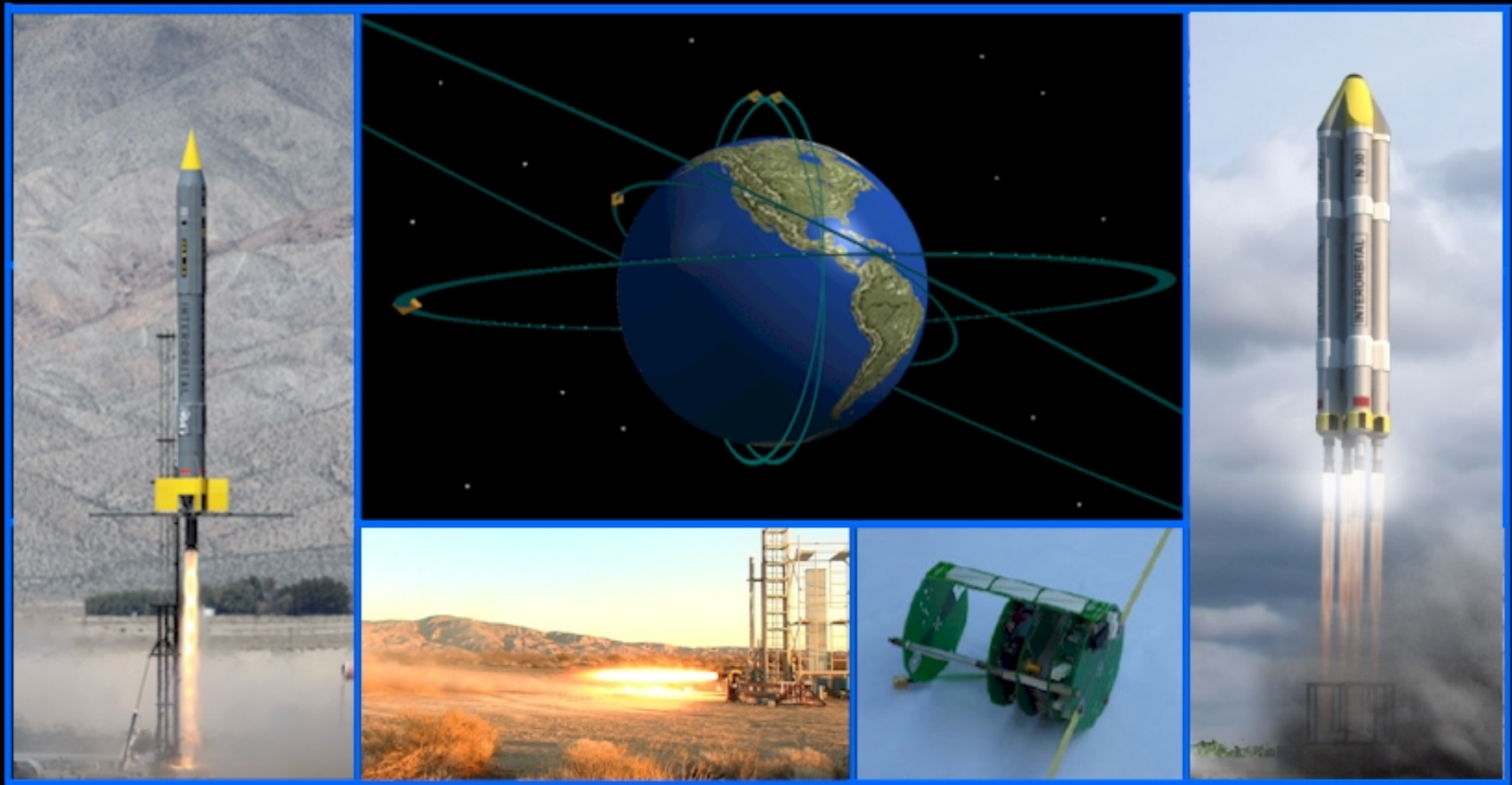


Interorbital Systems
www.interorbital.com

INTERORBITAL SYSTEMS: LAUNCH SERVICES TO LEO, LUNA, AND BEYOND

INTERPLANETARY SMALL SAT CONFERENCE, CAL TECH, April 25, 2016

Presenter: Randa Milliron, CEO/CoFounder, Interorbital Systems and Trans Lunar Research



