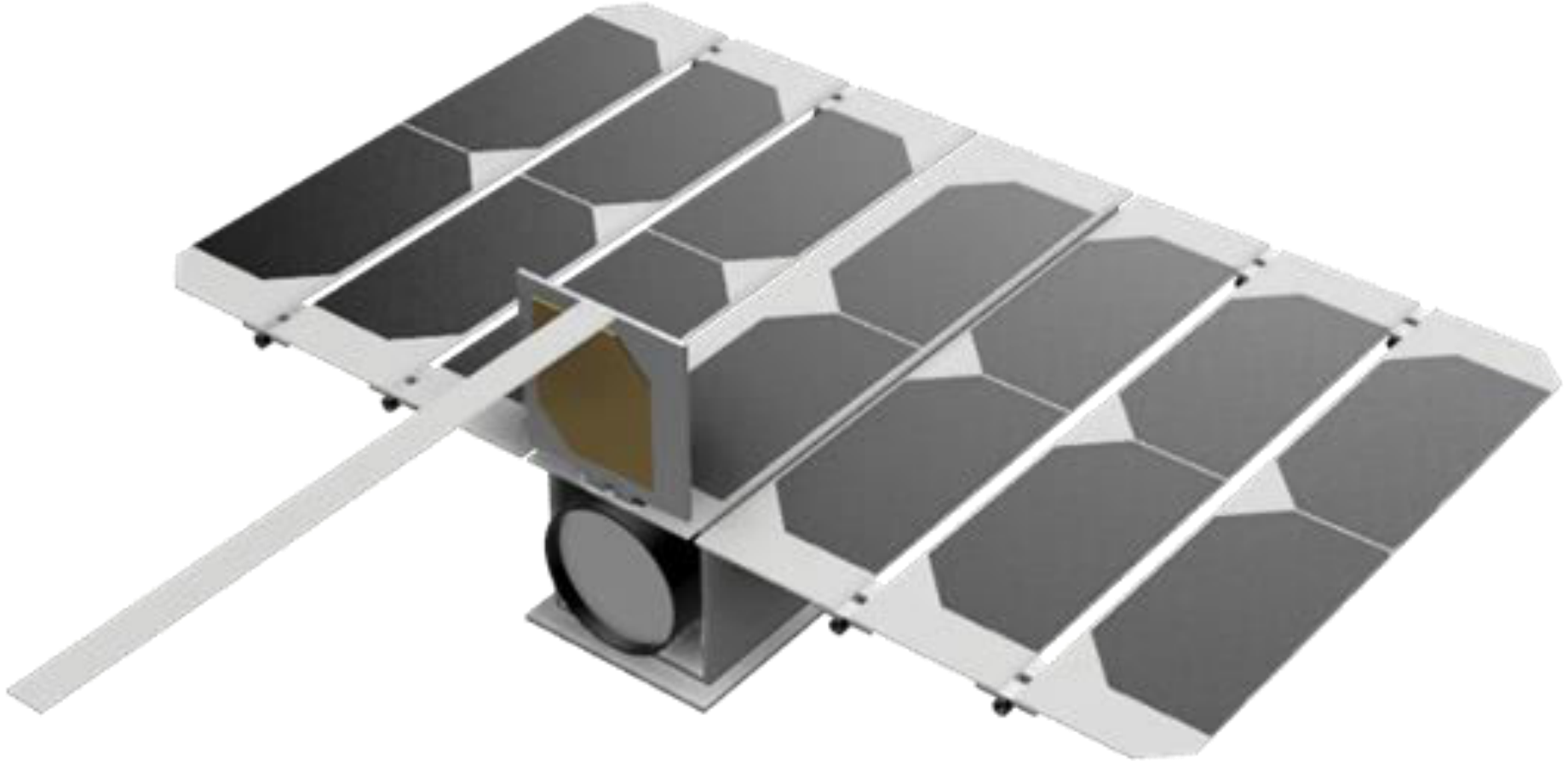
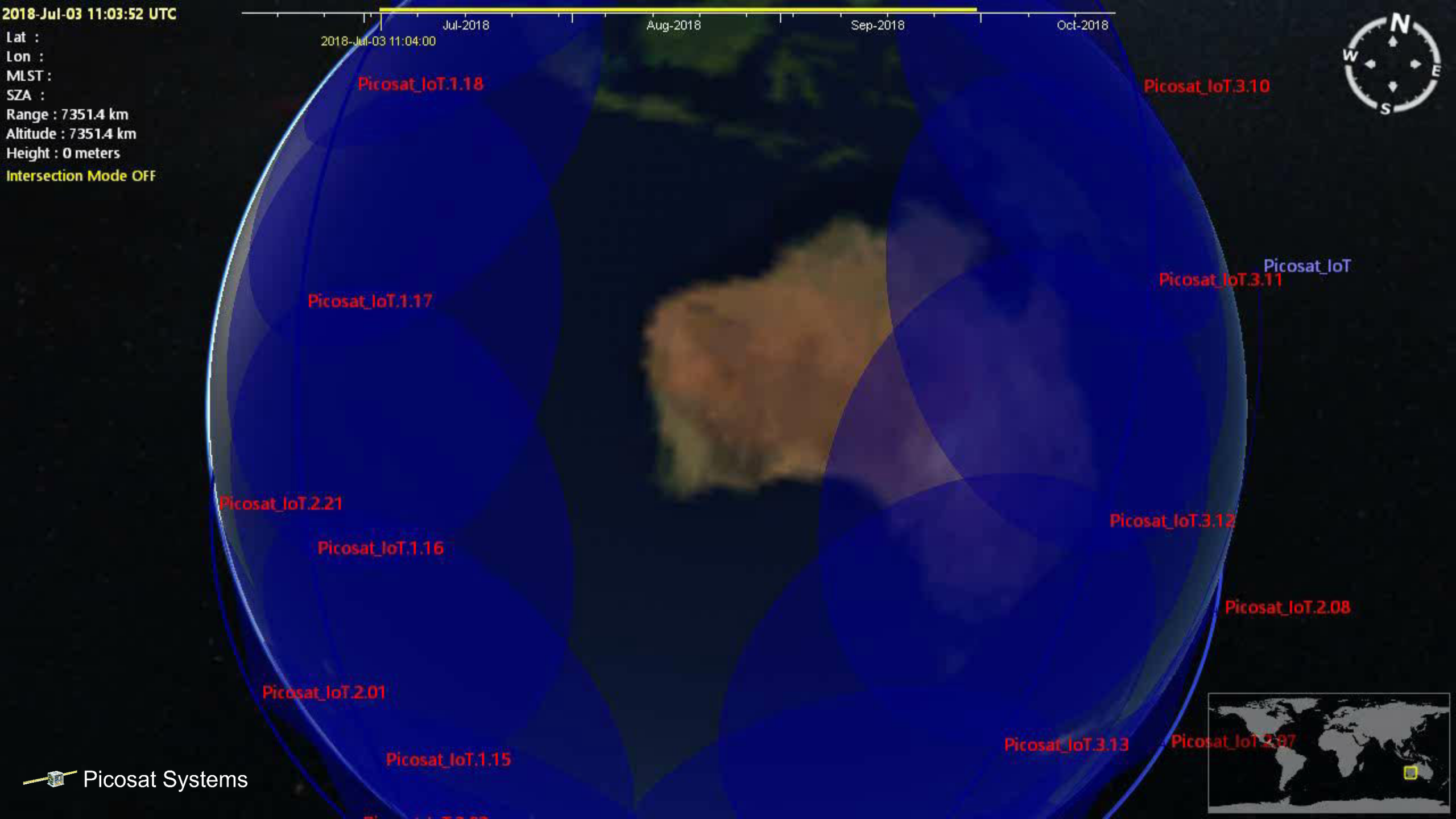
Commercial Platform



