Lunar Communications Infrastructure: Scenario Valuation for Early Networks

An Evidence-Gated Framework for Anchor Missions Coverage Phased Capital Service Adoption and Transaction Value

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Abstract

Early lunar communications networks are moving from architecture studies toward interoperable relay, navigation and direct-to-Earth services. NASA's LunaNet framework defines common communications, networking, position, navigation and timing interfaces. NASA selected Intuitive Machines in 2024 to develop initial lunar relay services. ESA's Moonlight programme describes a five-satellite communications and navigation architecture focused on the lunar south pole, with Lunar Pathfinder as a precursor. These programmes create evidence of institutional demand and technical direction. They do not establish a mature commercial market, predictable utilisation or a conventional infrastructure valuation.

This paper develops an evidence-gated valuation framework for an early lunar communications network. The framework separates eight value layers: funded anchor missions; technically executable coverage; interoperable user terminals and protocols; spectrum and regulatory rights; deployed and accepted relay capacity; direct-to-Earth and terrestrial network integration; recurring service adoption; and collected cash. It treats every layer according to the evidence available at the valuation date. Announced missions provide a demand map. Executed service orders and funded task orders support contracted revenue. Validated interfaces, launched relays, accepted service and paid invoices support progressively stronger value.

The model addresses the features that make early lunar networks unusual. Demand arrives in mission-sized blocks and can move with launch schedules. Coverage depends on orbital geometry, line of sight, relay availability, Earth stations, user terminals, spectrum coordination and service priority. Capital must be committed before a diversified customer base exists. Government agencies can be anchor customers, standards setters, counterparties and sources of programme risk. Navigation, timing, store-and-forward networking and high-rate communications can share infrastructure while following different acceptance paths.

A wholly hypothetical case considers a four-relay network serving south-polar, far-side and cislunar users through phased deployment. The scenario assumes six funded anchor missions, fourteen probability-weighted follow-on missions and USD 420 million of total programme capital through service acceptance. An evidence-gated enterprise-value bridge produces an illustrative USD 310 million transaction value before contingent consideration. Cash at completion reflects funded contracts, transferable technology and completed programme work. Deferred consideration is tied to launch, coverage, interoperability, service acceptance, retained missions and collected cash. The numbers describe no company and are used only to demonstrate the method.

The central conclusion is that an early lunar network should be valued through funded mission demand and accepted service rather than a forecast of the lunar economy. Coverage becomes valuable when a defined user can access an authorised, interoperable and available service at the required location and

time. Capital should be released in stages as technical and commercial evidence accumulates. This approach permits strategic investment while keeping uncontracted missions, undeployed capacity and remote option value outside the base case.

JEL Classification: G12, G24, G32, G34, L63, L93, O32, O33

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Introduction

The immediate task is to define the investment decision before projecting a lunar-network market. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises mission schedules, agency architectures, procurement documents and technical standards. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that a broad lunar-economy narrative can conceal the timing and concentration of real demand. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to state the perimeter, valuation date, target service and evidence hierarchy before modelling. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

1 Define the transaction perimeter

The immediate task is to identify the assets, contracts and capabilities that transfer at closing. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises relay designs, spacecraft work in progress, payloads, spectrum filings, software, patents, user terminals, ground agreements and service orders. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that programmes often depend on parent-company licences, shared staff, government-furnished equipment or non-transferable partnerships. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to map legal ownership, control, assignment rights, export restrictions and funding obligations for every value-bearing item. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

2 Define an executable lunar service

The immediate task is to translate network ambition into a service a mission can buy and accept. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises coverage region, link budget, data rate, latency, availability, navigation accuracy, interface, priority, security and support terms. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that a relay in lunar orbit does not create service when the user terminal, Earth return path or operating authority is missing. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to value only service combinations that can be tested against a named mission profile. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

3 Build the anchor-mission demand ledger

The immediate task is to separate funded missions from announced, proposed and aspirational activity. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises appropriations, awarded contracts, task orders, launch bookings, payload manifests, mission design reviews and customer confirmation. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that public mission counts can include duplicated concepts, unfunded payloads and schedules that move together. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to assign probability, timing, service need, procurement route and cancellation exposure to each mission. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