Interorbital Systems

www.interorbital.com

ABOUT INTERORBITAL SYSTEMS



Interorbital: California C Corporation founded in 1995

Location: Mojave Air and Space Port, Mojave, California

R&D and manufacturing facilities

Two rocket engine test sites

Launch locations land/sea worldwide

Launch Provider for GLXP TEAM SYNERGY MOON



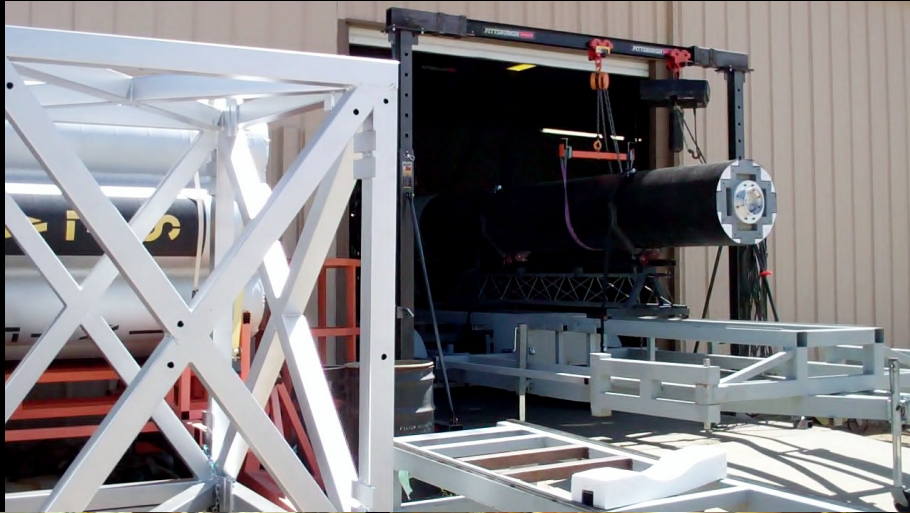
Interorbital Systems

www.interorbital.com

PROTOTYPING & TESTING



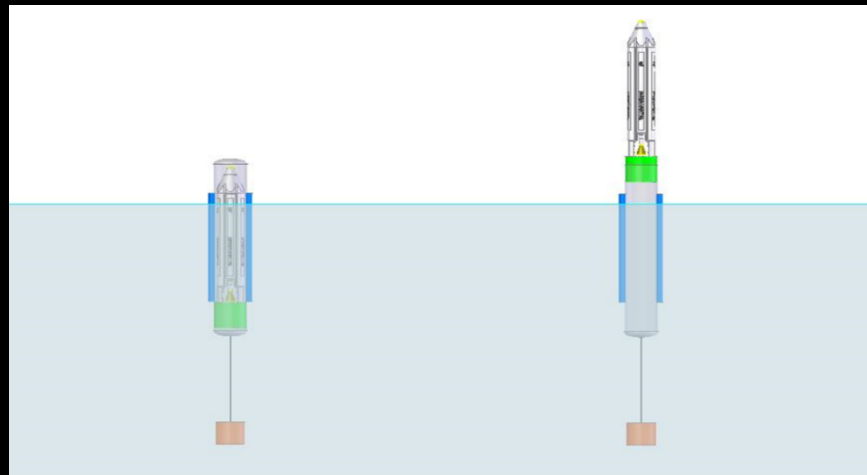
SEA/LAND LAUNCH: IOS MOBILE SPACEPORTS UNDER CONSTRUCTION AT MASP



FLOATING LAUNCH ADVANTAGES



- Complete flexibility in choosing orbit and inclination
- Makes Launch-on-Demand possible
- Launch site, trajectory, and schedule can be set to customer's requirement
- Requires only a minimum of launch support hardware
- Rapid-response; no waiting in a spaceport line
- The most cost-effective launch method



Interorbital Systems

www.interorbital.com

COMMON PROPULSION MODULE



The CPM is the basic building-block of the N-Series modular orbital launchers

Bi-propellant storable, high-density, hypergolic liquid rocket system

Blowdown propellant feed

CPMs clustered together in multiples to meet mission requirements for both small and large payloads

Stand-alone sounding rocket SR145:145-kg to 310km

Interorbital Systems

www.interorbital.com

ROCKET THRUSTER



Storable-Propellant Rocket Engine Technology

**Test of rocket thruster engine and
CPM controller at Mojave Spaceport**

**IOS is first in the US to use high-density nitric
acid, furfuryl alcohol, and turpentine as
propellants of choice**

**Substitutes for expensive, toxic hypergols
like hydrazine and nitrogen tetroxide**



ALL ROCKET ENGINES DESIGNED AND BUILT BY INTERORBITAL IN THE USA!

