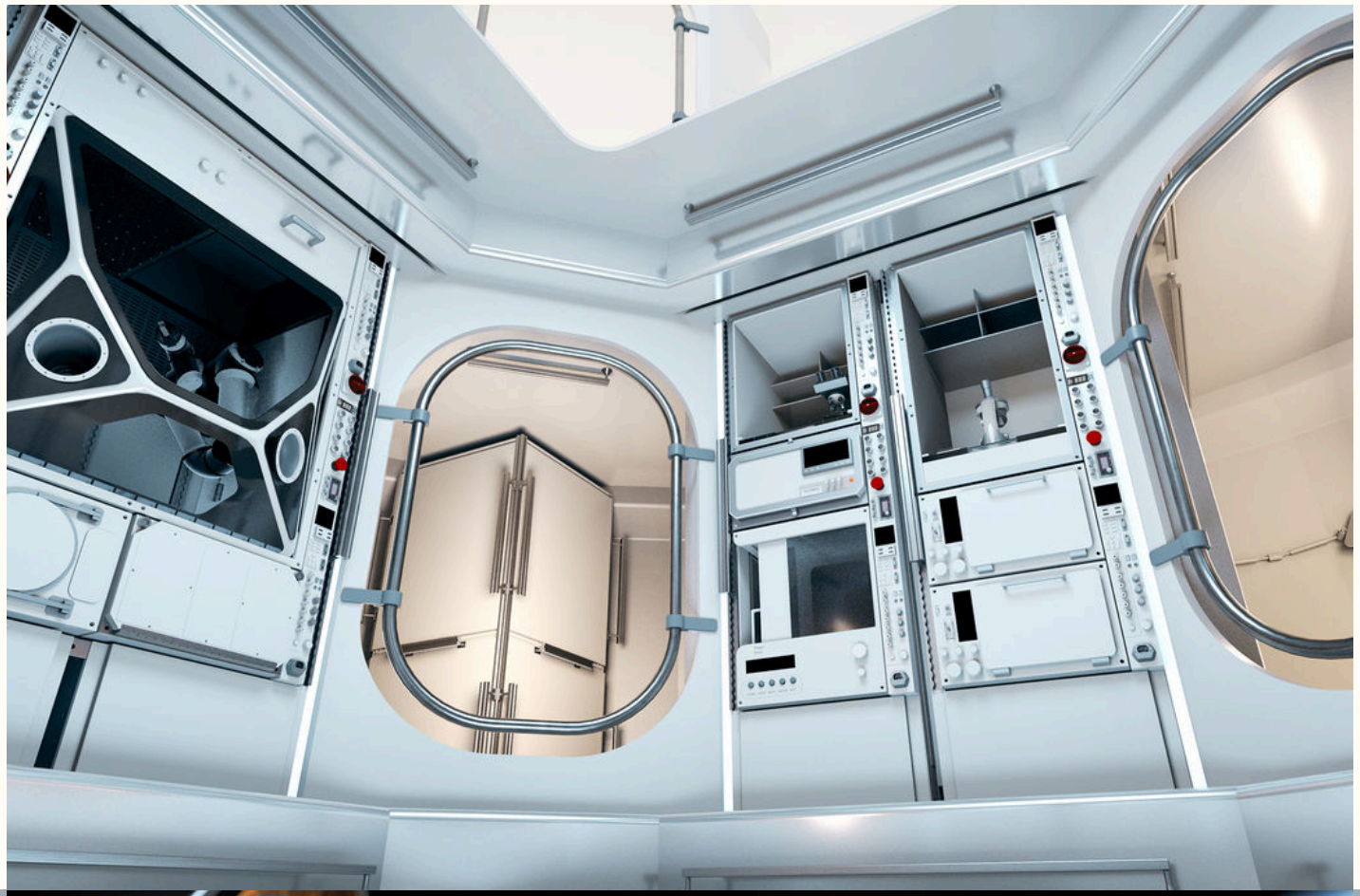
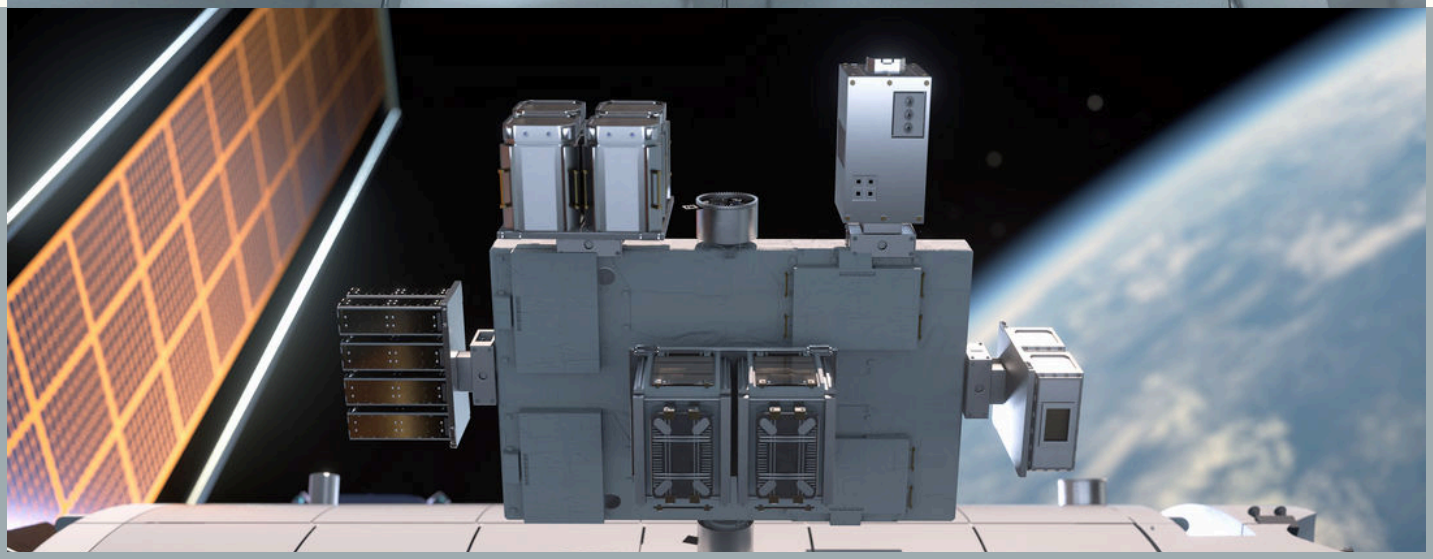
Starlab Payload Handbook