4 Model coverage from orbital geometry

The immediate task is to measure the service improvement created by each relay and ground path. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises orbit propagation, lunar terrain masks, Earth visibility, antenna patterns, link margins, occultation and station availability. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that average coverage percentages can hide gaps during landing, surface mobility or far-side operations. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to calculate availability for representative critical events and disclose modelling assumptions. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

5 Value south-polar and far-side access

The immediate task is to identify where relay coverage solves a mission constraint that direct-to-Earth service cannot. Spacecraft, payload, software, terrestrial networks and mission operations mature at

different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises landing-site coordinates, horizon masks, operational timelines, required data volumes and fallback paths. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that scarcity can be overstated when missions can change sites, use local storage or accept intermittent communication. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to link strategic value to funded users, required service windows and credible alternatives. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

6 Use LunaNet interoperability as a value gate

The immediate task is to test whether the network can participate in a multi-provider architecture. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises LunaNet services, applicable documents, delay-tolerant networking, navigation signals, security profiles and interface test results. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that nominal standards alignment can coexist with proprietary implementations and untested cross-provider behaviour. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to release interoperability value after representative user and provider tests pass. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

7 Separate communications, networking and navigation

The immediate task is to value each service line according to its own readiness and customer evidence. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises radio links, store-and-forward routing, time transfer, ranging, navigation messages and service monitoring. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that shared spacecraft can create cost efficiency while one immature payload delays the whole programme. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to allocate capital, schedule, acceptance and revenue to distinct service modules. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

8 Test spectrum and coordination rights

The immediate task is to confirm that planned links can operate lawfully and without harmful interference. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises ITU allocations and filings, national licences, coordination status, frequency plans, emission characteristics and interference analysis. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that filing activity does not prove priority, completed coordination or operational authority. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to condition value on effective rights and funded resolution of coordination risks. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

9 Design the capacity model

The immediate task is to convert relay payload capability into saleable mission service. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises bandwidth, coding, data rate, beam coverage, antenna pointing, power, contact schedules, onboard storage and Earth-link capacity. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that aggregate throughput can overstate capacity available at a specific lunar location or priority window. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to reconcile theoretical, technically feasible, scheduled, delivered and accepted capacity. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

10 Price mission priority and resilience

The immediate task is to distinguish routine data delivery from safety-critical and time-critical access. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises service classes, pre-emption rules, redundancy, restoration time, reserved capacity and incident obligations. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that high-priority commitments can reduce capacity sold to other users and create correlated liability. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to model reserved resources and service credits within unit

economics. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

11 Integrate direct-to-Earth and relay paths

The immediate task is to determine when a hybrid architecture reduces cost or improves resilience. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises user-terminal capability, lunar relay links, Earth stations, deep-space networks, terrestrial backhaul and routing policies. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that parallel paths can duplicate capital and operating cost without creating independent resilience. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to test common failure modes and assign traffic to the lowest-risk executable path. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

12 Test user-terminal readiness

The immediate task is to confirm that customers can access the service when their missions arrive. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises terminal mass, power, antenna, waveform, software, environmental qualification, integration schedule and test evidence. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that a network can reach orbit before compatible customer terminals complete qualification. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to treat terminal integration as a customer acquisition milestone and forecast its engineering cost. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

13 Measure technical readiness honestly

The immediate task is to separate laboratory performance from flight-qualified and operational capability. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises NASA technology-readiness definitions, design reviews, environmental tests, hardware-in-the-loop trials, launch acceptance and in-orbit commissioning. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that schedule confidence can be distorted when components at different readiness levels are presented as one system. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to assign probability and contingency by subsystem and critical path. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

14 Model launch and deployment dependency

The immediate task is to connect capital release and revenue timing to realistic access to lunar orbit. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises launch contract, integration slot, rideshare assumptions, transfer stage, propulsion margin, commissioning plan and insurance. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that a delay can defer revenue while fixed engineering and programme costs continue. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to run coordinated launch-delay, replacement and cash-runway cases. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