Interorbital Systems

www.interorbital.com

GPRE 7.5KNTA ROCKET ENGINE: CPM MAIN ENGINE TEST



ISP 245 seconds (sea level); Density specific impulse 323 seconds (sea level); Vacuum ISP = 305 seconds

Blowdown propellant feed; hypergolic propellants; no ignition system or turbopumps required

State-of-the-art, all-composite combustion chamber and nozzle. Designed for rapid mass production

Replaceable ablative chamber cartridge yields plug-and-play engine reusability

Interorbital Systems

www.interorbital.com

CPM TEST VEHICLE PRE-FLIGHT PREPARATIONS AND LAUNCH



Low-Altitude Suborbital Test Launch First Commercial Mission

Specifications:

Length: 30.0 ft (9.1 m)

Diameter: 2.1 ft (0.64 m)

Weight Loaded: 1,200 lbs (544 kg)

Engine Thrust (SL): 7,500 lbs (33,360 n)

Payload: 2 CubeSats and 2 TubeSats

Date: March 29, 2014

Upcoming/Now Booking:

Full-Performance, Space Altitude Launch projected for mid-2016. Cost: \$350,000 to lift up to 145 kg to apogee of 310 km.

Dedicated for small-sat payload testing and microgravity experimentation.

AST Launch Licensing in work

Interorbital Systems

www.interorbital.com

CPM TEST VEHICLE LIFT-OFF



CPM TV reached Mach 1.5 in under 5 seconds. Recovered rocket and all four payloads, intact and still functioning.

Interorbital Systems

www.interorbital.com

INTERORBITAL LAUNCHES 2016-2019



PAYLOADS on Low-Altitude Suborbital Test Flight II, Mid-2016. Sold Out

Boreal Space 3U CubeSat, Ames Research Center, CA
National University of Singapore,
Ulises I, Mexican Space Collective TubeSat
GLXP Team SYNERGY MOON, California/International
Team MILES, NASA CubeQuest Challenge
Miami School of Advertising/FNAZCA, Brazil
University of Zacatecas, Mexico 1U CubeSat
UNAM, Mexico City 3U CubeSat

Primary CPM Hardware to be Tested

Propulsion and Control Systems in flight
Health and Recovery Systems, Wireless-Encrypted CPM Controller
Telemetry, Guidance System, Payload Deployment System

PAYLOADS on Space-Altitude Suborbital Test Flight III, Q4, 2016

SYNERGY MOON GLXP
Boreal Space 3-U CubeSat, Ames Research Center, CA, 3U CubeSat
Ulises I, Music Project, Mexico
SpaceBooth, Belgium
Team MILES, NASA CubeQuest Challenge
GLXP Team SYNERGY MOON, Mojave, CA
UNAM, Mexico; 3U Cubesat
100kg remaining payload capacity remaining on Flight III at \$5,000/kg (Academic)

Interorbital Announces LEO, Lunar, and Interplanetary Missions!!!

2017, Q1: First NEPTUNE Orbital launch
2017: Project LUNAR BULLET in collaboration with Ed Belbruno of Innovative Orbital Design, Inc. and Interorbital Systems. RANGER-style MOON impact mission!!! Seeking addition of GLXP Bonus Prize for First GLXP Lunar Impact.' Lunar Direct.
2017 GLXP Moon Landing NEPTUNE 36: TLI 1 metric ton; 191kg on landing approach; 32kg rover payload. Lunar Direct.
2018: Escape Velocity Mission for five 6U CubeSats (Orion Overflow)
2018/19: VENUS Atmospheric Mission



Interorbital Systems

www.interorbital.com

CPM-GTV: CPM GUIDANCE TEST VEHICLE



Recovered, refitted, and re-purposed CPM TV in its new life as the guidance system test vehicle, CPM GTV, for the NEPTUNE rocket series

