

Space Telescopes
Asteroid Mining
Space Manufacturing

SPACEFAB.US 

Business Road Map

Cost efficient high value space telescopes

- Unique business model
- “Deployable optics” technology

Asteroid mining

- Priority on metal asteroids

Exponential Space Manufacturing

- Fully automated In-Space manufacturing



Space Telescopes

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Space Telescope Business

- *The* first commercial space telescope, for **both** Earth observation and space astronomy
- Maximize revenue
 - Earth observation on daytime side
 - Astronomy on night time side

Why Astronomy From Space

- Always perfect observing conditions
- Free of weather problems, atmospheric distortion, light pollution from city lights
- 24 hour operation, not just at night
- Longer camera exposure times
- Both Northern and Southern hemispheres are viewable
- All IR and UV wavelengths viewable, unblocked by atmosphere

Space Observatory Services Market

- **\$100M annual Total Available Market for professional and amateur astronomers**
- **Only a few professional and amateur astronomers have access to a space based telescope → severe shortage of availability**
- **Market can be *profitably* serviced from our initial satellite**
- **Working with a major US university on multi-million dollar NSF funded program, US colleges get access to our space telescope**

Earth Observation Services Market

- **\$1.6B annual Total Available Market**
 - Commercial mapping
 - Agriculture analysis
 - Pollution monitoring
 - Weather prediction
 - Security and Defense



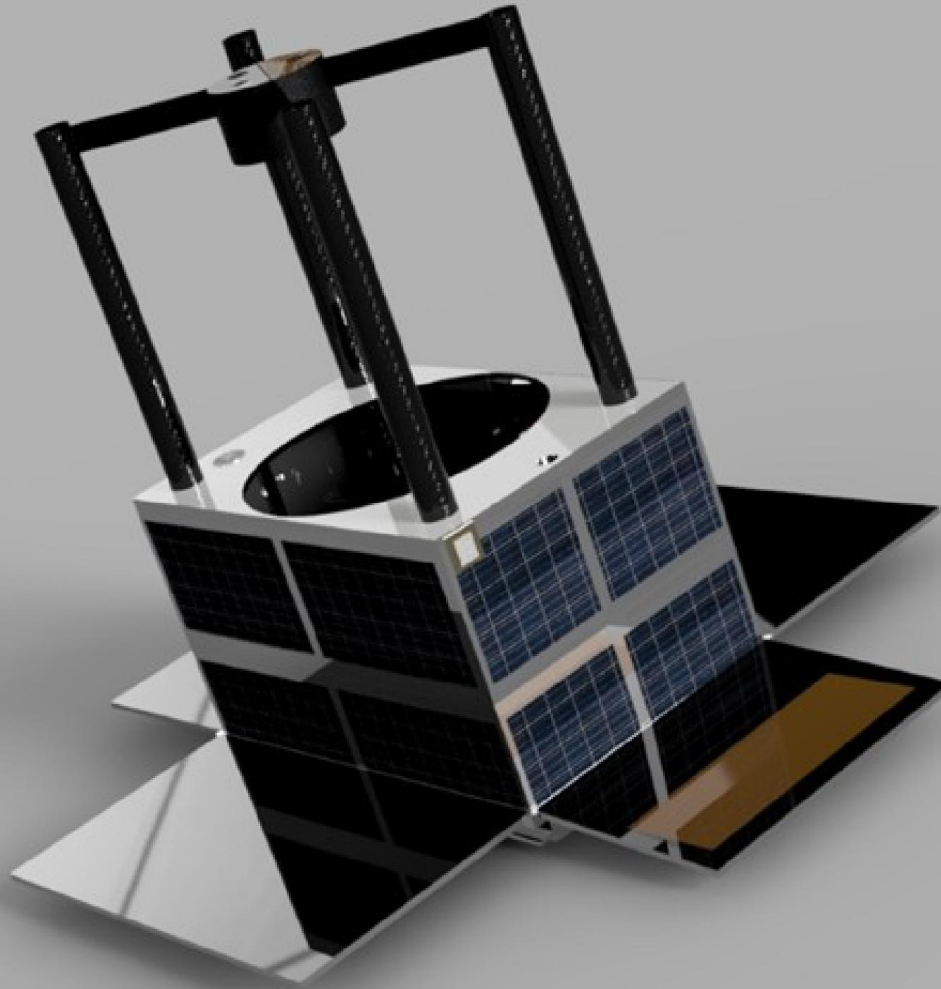
Waypoint Space Telescope Satellite

- **Design, build, and launch satellite #1 in 2019**
 - A corporate partner will subsidize the launch cost
 - 18 kg, 12U cubesat
 - Corrected Dall Kirkham telescope, 21 cm diameter
 - Deployable secondary mirror cuts spacecraft structure cost and launch cost in half
 - Image processing accelerated by on-board hardware
 - Three powerful cameras