15 Stage capital by evidence

The immediate task is to fund the programme through measurable technical and commercial gates. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises preliminary and critical design reviews, flight hardware, launch, orbit insertion, coverage tests, customer acceptance and cash receipts. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that fully funding the constellation before demand and service evidence mature concentrates downside. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to match equity, debt, milestone payments and strategic capital to risk retirement. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

16 Build the cost-to-serve model

The immediate task is to capture the continuing cost of reliable off-world infrastructure. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises mission operations, Earth stations, spectrum, software, cyber security, propulsion, collision assessment, spares, insurance and customer support. Diligence should reconcile

presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that early pricing can exclude lifecycle work and make gross margin appear stronger than cash economics. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to forecast cost by mission, service class and network phase. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

17 Convert contracts into bankable revenue

The immediate task is to distinguish awarded value from revenue that survives mission delay and service failure. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises funding ceilings, obligated amounts, minimum purchases, milestones, termination rights, customer acceptance and payment terms. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that headline contract value can include options, indefinite-delivery ceilings and reimbursable development. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to use only funded, enforceable and deliverable amounts in the contracted base. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

18 Address customer concentration

The immediate task is to measure dependence on a small number of agencies, primes and flagship missions. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises revenue, backlog, programme funding, renewal path, technical integration and substitution by customer. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that a single programme change can affect several missions and suppliers simultaneously. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to cap concentration value, maintain liquidity and diversify by mission class and jurisdiction. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

19 Model government procurement risk

The immediate task is to reflect the role of public buyers in creating and reshaping the market. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises budget authority, procurement vehicle, award protest, continuing resolutions, sovereign priorities and termination rights. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that institutional sponsorship does not remove annual funding, schedule and policy risk. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to tie forecasts to obligated funding and model programme-specific downside. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

20 Test commercial adoption

The immediate task is to identify services for which non-agency customers will pay from their own mission economics. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises customer interviews, mission budgets, make-or-buy analysis, launch dates, terminal plans, service orders and deposits. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that expressed interest can reflect technical curiosity without approved procurement. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to recognise commercial value after the buyer verifies budget, authority and contracting path. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

21 Value data and navigation adjacencies

The immediate task is to assess whether shared infrastructure supports incremental products. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises navigation corrections, time distribution, lunar surface mapping, weather and situational information, data custody and analytics. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that adjacent products can require new licences, sensors, processing and customer workflows. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to treat each adjacency as a separately funded option until customer acceptance is observed. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

22 Protect cyber and mission assurance

The immediate task is to evaluate whether the network can support safety-critical and government missions. Spacecraft, payload, software, terrestrial networks and mission operations mature at different

rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises identity, key management, encryption, secure boot, software supply chain, telemetry integrity, incident response and operational segregation. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that a compromised relay can affect multiple customers and undermine network trust. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to fund independent testing, resilient control paths and contractual allocation of incident responsibility. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

23 Address sovereign and export controls

The immediate task is to identify ownership and information restrictions that shape financing and M&A. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises foreign-investment rules, export classifications, technical-assistance controls, security agreements, customer consent and data residency. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that cross-border capital can restrict access to technology, facilities, personnel or government work. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to design governance, ring-fencing and closing conditions before value is committed. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

24 Build an evidence-gated forecast

The immediate task is to connect mission demand, service readiness and phased capacity to cash. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises mission-level start dates, probability, usage, price, acceptance, capital, operating cost, working capital and tax. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that smooth market-growth curves conceal lumpy missions and correlated schedule changes. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to forecast every anchor mission separately and keep uncontracted cohorts outside the base case. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

25 Select valuation methods

The immediate task is to use methods that reflect early infrastructure risk and strategic options. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises risk-adjusted discounted cash flow, milestone probability, replacement cost, precedent transactions, option value and scenario analysis. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that mature telecom multiples can capitalise demand that has not yet formed. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to reconcile methods to the same perimeter, funding need and evidence date. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

26 Build the enterprise-value bridge

The immediate task is to show how observed assets and contracts become transaction value. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises completed work, transferable intellectual property, funded backlog, accepted capacity, integration capital, liabilities and strategic options. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that combining programme spend and forecast cash flow can double count value. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to identify one evidence source and one valuation treatment for every bridge item. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

