Skymapper Pre-Seed Investment Memo

Skymapper is a space observation network powered by a fleet of smart telescopes.

- **Skymapper is the first DePIN focused on capturing images and video data of outer space.** The protocol captures, aggregates and standardizes astronomical and satellite tracking data through a network of smart telescopes. This data is valuable for both the commercial satellite industry (e.g., asset tracking, regulatory compliance, insurance underwriting) and public sector use cases (e.g., celestial event detection, space traffic management, national security, SETI).

- **Skymapper's data is valuable today, with the potential to grow 1000x over the next decade.** The number of active satellites is projected to grow from 13K today to 60K by 2030 (35% CAGR). As the number of satellites grows by n, the number of interactions between satellites grows by n^2, requiring more granular, lower-latency positioning data for maneuvering and collision avoidance. We believe the narrow market for optical-telescope based space imagery will grow to $500m/yr.

- **Co-founded by renowned astronomer and serial entrepreneur Franck Marchis.** Franck is one of the leading astronomers in the world, with over 400 academic publications and notable achievements including discovering the first triple-asteroid system. Franck has worked at the SETI Institute since 2007, where he serves as Senior Planetary Astronomer and Chair of the Exoplanet group at the Carl Sagan Center. In 2017, Franck became a Co-Founder and Chief Science Officer at Unistellar, a crowdfunded startup that sold 25K+ smart telescopes, generated $50M revenues and launched the highly-successful SETI Institute Citizen Science Program.

- **Generates astronomical & satellite data at a structurally lower cost than existing solutions.** By leveraging telescopes that are owned and operated by a global community, Skymapper lowers the cost of satellite observations from $150 today to below $30. Skymapper will sell low-cost hardware attachments that function as controllers and enclosures for existing smart telescopes. When a data customer such as a satellite operator requests an observation: 1) the network routes the request to several smart telescopes with line-of-sight view, 2) these telescopes record videos of the object/event and send them to validator nodes for processing, 3) validators participate in Skymapper's novel *Proof-of-Space-Observation* consensus to validate the accuracy of the data received before ultimately serving it to customers via API. Over time, Skymapper can charge a premium for observations with higher levels of detail, redundancy, frequency and/or anonymity.

- **Key partnerships will bootstrap both the supply- & demand- sides of the network globally.** Unistellar, where Franck remains a major shareholder, will enable tens of thousands of amateur astronomers to join the Skymapper network with a single click on Unistellar's mobile app. SETI Institute, where Franck will continue a part-time role as Researcher and Director of the Citizen Science Program, will showcase the network's capacity for scientific use cases. SETI Institute is a Schelling point in astronomy and will legitimize Skymapper's brand globally. We think Skymapper can reach 10k nodes faster than Geodnet (42 mos) and maybe even Helium Mobile (14 mos).

- **We are leading Skymapper's pre-seed round** [redacted] alongside Volt Capital and BoostVC. [redacted]

Key Links: founder website, linkedin, twitter | past companies: SETI Institute, Unistellar, VR2Planets

Top 3 Reasons We Have to Invest

1. Missionary founder with a unique level of credibility and relationships in the space industry.
When it comes to founder-market fit, we've never met a DePIN founder as uniquely well-suited to the protocol they're building as Franck. His credentials include:

- PhD in Planetary Science from the University of Toulouse
- Post-doc planetary astronomer at UC Berkeley focused on exoplanets
- Published 400+ academic publications with thousands of citations each year
- Discovered 12 asteroids from 2005 to 2016 with various different telescope types
- Asteroid 6639 was named after him after his discovery of the first triple-asteroid system
- Chair of the Exoplanet group at the Carl Sagan Center of the SETI Institute
- Science Council Chair at VR2 Planets, a space-themed VR visualization platform
- Awarded the 2024 Carl Sagan Director's Award by the SETI Institute
- Named 2023 Fellow by the California Academy of Sciences for his contributions to astronomy
- Director of Citizen Science at SETI, leading a community of 1k+ amateur astronomers
- Published 10 peer-reviewed articles leveraging crowdsourced telescope data
- Co-founder and Chief Science Officer at Unistellar, which sold 25k+ consumer telescopes sold

The other key person involved in the company today is Stefaan Vervaet, Franck's decade-long friend who introduced him to crypto and personally financed the first few months of the company's development. Stefaan is a crypto veteran who led network growth at Protocol Labs before launching his own venture-backed project, Akave, which is the decentralized data layer that Skymapper plans to use to store data. Both Franck and Stefaan are fully aligned behind the principles of why building Skymapper as a decentralized protocol matters: to create an unstoppable record of what happens in outer space.