Waypoint Space Telescope Satellite

- **High resolution 48 Mpixel visible and near-IR camera**
 - Astronomy: .6 arcsecond resolution
 - Earth observation: 1 meter GSD, super-resolution mode
- **Image intensified ultraviolet 8 Mpixel EMCCD camera**
 - Exposure time reduced by 20X
- **150 band hyperspectral camera**
 - 470 nm to 900 nm
 - 3 meter GSD

SpaceFab Waypoint Space Telescope



SpaceFab Waypoint Space Telescope

- Cameras for UV, visible, and hyperspectral imaging
- Laser communications to our optical ground stations
- SpaceFab deployable mirror technology provides Waypoint with 3X to 35X reduction in cost



<i>Satellite</i>	<i>Mass</i>	<i>Cost, incl. launch</i>	<i>Mirror Size</i>	<i>Ground Resolution</i>
SpaceFab Gen1	18 kg	Lowest	21 cm	1 m
Black Sky / SCOUT	55 kg	\$7M	25 cm	1 m
Beijing-1	166 kg	\$60M	31 cm	4 m
Razaksat	180 kg	\$70M	30 cm	2.5 m

Waypoint Satellite Marketing Plan

- **Astronomical imagery**
 - Low resolution is free
 - Public and private repositories
 - Archived and tasked imagery on demand
 - Subscription – access to all high resolution public data
- **Earth observation imagery**
 - Free low resolution
 - Archived and tasked imagery on demand
 - High resolution 1 meter GSD

