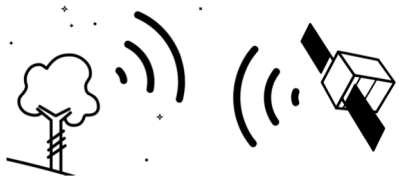
A 200 Year CubeSat That Sings With Trees



Interplanetary Small Satellite Conference,
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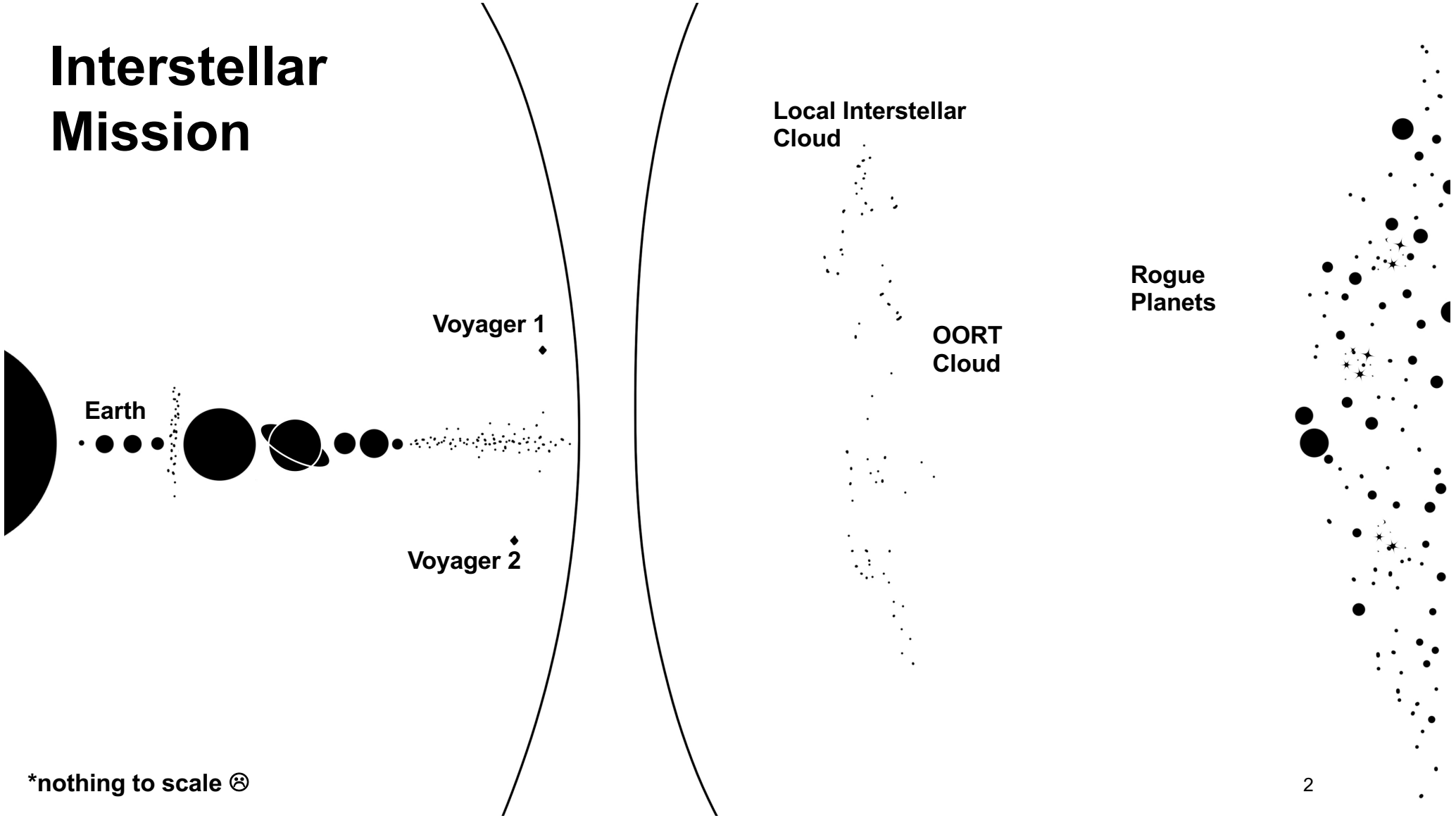