[Interorbital Systems](http://www.interorbital.com)

www.interorbital.com

CPM-GTV: CPM GUIDANCE TEST VEHICLE

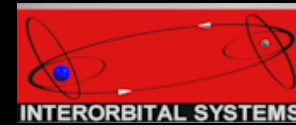


IOS CPM GTV awaits integration of its 7,500-lb-thrust bi-propellant liquid rocket engine. In a fully-fueled version, this rocket becomes the SR 145: Suborbital Rocket with a 145kg lift and 310km apogee capability. IOS SR 145 is a rapid-response, launch-on-demand vehicle, offering 8+ minutes of excellent quality microgravity, with hardware and software space-qualifying/space-test flight profile. SR 145 also serves as a SCUD-signature target, with complete mobile functionality, launching from both land and sea

Interorbital Systems

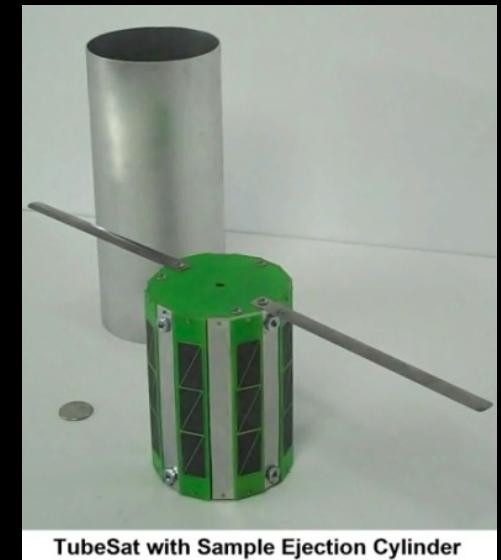
www.interorbital.com

PERSONAL SATELLITE KITS



KIT FEATURES:

- PCB Gerber Files
- Solar Cells
- Antennas
- A Li-ion battery pack (3.7 V 5200 mAh)
- Microcomputer (Arduino Mini)
- Transceiver (Radiometrix) for Up and Downlink
- Fasteners and Hardware
- Complete instructions and assembly guide
- Active Builders' Forum
- \$8,000 Academic Price: Kit & Launch



SATELLITE LAUNCH MANIFEST

128th Payload Booked!



CUBESATS

UC Irvine, UCISAT1

FPT University, Vietnam, F-1 CubeSat

Nanyang Technological University, Singapore VELOX-P CubeSat

Google Lunar X PRIZE (GLXP) Team PLAN B (Canada)

GLXP Team EuroLuna, Romit 1 (2-Unit CubeSat from Denmark)

NASA Independent Verification and Validation (IV&V) Facility, 1CubeSat

King Abdullah University, Saudi Arabia (KAUST) 2 CubeSats;1TubeSat

The Golden iPod: Voyager revisited; Earth to Sky,spaceweather.com, Bishop, CA STEM Program

Pakistan's I CUBE-1 Series, Islamabad Institute of Science and Technology

Boreal Space, California / M2M2Sky, Brazil; Wayfinder I

Rufs the Space Lion, Sweden

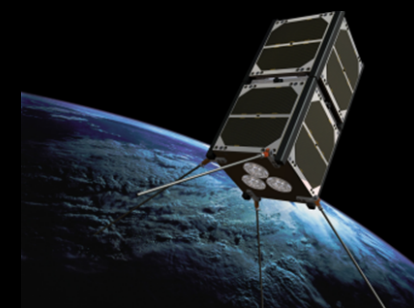
Solarem (UK)

Ars Technica (3U)

Dave Cote, Vancouver, Canada (3U)

MITRE Corporation

**Denmark's GLXP Team Euroluna:
Romit 1 2U (2-Unit) CubeSat >>**



Launch Cost: \$12,500-\$19,625, Academic

SATELLITE LAUNCH MANIFEST

128th Payload Booked!



