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## Modular Low Earth Orbital-Hub DLR Vision 2025

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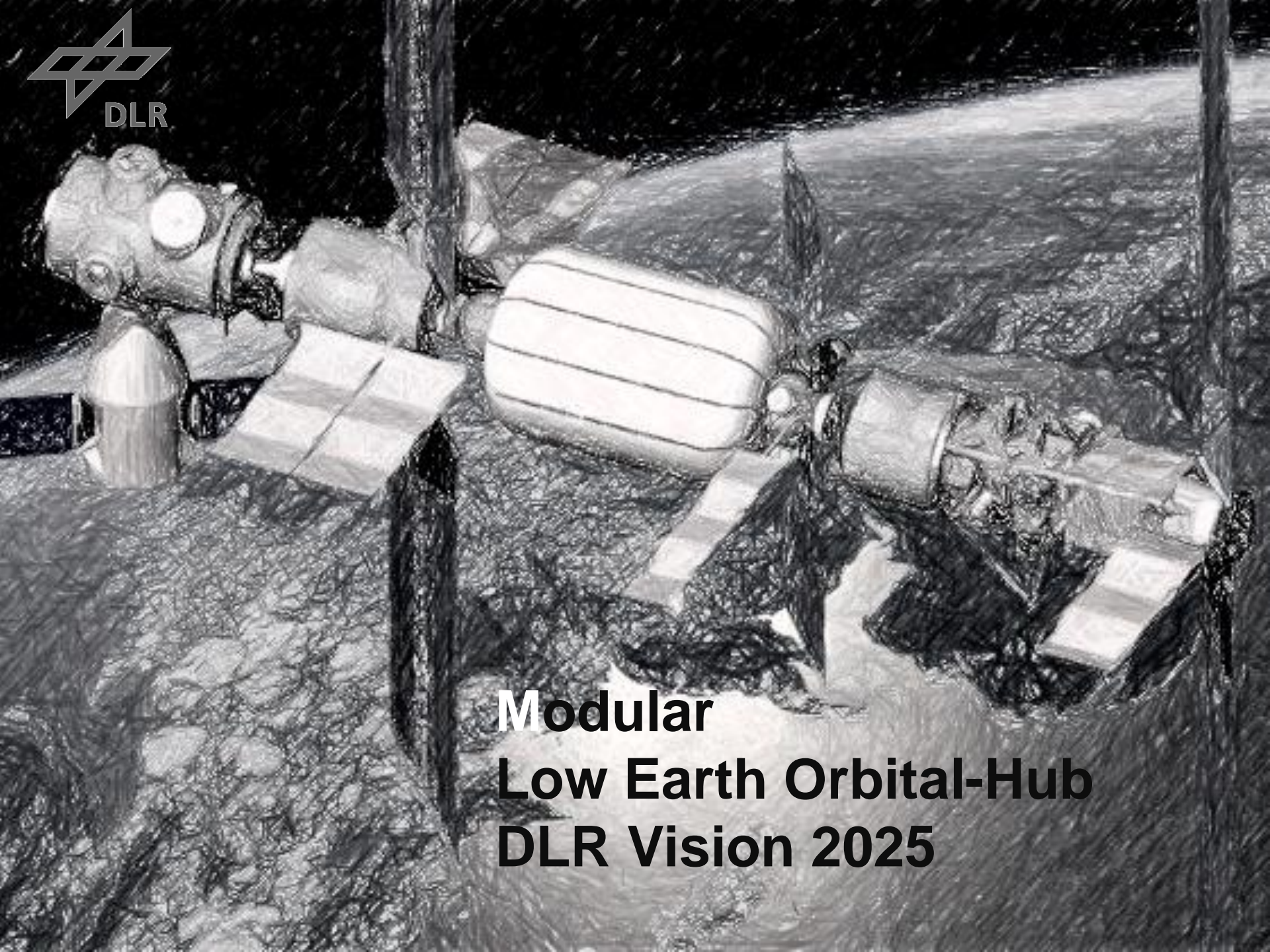
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**Modular  
Low Earth Orbital-Hub  
DLR Vision 2025**