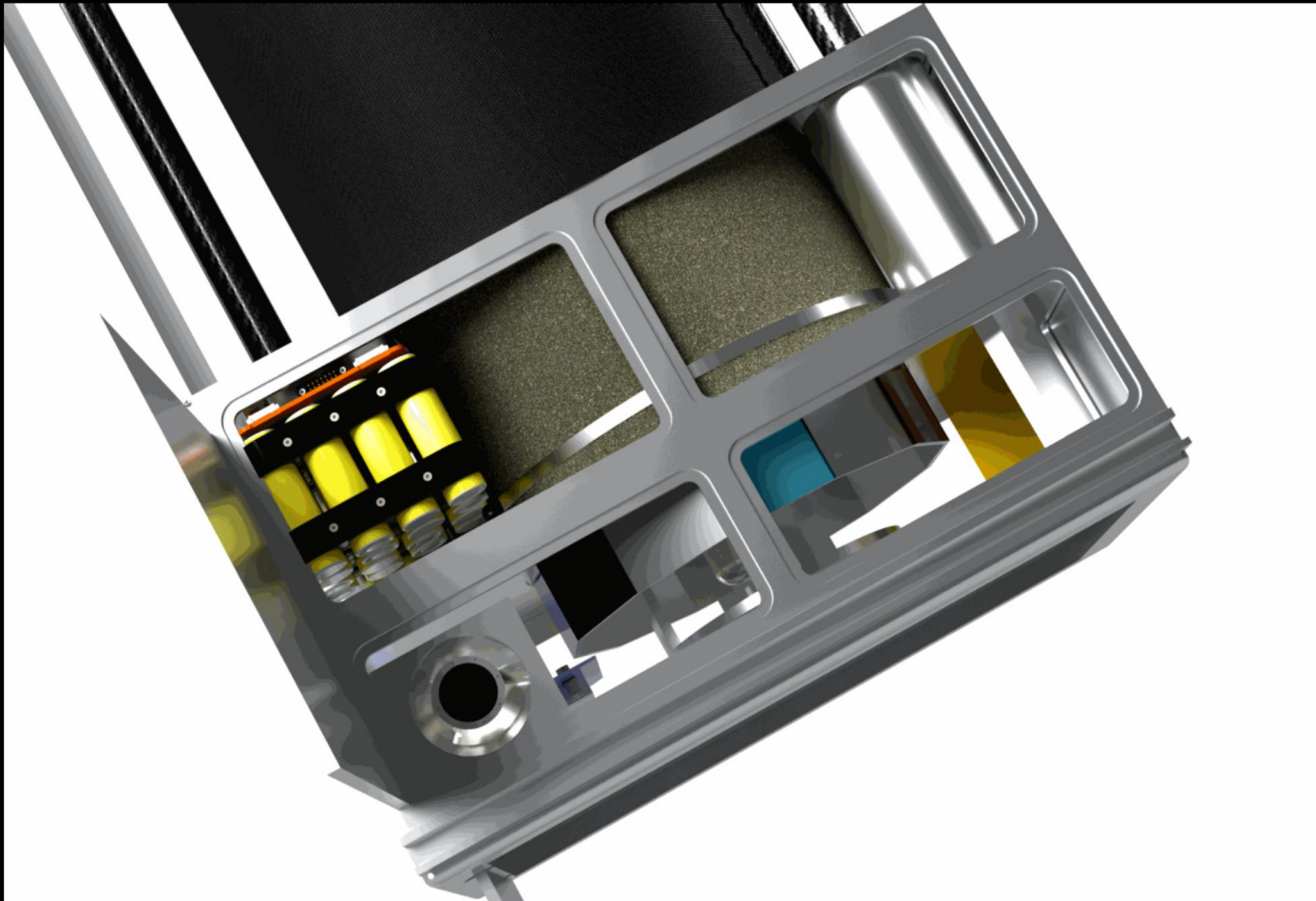


Waypoint Satellite Future Development

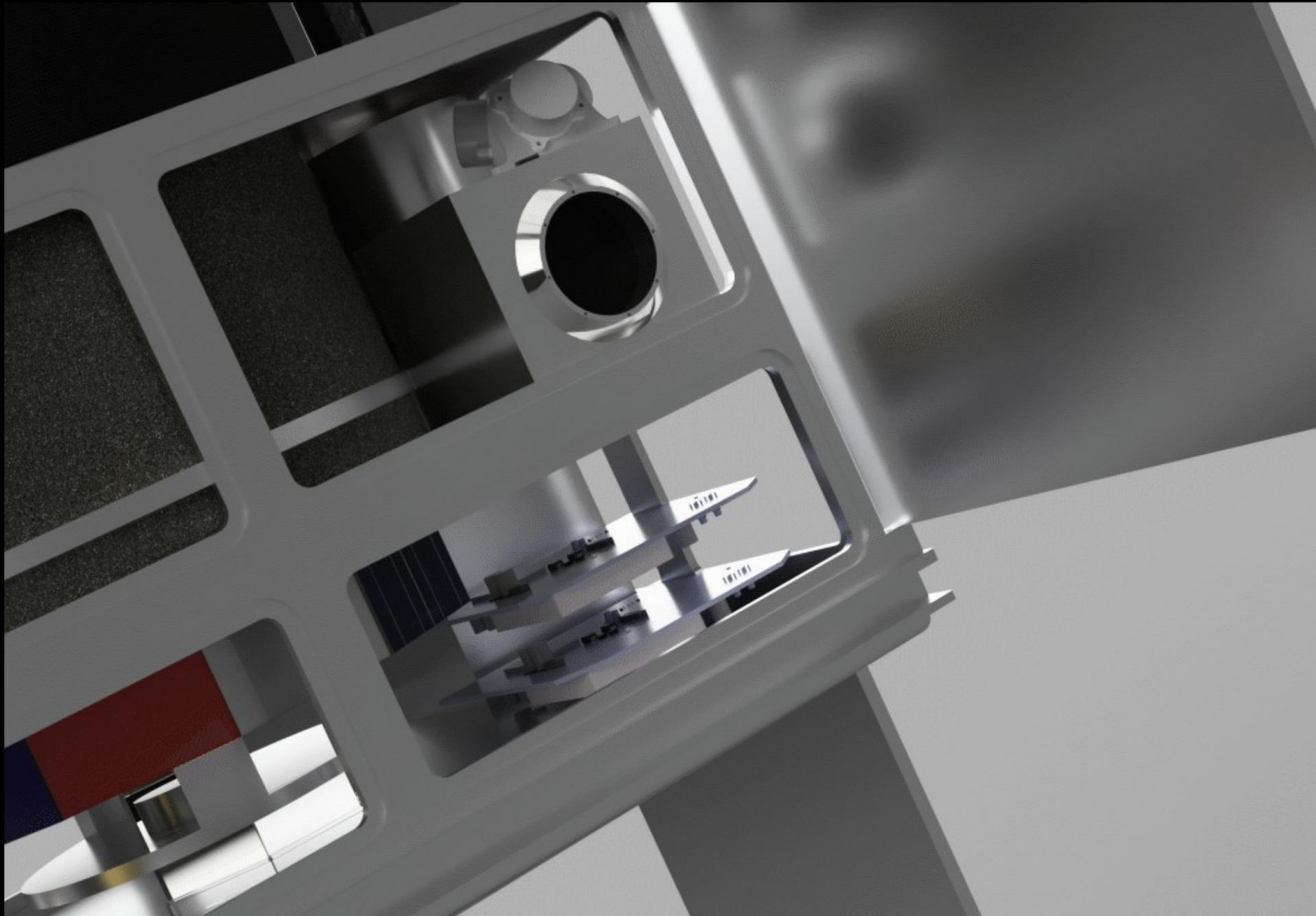
- **Build and launch constellation**
 - Four Waypoint satellites fit on a \$3M launcher
 - Low cost constellation with 1 meter GSD and high revisit rate
- **Future very high resolution optical satellite**
 - 30 cm GSD, super-resolution mode
 - Deployable secondary mirror cuts weight, size, and cost by an order of magnitude
 - Each satellite can be launched by a \$10M launcher



