Airbus Bartolomeo Platform

General Overview

Airbus Bartolomeo Platform

- External Platform on the International Space Station (ISS)
- Attached to Columbus Module
- Wide Range of Mission Opportunities
- Payload alignment in various directions (Ram, Zenith, Nadir)
- Provides highest data downlink rate on ISS
- Expected launch on SpX-20 (March 2020)
- Installation completed in April 2020

Airbus Bartolomeo: Robust Capabilities

- Capability to take advantage of all 3 major LEO phenomena:
  - Extreme Conditions of Space
  - Vantage Point - Remote Sensing and Satellite Deployment
  - Microgravity
- Ability to service ISS NL major markets and OGA Programs
  - Technology Development and TRL
  - Advanced Materials
  - Remote Sensing
  - NSF Transport Solicitation

Use Cases- Advanced Materials & Manufacturing

Use Case	Platform Capabilities & Benefits
Materials Testing	▪ With unobstructed Zenith-oriented view Bartolomeo gives the opportunity to expose material samples to space and solar radiation ▪ With unobstructed Ram-facing view the effects of atomic oxygen can be studied on samples ▪ Additional exposure to elements such as thermal cycling, vacuum, and space debris are present in all directions
In-Space Manufacturing	▪ Via Bartolomeo and its large / extendable payload envelopes on orbit in-space manufacturing can be performed to produce structures with fewer defects via 3D printing or other appropriate methods

Use Cases- Remote Sensing & Monitoring

Use Case	Platform Capabilities & Benefits
Remote Sensing	▪ The unobscured view of Earth from Bartolomeo in approximately 400 km orbit altitude enables high quality imaging with cost-efficient instrumentation ▪ Types of sensing can include (IR, Visible, UV, RF, etc.)
Astrophysics & Heliophysics	▪ Bartolomeo offers among the best view towards the Zenith direction from the ISS
Atmospheric Research	▪ All forward-facing payloads have unobstructed view to the space / atmosphere boundary ▪ Broadband data downlink capabilities of Bartolomeo allows for a high data production rate
Space Weather	▪ The unobstructed Zenith-oriented view allows cost-efficient space observation, e. g. for solar activity monitoring

Use Cases- Technology Development & Testing

Use Case	Platform Capabilities & Benefits
On-Orbit Assembly for Exploration	▪ Bartolomeo can provide an opportunity to assemble space system components on-orbit and deploy them with appropriate systems ▪ Short-term realization of a long-term vision to provide larger space systems unrestricted by the launcher payload fairing for exploration
Robotics Testing	▪ Bartolomeo can provide an opportunity to perform robotic operations in a protected testing environment
In-orbit Testing	▪ With power, data and viewing available Bartolomeo can serve as general in-orbit demonstration test bed ▪ If compliant with safety regulations any technology can be tested on ISS as long as it is of civilian purpose
Propulsion Testing	▪ With available power of up to 800 W per payload Bartolomeo can serve as testbed for new electric space propulsion systems
Spacecraft Deployment	▪ One of the Bartolomeo payload sites can be converted to a small satellite deployment system ▪ If deployed directly from Bartolomeo satellites can have more mass than deployable by existing systems on the ISS

NSF/CASIS Transport Phenomena Solicitation Focus Areas for Bartolomeo

Main Solicitation Focus Area	Specific Focus Area	Types of Investigations for Bartolomeo Platform
Thermal Transport	Radiation	▪ Payloads on the Bartolomeo platform can be exposed to the external environment of space which contains high levels of radiation ▪ Platform slots can face three different directions (ram, zenith, nadir) where each provide a different level of radiation exposure on a payload
Thermal Transport & Fluid Dynamics	Phase Transitions	▪ Studies that can utilize both the microgravity and the rapid temperature cycling of the external space environment
Thermal Transport & Fluid Dynamics	High Resolution Modeling	▪ Bartolomeo downlink can deliver larger amounts of data faster than current ISS capabilities, improving the real time modeling capabilities for thermal profiles, single & multiphase flow profiles, etc.
Fluid Dynamics	Cryogenics	▪ Bartolomeo can support low temperature investigations and is safer to use with more volatile fluids being an external platform
Combustion	Low Temperature Chemistry	▪ Lower temperature combustion chemistry can be supported on the platform and is safer to conduct externally

