



CII HPO GEO & LEO Concept of Operations

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Background



- This appendix is a high level description of what an HPL would encounter from hosting on Geostationary or Low Earth Orbit missions
 - GEO information was derived from the GOES missions and the RFI responses from GEO owner/operators
 - LEO information was derived from the knowledge of how NASA/NOAA operates its polar missions
 - Assumes:
 - All Earth Science Instruments are nadir pointed
 - The HPL will “do no harm” to the host
 - Some interfaces are negotiable with the host
 - The HPL has a limited life, which is considerably shorter than the host



Introduction



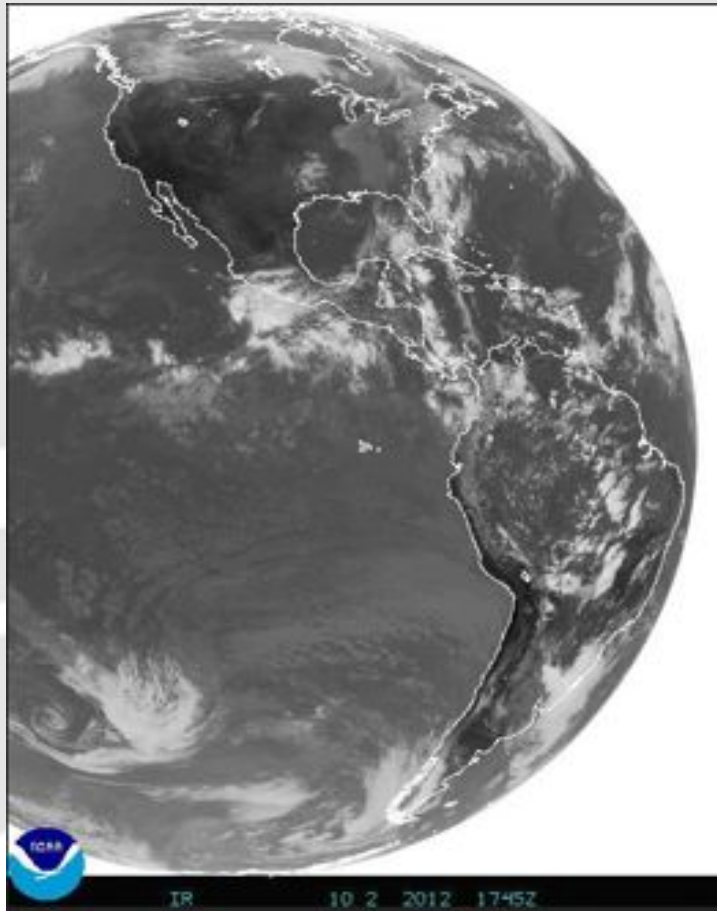
- This document:
 - Is not a requirements document
 - Provides a prospective for the developer with technical recommendations to aid in the design and operations of their instrument
 - Describes the systems, ops concept, and teams necessary to achieve a successful mission
 - Is intended to provide the developer with the understanding that by hosting a payload on a commercial spacecraft, it isn't "NASA business as usual" and negotiations with the host spacecraft are required
 - Supports a "do no harm to the host" philosophy