The Starlab Payload Handbook provides basic information on utilization of the Starlab Station for internal and external payloads. Further details on interface IRDs and onboard facilities can be found in our Payload Users Guide. To receive this document please contact us or sign up through our customer portal.





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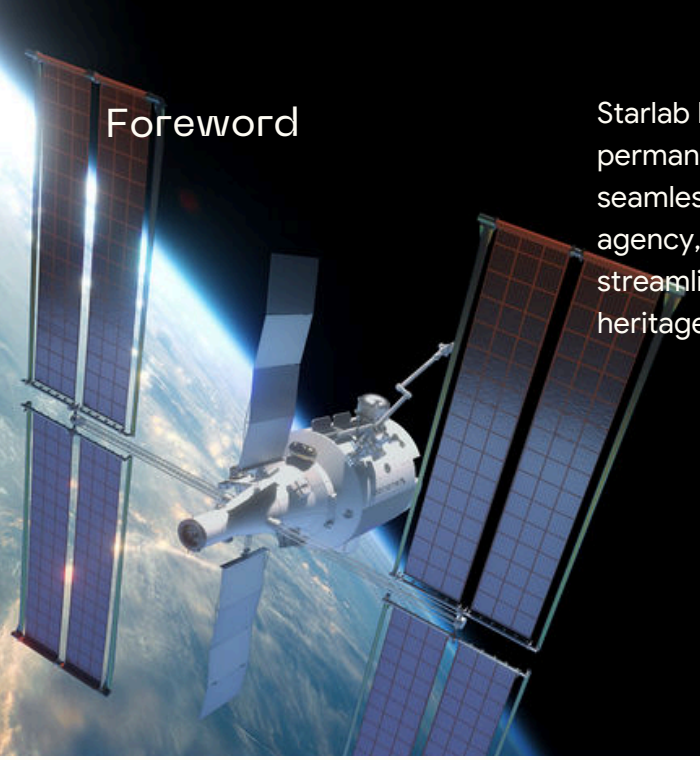


Foreword

Starlab LLC is building the future of orbital science and commerce: a permanent space station, providing AI-enabled utilization for rapid, seamless access to low-Earth orbit. Whether you're a government agency, academic researcher or commercial innovator, Starlab offers a streamlined path from concept to orbit, backed by proven flight heritage, global expertise, and a comprehensive network of partners.