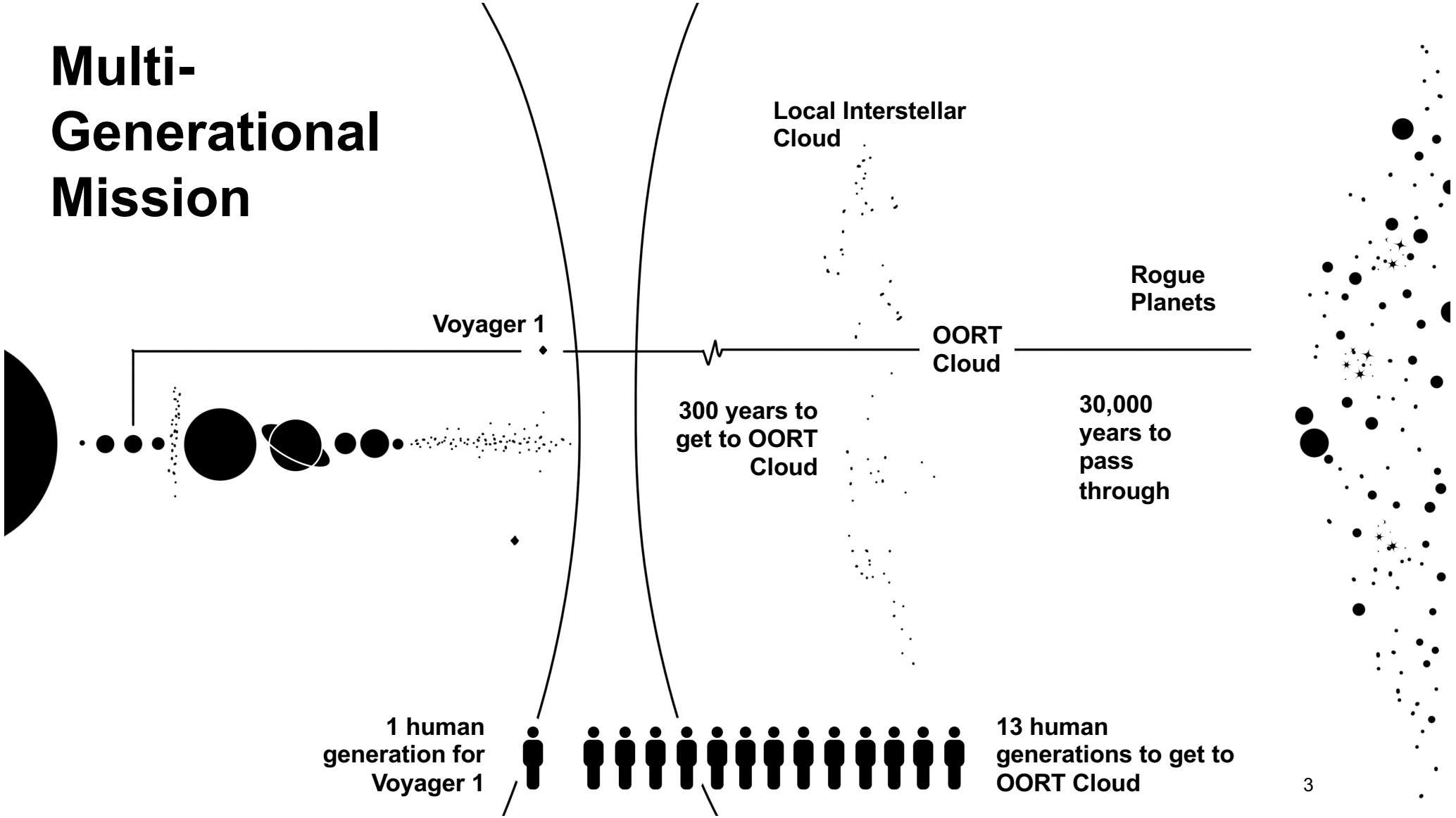
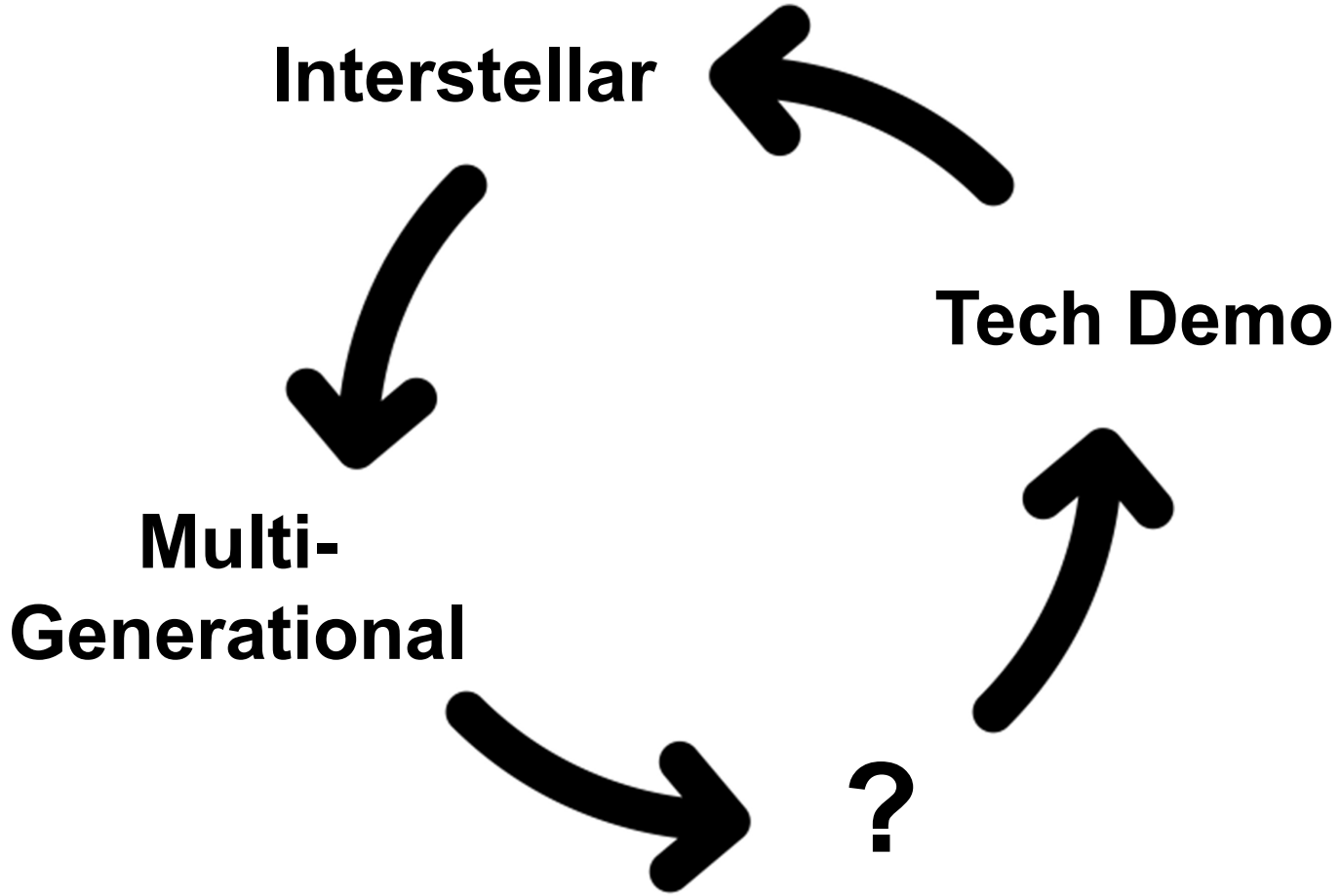
Interstellar Mission