27 Structure consideration around milestones

The immediate task is to allocate launch, acceptance, adoption and cash risk between buyer and seller. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises completion conditions, holdback, seller rollover, earn-out, milestone payments, warranties and specific indemnities. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that technical milestones can be met without creating retained customer value. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to link contingent payments to accepted service, retained funded missions and

collected cash. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

28 Hypothetical transaction case

The immediate task is to apply the framework to a staged four-relay programme. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises six funded anchor missions, fourteen follow-on missions, USD 420 million total capital and defined acceptance gates. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that the scenario can fail through launch delay, mission cancellation, terminal slippage, cost growth or weak adoption. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to use the case only as a transparent demonstration and replace every input in a live mandate. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

29 Diligence and post-close governance

The immediate task is to turn the valuation assumptions into a controlled execution plan. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

The principal evidence comprises evidence room, subsystem readiness, mission contracts, link testing, capital baseline, risk register and board reporting. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that value can erode after closing when integration, programme management and customer commitments lack accountable owners. The base case should exclude value without an executable service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to track mission readiness, coverage, accepted service, capital variance, liquidity and cash collection against the deal case. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

30 Decision record and limitations

The immediate task is to preserve the distinction between observed evidence and scenario judgement. Spacecraft, payload, software, terrestrial networks and mission operations mature at different rates. Valuation should identify what exists, what remains funded development and what depends on a future mission, approval or launch.

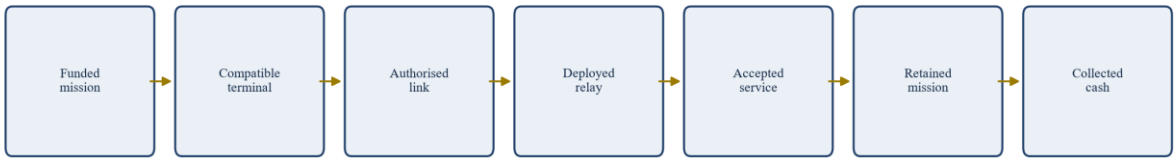
The principal evidence comprises dated sources, model versions, approvals, customer confirmation, technical tests and assumption owners. Diligence should reconcile presentations to dated original records. Technical evidence should connect to a service, customer, cost or capital milestone. Commercial evidence should identify budget authority and a procurement route.

The main risk is that public information cannot verify confidential contracts, technical performance, liabilities or transferability for a named target. The base case should exclude value without an executable

service, transferable right or funded commitment. Related launch, mission and programme assumptions should move together in downside cases. The proposed control is to require refreshed evidence, specialist advice and independent model review before a transaction decision. A named owner should maintain the evidence, probability and next decision date. Consideration and capital should follow the same gate.