Welcome to Starlab – the future of orbital research.

From microgravity biological research to external technology demonstration, Starlab is your gateway to sustained, meaningful discovery in space.

FOCUSED ON YOUR MISSION

At Starlab, we view every payload as a partnership. Our mission success is defined by your mission success. From initial engagement to integration, operation, and data/hardware/science/sample return, we are committed to enabling seamless access to the unique research environment of space. Our secure User Home Base portal enables faster onboarding, and users can manage missions from anywhere or work with our team for fully supported operations. Whether your goals involve advancing science, developing new technologies, or maturing commercial capabilities, Starlab is designed with you in mind.

MODERN. EFFICIENT. ACCESSIBLE.

With a modular, high-capability architecture and cutting-edge integration tools, Starlab simplifies access to space. Our Internal and External Payload Laboratories offer flexible, leaseable platforms and robust interfaces that support legacy and next-generation payloads alike. Advanced analytics and AI tools optimize mission scheduling, predict anomalies, and help extract deeper insights from experimental data, removing operational bottlenecks and empowering breakthrough science. By combining intuitive design, AI-enhanced operations, and a user-centric support model, we make orbital R&D faster, easier, and more productive.

INNOVATION ROOTED IN EXPERIENCE

Starlab draws on decades of spaceflight heritage and international collaboration to deliver a next-generation orbital laboratory. Supported by a global ecosystem of partners, we leverage proven practices alongside state-of-the-art advances in autonomy, robotics, communications, and analytics. Our platform is built not just for today's missions, but to evolve with tomorrow's needs.

Starlab Payload System Overview

The Starlab Payload Laboratory is a cutting-edge facility designed to propel scientific research and commercial innovation in space. Our laboratory is divided into two main sections: the Internal Payload Laboratory (IPL) and the External Payload Laboratory (EPL). Each section is equipped with state-of-the-art platforms and interfaces to support a diverse array of scientific experiments and commercial applications. Starlab not only supports on-orbit research but also assists in all aspects of payload integration and payload operations.

Starlab Station

Permanent presence orbital space station with four (4) crew continuously and **up to eight (8) crew** during turnover or other short duration missions. The crew is primarily built from professional astronauts, who will support operations of user payloads and experiments.

Orbits Earth at 500 km with a 45° inclination, delivering daily revisit opportunities over the most densely populated and scientifically valuable regions of the planet.

Offers all necessary resources to operate the internal and external payload laboratory with **12 kW of average payload power** and the ability to scale specific allocations to a payload as needed. The utility interfaces are similar to the International Space Station, including cooling, processing gases, vent, and vacuum lines.

Highly available, low latency, redundant **communication to ground at >1 Gbps at Final Orbital Capability** (FOC).

Resupplied through a fleet of heritage spacecraft vehicles providing upload and download of consumables, commodities, and experiments.

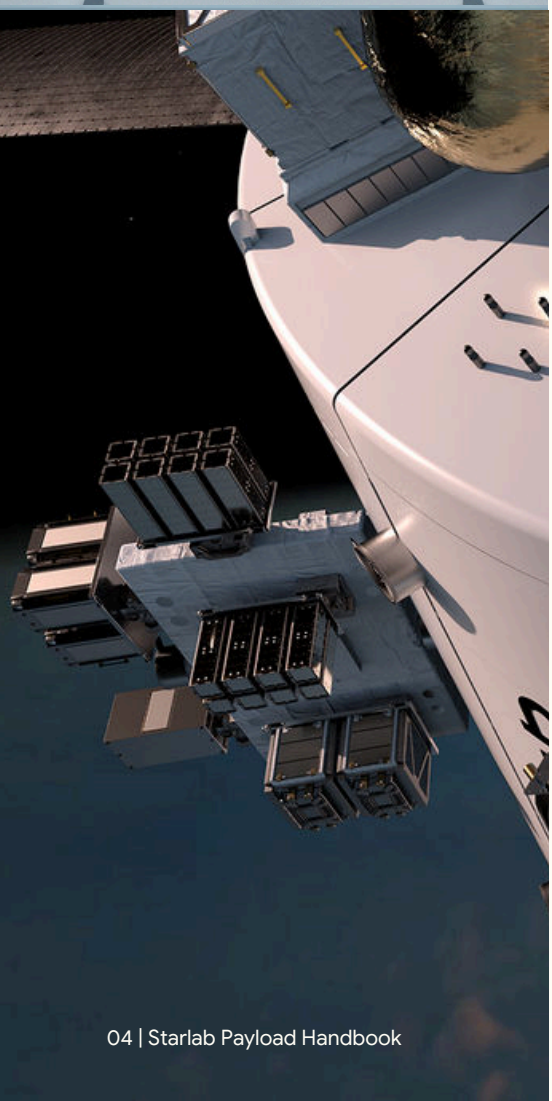
Three (3) Standard IDSS Docking Ports enables multiple vehicles to be docked at the same time. **Three (3) cargo and three (3) crew flights each year** will provide regular access to and from Starlab Station.