TUBESATS

Morehead State University (Kentucky Space) (TubeSat and 2 suborbital payloads)
InterAmerican University of Puerto Rico
University of Sydney (2) *i-INSPIRE (initial-INtegrated SPectrograph, Imager & Radiation Explorer)*
Aslan Academy (Private LA High School) STEM Program
Project Calliope (Space Music Project)
Universidad de Puerto Rico/Marcelino Canino Middle School, STEM micro- meteoroid impact study
GLXP Team SYNERGY MOON Space-Qualifying Rover Team AUV's Comms
GLXP Team Part-Time Scientists / Fluid & Reason Software (2) (US/Germany)
Naval Postgraduate School (3); TubeSats as ad-hoc orbital communication nodes
Defense Science and Technology Lab (DSTL) United Kingdom
Austrian Arts Group mur.at with MURSAT: Earth-as-Art Project
United States Military Academy at West Point (2)
Brazilian Space Institute/108 5th-7th Graders, Ubatuba, Sao Paulo, Brazil STEM Program
Mexican Satellite Project ULISES Sat from PLAY Festival's Arts/Soccer Opera from Space
TriVector Services (Huntsville) TRACsat – TriVector Radiation and Attitude Control Satellite
La Despensa (The Pantry) Advertising Agency/Iniciativas en Idiomas (Madrid, Spain)
AKQA Advertising, San Francisco
Universidad de Chile, Santiago
Galaxy Global, 1 TubeSat, donated to NASA Educational Program
Mountain View/Los Altos School District
NASA Independent Verification and Validation (IV&V) Facility (5)
IBM (4)

Price: \$8,000 Kit and Launch (Academic)

SATELLITE LAUNCH MANIFEST

128th Payload Booked!



TUBESATS

Institute of Advanced Media Arts and Sciences/The Science Project, Inc., Japan (7)

University of Sao Paulo, Brazil (2)

David Lawrence K-8 School, North Miami, Florida

RADG, Ohio---Undisclosed Advertising Project

Jose Virgilio Braghetto Neto/OMNI LABS, Brazil

Ute Mountain Ute/Colorado State University Extension 4H

KEN KATO---Personal Satellite Project, Japan

Ryerson University, Toronto, Canada

DOCTOR WHO TARDIS in Orbit: Robert Doyle and Team

Emmanuel Lesser, Spacebooth, Belgium

University Nova de Lisboa, Portugal

National University of Singapore, RSPL (3)

Manhattan Satellite Lab; NYCSAT-1

RMC s.r.o.; *Popular SK*, Slovakia

Penn State University, Wilkes-Barre Campus

Universidad Autónoma de Autónoma de Zacatecas, Mexico (2)

MEDO, South Africa

NoiseFigure Research

Technical University of Moldova

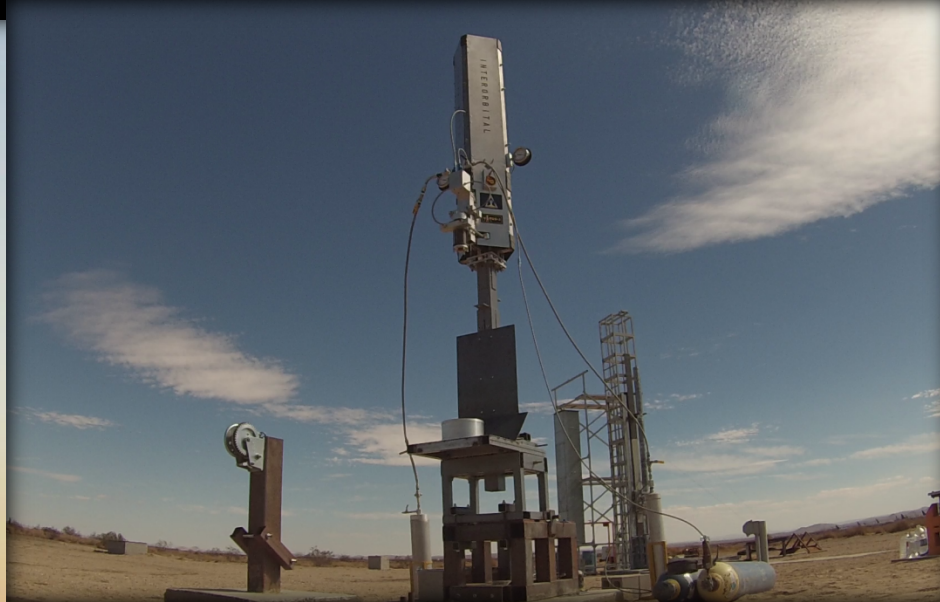
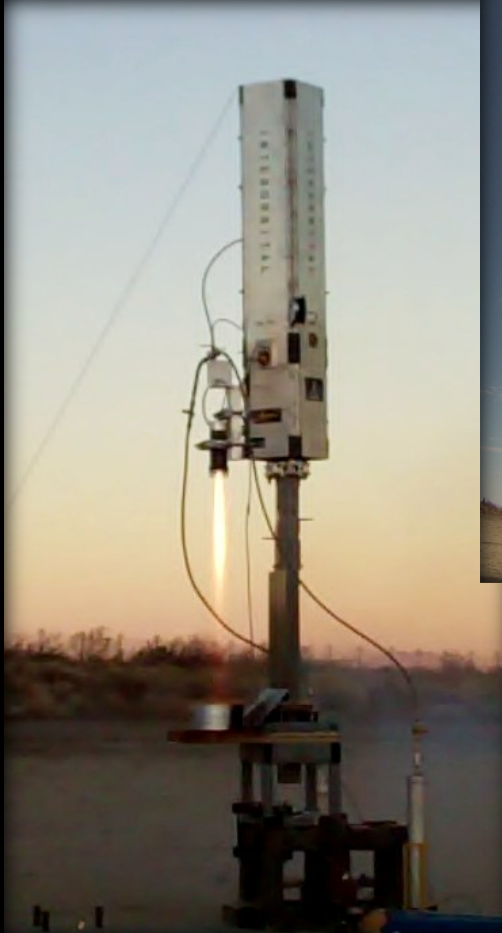
Harmony School of Excellence, Austin