Orbits

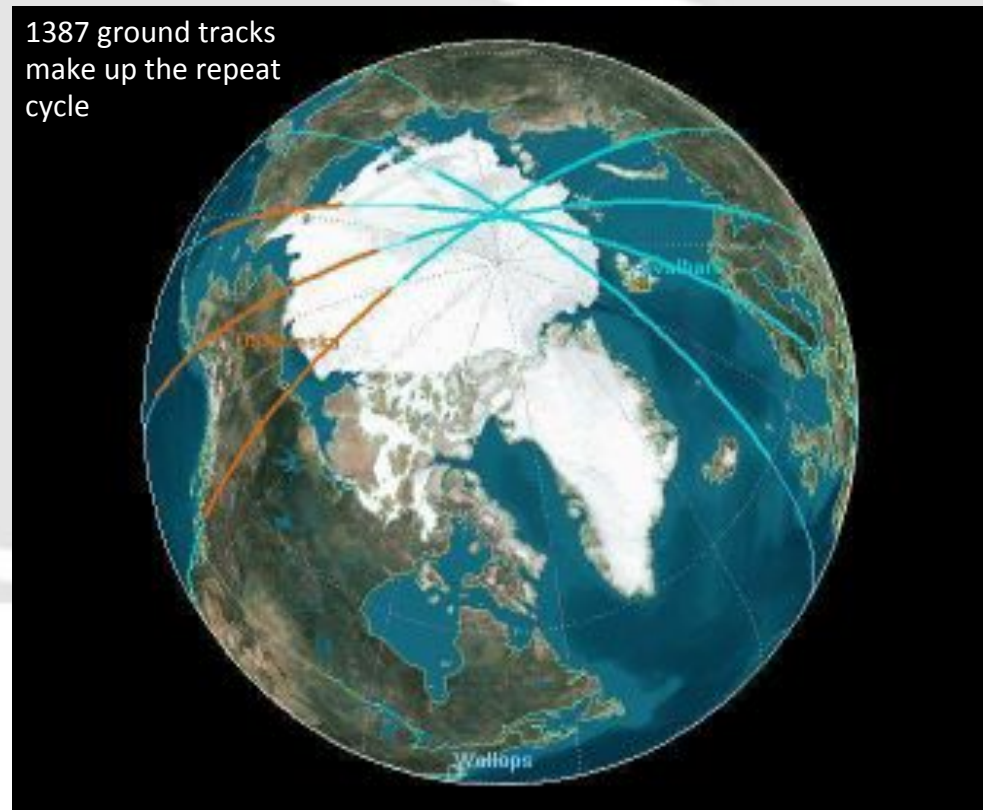


- GEO at 100^oW



- LEO at 92^o inclination, 481km altitude, 91 day repeat (example only)

1387 ground tracks
make up the repeat
cycle



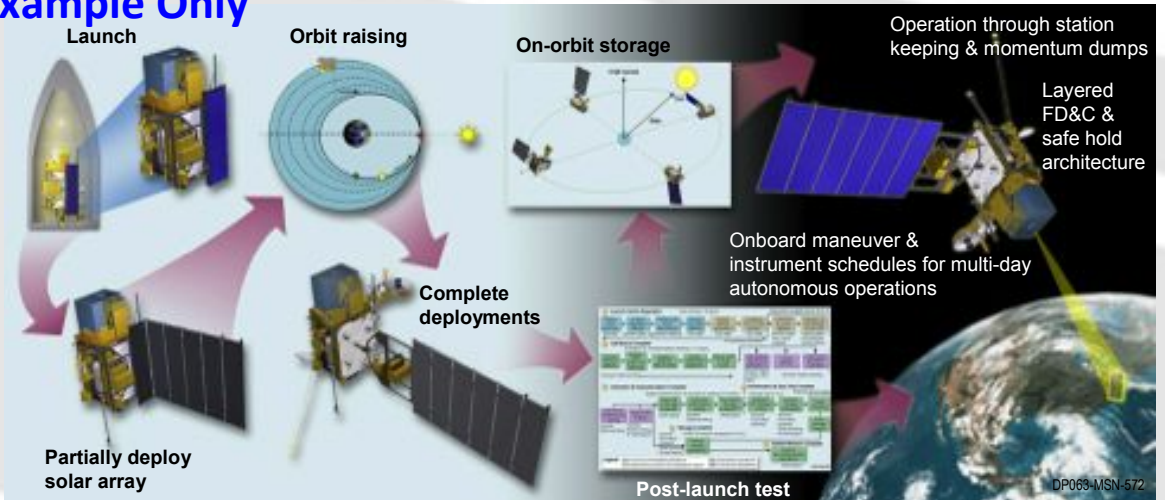


GEO Launch & Checkout Flow



- Launch, Ascent & Fairing separation are the same (time may vary depending on LV), HPL will be powered off
- Partial solar array deployment
- Orbit raising may take 7-10 days (conventional) or up to 6 months for all electric propulsion system
 - May go directly into desired or storage location

Example Only



- Complete deployments
- Perform checkout of host – normal ops
 - GOES-R series 6 months, commercial up to 2 months
- HPL Power enabled
- Perform checkout of HPL – normal ops



