# Accessing Space with the ISS Bartolomeo Platform

## Announcement of Opportunity with the United Nations Office of Outer Space Affairs (UNOOSA)

DEFENCE AND SPACE

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25 November 2019

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# Overview to Bartolomeo

- Concept of Operations
- Platform Design and Capabilities
- All-in-one Space Mission Service
- Capability offered within the UNOOSA cooperation
- Specific Payload Requirements



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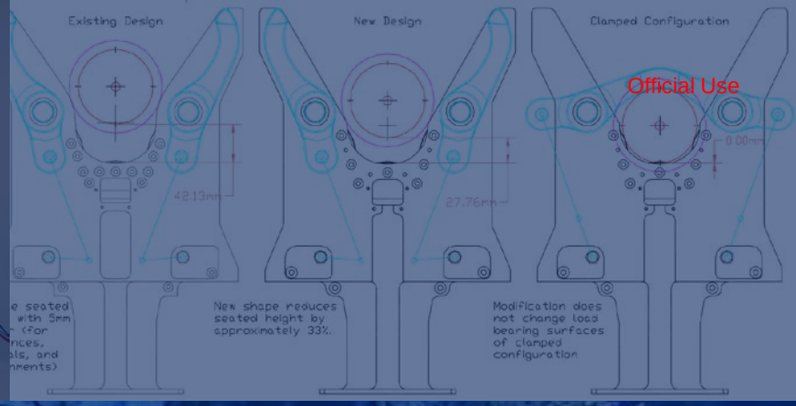
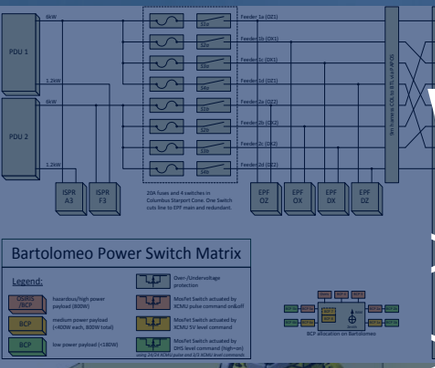
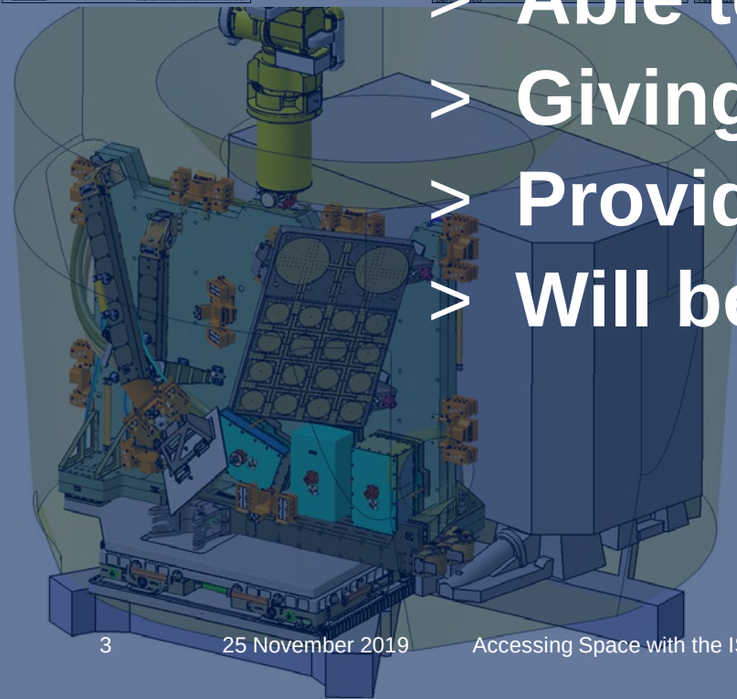


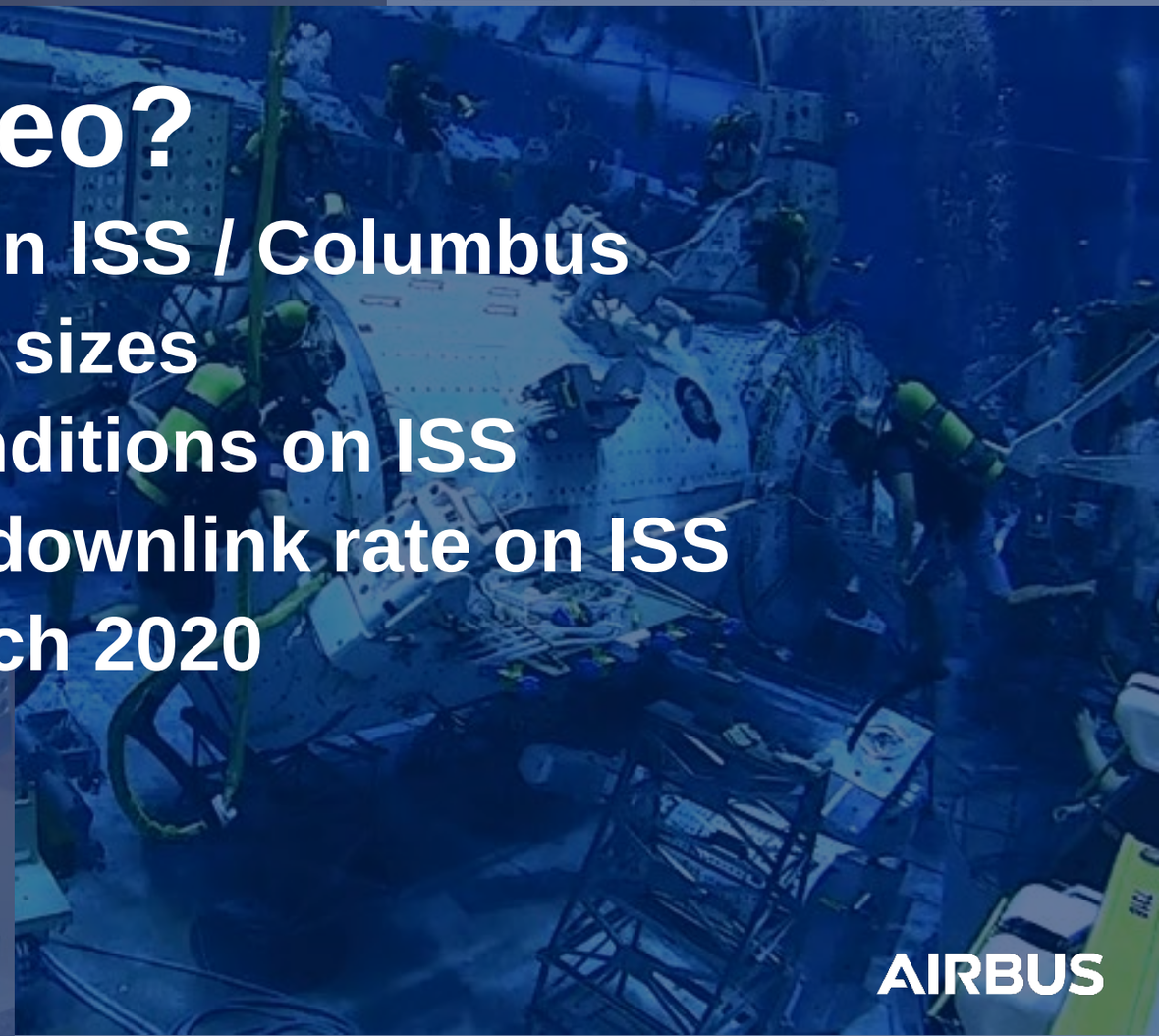





# What is Bartolomeo?

- New external platform on ISS / Columbus
- Able to host all payload sizes
- Giving best viewing conditions on ISS
- Providing highest data downlink rate on ISS
- Will be launched in March 2020