*nothing to scale ☹

Multi-Generational Mission




Interstellar
Tech Demo
Multi-
Generational
?

What is multi-generational?

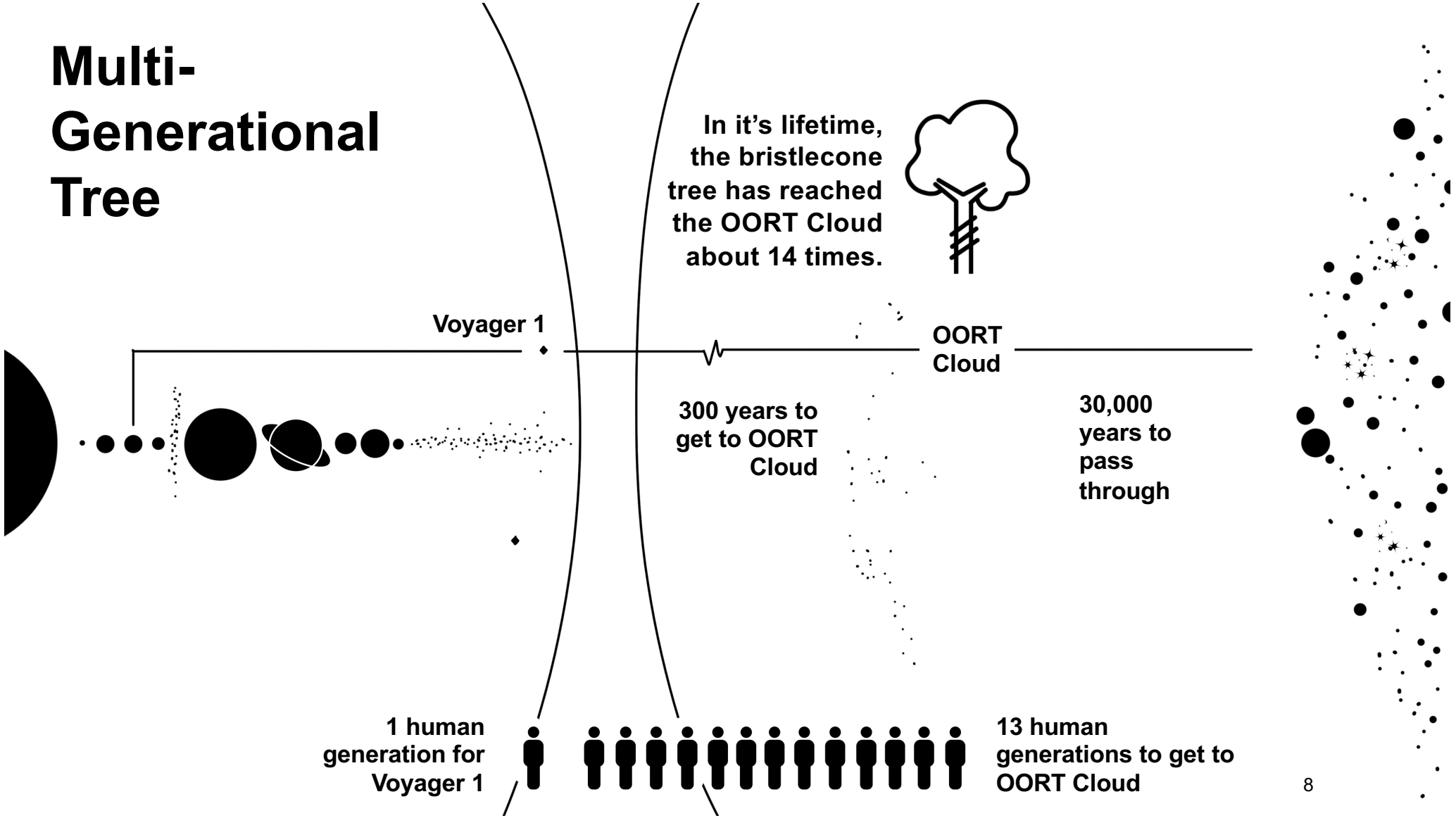

SAMSUNG
499.99
797.99
425.59
899.99
Music and Radio in One Free App

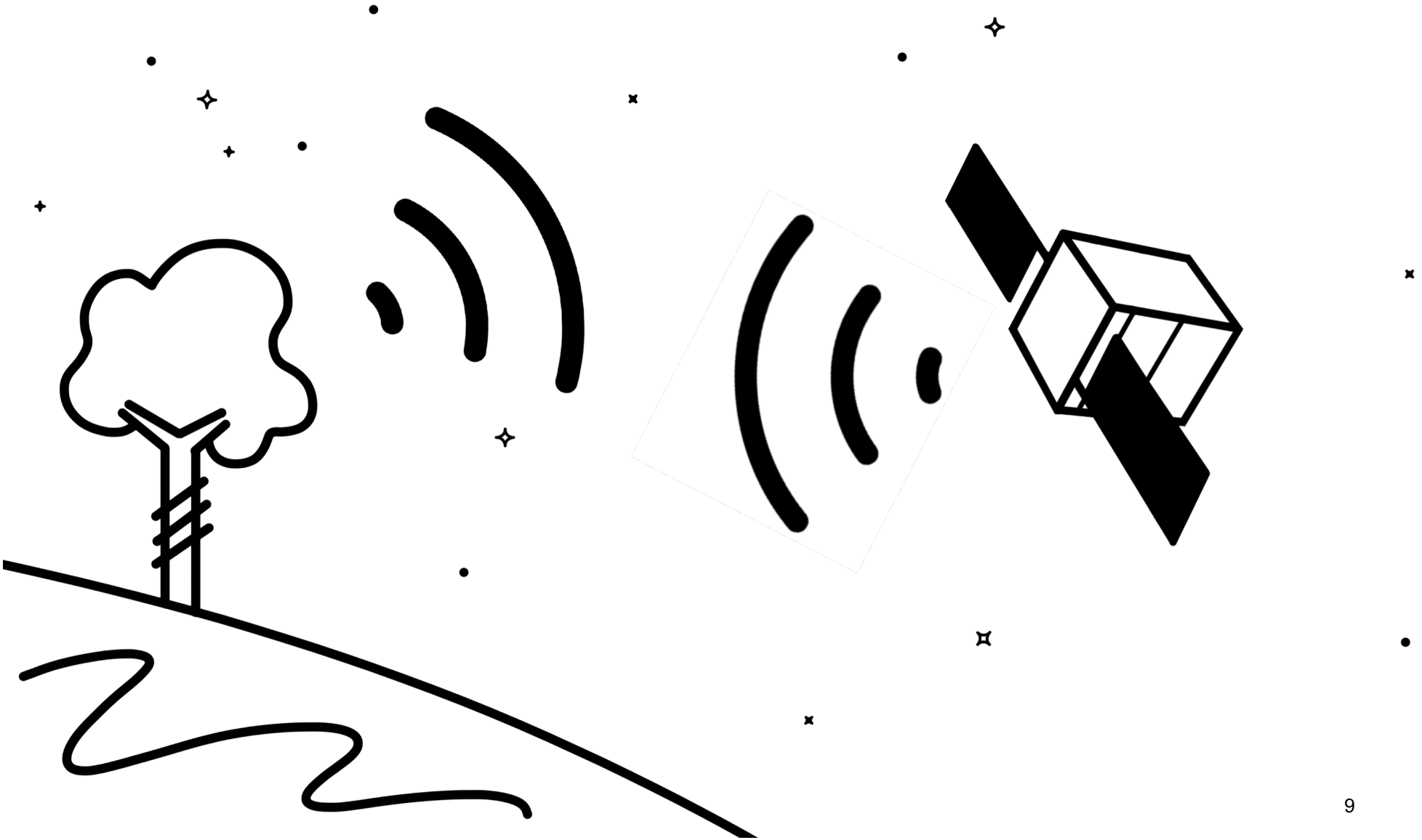

$8999
$10999
UWK-554

Multi-Generational Trees

The Ancient Bristlecone Pine Forest in White Mountains in Inyo County, Eastern California. The oldest tree is 5,067 years old.

Multi-Generational Tree





How could a CubeSat last 200 years?

- Turned off most of the time (1%?)
- ~1000 km altitude orbit
- Simplified CubeSat systems (back to the future)
  - No batteries
  - No attitude control
  - Simplest computer with timer (analog?) possible
  - Maximize the outer surface area, minimize mass
    - Populate with solar cells on every face of the large ~1 m^3 cube, 0.5 cm thick aluminum
    - Low gain patch ~omni antennas on two opposite faces
- An accelerated ground test of 2-3 years could help test several configurations

200 CubeSat Subsystem trade space (1 of 2)

Thermal

- All passive architecture
  - No heater
  - No louvers
  - No flight software control
  - No mechanically actuated heaters
  - No pumps
- Thermal control coatings
  - Black paint
  - Bare metals
- MLI
- Only the skin
- It's an envelope
- 1 mm – 3 mm thick
- 0.5 kg/m^2 of surface area +/- 20%

