SpaceTime Protocol (STP) - DePrize Problem Challenge

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Date: 2023-12-19

Abstract

Spacetime Protocol's proposal outlines a groundbreaking solution to the evolving demands of lunar and far orbit exploration for the current generation of aerospace enthusiasts. Leveraging commercial off the shelf components, SpaceTime Protocol aims to create a competition based on interconnectivity of separately built satellites. Through use of accessible components and a standardized protocol, two satellite bodies will establish proven communication links without requiring a major investment of capital. Spacetime Protocol's approach fosters collaboration, accessibility, and provides a pathway for students to contribute meaningfully to the future of space exploration.

Problem Statement

The current generation of aerospace enthusiasts have gained foundational skills through cubesat standardization in college. However, the next frontier of lunar and far orbit exploration demands advanced Position, Navigation, and Timing (PNT) capabilities. Development of PNT technology is spearheaded by traditional aerospace companies with multi-billion dollar contracts, leaving an opening in the market for small-scale and easily distributed technology.

SpaceTime Protocol proposes a revolutionary approach leveraging established communication links for dual purposes. By incorporating precision clocks into the wireless communications system, we can achieve high accuracy timing and ranging precision between two entities in space. This concept is based on proven concepts demonstrated on Earth and in space, and has been developed at a high level by MoonDAO's LunA-10 submission.

To achieve this precision, Open Compute Project's Time Card is an open source hardware and firmware design for a sub-nanosecond precision clock. The Time Card is built with commercial off the shelf (COTS) components. The base design for the Time Card is a PCIe card with GNSS antennas. This is a good starting point, but is not sufficient for a space mission in terms of form factor, and the component selection was not done with the space environment in mind.

Solution

Long-term vision, now to December 2024

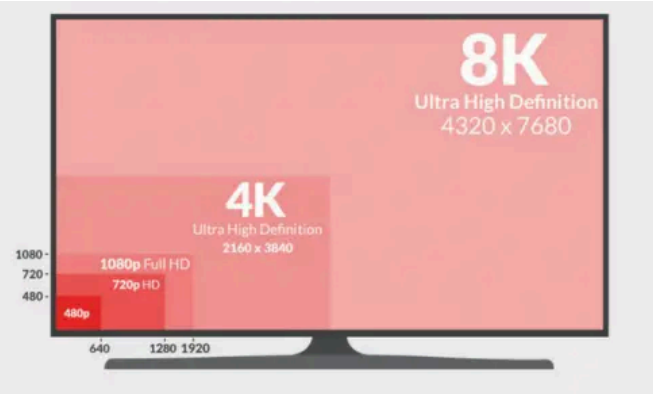
Spacetime Protocol's innovative solution involves creating a competition that showcases the decentralized and open source aspects of this project. Two satellite bodies will engage in interconnected interactions, demonstrating the technology's viability. Simultaneously, we aim to empower current college students and future engineers by providing resources that lower the barriers to entry into satellite development careers.

The task at hand is to fork the Time Card's design into a space-ready design. "Space-ready" is a trait that will be validated in LEO at the culmination of this project. Such design may include reworks to be in a cubesat-compatible form factor, or perhaps selecting alternative components to meet limited spacecraft power constraints or reliability targets in a space environment. This project does not prescribe a design. Instead, we propose a competition that yields one or more designs, validated in a space environment and tailored for this problem.

MoonDAO will host a competition to accelerate development in decentralized and open lunar infrastructure, and along the way MoonDAO will make lasting connections in professional and academic space communities. Any investments into running the DePrize, material and otherwise, are directly applicable to future DePrize competitions. Examples of such investments would be on-chain systems for accepting and "backing" competition entries, or space environment testing equipment like our very own thermal-vacuum chamber, or citations in published research papers.

Where are we now

If the end result was an 8K picture, we have a 720p idea of what it looks like right now. Broad strokes, intentions, a vision, and intuitions about the level of effort needed to get us there.