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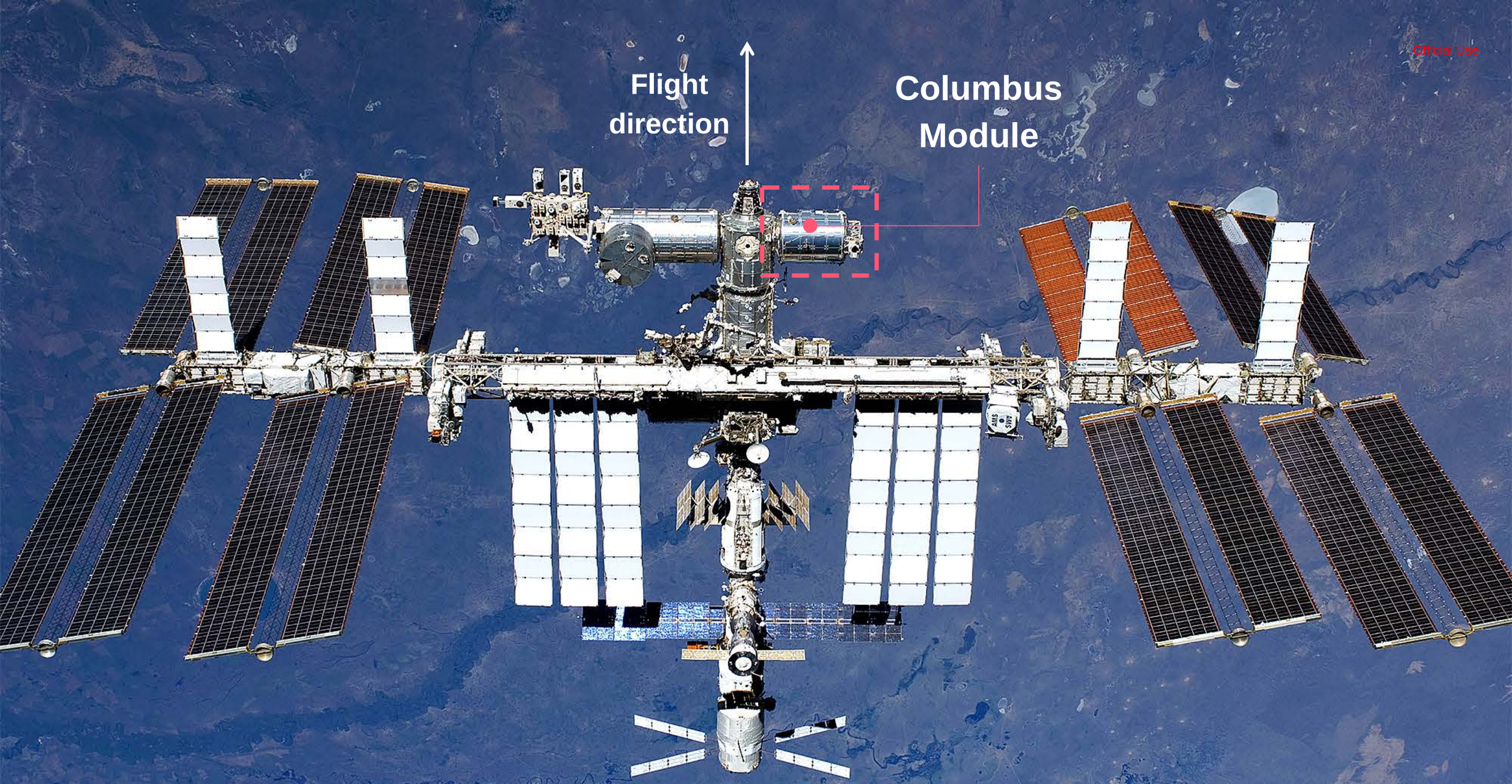




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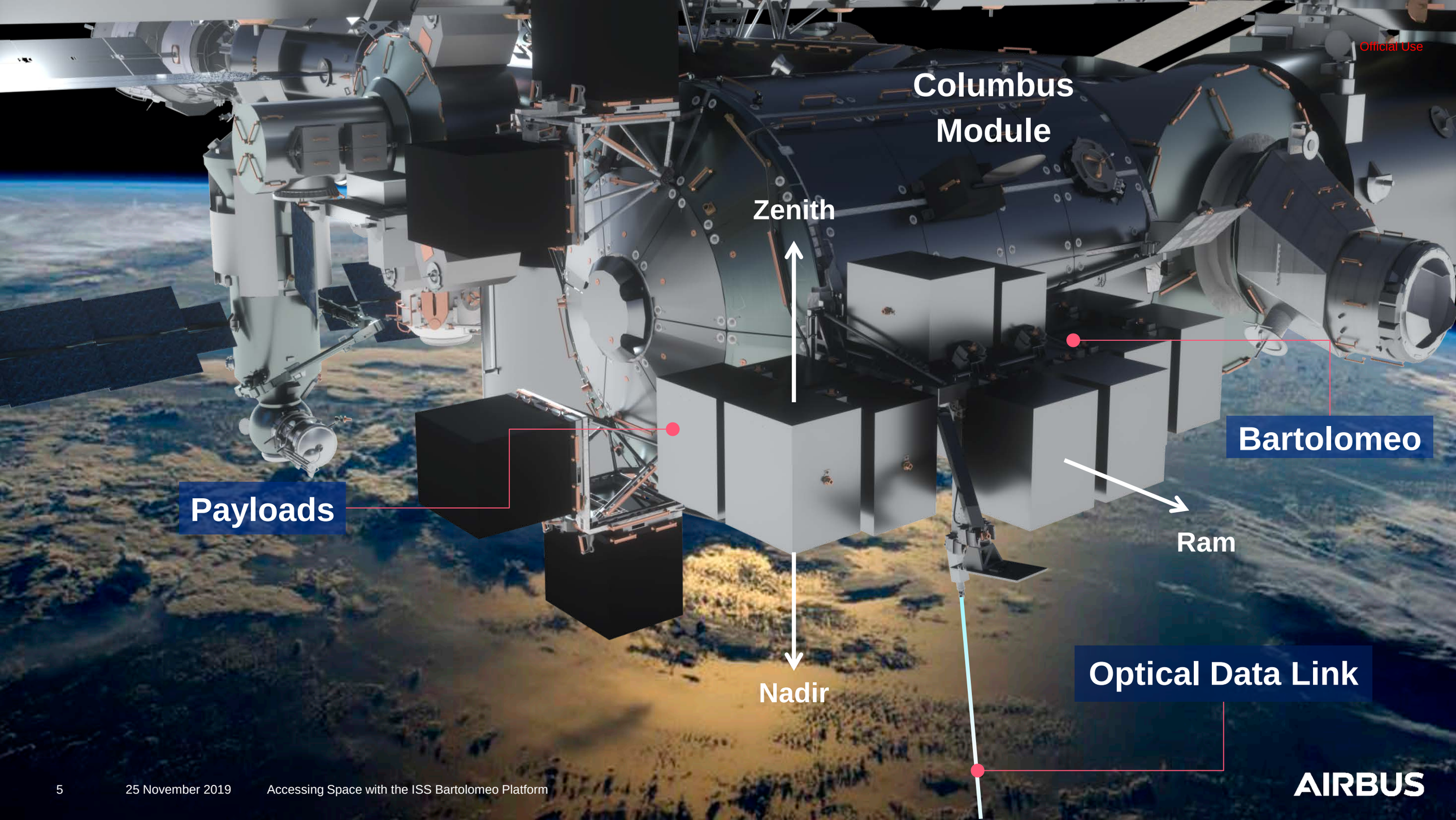




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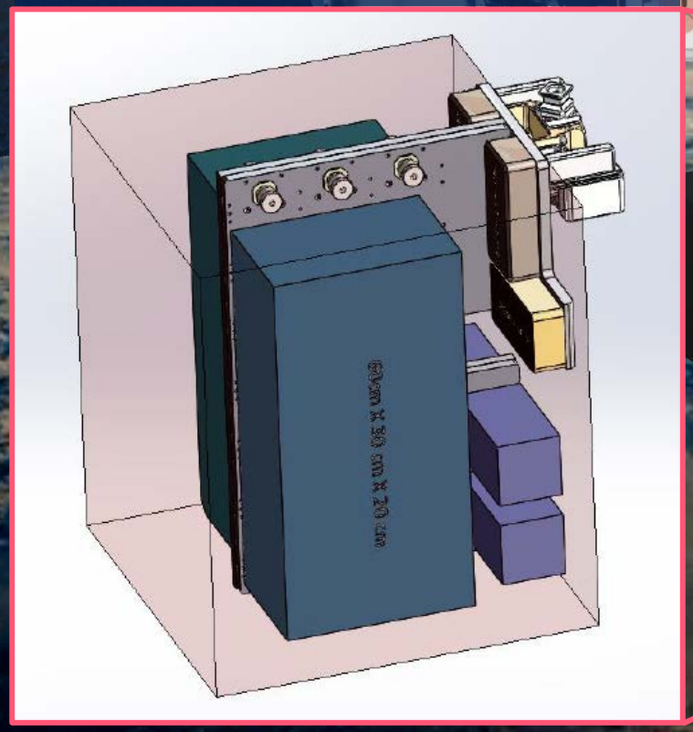
Columbus Module

Zenith

ArgUS Multi-Payload Carrier



Bartolomeo

Ram

Nadir

Optical Data Link



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# Bartolomeo Concept of Operations



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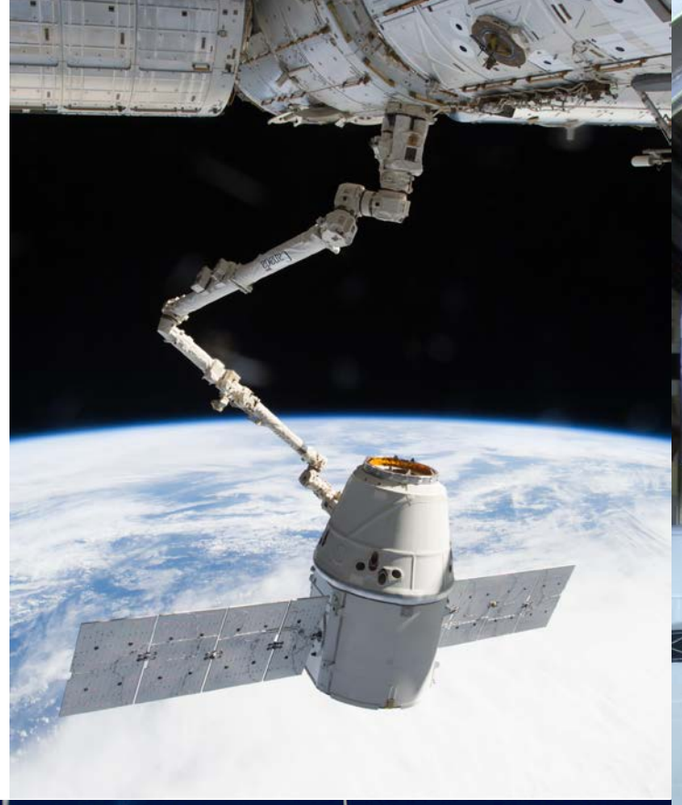
# Payload Launch