# Low Earth Orbital-Hub DLR Vision 2025

44th Space Congress, Cape Canaveral, Florida

May 24-26, 2016

Institut für Raumfahrtssysteme  
Systemanalyse Raumsegment



Dr. Oliver Romberg



Wissen für Morgen



# Low Earth Orbital-Hub DLR Vision 2025

44th Space Congress, Cape Canaveral, Florida

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## Content:

- Introduction
- Project Goal
- O-Hub Concept
- Conclusions

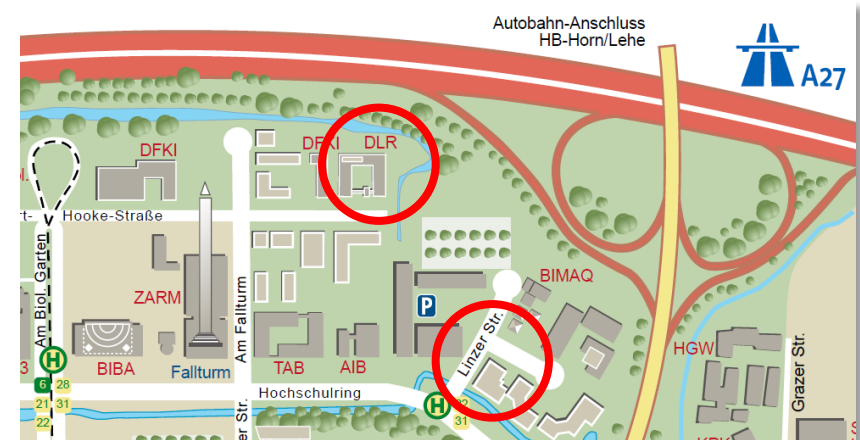


Wissen für Morgen

# Institute of Space Systems / Bremen



- Studies and analyses of launch vehicles and orbital systems to evaluate their technical performance and costs
- Design and development of spacecraft / missions (small satellites, lander vehicle)
- Development of technologies for
  - Cryogenic Propellant Management
  - Planetary Landing
  - Satellite Subsystems
  - Guidance Navigation and Control
  - High Precision Optical Measurements
  - Habitation & Life-Support-Systems



# Project Goal Modular Orbital-Hub

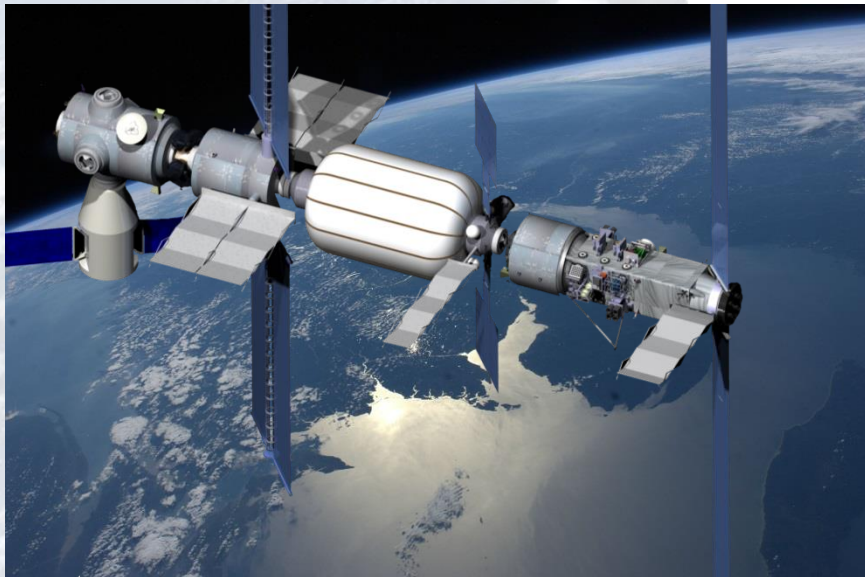
**Proposals for the German/European position to  
continue manned spaceflight in LEO  
(Outpost, Observatory)**