3P Picosatellite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SZA :
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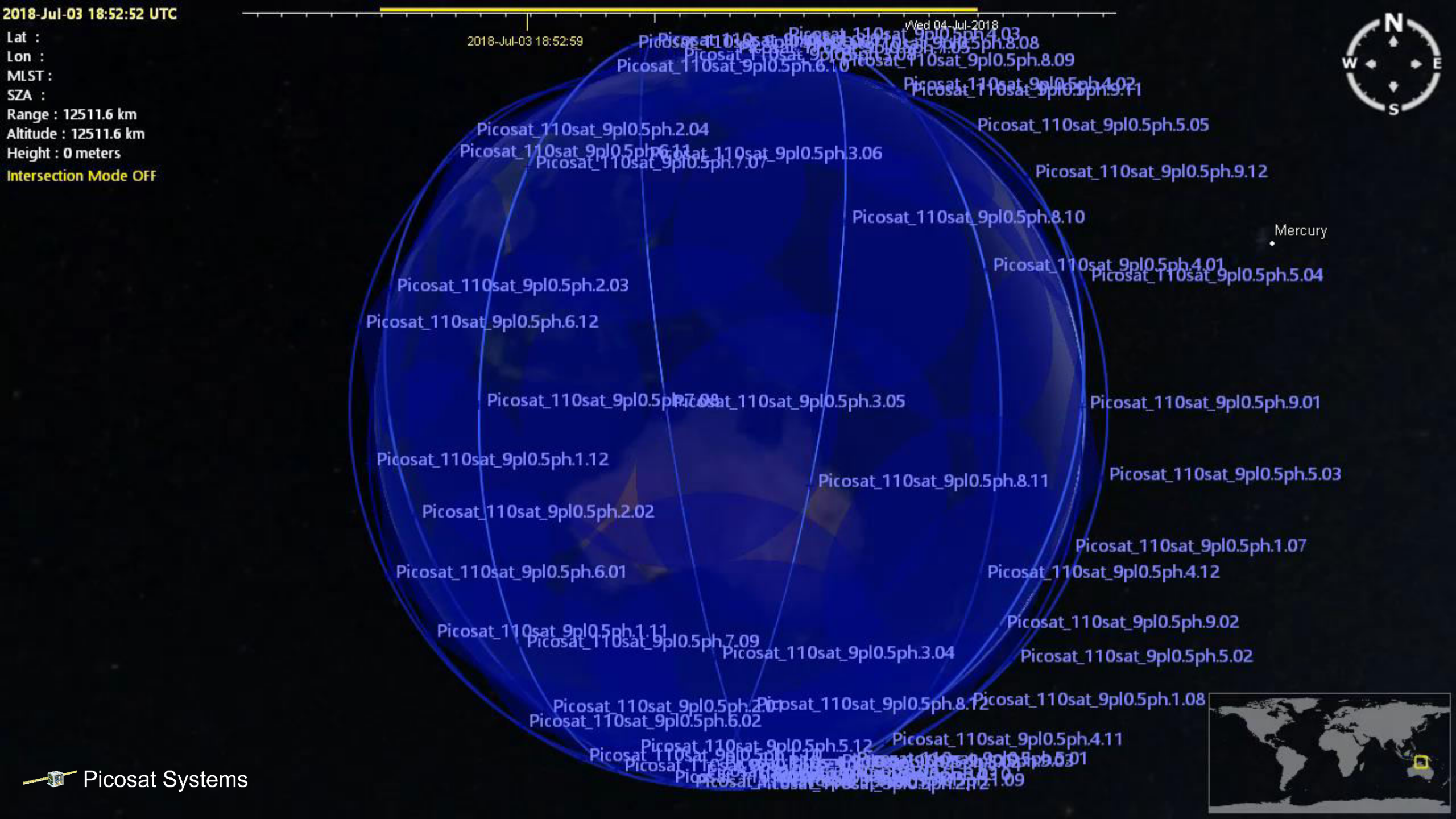
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Contact