- Launch with any ISS supply vehicle
- Launch opportunity every 2 – 3 months



[Image credit: NASA]

**Pressurized payload launch in ISS visiting vehicle pressurized compartment**

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# Payload Installation

**Payload installation by ISS Robotic Manipulation System**

[Image credit: NASA]

[Image credit: NASA]

Official Use

**Payload transfer through either ISS payload airlock**

[Image credit: NanoRacks]

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# Payload Retrieval


[Image credit: NASA]



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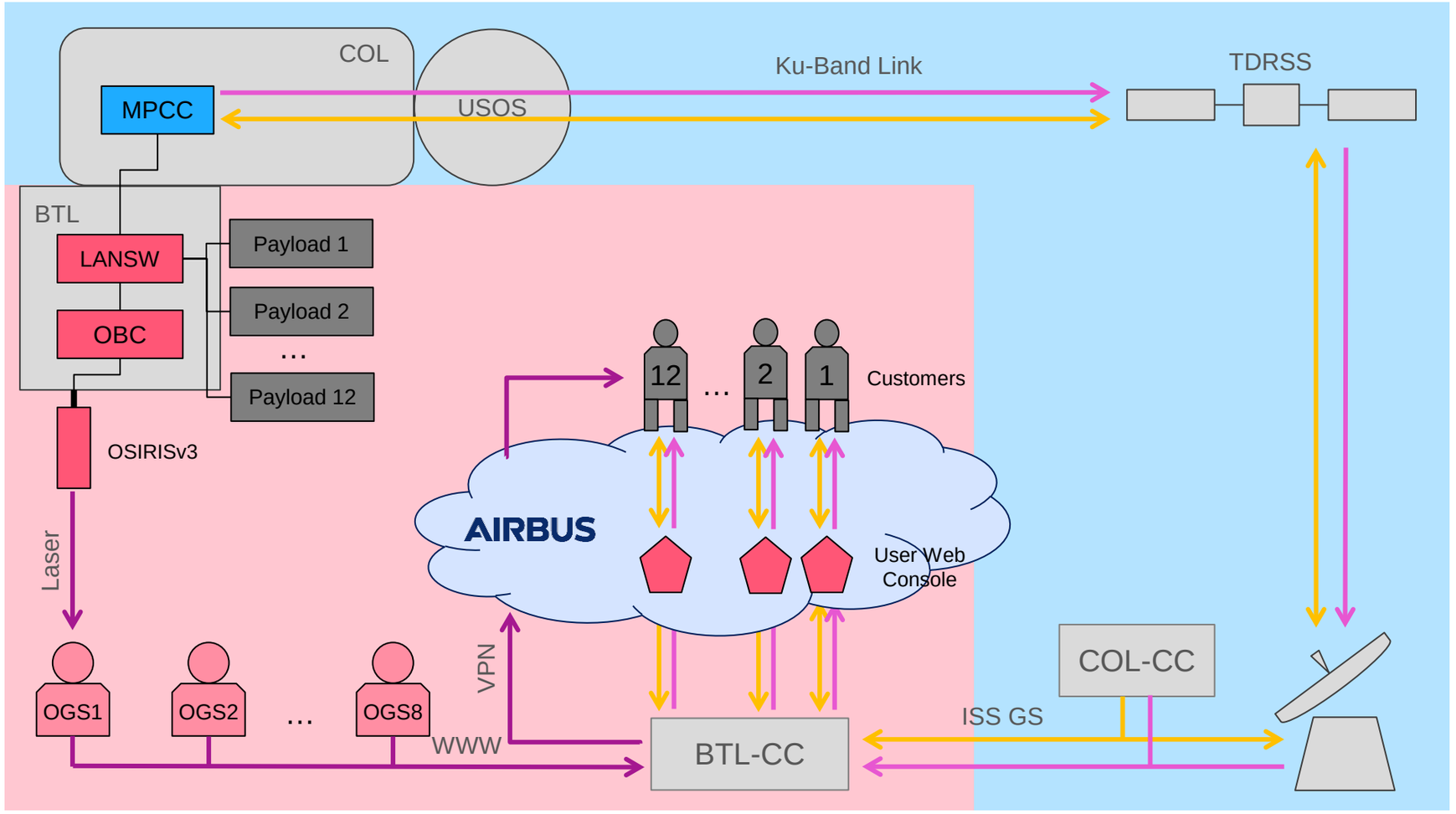
# Payload Operation




TM/TC link

Near Real Time Data downlink (1 Mbps)

High capacity data downlink (upgrade)

| Link Capacity | |
|---|---|
| **Downlink** | 1-10 Mbps |
| **Uplink** | 1 Mbps |
| **Latency** | below 1 s |



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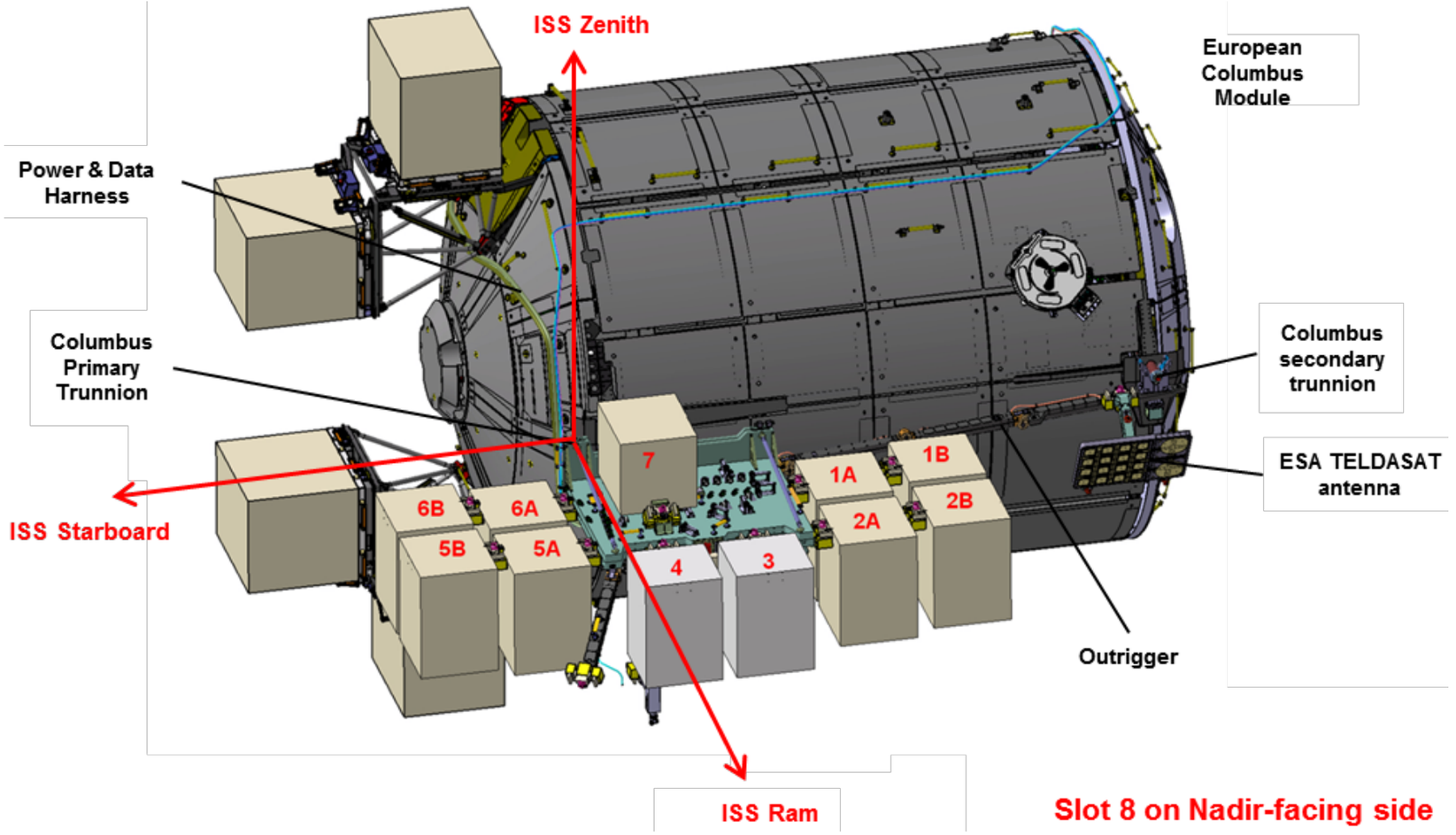
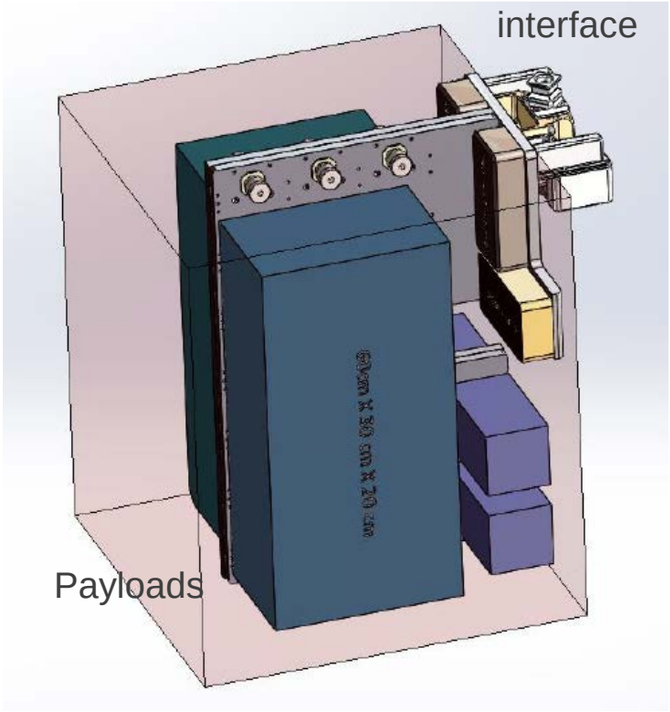
# Bartolomeo Platform Design and Capabilities

