**Earth–Aegis Long-Hauler Dossier**
*A Spacefaring Railroad for Cargo and Crew Transfer*

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## 1. Overview

The Earth–Aegis Long-Hauler is a heavy-duty, zero-g-native transport vehicle designed to move both cargo and passengers between Earth orbit and Aegis Station. Built from current and near-term technology, the Long-Hauler functions as a modular, reusable space train — capable of ferrying large crew rotations and freight shipments with high reliability and low operating cost.

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## 2. Mission Profile

- Transfer up to 48 passengers or crew members between LEO and Aegis Station
- Deliver bulk freight, water tanks, habitat shells, RONs, and mission equipment
- Serve as a lifeline for station resupply, construction support, and evacuation
- Operate autonomously or under remote supervision

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## 3. Specifications (Current-Tech Compatible)

| Attribute | Value / Estimate |
|---|---|
| Total Length | 50–70 meters |
| Passenger Capacity | 24–48 (short-duration config) |
| Cargo Capacity | 20–30 metric tons |
| Pressurized Volume | ~100–120 $m^3$ (crew module) |
| Transfer Duration | 5–7 days (chemical) |
| Power Supply | Solar array (250–400 $m^2$) + battery |
| Propulsion (Main) | Ion or Hall-effect electric drive |
| Propulsion (Boost) | Methalox or hypergolic kick stage |
| Docking Ports | Fore and aft |
| Reusability | 5–10 round trips minimum |

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## 4. Modular Architecture

The Long-Hauler is structured like a zero-g orbital train. Each section is modular and designed for rapid reconfiguration based on mission type. The standard operational layout (from front to rear) includes:

1. **Crew Command Module (Foremost)**
    - Piloting, nav systems, and docking collar for Aegis Station
    - Life support and comms integration
2. **Passenger Modules (Stackable)**
    - 8–16 bunks per car
    - Shared hygiene unit, galley, and emergency systems
    - Expandable up to 48-person total capacity
3. **Cargo Modules**
    - Modular pallets, tanks, or pressurized bays
    - ISO lock rails with robotic access points
    - Configurable per flight for mass or volume priority
4. **Power & Radiator Section**
    - Midship or rear-mounted solar arrays or Kilopower reactor
    - Thermal loops and radiator fins for heat management
5. **Propulsion Stack (Aftmost)**
    - Ion or Hall-effect thruster array for long-haul burns
    - Chemical kicker stage for transfer and rendezvous
    - RCS system for attitude and docking control
      The Long-Hauler is built around a central spine and modular dock system:

- **Crew Module**: Pressurized, habitable transport for crew
- **Freight Pods**: Palletized cargo, water tanks, or research payloads
- **Power Block**: Solar panels or small reactor + battery racks
- **Propulsion Stack**: Electric thruster frame + maneuvering system
- **Chemical Kick Stage**: Detachable booster for orbit changes

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## 5. Crew Module Features

- Up to 48 passengers in stacked sleeping bays
- Communal galley and hygiene pod (toilet + water reclamation)
- Emergency supplies, medkit, $O_2$/$N_2$ tanks
- Central corridor with group lighting and comms
- Minimal radiation shielding via water walls or mass buffers

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## 6. Freight Integration

- Standard cargo racks and ISO-compatible pallet mounts
- External access via robotic arm or EVA
- Internal cargo bay configurable for:
    - RON units
    - Regolith processor skids
    - Sample returns or water tanks

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## 7. Systems & Operations

- **Propulsion**: Ion/Hall thrusters for long-term efficiency
- **Boost Stage**: Methalox for quick departure or capture
- **Power**: Solar arrays or Kilopower-class reactor
- **Life Support**: ECLSS ($CO_2$ scrubbers, $O_2$/$N_2$ tanks)
- **Docking**: NASA/ESA standard ports, front and rear
- **Automation**: Autonomous nav, with ground override

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## 8. Role in Aegis Infrastructure

- Enables full crew rotations without capsule reliance
- Hauls critical cargo that won't fit inside conventional capsules
- May support emergency evacuation or mobile depot roles
- Scales with station growth and lunar operations

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