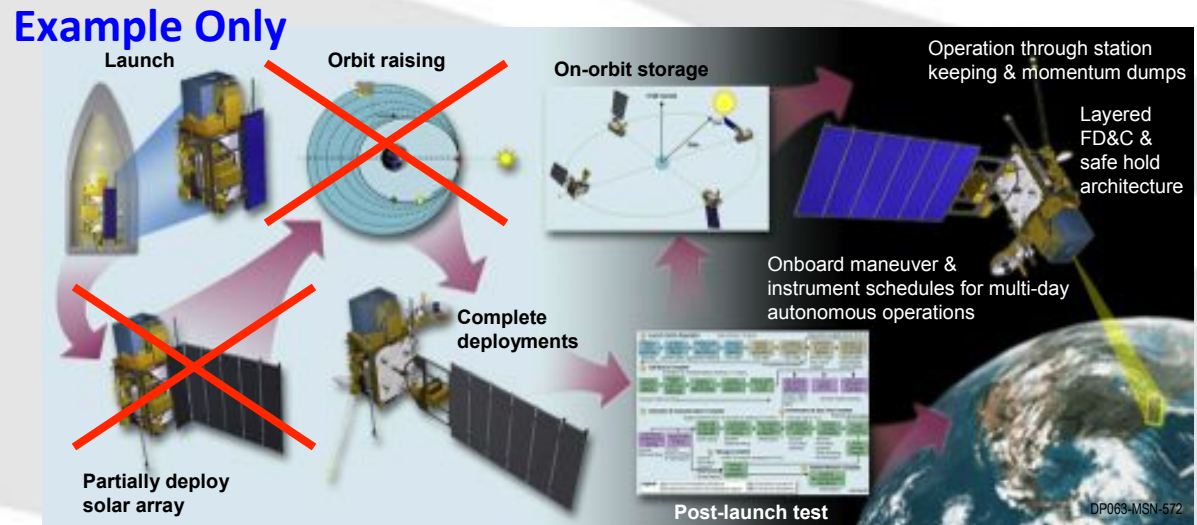
LEO Launch & Checkout Flow



- Launch, Ascent & Fairing separation are the same (time may vary depending on LV), HPL will be powered off

- Direct injection
 - Either into desired* or storage location

- Complete deployments



- Perform checkout of Host – normal ops
 - ~3 months
- HPL Power enabled
- Perform checkout of HPL – normal ops
 - ~3 months

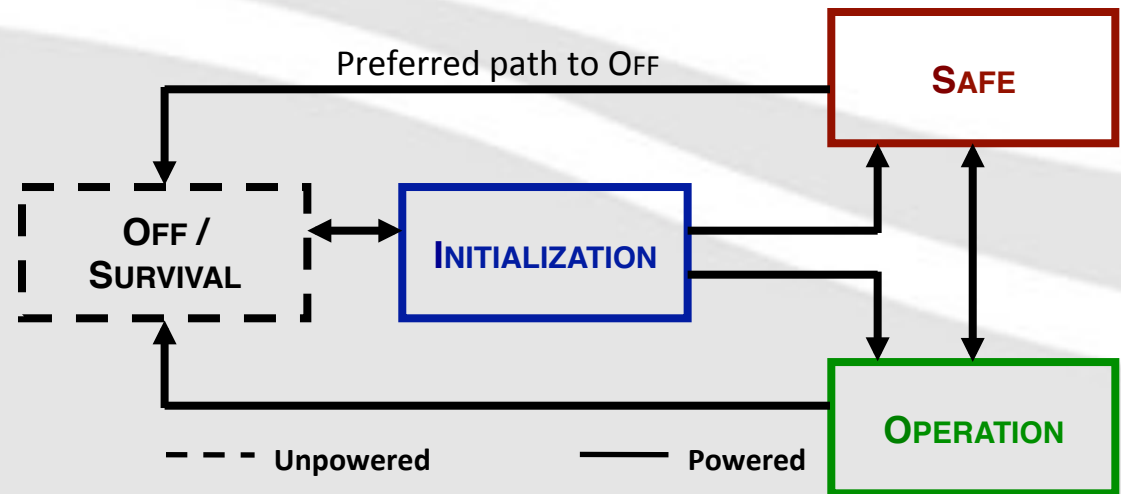
* Typical



HPL Concept of Operations Flow



- Powered OFF through Host successful checkout
 - Instrument survival heaters enabled by Host during ascent/checkout (time negotiable)