# Payload Accommodation




**ArgUS Multi-Payload Carrier**

- ArgUS can be accommodated on Slot either slot
- Slot selected based on payload requirements and overall booking situation



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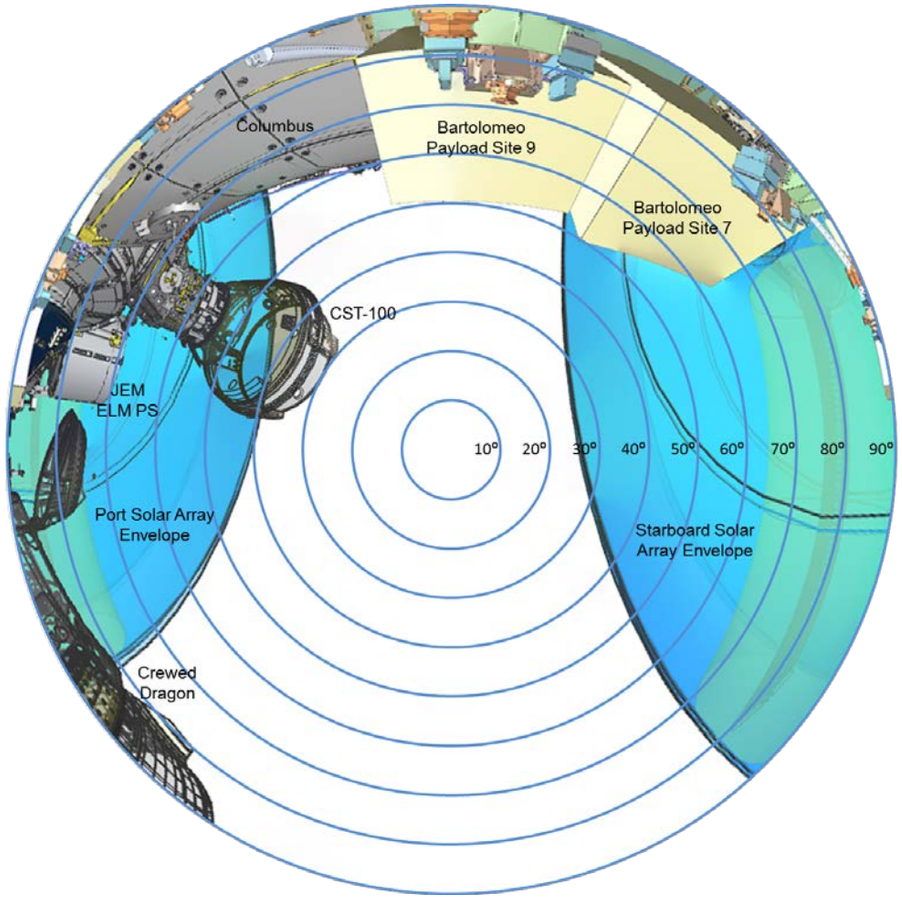
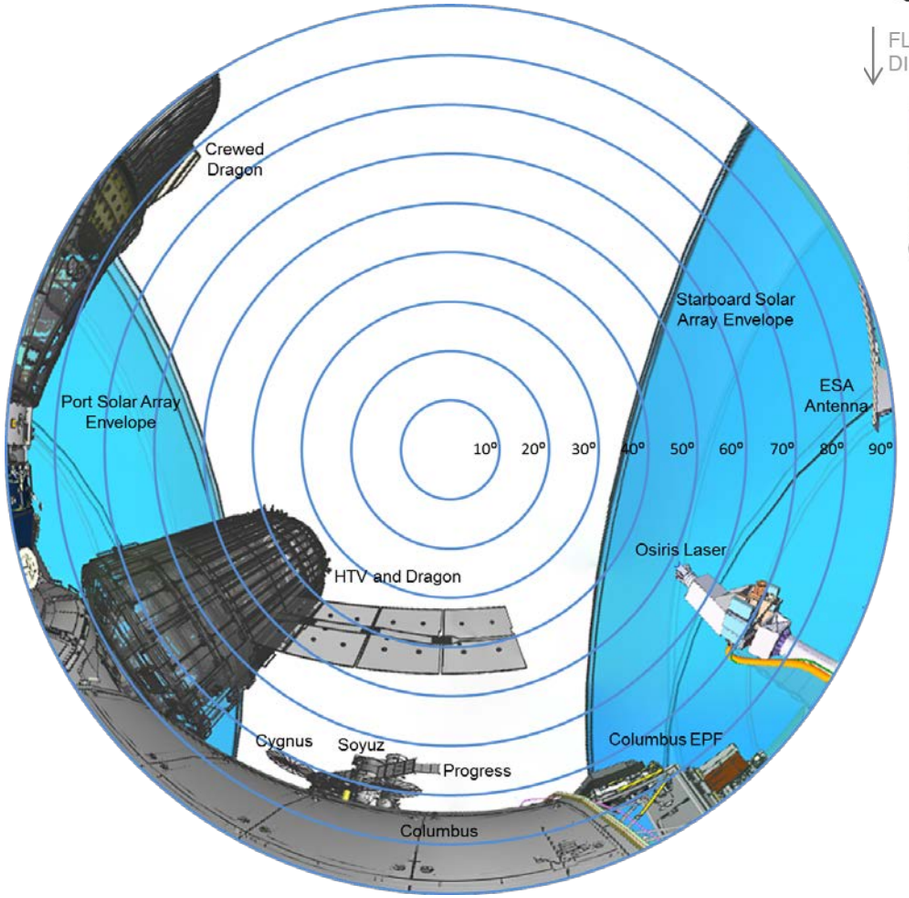
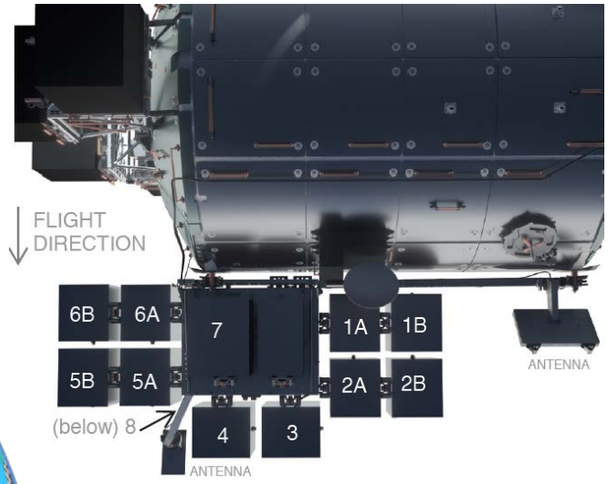
# Payload Viewing




**Slot 3 Zenith View**
**[image credit: NASA]**




**Slot 3 Nadir View**
**[image credit: NASA]**




## Payload viewing quality

| Slots | Nadir | Zenith | Ram |
|---|---|---|---|
| 1A | | | |
| 1B | | | |
| 2A | | | |
| 2B | | | |
| 3 | | | |
| 4 | | | |
| 5A | | | |
| 5B | | | |
| 6A | | | |
| 6B | | | |
| 7 | | | |
| 8 | | | |



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# Bartolomeo All-in-one Space Mission Service

# Bartolomeo All-in-one Space Mission Service (Standard Service)

↘ Standard service

**Payload transfer**
to the outside of the ISS

**Payload operation**
on the Bartolomeo platform

**L+3 months**

**Contract signature L-20 months**

**Payload launch**
on any ISS service vehicle

**Payload installation**
using the ISS Robotic Manipulator System

**Payload data**
Data delivery to the customer



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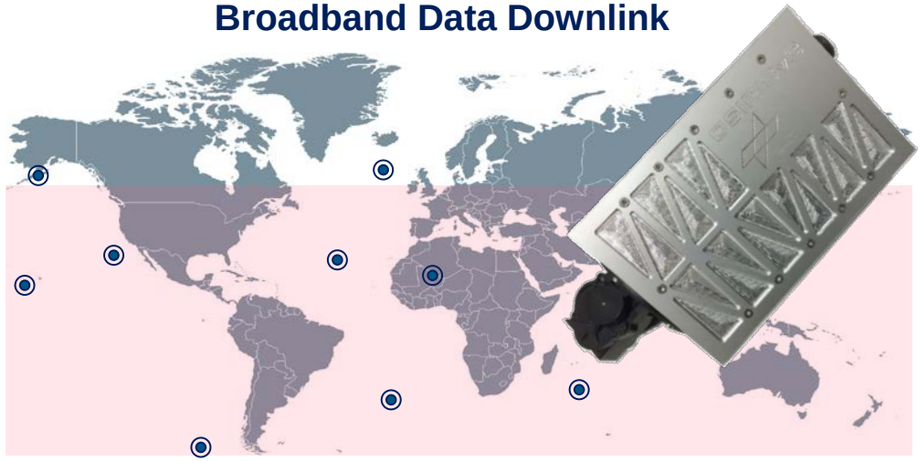
# Bartolomeo All-in-one Space Mission Service

