SFA Workshop on Regional Perspectives

Space Presentation

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Small Satellites (SmallSats)

- SpaceX Big Rocket
  - When built, among the largest rockets ever constructed
  - 100 ton payloads cheaply to Low Earth Orbit (LEO)
  - 1,000 MicroSats placed into proliferated LEO on single launch
  - Self-building '*LEGO*' kits that can build larger and more complex space satellites and stations than we know today
- One kilogram of stuff into space
  - 2004, 40K($US)/kg; 2018, $2.5K/kg; 2020 $47/kg
  - Can reusable rockets and 3-dimensional printing in space drive costs even lower?
- Decreasing costs catapults mom and pop space rangers into space realm and exponentially advances technology much like the internet did for computing

Proliferated LEO Constellations

- Trend toward constellations of many more smaller satellites in Low Earth Orbit (LEO)
- Motivations:
  - 100% global coverage, lower cost to build & launch, shorter life with faster technology refresh rate, higher constellation mission resilience if an individual satellite(s) were lost
- Current focus is global satellite communications (SATCOM)
- Planning and design of architectures for other mission areas ongoing:
  - Private and Military SATCOM
  - Broadband - Internet for All
  - Position, Navigation and Timing (PNT)
  - Missile Warning
  - Earth Imaging

Who's Who in Proliferated LEO

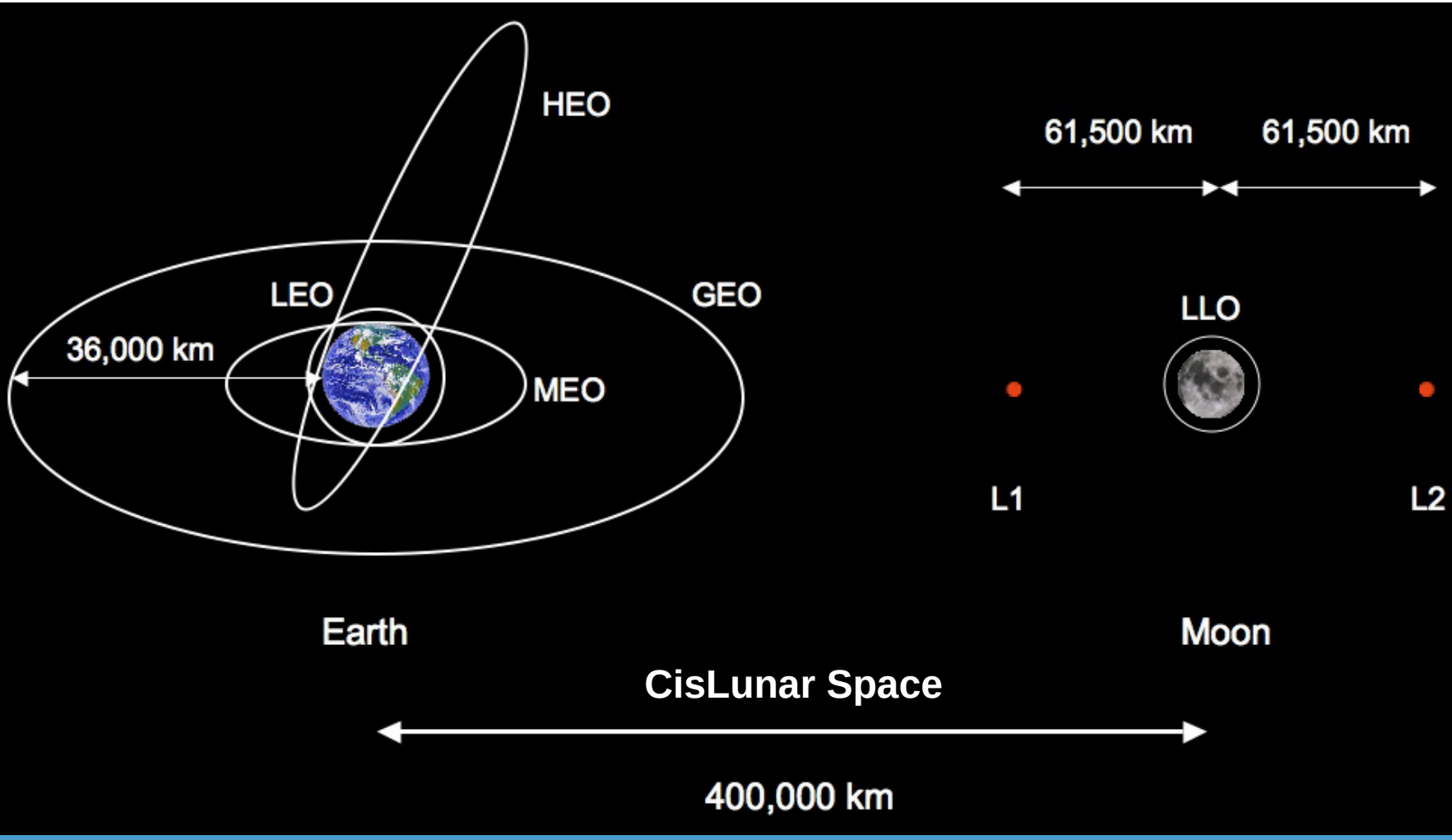
SATCOM Internet

- Uncensored access to the internet
  - Governments attempting to block access may cause unintended denial to other space-based services
  - How would attempting to jam private satellite communications (SATCOM) internet providers be interpreted by the global community?
- Remote locations
  - Isolated communities can become part of the global collective awareness
  - Economic advances in rural areas
  - Retard population migration to mega cities

