



# MeznSat: A New CubeSat for Monitoring Greenhouse Gases

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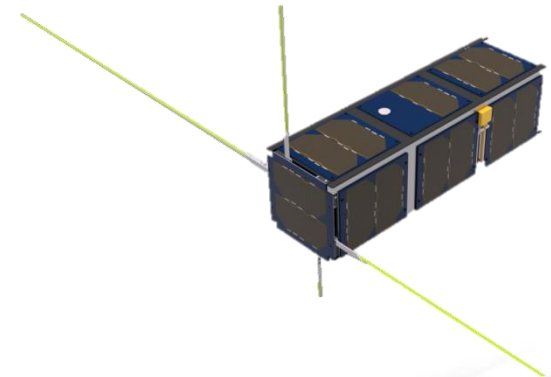
## Summary



- Mission Brief and Overview
- Payloads and Science
- Spacecraft Overview
- Program Management

# Mission Brief

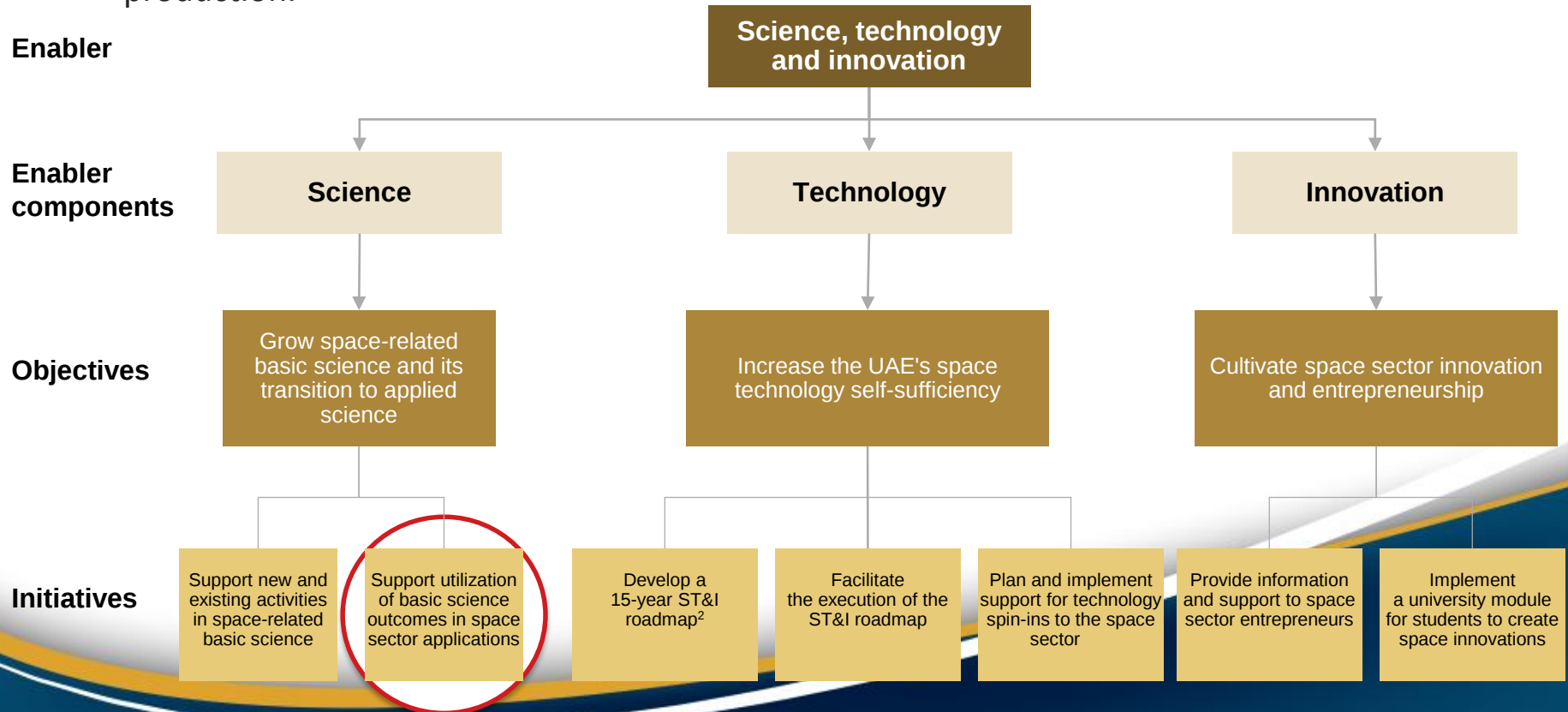
- MeznSat is a new satellite initiated and funded by the UAE Space Agency and in partnership with Masdar Institute and the American University of Ras Al Khaimah (AURAK).
- MeznSat will be a 3U satellite and will be developed, built and tested primarily by university students to detect Green-House Gas (GHG) concentrations.
- The project aim is to offer the UAE space industry with qualified well-trained graduates through hands-on experience based on one of the UAE Space Agency's primary objectives of building capacity.
- In addition, the MeznSat project opens windows for advanced space-oriented research relevant to the UAE.
- **Planned to launch mid-2019**, MeznSat will be developed by students.
  - The satellite will be launched from a site in Japan operated by the Japan Aerospace Exploration Agency.