Base 11/ West Los Angeles College (2)

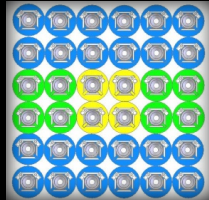
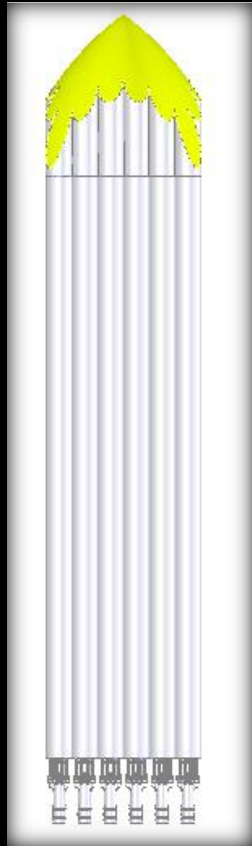
Shasta College, California

Price: \$8,000 Kit and Launch (Academic)

GOOGLE LUNAR X PRIZE LUNAR LANDING SYSTEM: INTERORBITAL/SYNERGY MOON



NEPTUNE 36 (N36) MEDIUM-LIFT ROCKET



INTERORBITAL SYSTEMS / SYNERGY MOON

36 Common Propulsion Modules (CPMs)

36 Ablatively-Cooled Liquid Rocket Engines

Four Stages (Lunar Transfer Vehicle = Stage 4)

Gimbaled Steering ; Modular; Ocean-Launched

Alternate Approaches:

* 5 launches of smaller five-module rockets with rendezvous and docking on-orbit assembly to create an augmented vehicle

* Using larger CPMs to reduce number of modules needed

NEPTUNE 36: 1 Metric Ton (~2000 lbs) to LEO; 191 kg (421 lbs) to TLI; 32kg (70 lbs) to Lunar Surface