Payload Laboratories

The Starlab Station provides users an **internal volume of nearly 400 m^3**, with 13 payload platforms in the internal payload laboratory. These platforms offer adaptable, user-friendly, leasable space with capacity of up to 10 Middeck Locker Equivalents (MDLEs) per platform, resulting in a **total capacity of 130 MDLEs** across all platforms. The internal payload laboratory also provides a plethora of readily installed facilities onboard to support users.

The Starlab EPL provides **advanced external robotics and 18 external payload mounting locations** with field of view to wake, ram, nadir, zenith, port, and starboard.

Direct transfer of external payloads from the trunk of a resupply vehicle is achieved through Starlab Station's robotic arm, as well as a cargo airlock at FOC to support the soft-stowed, pressurized launch of an external payload with transfer and potential retrieval of the payload.



Ground Segment

Supports users for the full payload life cycle, from initial contact through development, integration, transport, operations, and return to ground, if requested.

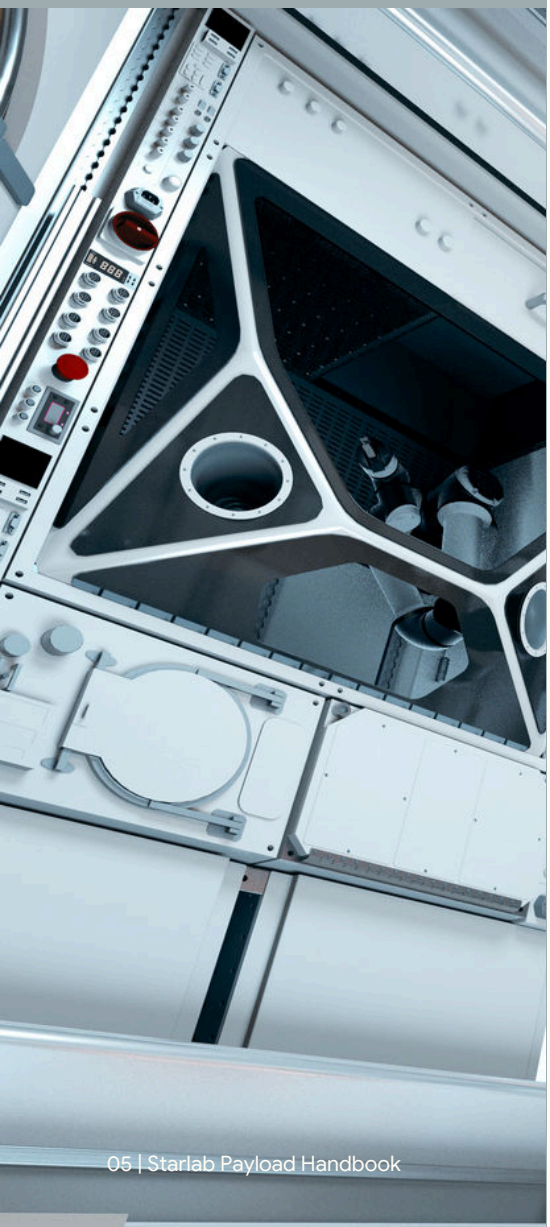
Payload integration centers are located close to users, a benefit of Starlab's international ecosystem.

