Understood, Hugh — here's a unified **technical summary** of everything we've built together so far: from the Earth-based mass driver through the full interplanetary logistics chain.
No civils, no money, pure system architecture — the "engineering bones" of humanity's spacefaring infrastructure.

Integrated Technical Summary — Earth–Moon–Mars Transit Infrastructure (Revision Zero, October 2025)

1. Earth Launch and Initial Ascent

The foundation of the system is the *Alpine Mass Driver*: a 2,000 km electromagnetic launch tunnel built through the Alps, following a logarithmic spiral that begins steeply vertical and flattens into a near-horizontal tangent at a 5 km-altitude muzzle.
The rail uses segmented linear synchronous motors and superconducting coils to accelerate 4-ton sleds to ≈ 10.7 km s^{-1} at ≤ 3 g sustained. Launches occur hourly—alternating 3-ton payloads and 3-ton propellant pods. The driver's exit trajectory ("the Slingshot") imparts both altitude and tangential velocity, placing cargo on a sub-orbital or high-elliptical path whose apogee reaches geosynchronous altitude. Atmospheric losses are minimized by the mountain altitude, smooth curvature, and aerodynamic fairing of each sled.

2. Geosynchronous Capture and Orbital Depots

Reusable 10-ton *solar- or nuclear-electric tugs* await near GEO to circularize incoming payloads. Each tug mounts a 10 MW closed-Brayton nuclear plant with radiators totaling ≈ 5 t, driving high-Isp (≈ 3,000 s) Hall or ion thrusters. A 1-t propellant load circularizes 3 t of cargo in ≈ 12 hours.
Captured cargo is delivered to *GEO Depots*—modular stations combining habitation, machine shops, and propellant storage. Depots are distributed around the equatorial ring to absorb steady inbound traffic and serve as staging hubs for interplanetary vehicles. Fuel and cargo are launched separately from Earth, so the depots function as orbital refineries and service yards.

3. Lagrange-Point Network

From GEO, tugs ferry standardized cargo pods to the Earth–Moon Lagrange points (E-M L1 and L2). Each depot functions as an industrial node—L1 specializing in outbound assembly and L2 in lunar logistics. The tug fleet operates in rotation: refuel at GEO → transfer → refuel at L1 → return.
Lagrange depots store propellants, spare parts, and regolith feedstock, operating largely on continuous-duty SEP power. Their geometry offers long-term orbital stability and near-constant line of sight to both Earth and Moon, ideal for communication and power beaming.

4. Lunar Operations and Regolith Mining

Lunar synchronous orbit hosts a smaller depot receiving cargo from L1. Automated landers lower mining equipment to high-latitude or near-polar sites. Mining focuses on bulk *regolith excavation* for oxygen, silicon, and metallic feedstocks, plus cryogenic extraction of hydrogen from polar volatiles.
Processing plants convert regolith into refined oxygen, metals, and structural composites. Refined propellants—hydrogen and oxygen—are lofted back to lunar orbit by small electromagnetic catapults or chemical shuttles, feeding the L1 depots. Thus, lunar industry closes the local propellant cycle, freeing the Earth driver from lifting chemical fuel once the loop matures.

5. Beyond-Earth Transport Chain

From the L1/L2 complex, *heavy orbital transfer vehicles* are assembled for Mars and outer-planet missions. These multi-reactor nuclear-electric ships carry high-efficiency thrusters, large cryogenic tanks, and spin-gravity habitation modules.
Cargo streams from the Earth system through the sequence:
Earth → GEO → L1 → Lunar → L1 → Outbound.
All tugs, depots, and vehicles share standardized mechanical interfaces and power couplings—no incompatible “adapters,” no single-point dependencies.
Every stage is reusable, refuelable, and maintainable in orbit by human and robotic crews.

6. Long-Term Architecture

Once mature, the network becomes a *permanent interplanetary rail system*: energy on Earth supplied by the Alpine reactors, mass delivered to orbit magnetically, refined materials supplied from the Moon, and interplanetary transport driven by steady-state nuclear-electric power.
Expansion naturally proceeds to additional Earth launch sites (equatorial, Andean, or Himalayan), mirrored mass drivers on the Moon, and industrial expansion into the Martian system. Each node—mass driver, depot, or tug—is modular, repairable, and designed for centuries of operation.

Summary Essence:
A continuous mechanical-electrical logistics chain linking Earth’s surface to cislunar space, based on reusable electric propulsion, modular depots, and the Alpine Mass Driver as humanity’s first permanent launch artery—the backbone of an interplanetary civilization.