# UAE Space Agency STI Road Map



- This project is in line with the implementation plan for the UAE-SA Science, Technology and Innovation (STI) Roadmap
- Fulfilling at least one of its objectives
  - Developing earth science research capabilities,
  - A focus on applications that would help convey insights into man made effects on the environment such as such as discretizing CO2 and CH4 production.



# Mission Objectives

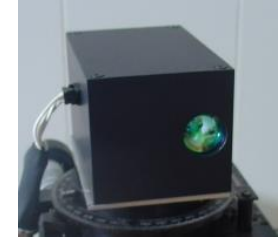
The project has two general objectives as outlined below:

- **Scientific Objective:** To deploy an Earth observing CubeSat equipped with a near-infrared spectrometer, Shortwave Infrared (SWIR), that is able to detect and estimate the levels of Methane and Carbon Dioxide in the atmosphere.
- **Educational Objective:** Relatively low-cost hands-on space training for Emiratis, and hence offering the UAE space industry qualified well-trained graduates who can become effective players in the UAE space program.



# Primary Payload: ARGUS 2000 SWIR Spectrometer

- SWIR: 1000nm-1700nm
- ~1.5 km (across track) by ~10 km (along track) ground resolution
- Determine column densities of CO<sub>2</sub>, H<sub>2</sub>O and CH<sub>4</sub>
- Space worthiness proven by CanX-2, SathyambaSat



# Main Science Objective - GHG

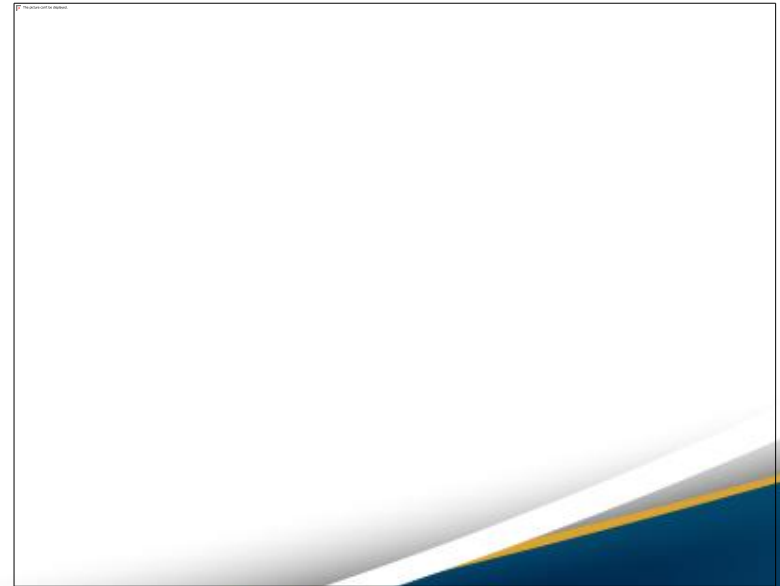
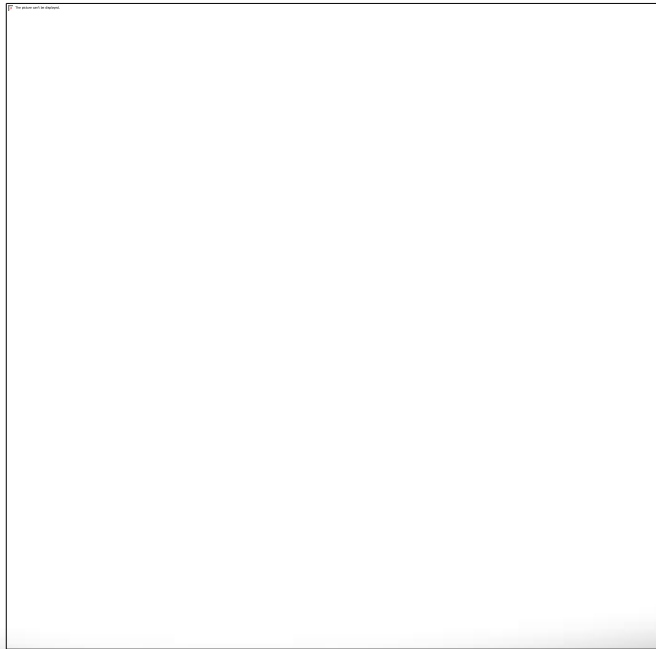
- The main science objective is to retrieve total column  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and  $\text{CH}_4$  concentrations.