Bartolomeo Services

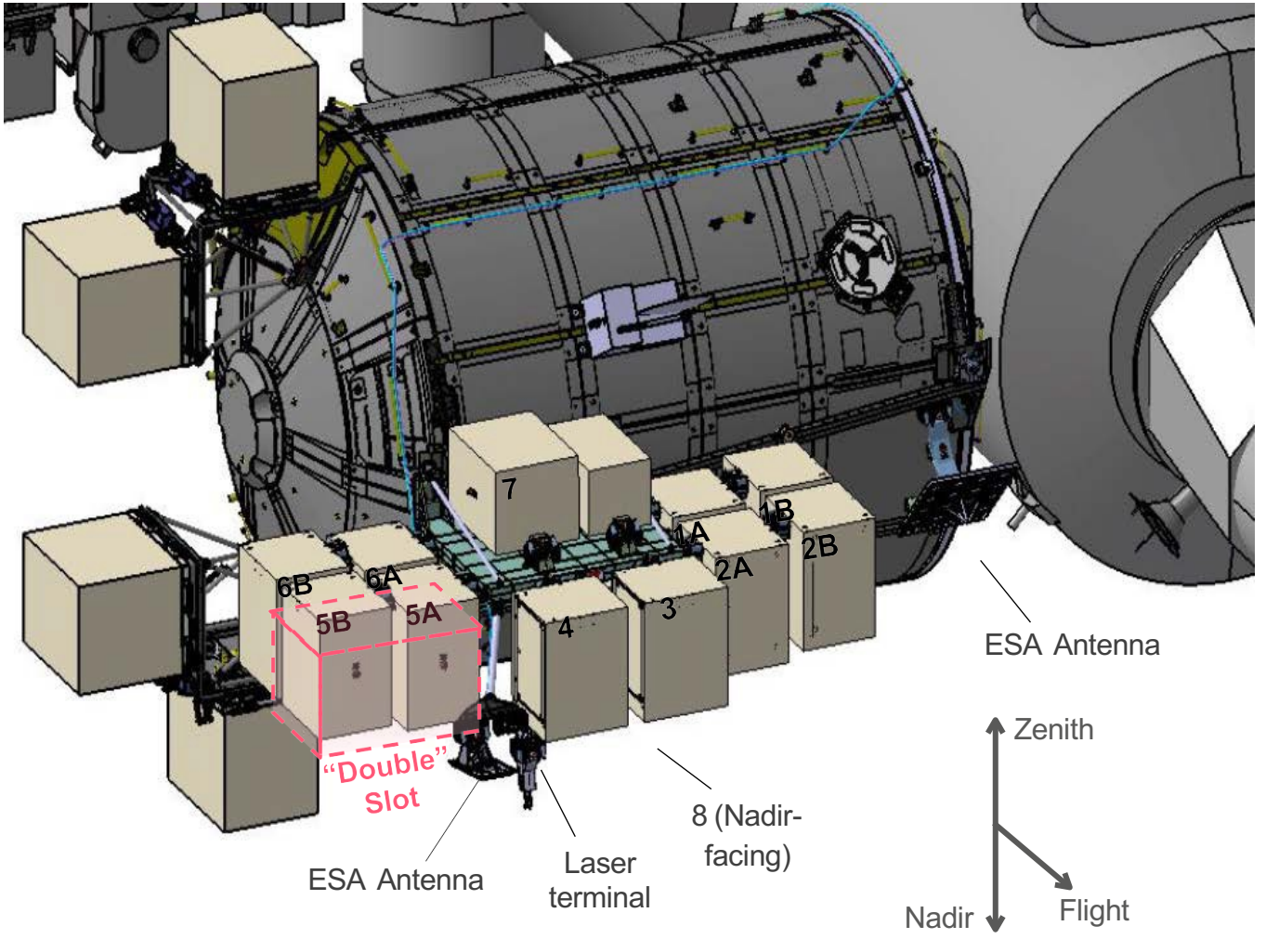
- **Included:**
  - Payload Mission Manager for guidance through agency acceptance and safety reviews
  - Final payload tests, integration and installation on the launcher
  - Launch (USA and ESA countries)
  - Installation on Bartolomeo Platform
  - Payload-Bartolomeo interface
  - Operation interface via the Airbus Cloud Console
  - Data Delivery
  - End of Life Disposal