- Optional services

| Optional Services |
| --- |
| Use of the broadband data downlink |
| Payload / sample return |
| Payload design support |

**Payload Return**

**Broadband Data Downlink**



# Capability offered within the upcoming 1st Announcement of Opportunity



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# Capability offered within the Opportunity

- **3U-sized payload** will be integrated, launched, installed and operated as part of the Bartolomeo / ArgUS Multi-Payload Carrier free of charge (Standard Service)
  - 1U = 10 x 10 x 10 cm
- **Mission duration 1 year** is included


Optional Services:

- Larger payload sizes and longer mission durations are available at 100,000 € / U / year
- Payload return available at 75,000 € / kg



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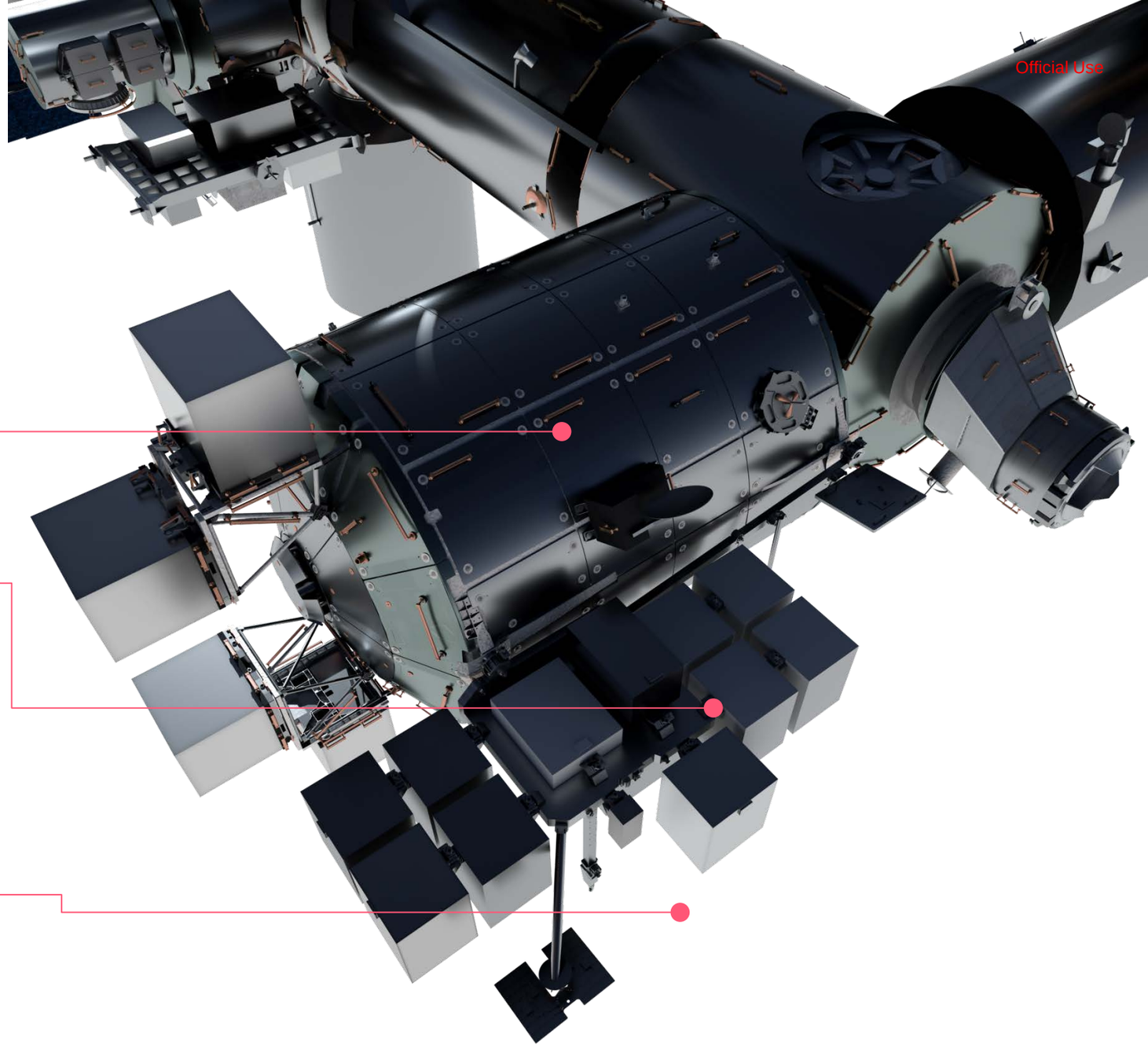
# Specific Payload Requirements

# Payload Requirements

| General Mission Requirements |
| --- |
| ISS Orbit Characteristics |
| Payload Attitude Characteristics |

| Payload Design Requirements |
| --- |
| Mechanical Interfaces |
| Electrical Interfaces |
| Data Interfaces |
| Software Interfaces |
| Safety Requirements |

| Environmental Requirements |
| --- |
| Mechanical Environment |
| Thermal Environment |
| Electro-magnetic Environment |
| Space Environment |





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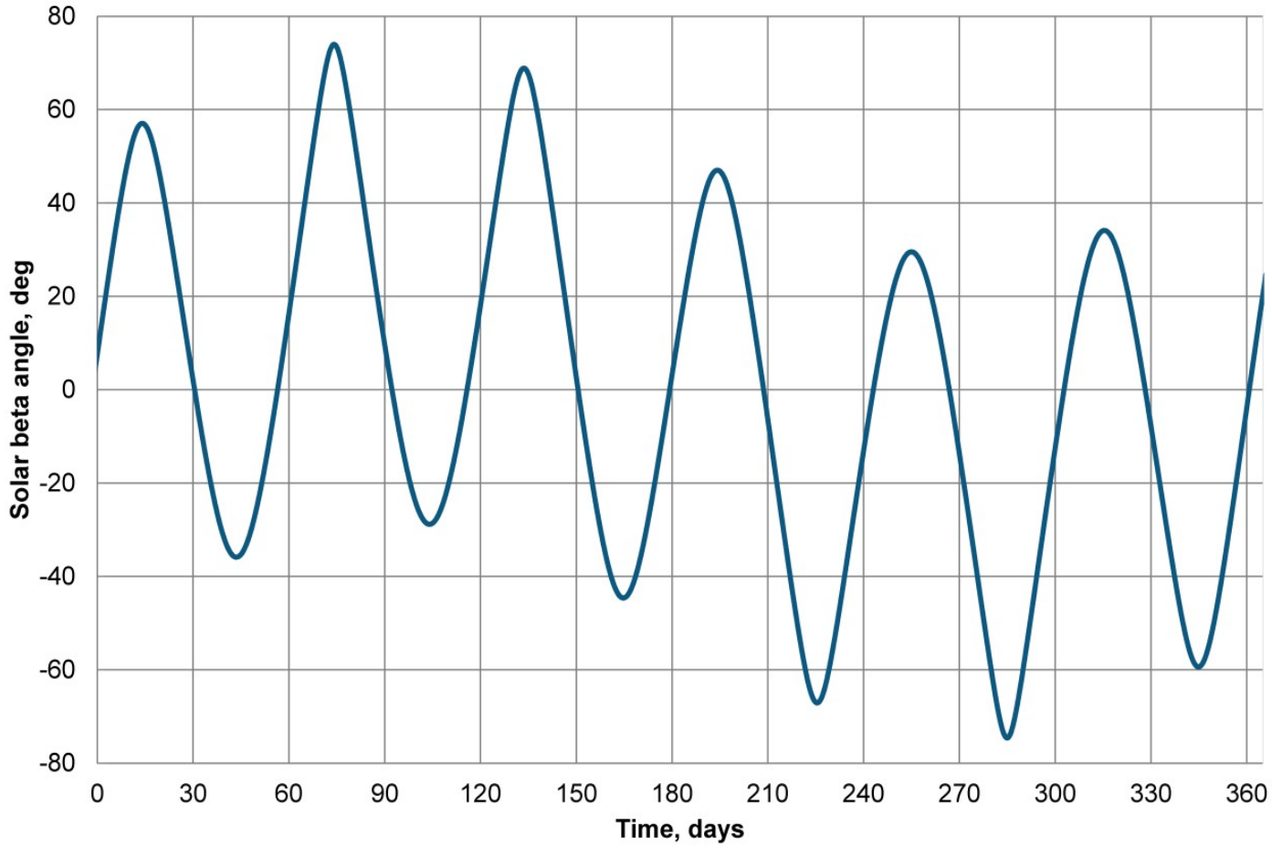
# General Mission Requirements