2. Day-one partnerships to bootstrap both the supply- and demand-sides of the network.
Supply: Franck is a co-founder and remains a major shareholder of Unistellar, a company that was crowdfunded by the amateur astronomer community and would go on to sell 25k+ smart telescopes. More than 10K telescopes remain active on a monthly basis. Skymapper has secured a signed LOI to integrate into Unistellar's mobile app to allow for telescope owners to onboard onto the network in a few clicks, and will expand to support other smart telescope brands shortly thereafter. The initial hardware R&D will be focused on creating a low-cost enclosure plus smart controller that enables users to leave their telescope operating outdoors 24/7 while being programmatically controlled by Skymapper and earning rewards.

Demand: Franck is a Senior Planetary Astronomer at the SETI Institute, where he will continue to spend 20% of his time on a part-time basis going forward. Skymapper has secured a signed LOI to use SETI Institute's citizen science capabilities to produce novel crowdsourced astronomy research. Franck has already published 10 peer-reviewed articles leveraging crowdsourced data from amateur astronomers. While demand from astronomers is unlikely to provide meaningful revenues itself, the partnership with the SETI Institute provides a massive amount of credibility and showcases the network's global capabilities.

3. Picks-and-shovels for an emerging industry that can compound at double-digits for decades.
The number of satellites in orbit is projected to grow at a 35% CAGR over the next five years. As satellites become smaller, more nimble, and easier to launch, the number of them in orbit could feasibly grow at 35% annually for another decade after that, reaching 1 million by 2040. Businesses levered to this growth, particularly those that can exert pricing power on a per-satellite basis, will carve-out profitable "niches" that will end up being worth billions of dollars in retrospect. Asset tracking, which is indexed not just to the growth of satellite launches, but to the growth of interactions between the entire stock of orbiting satellites and space debris, has the potential to be among the most valuable of those niches.

APPENDIX

***How** are satellites tracked?*

There are two categories of technologies for tracking satellites: radar and optical telescopes.

- **Radars** send high-frequency radio waves which bounce off the surface of satellites and create echoes that are received back on earth. The round-trip travel time can be used to determine a satellite's relative position, and the doppler shift can be used to determine its velocity.
    - Radars use mid- to high-frequency spectrum, anywhere from 2 to 110 GHz, to transmit signals strong enough to bounce back to earth. Pros: radar signals are unaffected by clouds and terrestrial weather conditions. Cons: radars are extremely power-hungry and therefore expensive to operate, they use spectrum that requires country-by-country licenses to transmit over, and they can be unreliable during events like solar flares.
    - Because of the exorbitant power requirements, radars are best-suited for tracking LEO satellites that orbit less than thousand miles above the earth. For context, the US Space Fence radar requires ~50,000x as much electricity as a typical 5G cell phone tower.

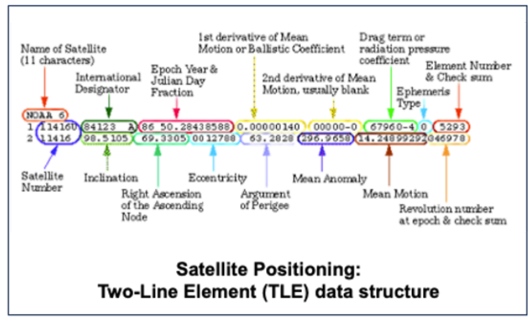
- **Optical telescopes** capture visible, ultraviolet and near-infrared light waves that are emitted by the sun and reflected off satellites before reaching telescopes back on the earth. Most telescopes use lenses and/or mirrors to magnify these signals before processing them into images.
    - Telescopes leverage the sun to "send" signals and only need to passively receive them. Pros: due to lower power requirements, telescopes can be much cheaper to operate than radars while providing similar levels of accuracy. Cons: telescopes are highly sensitive to environmental conditions; they're only effective at night and in clear skies.
    - GEO satellites, which are stationary relative to the earth's surface, are easy to track with optical telescopes. LEO satellites orbit the earth ~15 times per day in order to stay in orbit, and are typically only visible by optical telescopes during dawn and dusk.

- The above refers to *terrestrial* sensors. **Orbital sensors**, i.e. deploying radars or telescopes on satellites themselves, is also an option. This has some advantages, like avoiding terrestrial weather altogether, but is extremely expensive to deploy and operate, and is therefore rarely used for the purpose of tracking other satellites. Instead, orbital telescopes are primarily used for capturing images of objects in deep space, e.g. planets and asteroids, and orbital radars are primarily used for generating high-resolution maps of the earth's surface, often for military use.
    - The first dedicated satellites for tracking space debris were launched in 2024 by NorthStar Data, a Canadian company that has raised $115m since its founding in 2015.