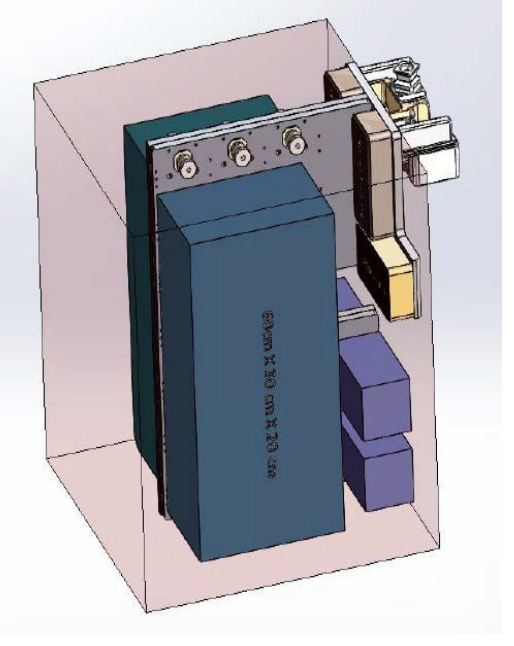
- **Extra Options:**
  - Up to 2 TB/day data provision via Bartolomeo's own optical link (laser comm)
  - Payload development consultancy
  - Payload return to Earth

Bartolomeo Specifications

- **12 total slots on platform:**
  - Volume per slot: up to 100 x 80 x 70 cm^3 (560 U)
  - Slots may be subdivided for small payloads, or doubled for larger payloads
- **Mass per slot: up to 250 kg**
- **Power per slot:**
  - Up to 180 W (standard) – supports power requirements of many sensors, telescopes
  - Up to 800 W (specific slots) – for furnaces (heaters), manufacturing systems, propulsion tests
- **Data rate:**
  - Up to 0.1 Mbit/s (via ISS)
  - Up to 2 TB/day (~185 Mbit/s) via Bartolomeo optical link (extra)

Payload Accommodation





ArgUS Multi-Payload Adapter

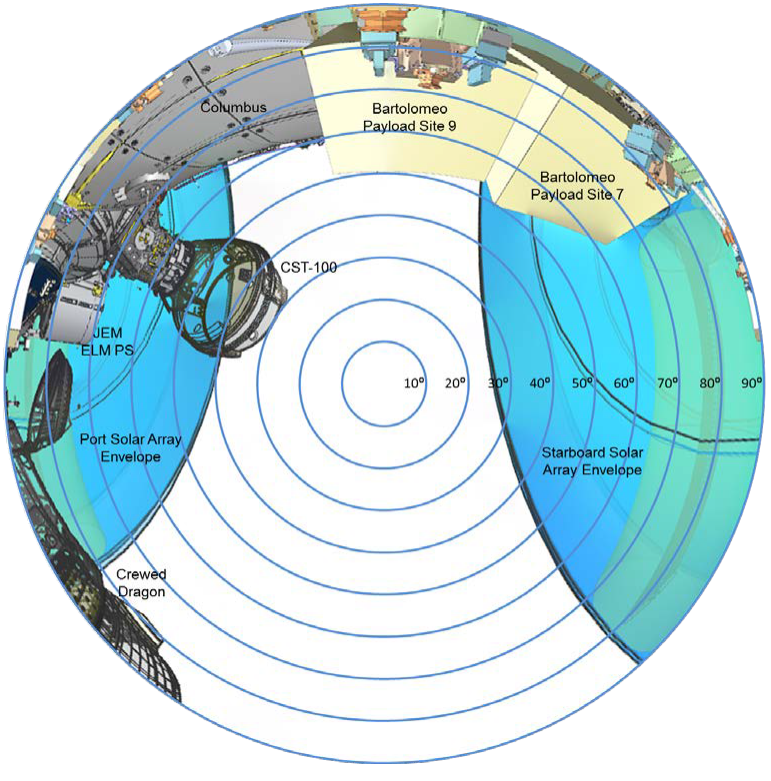
- Up to 120 U on each side
- Can hold 10 separate payloads