## ISS orbit characteristics




| ISS Orbit Parameter | Value |
|---|---|
| Orbital inclination | 51.64 deg |
| Orbit altitude | 403 to 408 km |
| Orbital period | 92.89 minutes |
| Solar beta angle variation | -75 to +75 deg |
| Position error | 6 m |
| Semi-major axis error | 20 m |



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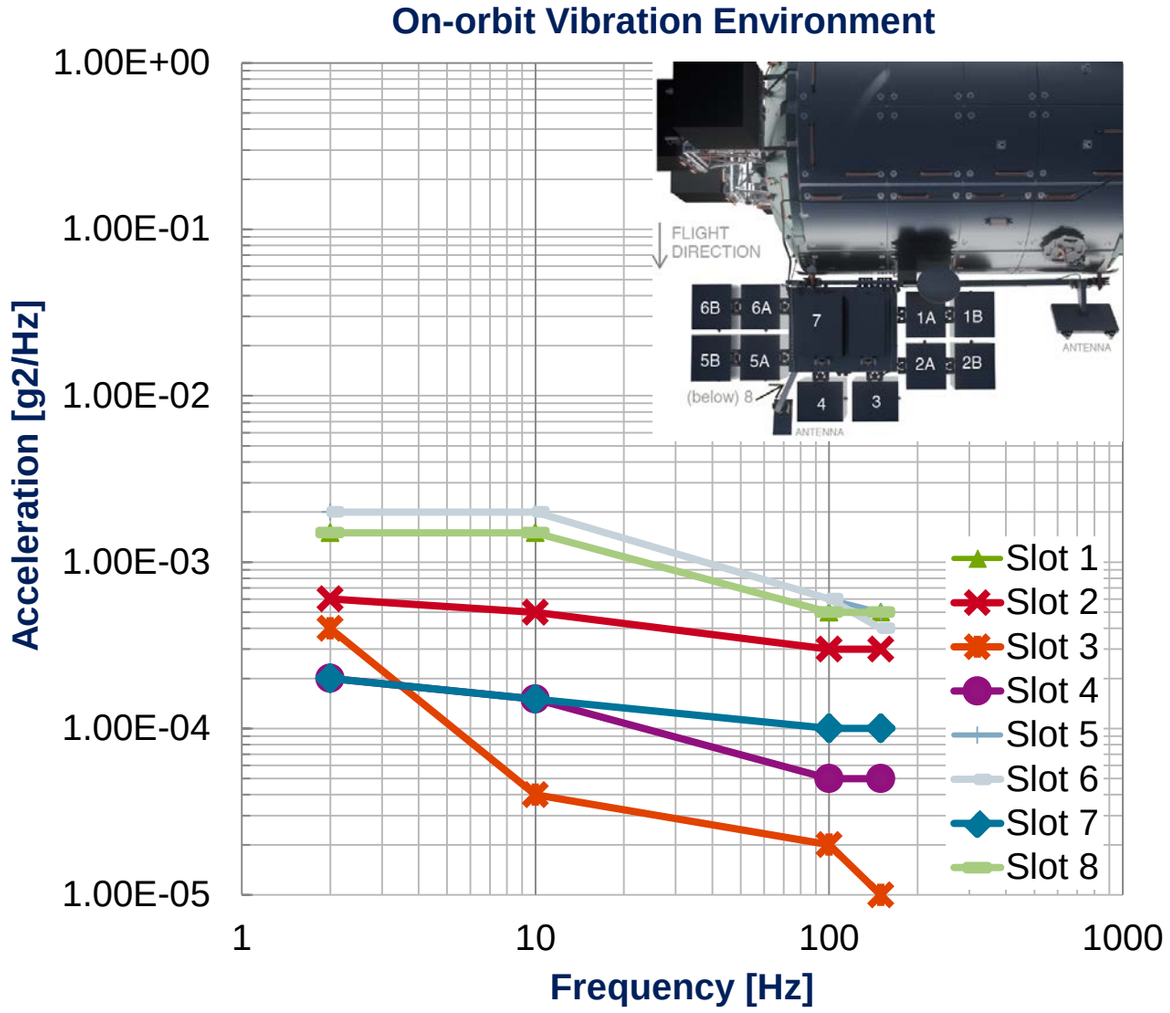
# General Mission Requirements

## Payload attitude characteristics

| ISS Attitude | Yaw | Pitch | Roll |
|---|---|---|---|
| **+XVV +Z Nadir (TEA)** | **-15° to +15°** | **-20° to +15°** | **-15° to +15°** |
| -XVV +Z Nadir | +165° to +195° | -20° to +15° | -15° to +15° |
| +YVV +Z Nadir | -110° to -80° | -20° to +15° | -15° to +15° |
| -YVV +Z Nadir | +75° to +105° | -20° to +15° | -15° to +15° |
| +ZVV -X Nadir | -15° to +15° | +75° to +105° | -15° to +15° |
| -ZVV -X Nadir | +165° to +195° | +75° to +105° | -15° to +15° |

| Payload Attitude Parameter | Typical Performance |
|---|---|
| Attitude rate non-micro-gravity mode | ±0.05 deg/s/axis |
| Attitude knowledge at S0 truss | <0.25 deg/axis (3σ) |
| Attitude knowledge on Bartolomeo | <1.0 deg/axis (3σ) |



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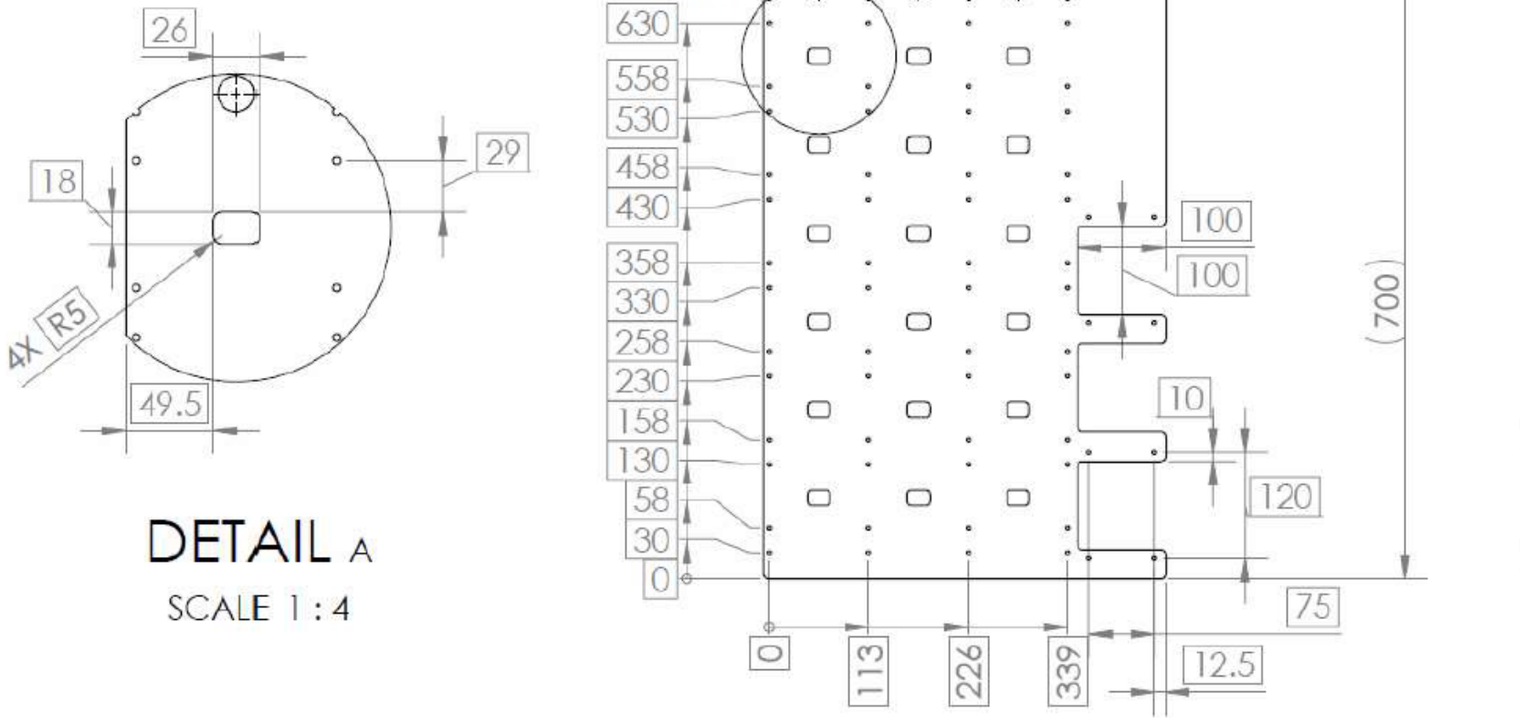
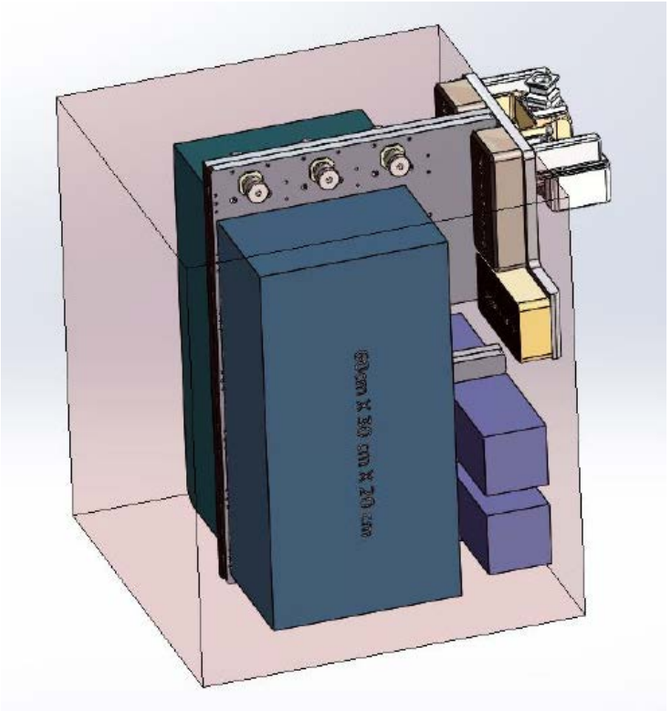
# Payload Design Requirements