	Radar	Telescopes
Function	Send & Receive	Receive
Data Capture	Distance, velocity, shape	Images
Pros	Reliability: works 24/7/365, except for solar flares	Inexpensive: consumer telescopes are available below $5k
Cons	Expensive: uses ~1000x more electricity than a telescope	Reliability: only works at night and in clear skies.
Best for Tracking	LEO satellites 100 to 1,000 mile altitude	GEO satellites 22,236 mile altitude
Radiofrequency Spectrum	S/C/X/K/V/W Bands 2 to 110 GHz Heavily regulated	Visible, UV, IR Bands 215 to 30,000 THz Lightly regulated

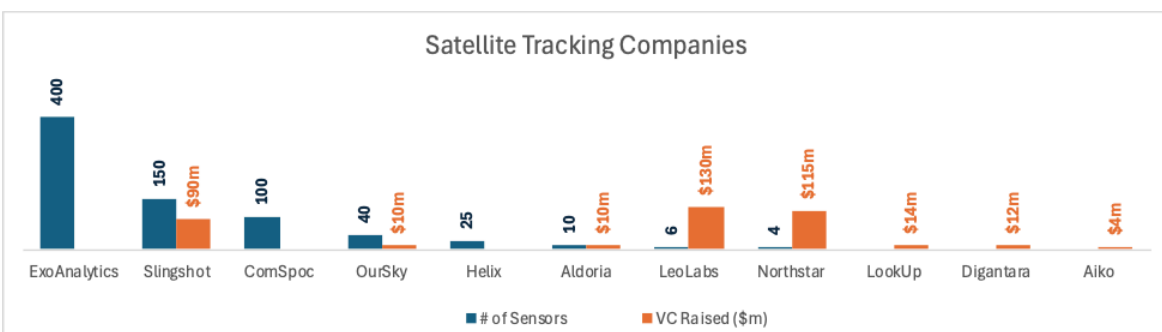
***Who** tracks satellites?*

Satellite tracking infrastructure is primarily owned by federal space agencies and a few dozen commercial vendors. The US Space Force oversees the Space Surveillance Network (SSN) which consists of ~30 optical telescopes and radars operated by the US military around the world. The SSN tracks satellites and hosts a publicly-accessible database, [SpaceTrack](), that reports positioning data in standard [TLE format](). SpaceTrack is not suited for commercial purposes given the API cap of 300 [requests per hour]().



The other major space agencies represent Russia, China, Japan, India and the European Space Agency, however the US Space Force is the largest with a $25B annual budget, of which roughly $1.5B is spent on the tracking and monitoring of satellites and space debris, also known as [Space Domain Awareness](). Global spending on military space technologies was [$57B in 2023](), according to the Space Foundation.

Commercial operators of satellite tracking infrastructure are either subscale, hindered by massive capital requirements, or subsidized by larger defense-related conglomerates. The eight venture-backed companies in the space raised nearly $400m and operate less than 250 sensors in aggregate today. Exoanalytics, the most scaled player, operates 400 sensors across 35 locations, which allows them to collect [20-30 images per second]() resulting in 40TB of space image data collected each day.



Satellite tracking is becoming increasingly critical as space traffic becomes more [dense, dynamic & deep]():

- **Dense:** as the number of space objects grows by n, the interactions between them grow by n^2. There are 13K satellites in orbit today plus more than 670K space debris larger than a centimeter.
- **Dynamic:** a decade ago, satellites were relatively stationary once in orbit. Today's satellites are programmable and multi-purpose, and tend to maneuver much more frequently than in the past.
- **Deep:** satellites are no-longer limited to low-earth ([LEO]()) and geo-stationary ([GEO]()) orbits. Operators are beginning to launch satellites in very-low earth ([VLEO]()) and high-earth ([HEO]()) orbits, both closer and further from the earth than ever before, requiring new methods of tracking.

***How big** is the opportunity?*

We're assuming 13K satellites growing to 60K by 2030. ExoAnalytics charges thousands of dollars per month to track a single satellite. OurSky charges $500 per satellite-month for using its API. This implies a market opportunity of $350m ARR at the bottom end of the range. Given that Starlink is projected to be roughly half of the growth, a more conservative estimate for the ex-Starlink market is $175m ARR.