Waypoint - Interior View



Waypoint - Interior View



Customers can take pictures like this from our satellite



Customers can take pictures like this from our satellite



M83

.6 arcsec / pixel

Customers can take pictures like this from our satellite





ASTEROID MINING

SPACE MANUFACTURING



SpaceFab.US 

Space Manufacturing Business Line

- **Asteroid Mining and Exponential Space Manufacturing**
 - Build on technology from Space Telescope business
 - Robotic processing of metal asteroids into bulk metals
 - Make and assemble metal tooling and machinery using 3D printing and CNC machine tools
 - Exponential growth in manufacturing capacity
 - Provide in-space manufacturing as a service

Exponential Reduction In Costs

- Fully automated in-space manufacturing will drive most costs down to zero
 - Raw material and real estate cost: zero
 - Continuous reduction in costs of labor, energy, equipment, and transportation means fabrication costs will approach zero
- Large billion dollar structures such as power beaming satellites or large space stations will become affordable

Intellectual Property

- **Patent pending ion accelerator**
- **Additional intellectual property to be filed**
 - telescope vibration control system
 - extendable boom
 - repairable robotic arm

Who We Are

Randy Chung, Co-founder, CEO and Chairman of the Board

- Founder of EdgeStream, Inc. , Internet streaming video delivery
 - CTO for 15 years, system and software
- System and integrated circuit Electrical Engineer, total of 25 years
 - Satellite engineering, radar signal processing at Hughes Aircraft
 - Developed a billion dollar product, world's first single chip hard disk controller at Western Digital, used in IBM PC-AT
 - Developed CMOS imager integrated circuit products at Rockwell Semiconductor and Conexant



Who We Are

Sean League, Co-founder & Spacecraft Engineering Director

- Experienced company founder of US Telescopes, Inc.
- Astrophysicist, optical networking engineer, observatory and telescope sales and design
- nLight Inc. (anti-missile lasers), MCI Worldcom, Nortel



Partners

Dr. Robert Chung, Member of SpaceFab.US Board of Directors

- Visiting Professor at University of California at Berkeley, experienced in demography and statistical analysis

Yen Choi, Member of SpaceFab Board of Advisors



- Co-founder and Board Member of Fibersat, a satellite operator. Co-founder and Board Member of Netcom Africa, a pan African Network Services Provider.

Richard Hedrick, Member of SpaceFab Board of Advisors



- President and CEO of PlaneWave Instruments, manufacturer of observatory class astronomical telescopes.