## Mechanical interfaces




**ArgUS Multi-Payload Adapter**



- ArgUS base plate hole pattern to be respected
- ArgUS soft dock feature to be implemented



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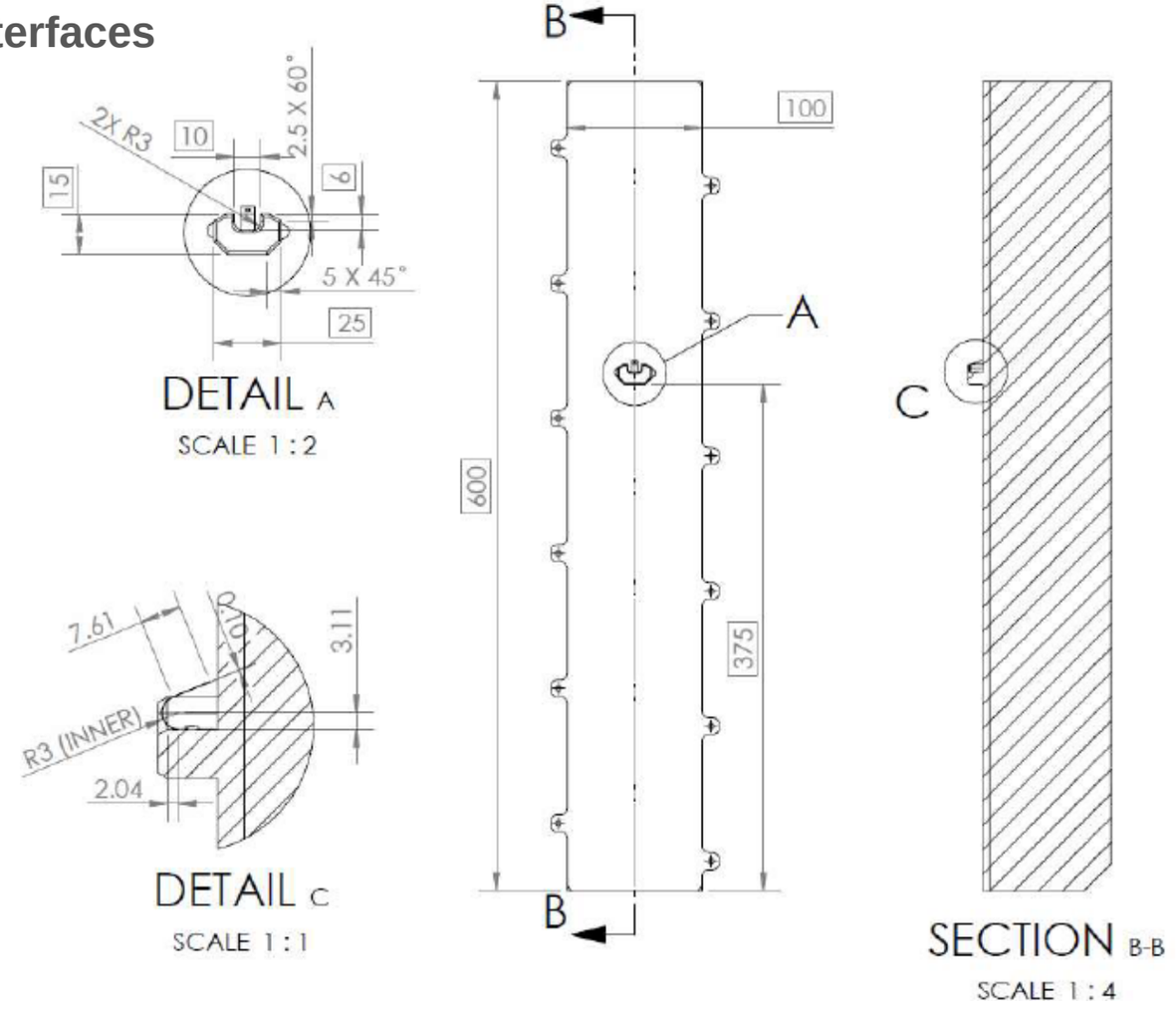
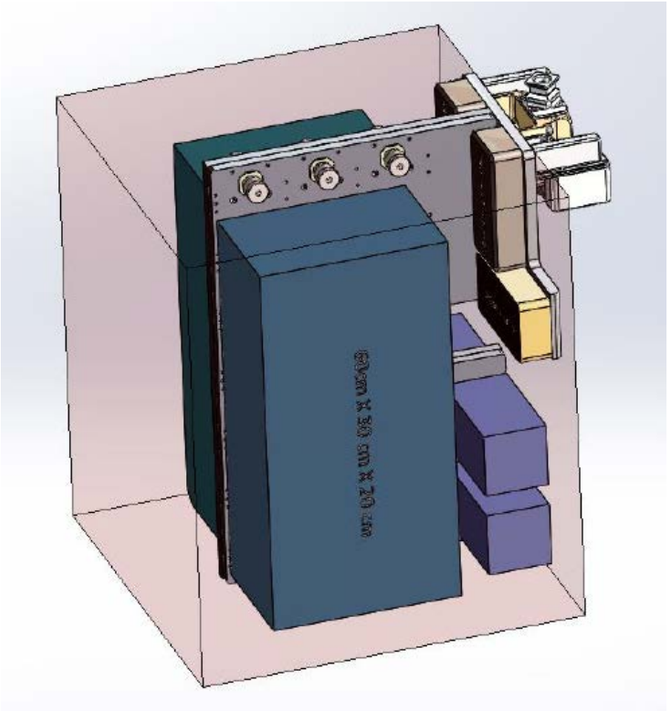
# Payload Design Requirements

## Mechanical interfaces




### ArgUS Multi-Payload Carrier



- ArgUS base plate hole pattern to be respected
- ArgUS soft dock feature to be implemented



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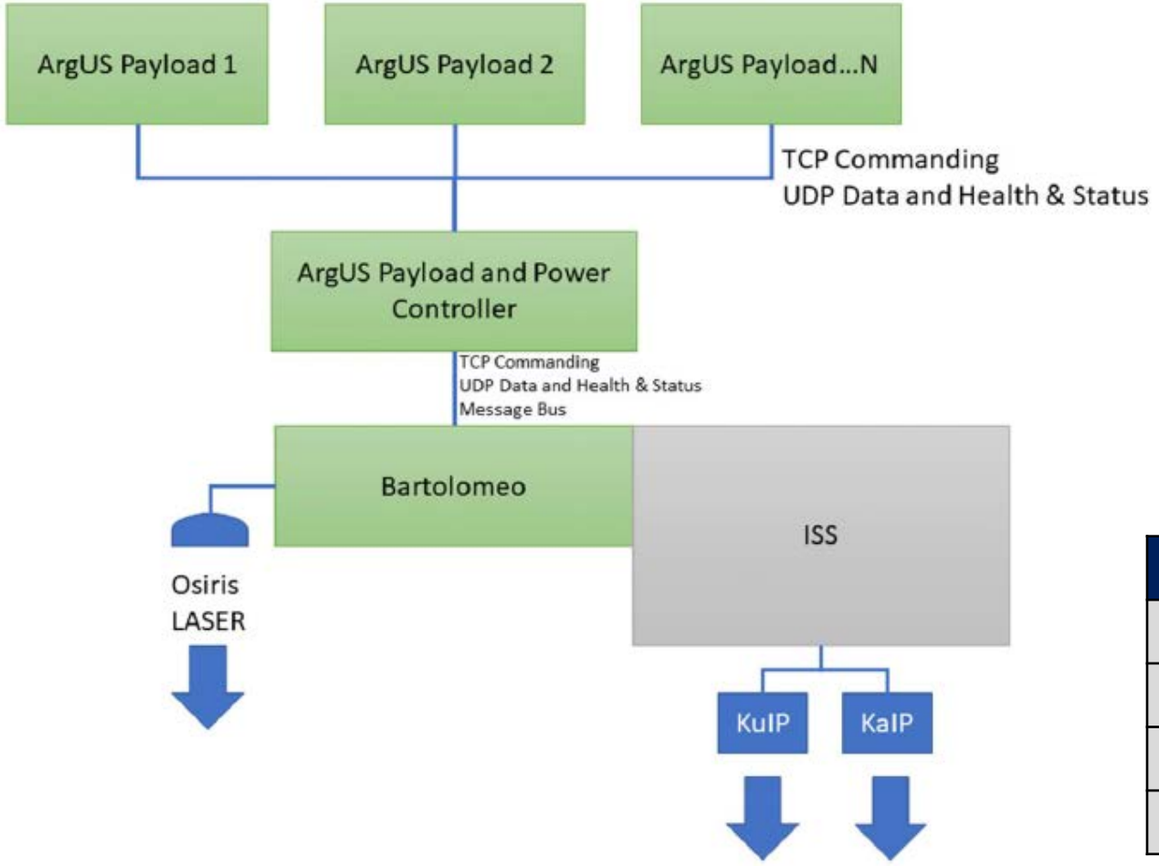
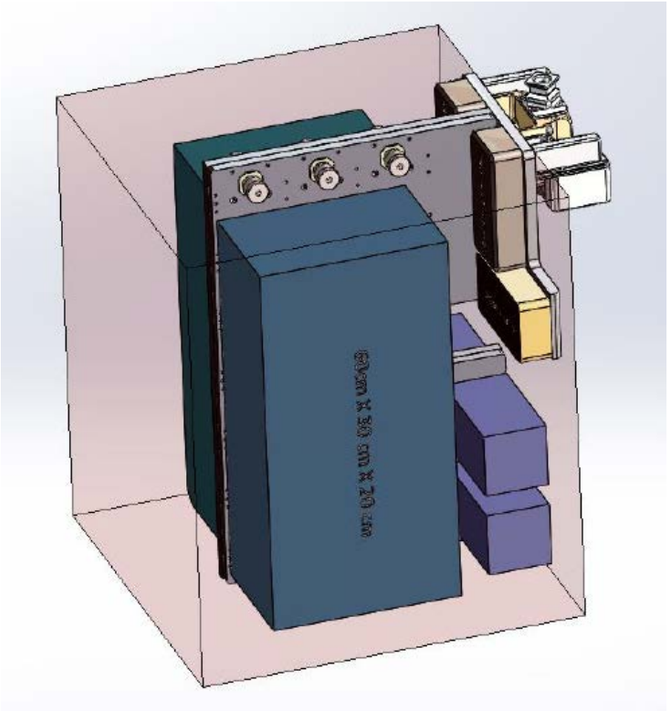
# Payload Design Requirements