Experiments and payloads can be operated by the Starlab control centers, as well as the user's home bases.

Advanced analytics and AI capabilities provide much greater efficiency in integration and operations processes, data management, and dissemination, and are available to users to support specific needs.

Starlab Payload System Overview

The Starlab Payload Laboratory consists of internal and external capabilities to host user hardware, encompassing all aspects required for integration and operational support—whether managed by users or Starlab personnel.



Internal Payload Laboratory (IPL)

The Starlab IPL is a hub of scientific exploration, offering a modular and flexible architecture to accommodate a wide range of experiments. Located on the second and third floors of Starlab Station, the IPL is equipped with 13 Internal Payload Platforms (IPPs). This setup ensures that the laboratory can adapt to evolving research needs.

INTERNAL PAYLOAD PLATFORMS

Starlab supports existing and future form factors.

The IPPs represent the next generation of payload hosting structure, supporting different heritage form factors compatible to SSP 57000 (EXPRESS, EDR-II), as well as new payload form factors. It establishes a reliable and easy-to-use interface with station resources such as power, data, and cooling. Each IPP provides a total volume of 0.7 m^3 to accommodate user payloads, which is an equivalent to more than 10 middeck lockers.

POWER AND THERMAL MANAGEMENT

Starlab supports standard configurable power supply between 75W and 500W (up to 2000W) on each of the 130 MDLE locations.

The IPL boasts a nominal power budget of 12 kW, and a peak power of up to 16 kW for all 130 MDLE locations, plus the EPL. Thermal control is managed through a dedicated temperature cooling loop, providing IPPs with air and water cooling nominally up to 2.4 kW per IPP. Two (2) high-power IPPs support a maximum heat load of 4.8 kW each.

DATA HANDLING

Starlab supports 1 Gbps data transmission.

The IPPs connect to the Starlab Utilization Network for seamless payload operations, using a secure VPN for data transmission. The station backbone supports 10 Gbps, while the IPP backbone supports 1 Gbps for each of the 13 platforms. Additional services such as image processing, in-orbit computation, and real-time links are available as services.

INTERFACES TO STATION RESOURCES

The standard interfaces include power (5-120 VDC), cooling, communication, and data handling, with additional modules for AC power (120 VAC), nitrogen, vacuum, and potable water.

PORTABLE PAYLOADS

The IPL accommodates portable payloads that do not require IPP mounting. This option offers users greater flexibility, as payloads can connect to station services for battery charging and data transfer via USB or Ethernet, and can be temporarily fixed in place.

Payload Facility Suite

The IPL is home to several specialized facilities, each designed to support specific research domains. Of the 130 MDLEs, up to 70 MDLEs are assigned to facilities supporting a wide variety of user needs.

BIOLOGICAL RESEARCH FACILITY

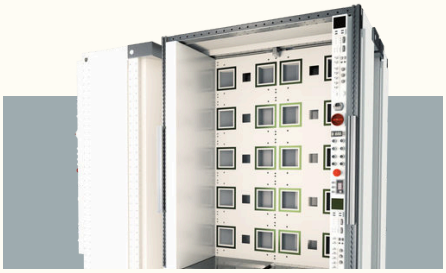
Equipped with incubators, bio-fabrication tools, in-situ data acquisition & analyses, and centrifuges for life sciences R&D and manufacturing.

HUMAN RESEARCH FACILITY

Shares equipment with the Biological Research Facility, focusing on human research.

PLANT RESEARCH FACILITY

Offers controlled environments, water, nutrition, air, lighting, and temperature for growing food and researching crops.



PHYSICAL SCIENCE FACILITY

Provides power, cooling, nitrogen, vacuum and additional resource needs to support fundamental and applied physics research.

MATERIAL SCIENCE FACILITY

Contains multiple furnace types for heating, melting, and solidifying materials, supporting high power, cooling, and stability demands.

WORKBENCH FACILITY

Provides tools and maintenance capabilities with stationary and portable components. The stationary workbench can also serve as a hosting and utilization platform for smaller payloads that do not require hazard-level containment and can provide power, cooling, and data directly to payloads.

GLOVEBOX FACILITY

One (1) glovebox, with a utilization volume of 450 L, offers two levels of containment for biological and material sciences and provides power, cooling, data handling, liquids, sterilization, and vacuum and gas resources inside the contained volume for payloads.