We have the ingredients, now we have to write the recipe. Our target is to have a solid "recipe" for a Spacetime Protocol DePrize by the end of Q3 (September 2024) that is ready to start outreach, promotion, and onboard applicants. That leaves Q1 (January-March 2024) for the prototyping and scope definition, and Q2 (March-June 2024) for testing and polishing the mechanics of DePrize and validating our assumptions with technical experts.

Near-term vision, now to March 2024

The Q1 goal of the Spacetime Protocol DePrize project is to crystalize the intent and scope of the Spacetime Protocol DePrize.

Benefits

DePrize Pilot Run & Spacetime Protocol Proof-of-Concept
This concept is spun out of other MoonDAO's projects and is a way to mature multiple projects simultaneously. DePrize and Spacetime Protocol are independent projects that have an opportunity to co-develop and accelerate each other's development. By the end, both should be at a greater level of maturity.

DePrize is matured by establishing an initial flagship project that demonstrates key values and principles of decentralized lunar development. Spacetime Protocol serves as an alpha test to accelerate and debug mechanisms of DePrize itself without risking delicate relationships with third parties.

The project seeks to generate rapid design iterations in parallel to accelerate the path toward flight-qualify the Spacetime Protocol. Through rigorous evaluation processes of DePrize applicants, we ensure the reliability and readiness of the technology itself and prototypes for lunar exploration.

Collaboration & Access as Key Deliverables
The competition model fosters a novel approach, specifically including collaboration, interoperability, and community contributions as primary outcomes. This reinforces the idea that collective efforts are crucial in advancing space exploration.

The project lowers the financial barrier to entry to developing space technology and infrastructure. Unlike a complete vehicle build, the project aims to limit the scope and complexity of the problem to making a component module that can integrate with an existing spacecraft communications system. The structure of the DePrize competition favors designs sourced from commercially available and/or open sourced parts.

Risks

Student Engagement
Ensuring sustained interest and participation among students is a critical risk. Spacetime Protocol will implement engaging strategies and mentorship programs to maintain student involvement. The success of the project hinges on effective collaboration between student teams. Clear guidelines, support structures, and regular check-ins will be implemented to mitigate challenges.

Funding and Sponsorship

Dependency on industry partners for funding poses a risk. Spacetime Protocol will diversify funding sources, actively seek sponsorships, and establish contingency plans to address potential financial challenges.

Insufficient Technical Resources
There is a risk that the technical resources that we (MoonDAO) can provide will not be sufficient to support these very technical projects to completion. MoonDAO must recruit technical advisors with expertise in Timekeeping, Wireless Communications, FPGAs, and Space Environments for guidance and support. Some of these advisors could be sourced from within MoonDAO, but it is likely that most will be from external organizations. Related to the risk of working with student teams, there is a risk that we will not have sufficient staffing to support all teams with the attention they need.

Objectives and Key Results:

Objectives listed here cover a 12 week period starting January 2024. At the end of the period, more OKRs will be proposed for the next 12 weeks as a “follow-on” MoonDAO project.

Objective #1: Benchmarking Established Competitions
Key Results for Objective #1:
- Leverage existing competitive requirement documents, create a comprehensive set of “must haves” for a DePrize competition.
- Establish a management process for competition entry and evaluation/acceptance criteria for submitted materials.
- Identify other technical student competitions and compile some documentation about how they were set up, rules, constraints, and outcomes.

Members responsible for OKR and their role:
Ashley Kosak - Requirements gathering and synthesis, entry process
Philip Linden - Entry criteria, “must haves” establishment

Objective #2: Scope Definition
Key Results for Objective #2:
- Clearly state the desired outcomes as a Request for Proposal that lays out the *intent* of the competition deliverables.
- Choose a framework for mentorship and technical development.