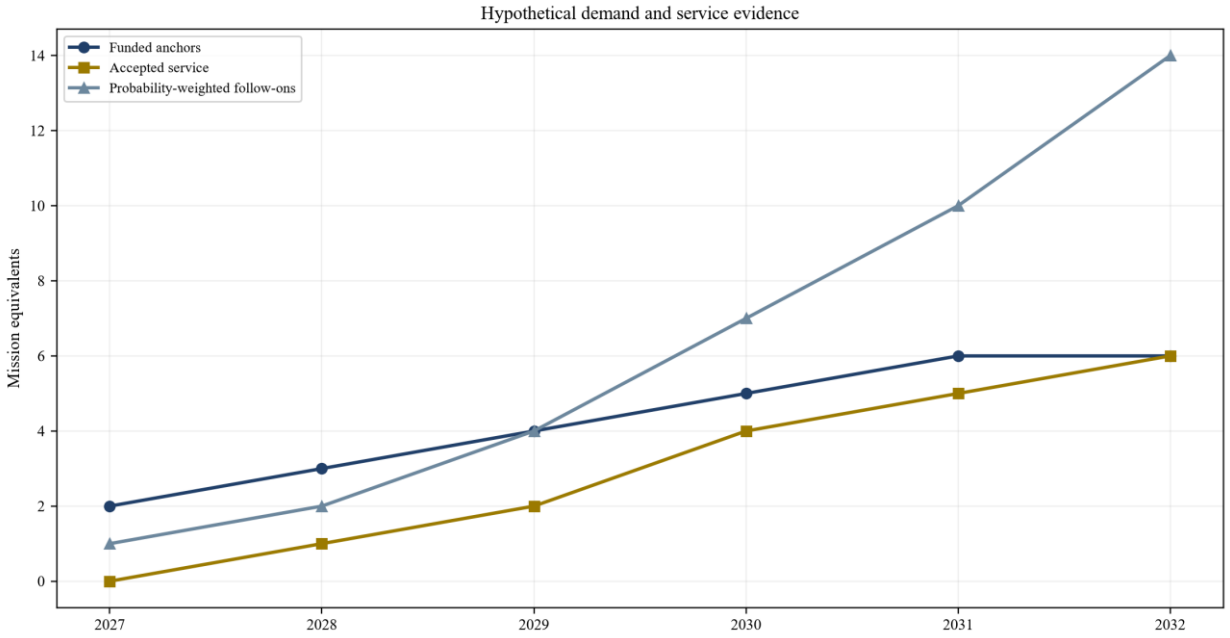
Figure 1. Lunar-network evidence ladder

Value strengthens as technical and commercial evidence accumulates



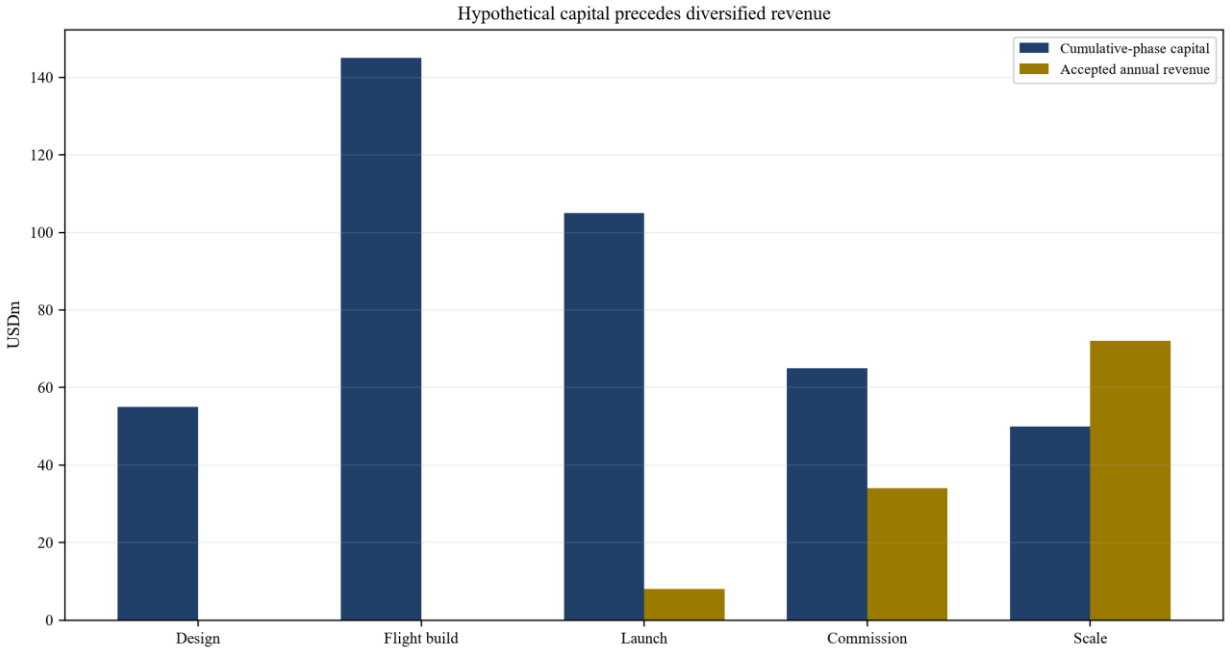
Proposed progression from mission demand to collected service cash.