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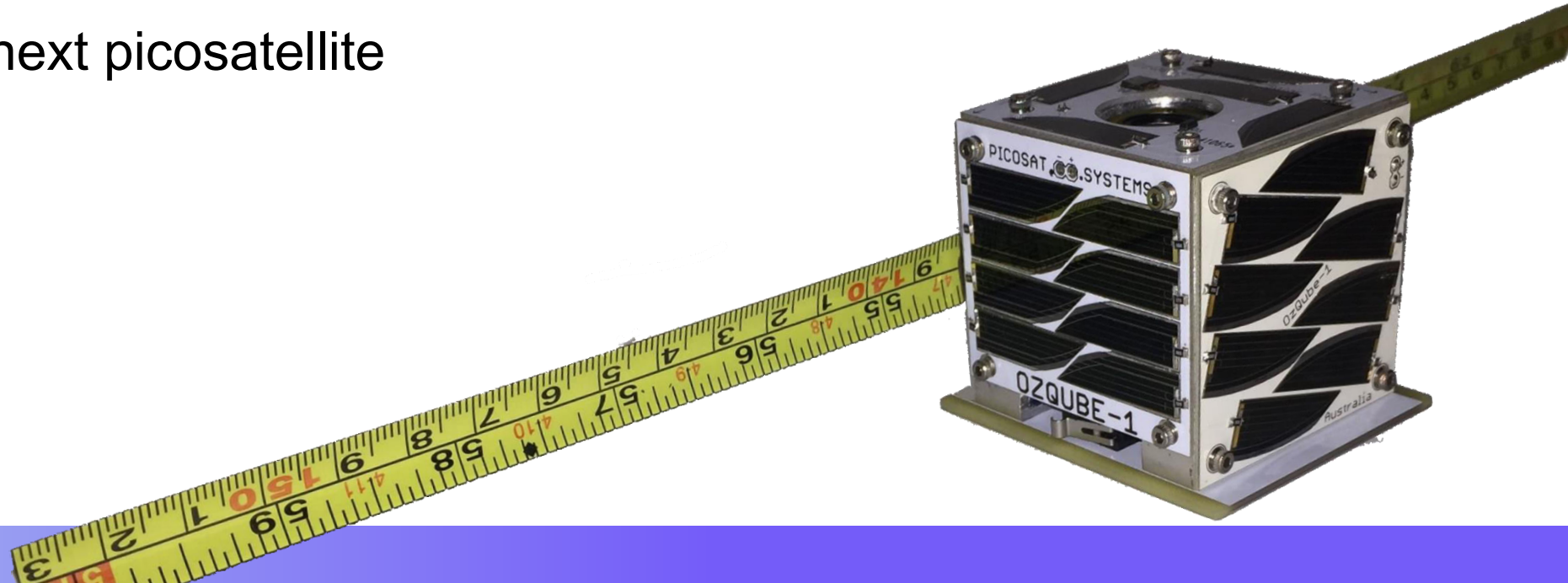
Let us build your next picosatellite mission!



Extra Slides


ICRAR
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Zero-G Collaboration
Press release & video: www.icrar.org/picosat

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