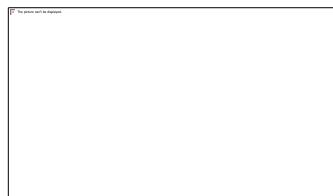
# Tentative Science Mission – Red Tide



- A tentative secondary mission is to measure the total suspended matter (TSM) in the coastal waters of UAE.
- TSM can be used as a proxy for nutrient concentration in the water.
  - The idea is to use the data to correlate with algae bloom occurrences and to develop a model to predict onset of algal blooms based on TSM measurements and sea surface temperatures observed by other satellites.



## Secondary Payload: MICAM-1 (Tokyo University of Science)



|                                    |                     |                            |
|------------------------------------|---------------------|----------------------------|
| <b>Array Size</b>                  |                     | 1280x1024 (SXGA)           |
| <b>Power Supply</b>                | <b>Core</b>         | 2.5VDC+/-10%               |
|                                    | <b>Analog</b>       | 3.3VDC+/-10%               |
|                                    | <b>I/O</b>          | 3.3VDC+/-10%               |
| <b>Power Requirements</b>          | <b>Active</b>       | 150mW                      |
|                                    | <b>Standby</b>      | 30μW                       |
| <b>Temperature Range</b>           | <b>Operation</b>    | 0°C to 70°C                |
|                                    | <b>Stable Image</b> | 0°C to 70°C                |
| <b>Output Formats (10-bit)</b>     |                     | RAW RGB Data               |
| <b>Lens Size</b>                   |                     | 1/3"                       |
| <b>Maximum Image Transfer Rate</b> | <b>SXGA</b>         | 15fps                      |
|                                    | <b>VGA</b>          | 30fps                      |
| <b>Sensitivity</b>                 |                     | 1.0 V/Lux-sec              |
| <b>SN Ratio</b>                    |                     | 54dB                       |
| <b>Dynamic Range</b>               |                     | 60dB                       |
| <b>Scan Mode</b>                   |                     | Progressive/Interlaced     |
| <b>Maximum Exposure Interval</b>   |                     | 1048 x t <sub>ROW</sub>    |
| <b>Pixel Size</b>                  |                     | 4.2μm x 4.2μm              |
| <b>Dark Current</b>                |                     | 28 mV/s                    |
| <b>Fixed Pattern Noise</b>         |                     | <0.03% of V <sub>p-p</sub> |
| <b>Image Area</b>                  |                     | 5.4mm x 4.3 mm             |
| <b>Package Dimensions</b>          |                     | .56 in. x .56 in.          |