## Electrical and data interfaces




## ArgUS Multi-Payload Adapter



| ArgUS Interface Parameters | |
|---|---|
| Power (operational) | 28 VDC up to 140 W |
| Power (survival) | 28 VDC up to 20 W |
| Data downlink | 0.1 Mbit / s |
| Commanding and Monitoring | Near Real time through Columbus |



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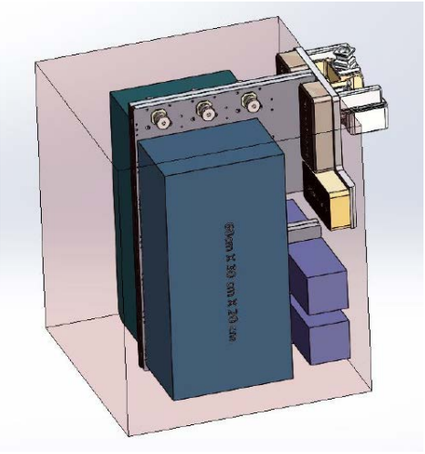
# Payload Design Requirements

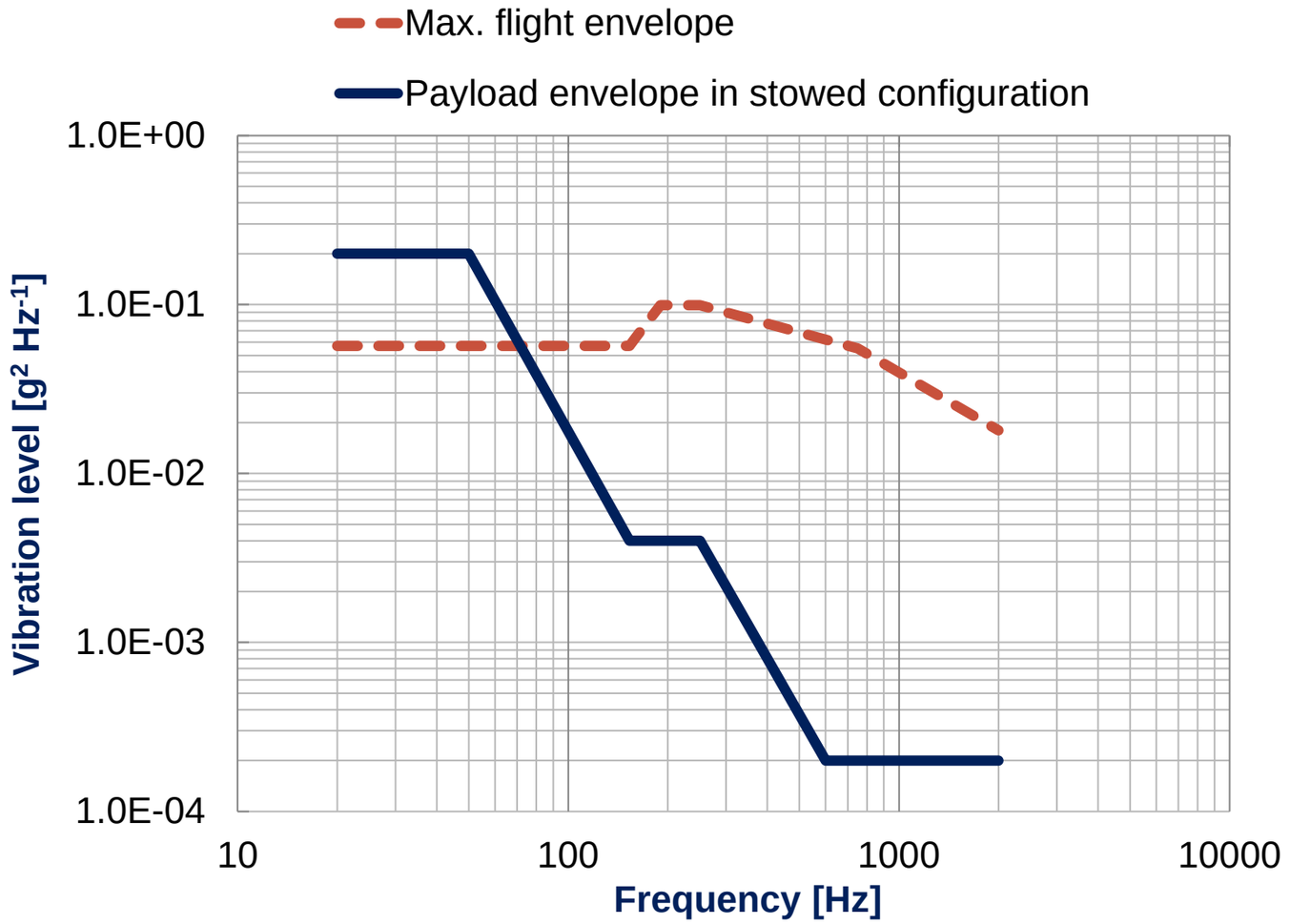


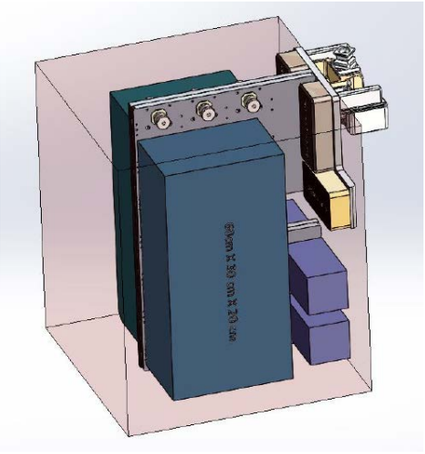
## Safety requirements

| Hazard | Control |
|---|---|
| Structural hazards | • Application of factor of safety with positive margin; design for minimum risk<br>• Fault tolerance where applicable<br>• Redundant mechanism |
| Electrically operated systems | • Inhibits to control inadvertent operations appropriate to the hazard level<br>• Redundancy as necessary to perform required functions, Design controls i.e. EMI |
| Leakage of toxic substances | • Fault tolerance in seals appropriate<br>• Structural strength of containers |
| Flammable materials | • Elimination of flammable materials<br>• Containment<br>• Wire sizing and fusing |
| Pressure systems | • Factor of safety |
| RF systems | • Design to have power below hazard level and frequency in approved range<br>• Inhibits to control inadvertent operations appropriate to the hazard level |
| Battery hazards | • Containment<br>• Protection circuits |

# Environmental Requirements

- **Mechanical environment**
  - Launch loads for pressurized launch packed in foam
  - On-orbit loads caused by crew handling, airlock operations, robotic operations
- Electro-magnetic environment
- Space environment
  - ATOX environment
  - Plasma environment
  - Radiation environment





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# Specific Payload Requirements

- **Documentation to be followed:**
  - Bartolomeo User Guide (provided in the AO documentation)
  - ArgUS / Payload Interfaces Definition Document (will be provided after selection)

- **Design suggestions:**
  - Tailor your idea to the environment and interfaces
  - Simplify your design as much as possible
  - No pre-qualified hardware expected, qualification will be done through dedicated testing of the integrated hardware

# Contact

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