SYNERGY MOON GLXP Launcher

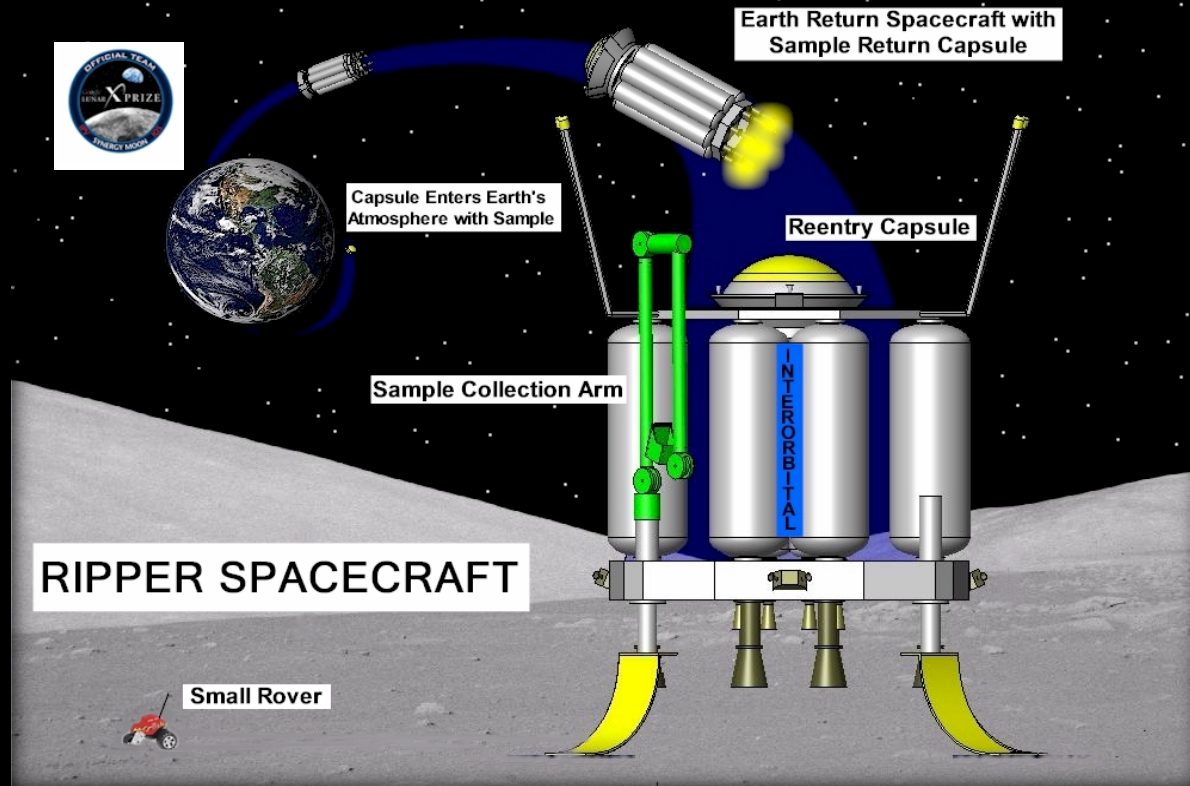
Lunar Direct; No Parking Orbit



Interorbital Systems

www.interorbital.com

IOS LUNAR SAMPLE RETURN MISSION



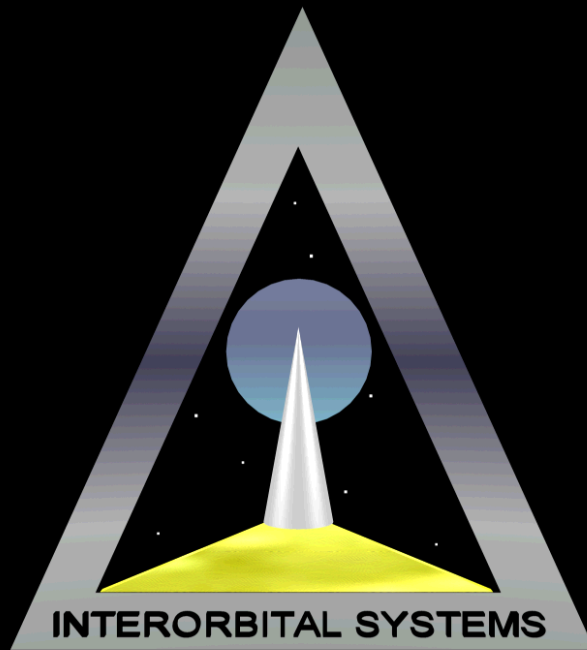
X PRIZE FOLLOW-ON MISSIONS

PRE-SALE OF LUNAR MATERIAL TO COLLECTORS AND RESEARCHERS

Dedicated and Ride-Share Launch Opportunities for Small Satellite Payloads to the Moon and Beyond

Interorbital Systems

www.interorbital.com



Interorbital Systems
www.interorbital.com