## Experiments with the RGB camera

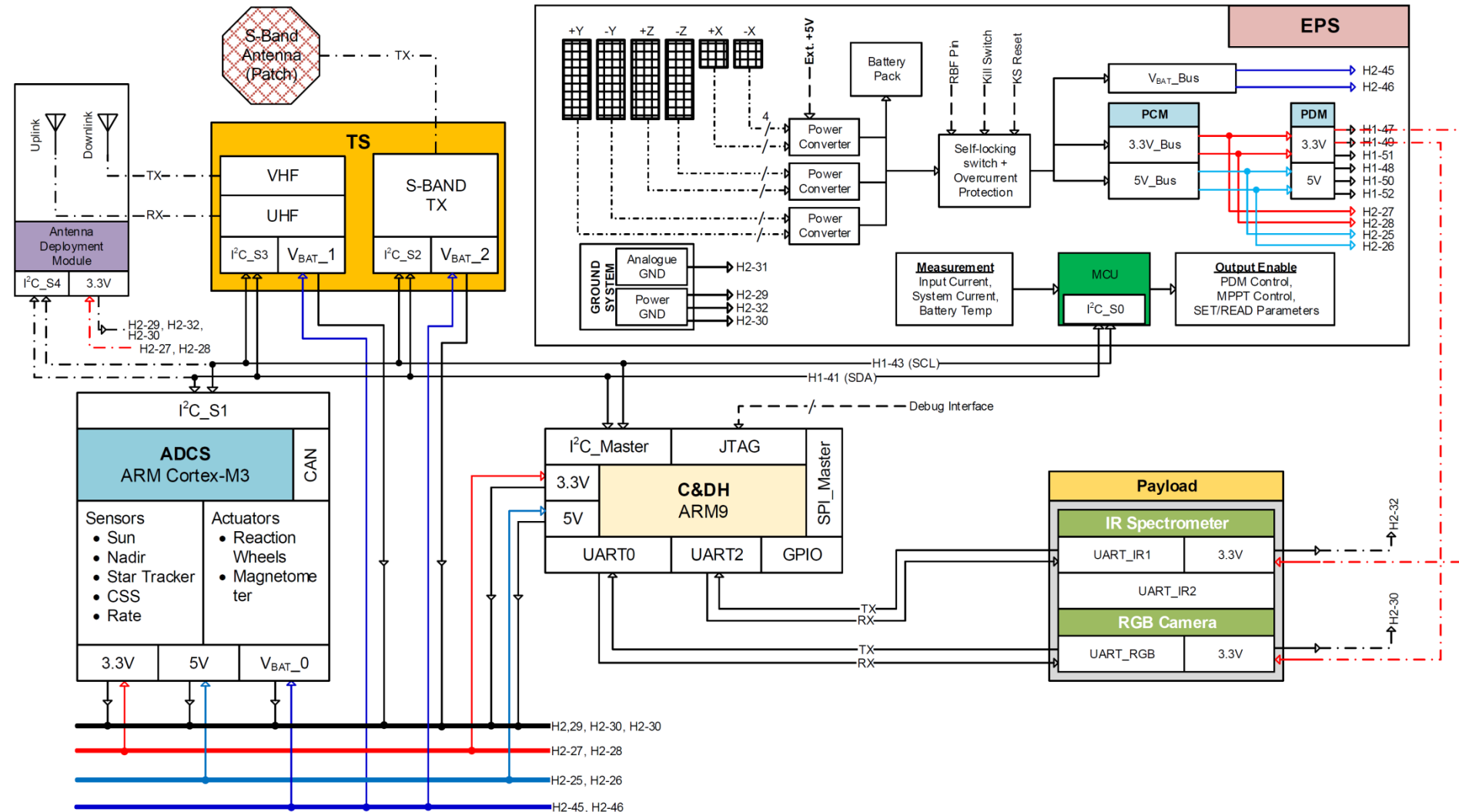


- The RGB camera provides two exclusive benefits:
  - ❖ RGB camera provides relatively higher resolution images compared to SWIR sensor.
  - ❖ The SWIR camera is a single pixel hyperspectral sensor which requires high pointing accuracy. If the ADCS system cannot achieve high pointing accuracy, the RGB image can be used to correct the pointing errors on ground.
- Also, the combination of Visible and SWIR data is a unique dataset that can be used for accurate atmospheric correction of Visible bands using SWIR bands. This data will be provided to the global science community for experiments.
- We will also acquire images of moon during the mission using this combination to explore on-orbit calibration using lunar spectra.