Payload Accommodation

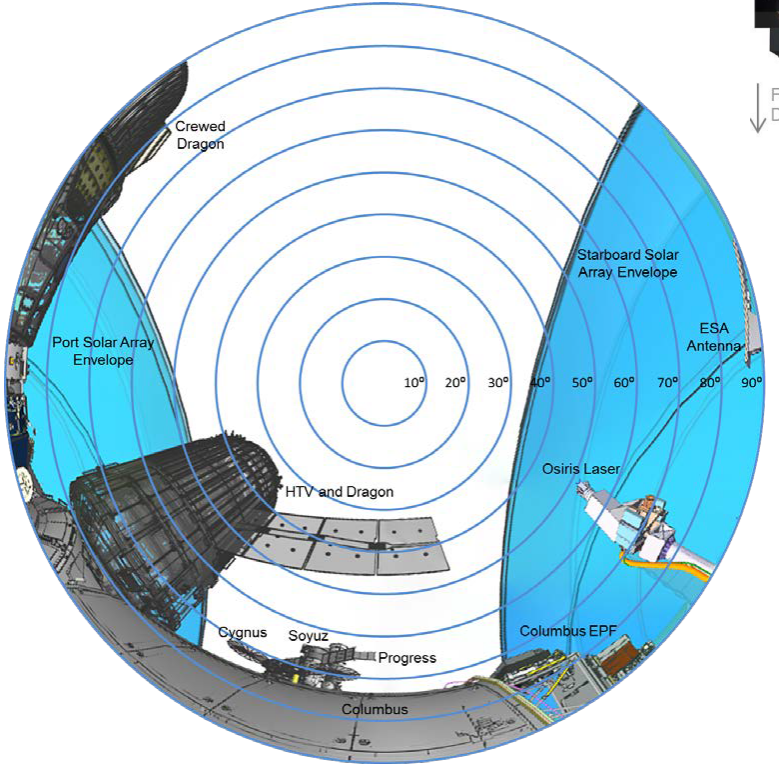
SLOT POSITION		1A	1B	2A	2B	3	4	5A	5B	6A	6B	7	8
[Option to combine slots]		—		—				—		—			
Power	800 W			x		x	x	x					
	400 W	x								x		x	x
	180 W		x		x				x		x		
Field of View	[Ram]			x	x	x	x	x	x				
	[Nadir]	x	x	x	x	x	x	x	x	x	x		x
	[Zenith]	x	x	x	x	x	x	x	x	x	x	x	
	[Port/Starboard]		x		x	x	x		x		x	x	x
[Operation of safety-critical payloads enabled]				x	x	x	x	x		x			

- Some payload slots can be combined into "Double Slots"
- High power 400–800 W can be provided
- Unconstrained field of view in Ram, Nadir, Zenith
- Some payload slots allow the operation of safety- critical payloads

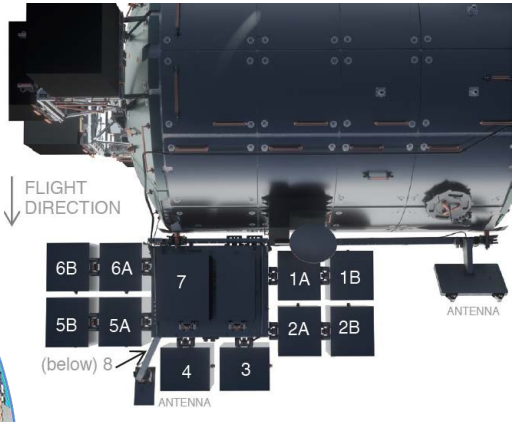
Payload Fields of View



Slot 3 Zenith View
[image credit: NASA]