Figure 2. Hypothetical anchor-mission schedule and accepted service



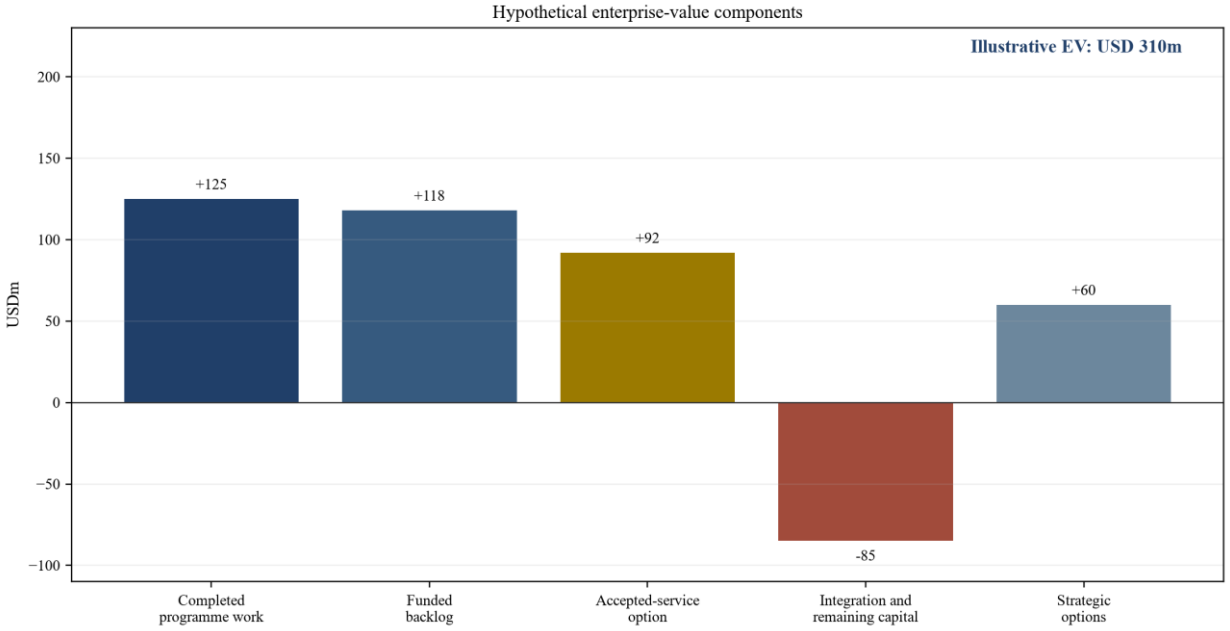
Illustrative mission counts; no programme or company is represented.

Figure 3. Hypothetical phased capital and contracted revenue



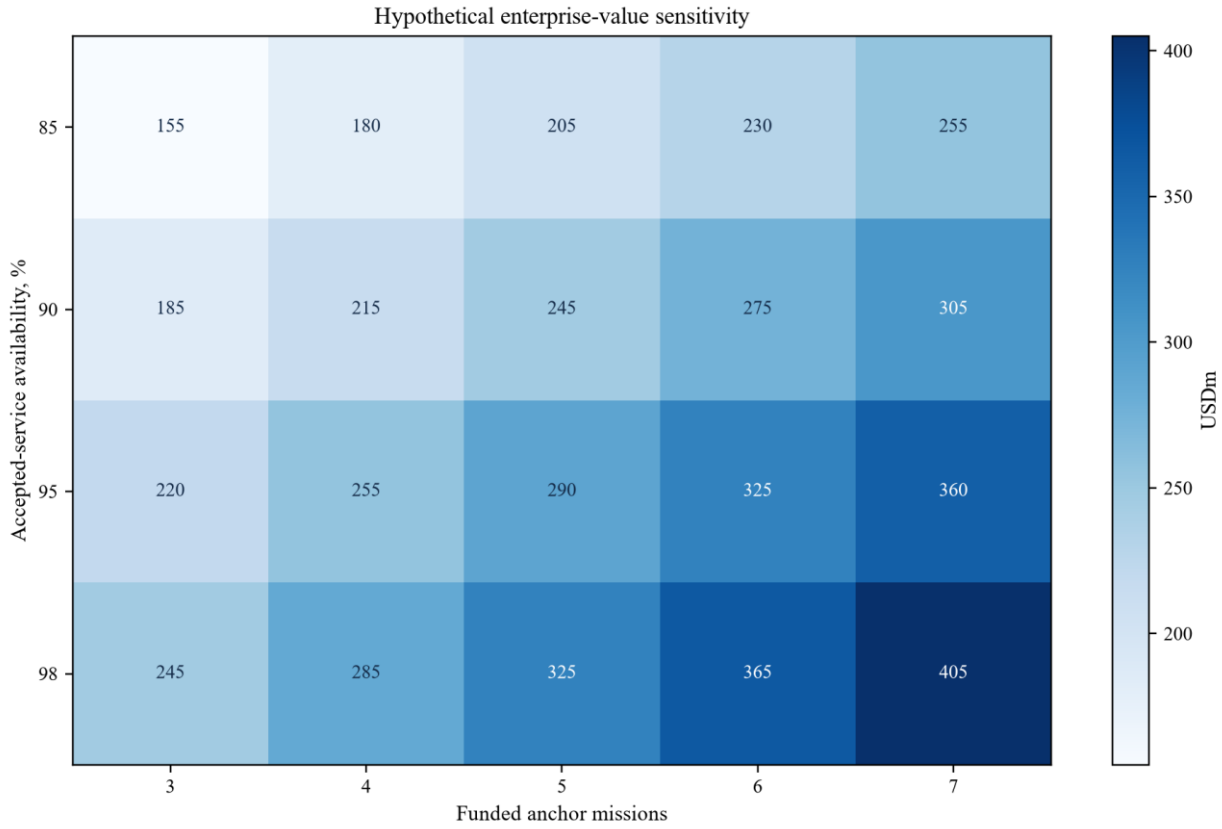
Illustrative USD millions; revenue is shown only after service acceptance.