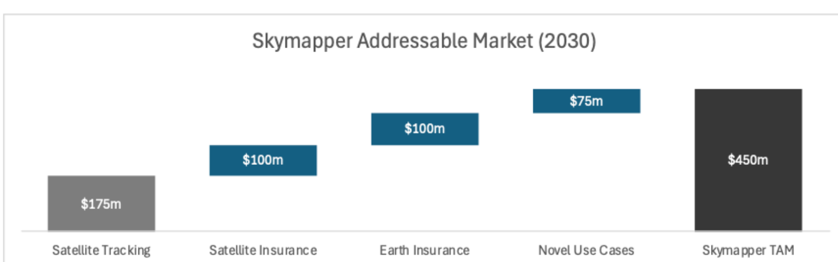
Skymapper will undercut competitors' pricing by 60%+ for basic observations, in order to induce latent demand for space data and attract new cohorts of developers and applications. Skymapper will capture value from its highest-value use cases via upcharges for higher levels of anonymity, speed & redundancy of observations. We expect Skymapper to set pricing somewhere around $60 for basic observations - a 60% discount from current industry pricing of $150 - while charging up to $1K per observation for the highest-value and most-sensitive use cases. We assume Skymapper is able to double the size of the addressable market by unlocking new long-tail use cases (e.g., training AI models with space image data) and price-discriminating the highest-value existing use cases (e.g., national and corporate intelligence).

Satellite insurance was a $550m GWP market in 2023. Penetration is low, with only 25% of GEO satellites having active insurance policies and less than 1% of LEO satellites (operators typically launch multiple LEO satellites in a constellation, and rely on redundancy rather than on insurance). Insurance is offered through two products: launch plus 1 year of operations, and in-orbit coverage renewed annually. The sector has been extremely challenging for insurers, with many exiting the market entirely after a 200% loss ratio across the industry in 2023. Without high-quality, reliable data at scale, it's impossible for insurers to responsibly underwrite satellite policies today. Given the incumbents have been burned recently, we expect a space-focused insurtech company to use Skymapper's data to meaningfully grow the market, including by creating smaller-dollar policies suitable for the risk profile of LEO satellites. We assume the satellite insurance industry grows to $5B/yr by 2030 and spends $100m/yr on space data.

There's an adjacent opportunity to sell data related to asteroid and other near-earth object detection, which is applicable to property insurance which is 100x bigger by premiums. For example, NASA is currently tracking an asteroid with a 2.3% chance of hitting earth in 2032. Planning for these events is a core part of insurers' capital planning and they are willing to pay a premium for data that enables better, faster decisions. We think selling space data to insurers back on earth is another $100m/yr opportunity.

Skymapper will enable developers to create new services and apps using space data. To name a few:

- Risk assessments for satellite operators (typically $20k to $250k per engagement)
- Tracking light pollution for environmental and urban planning use cases
- Powering space-related VR/AR experiences
- Training AI models to classify and predict space events
- Premium software for the amateur astronomer community
- EdTech platforms focused on astronomy



***What Do You Need To Believe** to return the fund?*

We're underwriting a $450m/yr in addressable revenues for Skymapper based on:

- **Satellite tracking revenues** of $175m/yr, based on: 1) the number of orbiting satellites increases from 13K to 60K, 2) the average satellite requires one observation per week, 3) the average cost-per- observation falls from $150 to $60.
- **Insurance-related data revenues** of $200m/yr, based on: 1) global satellite insurance premiums growing from $550m to $5B, 2) insurers spend 2% of premiums on space data, and 3) space data for terrestrial property insurance is equally as big a market as space data for satellite insurance.
- **Novel use case revenues** of $75m/yr, based on 60k developers paying an average of $100/mo for access to near real-time space observation data.

Satellite Tracking Revenues ($m)				
		Number of Satellites		
		30,000	60,000	90,000
Cost per Observation	$30	$43	$86	$130
	$60	$86	$173	$259
	$120	$173	$346	$518

Insurance Data Revenues ($m)				
		Global Satellite GWP ($B)		
		$1.0	$5.0	$10.0
Data spend as a % of GWP	1.0%	$20	$100	$200
	2.0%	$40	$200	$400
	5.0%	$100	$500	$1,000

Novel Use Case Revenues ($m)				
		Active/Paying Developers		
		30,000	60,000	90,000
Monthly per-seat price	$50	$18	$36	$54
	$100	$36	$72	$108
	$150	$54	$108	$162

Total Addressable Revenues ($m)			
	Bear	Base	Bull
Bear	$81	$222	$384
Base	$162	$445	$767
Bull	$327	$954	$1,680

Assuming $450m in addressable revenues, the market share Skymapper needs to return EV3 Fund II is:

- 15%, assuming an 8x terminal revenue multiple - in line with Meta and Google's public valuation
- 6%, assuming a 20x terminal revenue multiple - in line with SpaceX's latest private valuation
- 1%, assuming a 100x terminal revenue multiple - in line with other DePINs liquid valuation

It's likely that a meaningful portion, if not a majority of Skymapper's long-term revenues will come from the private sector. We see a typical pattern in other space and satellite related businesses, where the majority of clients (by count) are commercial but the majority of revenues (by dollars) are from the public sector. The US Space Force alone spends an estimated $1.5B annually on satellite and space debris tracking, three times the size of the addressable market opportunity we are underwriting.