Power

- Orientation independent
- 45 W EOL
- 900 cm^2 of solar cells
  - Active area is 720 cm^2

Telecomm

- UHF transmitters/receiver 7 cm x 4 cm (fits within 1 U)
- Two dipole antennas (opposite "ends" faces)
- 1 Watt standby
- 5 Watts
- Uplink separate from downlink
- Downlink: 2 kbps
- Uplink: 9 kbps (100 W R_f on tree side)

200 CubeSat Subsystem trade space (2 of 2)

C&DH

- x2 (only one on at a time), total of 4 cards:
  - Single card for processor (Sphinx)
  - Single card for timer (Sphinx custom)
  - Fault detection
- 5 Watts total operating, 1 Watt standby
- Cross strapping (H/W & S/W)

Propulsion: None

Structure

- There's nothing different about a 2 year mission (MARCO)
- 3mm wall thickness → 6.5 kg
- 0.5cm thickness → 11 kg "beefy"
- Will easily handle launch loads

Attitude Control: None

Payload Possibilities

- None
- Radiation sensors
- Camera
- Photodiodes (photometer)
- Sun sensor
- Earth limb sensor
- Ultraviolet spectrometer
- Visible spectrometer
- Infrared spectrometer
- Magnometer
- Plasma detector
- Microphone (vibrations)
- Dust detector
- Thermal imager
- Bolometer
- Langmuir probe, s/c charging

200 year CubeSat Can Start Now

- First step towards an interstellar probe
- Test of longevity
- Inspirational
- You’re now part of the story arc

Thank you for your time and interest