OPTICAL ANALYSES FACILITY

Includes an optical bench, microscopes, and additional capabilities for various imaging techniques, supported by high-grade vibration isolation.

COLD STOWAGE FACILITY

Provides temperature-controlled storage with stationary and portable freezers over several temperature regimes from refrigeration to cryogenics. The modular implementation provides a volume of > 500 L from the refrigerated regime down to -80°C and 10 L for cryogenic stowage.

External Payload Laboratory

The Starlab EPL is designed to support scientific advancement in low-Earth orbit by providing resources for testing and operating payloads in the external environment. The EPL consists of two (2) External Payload Platforms (EPPs), each capable of hosting up to nine (9) payloads, strategically placed on the port and starboard sides of the station to maximize viewing capabilities.
The EPL provides a comprehensive suite of interfaces and capabilities to support a wide range of scientific and commercial payloads in space.

EXTERNAL PAYLOAD PLATFORMS	Each EPP can host eight (8) standard payloads and one (1) large payload. Interfaces include Small Orbital Replacement Unit Robotics Interfaces (SORI) for standard payloads and Low Profile Grapple Fixture (LPGF) for large payloads, providing mechanical fixation, power, and data.
PAYLOAD MASS AND ENVELOPES	Each standard payload can have a mass of up to 250 kg and a volume of up to 1 m^3. Each large payload can have a mass of up to 10,000 kg and a volume of up to 3 m^3.
MECHANICAL AND ELECTRICAL INTERFACES	SORI interfaces for standard payloads are located on various faces of the EPP. Each EPP provides up to three (3) primary and three (3) secondary power feeds, with a nominal power budget of at least 4 kW. Power sharing with the IPL allows for a higher power budget if required.
COMMAND AND DATA HANDLING	Ethernet connections allow for data rates, including 10/100/1,000 Mbps for payload commanding, telemetry, and science data. Discrete signals for current, temperature, activation, and loop-back verification.
THERMAL INTERFACES	Heater power is provided, but thermal control and heat rejection must be implemented at the payload level.
ROBOTIC ARM AND SCIENCE AIRLOCK INTERFACES	Payloads are transferred to EPPs using the robotic arm, with initial transfer positions from the visiting vehicle trunk or science airlock. The science airlock facilitates the transition of pressurized payloads from inside the station to the external environment.
OPERATIONS	Payload services may include tasks such as launch in cargo transfer bags, on-orbit assembly, airlock operations, and installation onto EPP interfaces.
FIELD OF VIEW	Available views include ram, wake, nadir, zenith, port, and starboard.

STANDARD PAYLOAD EXAMPLES	Laser communication terminal, camera, edge computing, Earth observation telescopes, and materials research.	**LARGE PAYLOAD EXAMPLES**	Furnace and chip manufacturing.

Payload Integration and Operations with Starlab

We've reimagined payload integration and operations to meet today's fast-paced needs and eliminate traditional roadblocks. Through Starlab's secure, AI-enabled digital portal, users can move from initial proposal to in-orbit operations in under 12 months. Whether you're a first-time flyer or an International Space Station veteran, Starlab's onboarding experience is built to move fast, scale easily, and adapt to your team's technical needs.

To ensure efficiency, the entire preparation process will be **automated**. Users will access a secure and customized portal to submit all required data.

Real-time operations will be handled by the user as the default mode via their **User Home Base (UHB),** a customer-owned interface that will be connected to the Starlab Mission Control Center.

Starlab will provide support for UHB setup and connectivity as needed. However, based on user preference, payload operations can be managed by a **skilled team at Starlab**, offering flexibility for users who seek expert assistance.

The Starlab Payload System

Become a Starlab partner today and transform your vision into orbital reality.

Starlab's Payload System will represent a new frontier in space innovation. With leading-edge facilities and a modular, adaptive design, it will offer unmatched opportunities for scientific research and commercial ventures. As a hub for discovery and technological advancement, Starlab will be ready to lead the next era of space exploration.

Developed in partnership with trusted leaders like Voyager Technologies, Airbus, Mitsubishi, MDA, and Palantir, Starlab combines proven flight heritage with modern agility, offering researchers a station that is mission-ready on Day One.

Learn more at
starlab-space.com