On top of the value created from the network's data, we believe Skymapper will build meaningful upside from capabilities that won't show up in the metrics until several years into the future, including:

- The biggest and most actively-engaged community of amateur astronomers
- A historical tamper-proof record of natural and man-made events in space
- A critical piece of national security infrastructure for space-faring nations
- A crowdsourcing platform to accelerate the search for signs of extraterrestrial intelligence

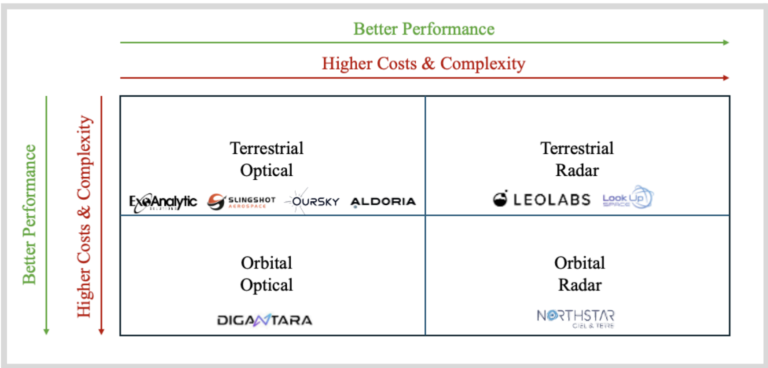
As the space economy grows - both in terms of the number of objects in space, the amount of talent flooding into the industry, and the soaring value of goods (and people) traveling to space - Skymapper has the opportunity to power the entire ecosystem with low-cost, real-time awareness of space conditions. In time, we believe Skymapper will be one of the most important infrastructure networks built this century.

***Can Skymapper create a better product** than centralized competitors?*

Satellite tracking and space awareness technologies compete on five factors (besides costs):

- Sensitivity: how small of an object can be detected?
- Range: how far away can objects be detected?
- Accuracy: how accurate are the measurements?
- Frequency: how often can objects be observed?
- Latency: how quickly can observations be produced?
- Reliability: how reliable is the technology in various conditions?

The framework for thinking about today's space tracking technologies is a 2x2 matrix of terrestrial vs orbital and optical vs radar, with the latter having better performance but much higher costs & complexity. Terrestrial optical is clearly the cheapest and most scalable solution, given that: 1) telescope performance-vs-cost is improving extremely quickly as it benefits from investments in the much-larger camera industry, and 2) sensors on earth are much cheaper to deploy and maintain than in orbit; however they suffer from drawbacks of low performance: poor reliability on cloudy days, poor latency due to long exposure and processing times, and low frequency for LEO satellites given their fast speed.



This framework misses a key ingredient that fundamentally shifts the efficient frontier—density. The "scaled" incumbents today operate sensors at less than 40 locations globally, and most startups (even ones funded with >$100m) operate at less than ten.

Most of the tradeoffs of terrestrial optical telescopes are solved by **density**: cloudy weather can be avoided from different angles, objects can be tracked faster and more often by multiple telescopes simultaneously, including fast-moving LEO objects. At 10x or 100x greater density, i.e. 400-4K locations, optical telescopes are both more performant and cheaper solution than any of the other options.

Space industry incumbents don't believe it's possible to scale a sensor network by 10-100x, which is why they'll be caught off guard when Skymapper drops the cost of high-quality space observations by 60-80%. We know it can be done with DePIN: Helium IoT's network is 15x bigger than the second-biggest LoRa network, and several DePINs with hardware in a similar price range have scaled beyond 1K global deployments including Geodnet, Starpower, WeatherXM, Helium Mobile and Wingbits.

The expected engineering challenges include: 1) building a user-friendly programmatic telescope enclosure so users can set-and-forget their telescopes outside in passive data collection mode, 2) creating trust-minimized protocols to coordinate and verify object detection tasks, and 3) processing a massive amount of raw image data (~1 GB per-minute per-telescope) in a cost-efficient manner.