- after ISS-operation
- based on benefit of human presence in space



# Orbital-Hub Concept Development

- Various DLR ISS experienced scientists/experts plus NASA and ESA Astronauts, Bigelow Aerospace, Airbus-DS participated in simultaneous design studies (Concurrent Engineering Studies)
- Result: Modular, simple but extendible platform with Free-Flyer

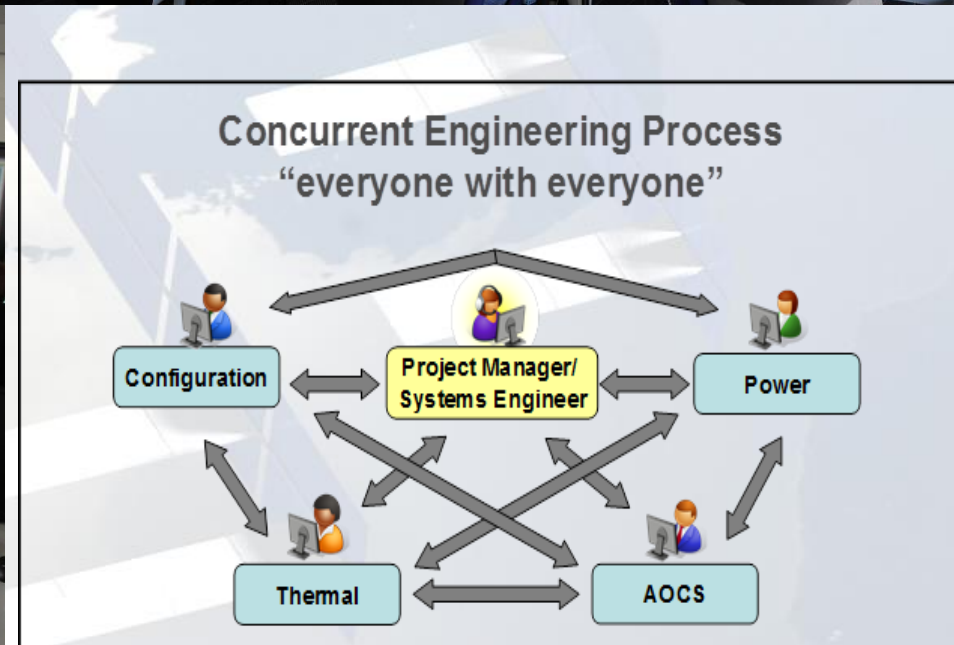


# Orbital-Hub Concept Development

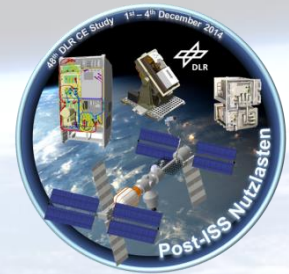


Concurrent  
Engineering  
Facility

- Simultaneous Design Laboratory
- Based on S/W Virtual Satellite
- Simultaneous involvement of experts for 1-2 weeks
- Common understanding
- Result: Mature Phase 0/A concept
- Outputs: Proposals for next phase







# Concept Development with Scientists in DLR CEF

## Participating Disciplines

- Science Coordination
- Architecture / Configuration
- Payload, I/Fs
- Material Physics
- Earth Observation
- Atmosphere Physics
- Human Physiology
- Gravitation Biology
- Radiation Biology
- Technology Demonstration / Expl.
- Operations
- Robotics
- Astronomy / Astrophysics
- To be added: Plasma Physics

tbd



# Main Objectives for Development

- **Significant cost reduction (lessons learnt from ISS), small concept!**
- **Utilization of O-Hub as platform for**
  - Earth Observation
  - Technology Demonstration
  - Commercial users (involvement of global players, private investments)
  - Science (following to ISS *but with Free Flyer*)
  - Exploration Preparation (crew-training for planetary missions, mission simulation)
- **High flexible, modular and extendible concept (“Space Village”)**
- **Involving worldwide roadmaps, synergy potentials with existing systems (e. g. Dream Chaser, Space Exploration, ...)**
- **Keeping human spaceflight alive (in EU / D)!**
- **More self-standing and dominant role for Europe/Germany in Space!**