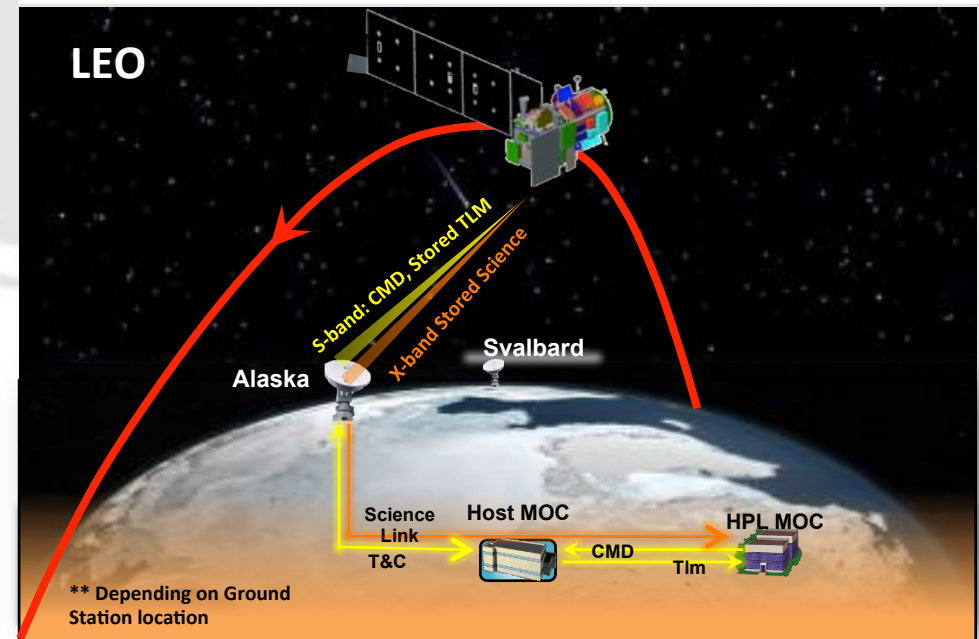
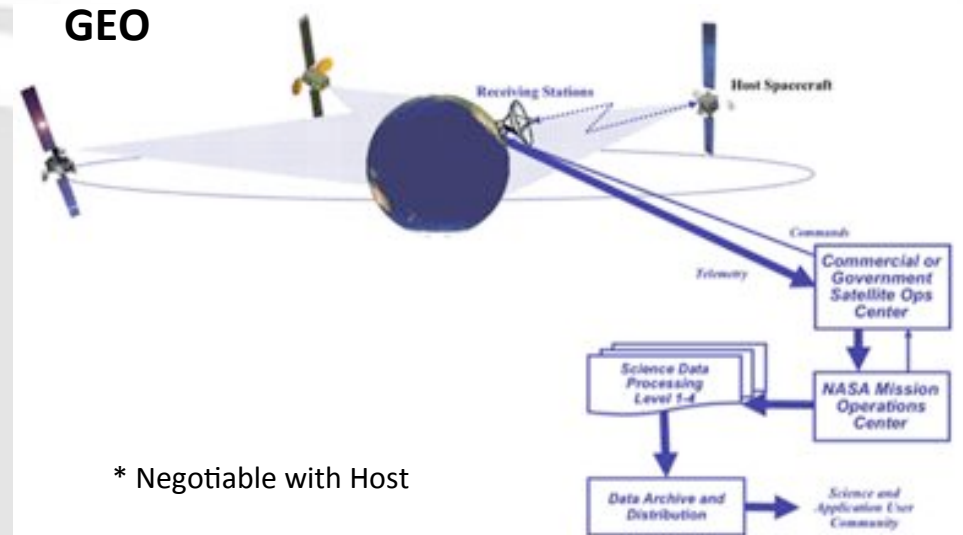
- Upon power on, HPL boots into initialization mode
 - Host Payload Ops Center (HPOC) performs checkout
- Upon successful completion, HPL autonomously enters into SAFE Mode or HPOC commands into Operational Mode
- Host spacecraft ops center (HSOC) or HPOC can command HPL into Safe Mode
 - Upon error detection, HPL autonomously enters into Safe Mode
- Host may maneuver spacecraft at will (negotiable contract item)
- Host may Power Off HPL without notice (in emergency condition)
 - HPL should be able to successfully recover
- HPL should actively decommission itself upon EOL
 - HPL survival heaters may be enabled for Host health & safety only



Ground Communications Concept



- GEO - Communications can be 24/7
- LEO - Communications limited based on ground station location**
- HPL will transmit data to host via Command & Data Handling Subsystem (1553, 422, Spacewire, etc.)*
- HPL data is embedded within host's downlink or via dedicated HPL downlink*
- HSOC will transfer data to HPOC
- Uplink commands originate from HPOC
- Commands transferred to HSOC
- Commands embedded within Host uplink commands
- Commands executed via Host C&DH Subsystem





Summary



- Negotiations with the host S/C are required and special requests, within their capability, can be worked out for a fee
- From launch through ascent, LEO/GEO are the same
 - Orbit injection and operations are different
- Communications
 - Downlink:
 - GEO – can be 24/7 (negotiable)
 - LEO – store and forward, limited throughout the day
 - Data can be sent to HPOC via Host or directly
 - All uplink commands are sent via the HSOC
- The Host takes precedence when it comes to anomaly resolution and safety
- Power can be cut without notice, HPL is expected to successfully recover