# Spacecraft Overview: Exploded View



# System Preliminary System Block Diagram

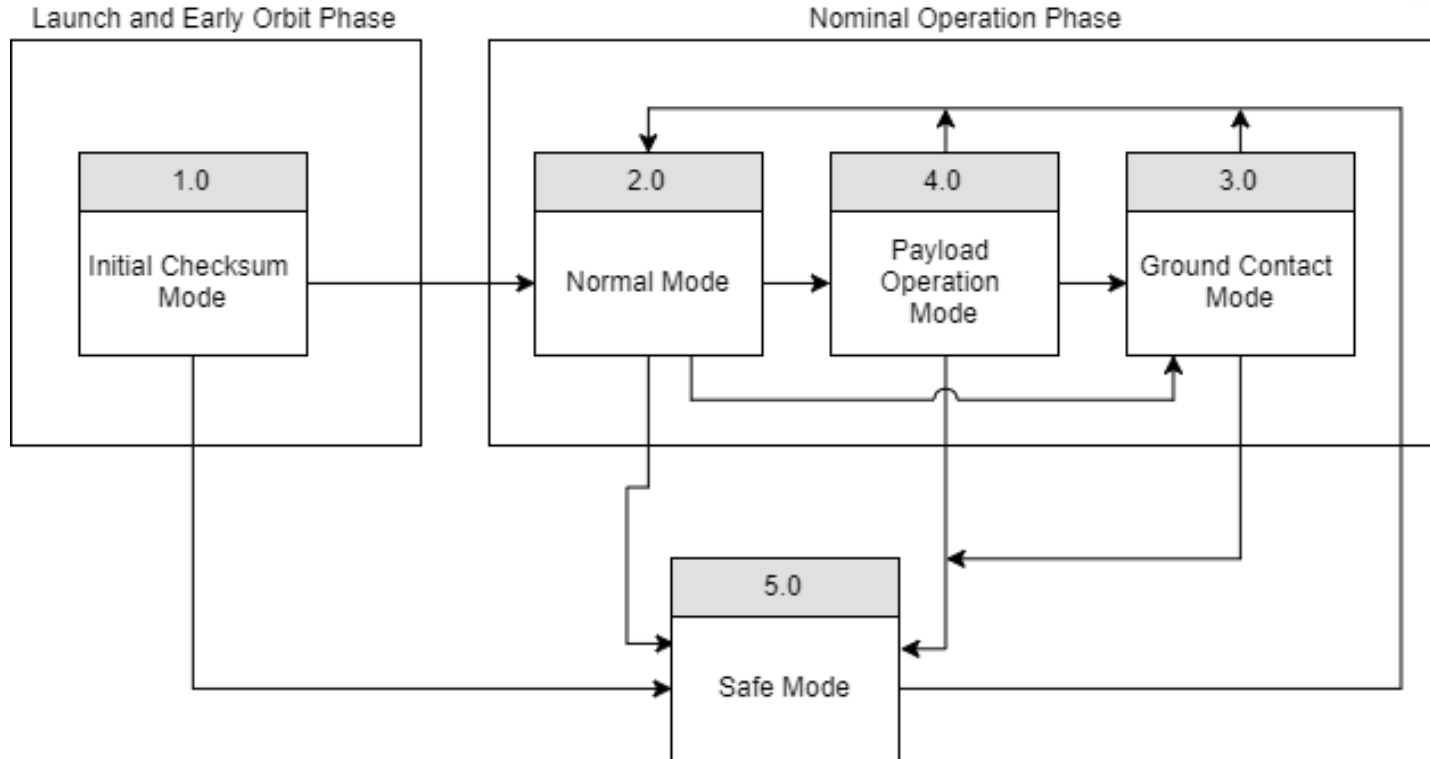


# Key Systems/Components



| Component/Subsystem             | Model                | Comments                                                          |
|---------------------------------|----------------------|-------------------------------------------------------------------|
| OBC                             | iOBC (ISIS)          | ARM9 Processor, 400 MHz.                                          |
| ADCS                            | CubeADCS (CubeSpace) | Integrated ADCS, 3 reaction Wheels, star tracker, <1 deg accuracy |
| Solar Panels, EPS and Batteries | TBD                  | possibly GomSpace batteries and EPS, Clyde Space solar panels     |
| VHF/UHF transceiver             | TRXVU (ISIS)         | 9600 bps downlink                                                 |