# Engineering Concepts for Modular LEO Platform

## Service Module

- Power (30 kW)
- Thermal
- Control momentum gyroscopes
- Toilet
- ECLSS

## Docking Node

- 5 docking / berthing ports
- Communication / data storage
- Crew exercise equipment
- ECLSS
- Cupola attached to 1 docking port

## Crew- / Cargo-Transfer

- Crew return vehicles
- Fuel / cargo supply / reboost
- Payload return capacity
- e.g. existing Dragon, CST-100, Cygnus, Dream Chaser, Soyuz, Shenzou, HTV

## Expandable Habitat

- ECLSS
- 3 crew accommodations
- Laboratory (4-5 racks)
- EVA capability
- e.g. existing Bigelow Aerospace concept (B330) tbc.

## Dockable Free-Flyer Service Module

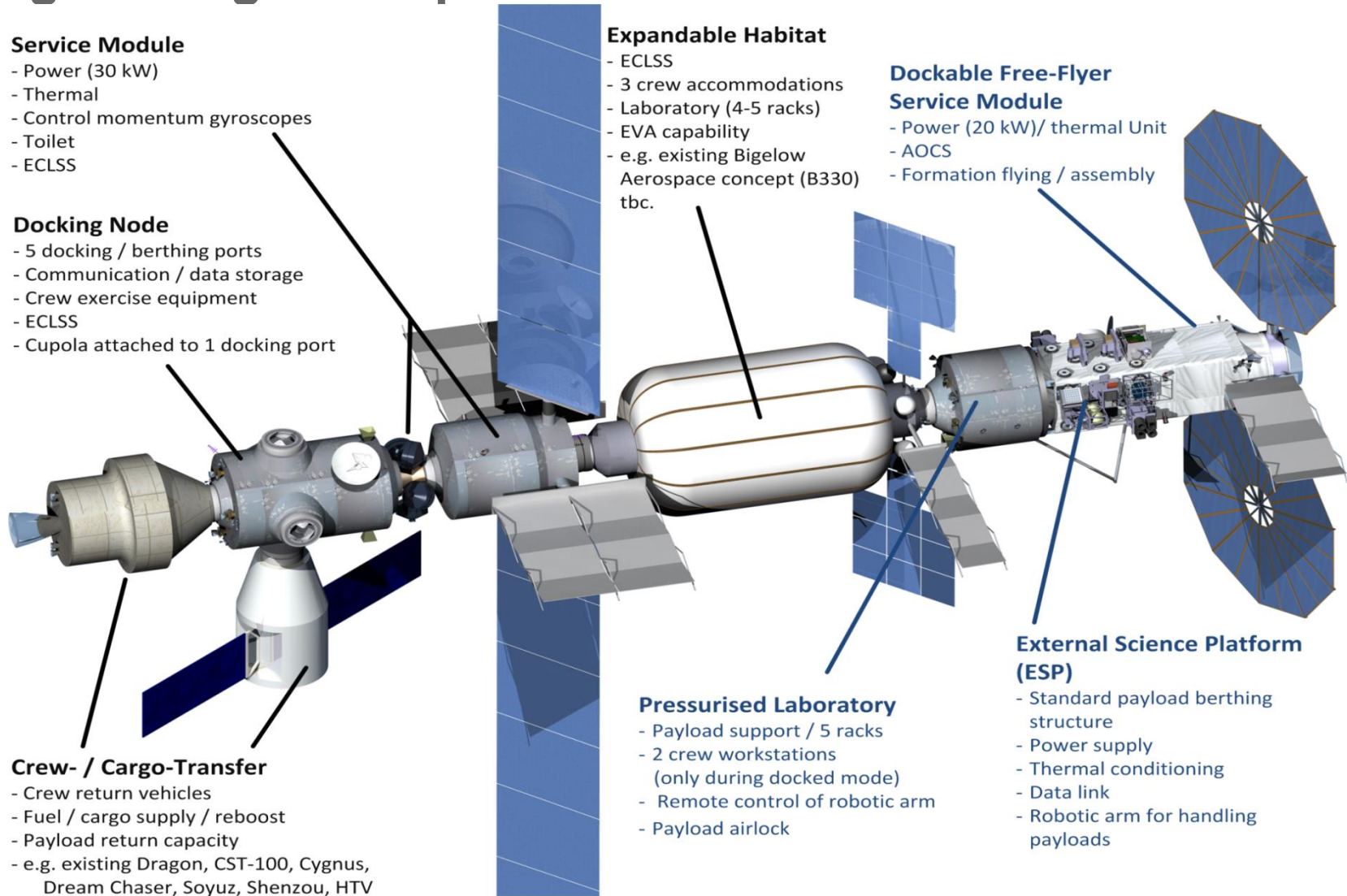
- Power (20 kW)/ thermal Unit
- AOCS
- Formation flying / assembly