Figure 4. Hypothetical enterprise-value bridge



Illustrative USD millions; no named company is represented.

Figure 5. Hypothetical valuation sensitivity



Illustrative enterprise value in USD millions by funded anchors and accepted-service availability.

Table 1. Lunar-network evidence and valuation treatment

Evidence state	Minimum record	Valuation treatment	Principal residual risk
Funded mission	Obligated contract or approved funded order	Contracted demand	Cancellation or schedule change
Compatible terminal	Qualified interface and successful test	Customer access option	Integration delay
Authorised link	Effective spectrum and operating authority	Executable coverage right	Coordination or renewal
Deployed relay	Launch and orbit confirmation	Physical capacity option	Commissioning failure
Accepted service	Customer acceptance and service log	Evidenced service revenue	Reliability and concentration
Retained mission	Renewal or follow-on order	Relationship value	Programme dependence
Collected cash	Reconciled invoice and receipt	Base cash-flow value	Working capital and set-off

Proposed minimum record for each value state.

Table 2. Hypothetical mission-demand conversion

Demand stage	Mission equivalents	Base-case treatment	Required evidence
Publicly announced	42	Context only	Official mission source
Technically addressable	27	Market boundary	Service and terminal fit
Funded procurement path	15	Probability-weighted	Budget and buyer process

Demand stage	Mission equivalents	Base-case treatment	Required evidence
Contracted or ordered	6	Contracted base	Funded agreement
Accepted service	4	Recurring revenue base	Service acceptance
Collected service cash	3	Cash-flow evidence	Invoice and receipt

Every figure is illustrative and describes no programme.

Table 3. Coverage-layer diligence

Layer	Principal evidence	Value contribution	Failure consequence
User terminal	Qualification and interface test	Addressable mission access	Customer cannot connect
Lunar link	Link budget and service test	Surface or orbital coverage	Data or command loss
Relay spacecraft	Commissioning and availability	Shared capacity	Regional service gap
Earth return	Station and backhaul acceptance	Delivery to customer network	Stranded lunar capacity
Network layer	Routing and custody test	Resilient data flow	Delay or loss
Navigation layer	Signal and accuracy validation	PNT service	Mission autonomy constrained

Proposed service decomposition.

Table 4. Hypothetical phased capital plan

Phase	Capital	Principal gate	Value released
Architecture and design	55	Critical design baseline	Transferable design package
Flight build and terminals	145	Qualified flight hardware	Launch-ready capacity
Launch and transfer	105	Relays in planned lunar orbits	Physical network option
Commissioning and acceptance	65	Representative accepted service	Service cash-flow option
Scale and redundancy	50	Retained anchors and availability	Network and resilience value
Total	420	All gates	Illustrative programme capital

Illustrative USD millions; financing terms are omitted.