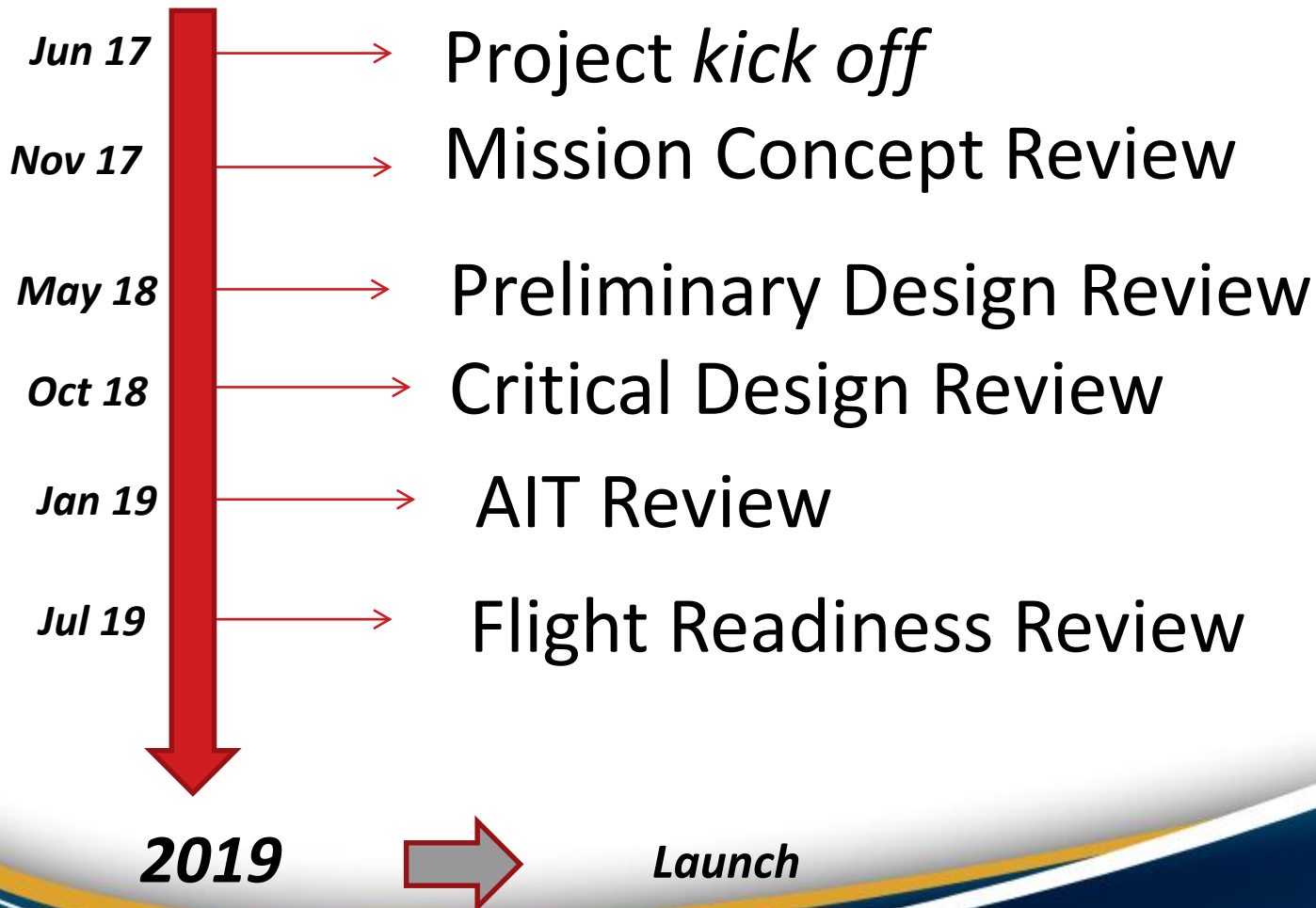
# Concept of Operations







## Program Schedule



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# Thank you