Space Travel

- REMINDER: Only several decades separated manned flight from manned orbit
  - Rapidly developing rocket engine technology will cause the cost of access to space to plummet
- Virgin Galactic is poised to take paying customers on up and back space adventures
- Blue Origin's 'New Shepard' re-usable launch vehicle can feasibly usher in the age of a space hop
  - Modify the capsule to enable the launch vehicle for transport of humans from GBR to AUS in 2 hours or so
- SpaceX has plans for circumlunar space travel

Orbits Above GEO (Cislunar)

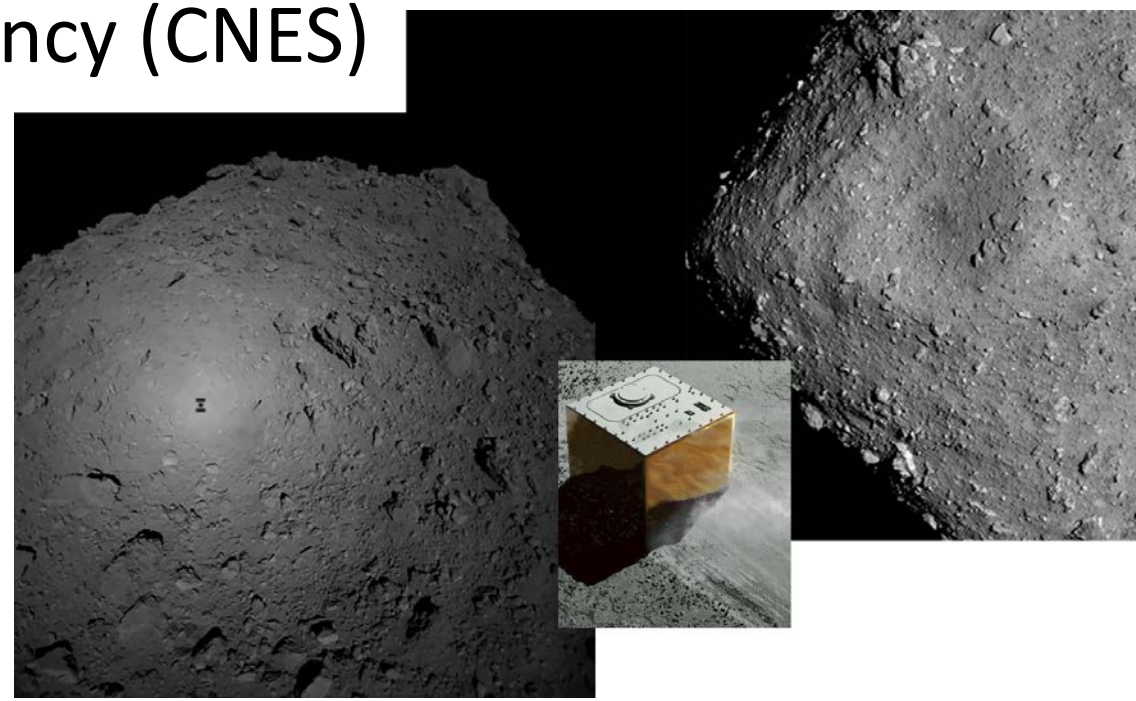


Cislunar Orbits

- Considerable interest in exploring beyond geostationary orbits (GEO)… but why?
  - Return to the Moon
  - Solar Observation
  - Access to non-Earthbound resources to enable further space travel
  - Asteroid mining
- How will regular and prolonged human presence on the Moon and its orbital region influence human activities on Earth?
- Will international competition for resources and military advantage extend here?

Asteroid Landing

- Japan Aerospace Exploration Agency (JAXA), German Aerospace Center (DLR), French space agency (CNES)
- Landed Oct 2018



Collection & Recycling

- Asteroid mining for rare earth materials
- By comparison, moon mining is technically simpler
- Space debris pickup
  - Materials can be recycled on Earth for monetary gain
- Opportunities for scientific community and private entities to profit

GPS Reliancy

- Global Positioning System (GPS) is easily jammed or spoofed
- Operating in a GPS-denied environment is highly likely to be a future reality for the Alliance
- The general public is addicted
  - Tell me again how I get to Grandma's house?
- Position Navigation and Timing (PNT)
  - Essential to banking industry and identifying when transactions take place
  - Necessary as well for our state of the art energy systems
- Possible to use commercial transmissions (WiFi, mobile phone towers, etc.) to geo-locate in the absence of Satellite Navigation (SatNav) data

Imagery Intelligence

- Commercial optical images already exist but they're regulated by space agreements
  - What will happen when unregulated commercial entities and non-state actors enter the scene?
- Observing from space in other wavelengths is more difficult yet doable
  - A decade ago synthetic aperture radar images required supercomputers to process imagery. Now the same computing power is carried in most people's pockets

Militarization of Space

- "Space Force"
  - Does it provoke increasing military activity in space from other actors?
- Usage of anti-satellites
  - Kinetic, ground-based methods are frowned upon due to large amounts of debris caused
  - Non-destructive options however…
    - Sails, nets, propulsion modules, passive and active tethers
  - Can even deorbit assets to collide with a target