Members responsible for OKR and their role:
Ashley Kosak - Mentorship Framework, documentation of hardware and protocols
Philip Linden - Author of technical documents for background topics and desired outcomes

Objective #3: Nurture Professional Connections & Sponsorship Opportunities
Key Results for Objective #4:
- Build a list of potential partnerships and grants for competition.
- Form connections with partners and introduce potential teams to MoonDAO.

- Recruit 1 subject matter expert as a technical advisor (via letters of intent) for:
    - Timekeeping
    - RF/Wireless Communications
    - FPGA design
    - Space Environments

Members responsible for OKR and their role:

Ashley Kosak - Requirements gathering and synthesis, entry process

Philip Linden - Entry criteria, “must haves” establishment, professional networking

Objective #4: Publish Supporting Backgrounders and Primers

Key Results for Objective #5:

- Prepare a primer on the core technologies and state of the art for deep space timekeeping. It should be an accessible document (under 10 pages, beautiful, and mostly plain language and illustrations)
- Publish the document on DeSci Labs

Members responsible for OKR and their role:

Philip Linden - Document author

Team Table (Table A)

Spacetime Protocol	
Rocketeer	*@philiplinden*
Initial Team	*Philip Linden, Chief of Technology* *Ashley Kosak, Chief of Operations*
Delegate	*@pmoncada*
Multi Language Representative (optional)	*N/A*
Multisig signers	*@mitchie_mitch* *@ryand2d* *@pmoncada* *@philiplinden* *@name.get*
Revenue Split Agreement Address	*N/A*

Team Member: Philip Linden (@phil aka @philiplinden)

Bio: I'm a spacecraft engineer, writer, and all around space nerd. My core values are: Do Good, Be Collaborative, Dream Big, Strive for Openness, and Take Pride in Every Task. My

professional experience includes R&D engineering for SpaceX (Mechanical/Reusability Engineering for Dragon Capsule), R&D engineering for Lockheed Martin Space (Electro-Optical engineer), Mission Operations for Planet Labs (Space Systems Engineer), and research for Open Lunar Foundation (Fellow).

Team Member: Ashley Kosak
Bio: Ashley Kosak is a mechanical engineer with experience in mission compliance, launch site and propulsion reliability at SpaceX engineering and Apple as an Operations Program Manager for regulatory compliance. Ashley has been published and recognized by the AIAA Diverse Dozen,Fortune Magazine, and Lioness Publications speaking about workplace equality and sustainability. Ashley is on the Board of Advisors for SoCal350, UC-Riversides Design Thinking program, and a fellow of FracTracker Alliance and Open Lunar Foundation.

Deadline for the project: End of Q1.

Budget Justifications (Table C)

These are fixed costs to make your project happen. This might also include bounties that you'll make inside of the DAO (it's recommended to have some amount allocated for bounties or competitions), or specific work that must be contracted out to complete the project. Please provide links to quotes where possible.

Description	Amount	Justification
Notion	$60	Plus Membership (3mo, 2 users), project management system
Google Workspace	$324	Q1 and Q2 Google Workspace Business Plus
Flex budget	$116	Unexpected costs or expenses that are discovered during development
Total	**0 ETH / $500**	

Transactions to be Executed (Table D)

Transaction Type	Amount	Token Type	Receiving Address
Send	$500 equivalent	ETH	0x4E1F1Cf3E973516Cd361816c9AdB6C6d922aBfD9

Revenue Distribution Agreement

- ☑ ~~N/A~~
- ☐ Standard MoonDAO Agreement.
    - ☐ Terms here:
- ☐ Different Agreement
    - ☐ Link to on-chain agreement:
    - ☐ Link to off-chain agreement:

In-Depth Approval Senate Signature

This is only required if your project requires up-front funding from MoonDAO or it is going to crowd-raise with support from MoonDAO.

Senate Member Signature #1 ____@mitchie_mitch_____
Senate Member Signature #2 _____@name.get_____
Senate Member Signature #3 _____@ryand2d_____