## Pressurised Laboratory

- Payload support / 5 racks
- 2 crew workstations (only during docked mode)
- Remote control of robotic arm
- Payload airlock

## External Science Platform (ESP)

- Standard payload berthing structure
- Power supply
- Thermal conditioning
- Data link
- Robotic arm for handling payloads



**Modular Orbital-Hub: Dockable Module/Platform as a European Initiative**



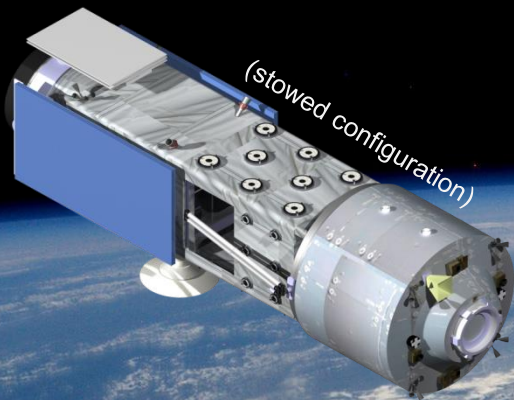
# Orbital-Hub Free-Flyer

- **Spacecraft:**

- launch mass: 18.7 t (w/o payload)
- propulsion: hybrid (chemical / electrical)
- diameter: 4.5 m
- length: 15.4 m
- power: 20 kW average

- **Features:**

- external decoupled Observation / Science Platform
- modular, scalable and attitude-flexible concept
- crew operation while docked at O-Hub / capsule / ISS
- transport by single A64-Launch
- low cost
- to be realised within ~8 years





# Conclusions and Next Steps

- *Further motivation and justification (beyond science) to build and operate human-tended infrastructures in LEO*
- High interest of possible users in Mini-Station with free flyer
- i. e. **Modular Orbital-Hub** involving space industry (ADS, Bigelow)
- Involvement of German key contributions for further consideration
  - Astronautical spaceflight in LEO
  - Ongoing requirements definition with int. community
  - Automated service modules, habitation modules
  - Robotic technology options
  - Advanced low thrust propulsion
  - Operations
- *Major Next Steps:*
  - *Detailed Design of O-Hub Free-Flyer Module in co-op with ADS*
  - *Detailed definition of use cases with international partners (commercial, industry, agencies, institutions)*

# Thank you for your interest!

April 2016

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Institute of Space Systems



System Analysis Space Segment