Table 5. Hypothetical enterprise-value bridge

Component	USDm	Evidence treatment
Completed programme work and transferable assets	125	Verified cost and usable output
Funded mission backlog	118	Risk-adjusted contracted contribution
Accepted-service growth option	92	Probability-weighted follow-ons
Integration and remaining capital	-85	Buyer funding before full service
Strategic network options	60	Separately risk-adjusted optionality
Enterprise value	310	Illustrative transaction value

Illustrative USD millions; no named company is represented.

Table 6. Hypothetical consideration structure

Consideration	USDm	Release evidence	Protection
Cash at completion	180	Transferable assets, funded backlog and consents	Warranties and escrow
Launch and commissioning milestone	35	Defined relays in target orbit	Independent technical test
Coverage and interoperability milestone	30	Representative users complete accepted service	Agreed test protocol
Mission-retention milestone	25	Named funded anchors remain active	Contribution threshold
Collected-cash milestone	15	Third-party receipts	Reconciliation and clawback
Seller rollover	25	Continuing equity	Funding and governance agreement

Illustrative allocation tied to observable outcomes.

Table 7. Investment-committee gates

Gate	Decision question	Minimum evidence	Failure response
Perimeter	Which rights and obligations transfer?	Asset, contract, IP and approval map	Exclude or condition
Demand	Which missions have funded authority?	Mission and procurement ledger	Remove from contracted base
Service	Can a representative user receive accepted service?	End-to-end test and acceptance	Defer service value
Capital	Is funding sufficient through the next gate?	Cost baseline, contingency and liquidity	Resize or stage financing
Regulation	Can links operate and ownership close?	Spectrum, export and investment approvals	Ring-fence, condition or stop
Valuation	Does each value item have one evidence source?	Evidence-linked bridge	Reprice or restructure
Governance	Who owns post-close risk retirement?	Milestones, owners and board dashboard	Withhold capital or consideration

Proposed decisions and failure responses.

Frequently asked questions

Q: What is the strongest evidence of value in an early lunar communications network? A: The strongest evidence is accepted service for a funded mission, supported by effective operating rights, compatible user equipment, completed end-to-end delivery, customer acceptance, an invoice and collected cash. Earlier technical and commercial milestones support progressively more contingent value.

Q: How should announced lunar missions be used in valuation? A: Announced missions should provide market context and a diligence pipeline. They should enter a forecast only after funding, schedule, service need, customer authority and procurement route are verified. Correlated programme delays should be modelled together.

Q: Does a relay satellite create commercial coverage when it reaches lunar orbit? A: Orbital deployment creates a physical capacity option. Commercial coverage also requires authorised spectrum, compatible terminals, a functioning Earth return path, operational control, service availability and customer acceptance for a defined mission profile.

Q: How should LunaNet compliance affect value? A: LunaNet-aligned interfaces can broaden potential interoperability and reduce customer integration friction. Value should follow completed cross-provider and user tests, reusable configurations and accepted service rather than a statement of intended compliance.

Q: Which valuation method is most suitable for an early network? A: A risk-adjusted discounted cash-flow model should be combined with milestone probability, replacement-cost checks and separately stated strategic options. Mature telecommunications multiples can provide context after differences in demand maturity, capital intensity and government concentration are reconciled.

Q: How should capital be released? A: Capital should be staged around design maturity, qualified flight hardware, launch, commissioning, coverage tests, interoperability, customer acceptance and liquidity. Each gate should have objective evidence, an accountable owner and a defined response when it is missed.

Q: How can transaction structure allocate uncertainty? A: Cash at completion can reflect transferable assets and funded backlog. Deferred consideration can depend on launch, commissioning, accepted coverage, retained anchor missions and collected cash. Seller rollover can align longer-term outcomes when governance and future funding are clear.

Q: What should the board monitor after closing? A: The board should monitor funded mission coverage, subsystem readiness, launch and commissioning milestones, accepted-service availability, terminal integration, capital variance, liquidity, customer concentration, regulatory status, incidents and cash collection against the original deal case.

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