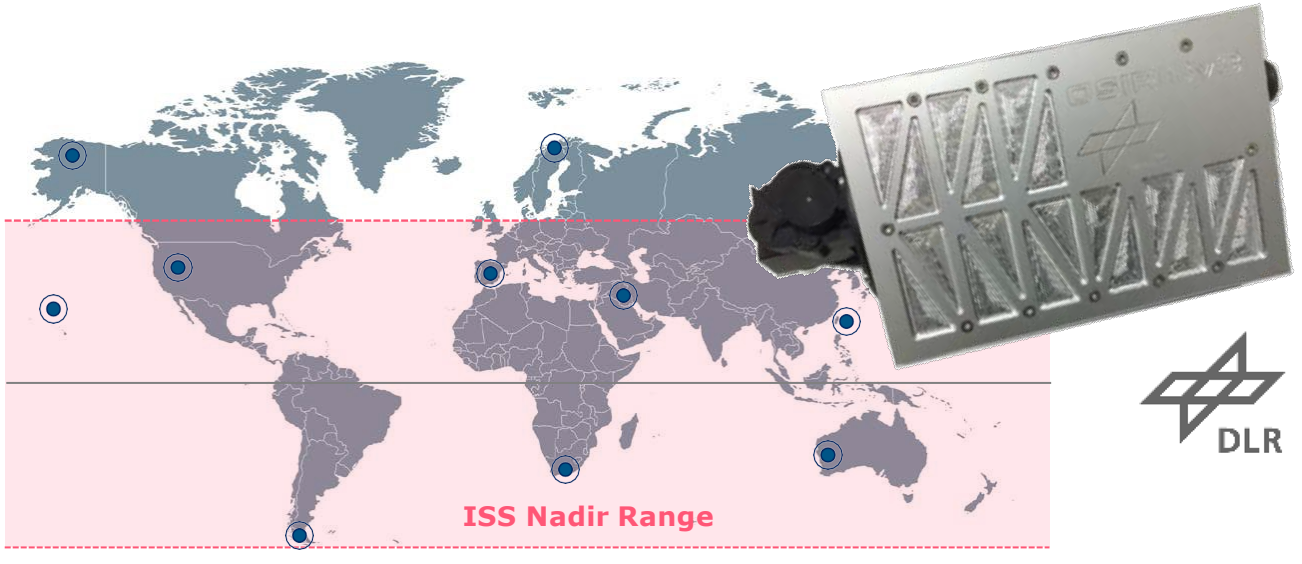
Slot 3 Nadir View
[image credit: NASA]



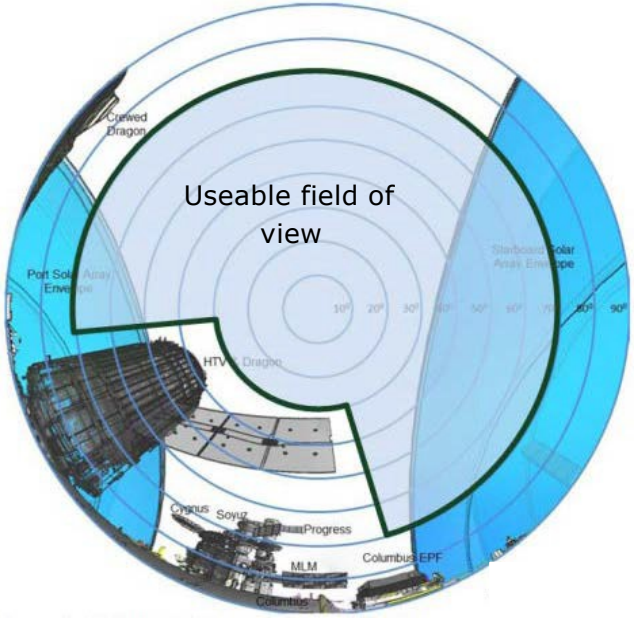
Payload viewing quality

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

Broadband Data Downlink



Optical Ground Segment



OSIRISv3 Field of View

- Commercial ground stations distributed worldwide will be used
- Some field of view restrictions exist to visiting vehicles and solar arrays
- Conservative achievable mean data throughput 1.375 TB / day, maximum achievable 2.5 TB / day
- Ground segment can provide around 100 GB within 45 minutes of downlink

Throughput Analysis Parameters	
OSIRISv3 max. channel rate	10 Gbps
Buffer size	500 GB
Number of ground stations	8
Minimum elevation angle	15 deg

Mapping of Uses Cases to Platform Positions

Slot Direction

Use -> Case	Materials Testing	In-Space Manufact-uring	Remote Sensing	Astro & Helio Physics	Atmo-spheric Research	Space Weather	On-Orbit Assembly	Robotics Testing	In-Orbit Testing	Propulsion Testing	Spacecraft Deploy-ment
Nadir (All except 7)		X	X				X	X	X		
Zenith (All except 8)	X	X		X		X	X	X	X	X	X
Ram (2B, 3, 4, 5B, 7)	X	X			X		X	X	X	X	X