The Geo Web: A Geo-Navigated, Open Information Network

Draft 2

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ABSTRACT

Smartphones have revolutionized our world by putting the internet into our pockets–making it accessible everywhere we go. As smart devices shrink to fit on our wrists, on our eyeglasses, and eventually embedded inside of us, the time we spend on the internet transitions from discrete, conscious interactions to a continuous experience. The Geo Web is an open information network designed for this future. Using geolocation as its primary navigation mechanism, it can create user experiences that blend our physical and digital worlds. The Geo Web doesn't just enable augmented reality, it enables an augmented *shared* reality.

The Geo Web is based on an authoritative digital land registry maintained in an Ethereum smart contract. This narrow-waist protocol supports open innovation and shared user experiences. It stands in opposition to the proprietary, siloed app store model that dominates our current smart devices. Geo Web publishers anchor digital content in the physical world through the digital land that they control. Geo Web users discover and resolve content on the open network with their smart device's geolocation. Digital land is administered under a *Self-Assessed Licenses Sold via Auction* (SALSA) system that emphasizes allocative efficiency and egalitarian principles. The Geo Web is public good infrastructure created with prosocial mechanism design.

1. INTRODUCTION

The internet and World Wide Web's minimalist protocol designs were key to scaling the networks to billions of devices and across years of hardware, software, and use case innovation. The protocols had contemporary competitors that were more opinionated, had more features, and/or had proprietary backing. Yet the open, free, and decentralized approaches became the de facto standards.

The emergent properties of these networks turned out not to reflect their founding principles. "Big Tech" has successfully accrued almost unimaginable value and power. Massive corporations have become gatekeepers of ecosystems designed to be permissionless and democratizing. Smartphone app stores embody the problems with centralization: rent seeking, innovation suppression, and censorship. There are over 4 billion internet users as of 2020. They are largely beholden to decisions made by few. Users' participation in the value distribution and governance of the world's driving economic and social force is limited.

It is with this two-part lesson in mind that the technical and mechanism design for this new web experience are proposed.

The Geo Web's core protocol is a geographic namespace table and lookup—the *Digital Land Registry*. It is analogous to the Web's DNS. Its design is deliberately minimalist. It enables powerful, frictionless user

experiences that can augment rather than pull attention away from daily life as smartphone usage so often does today. It can scale to billions of devices and currently unimaginable use cases. It provides an alternative application model to app stores or proprietary AI assistants that monopolize power and personal data.

The Geo Web can become more pervasive than the World Wide Web is today. It is important that the network benefits and empowers the individual user. The Geo Web's design draws inspiration from breakthroughs in mechanism design and the Web 3.0[1] space: egalitarian market mechanisms, distributed infrastructure, user-controlled data, and decentralized governance.

2. DIGITAL LAND

The Geo Web's core enabling component is *digital land*. Practically speaking, digital land can be used to map digital content to real world locations. Content can be anchored to specified points or span areas. Control of a digital land parcel confers the exclusive right to place Geo Web content within its boundaries. This differs from a traditional system of geotagging. The link between geolocation and the "right" content is unambiguous.

Digital land parcels are the unique identifiers of the Geo Web's global geographic namespace. Each parcel consists of one or more unique, contiguous rectangles from a static grid system.[2] Land parcels define boundaries on the Geo Web and create order in a shared digital layer that spans Earth.[3]

The *Digital Land Registry* (DLR) is an Ethereum smart contract that maintains the spatial and non-spatial attributes of digital land. It is similar in form and function to the registries at the heart of DNS and the Ethereum Name Service.

[1] Web 3.0 is used here to refer collectively to the various efforts in cryptography, blockchains, and related technologies that aim to distribute power and value of networks to their stakeholders and users.
[2] The grid system is created with standard length/precision Geohashes. Digital land also includes the vertical space above land and water which can be subsequently defined with height/altitude.
[3] Unlimited digital land layers are technically possible. Think of these like the different top-level domains of the World Wide Web and DNS. Network effects should limit excessive proliferation. Defined use case implementations may provide user motivation sufficient to overcome switching costs.

Sample Data in the Digital Land Registry

Digital land[4] can be licensed, transferred, and utilized independent of surface land. In this way, digital land is similar to mineral, water, and airspace rights in the United States. Physical land owners may control their land's digital counterpart, but not necessarily.

3. BROWSING

The Geo Web can be the constant digital complement to everyday lived experience. It's intended to augment life experiences rather than pull attention away from them. Initially, it can be accessed in discrete experiences through smartphones and smartwatches. As smart device screens disappear, browsing the Geo Web can become coincident to experiencing the physical world.

The World Wide Web has effectively infinite "space" between hyperlinks and subdomains. Abundance is an undoubtedly valuable concept for the Web, but it comes with tradeoffs. Browsing the Web requires active participation and filtering to find valuable content: typing a URL, switching between apps, and/or searching Google. This model isn't desirable or necessarily feasible for a web experience based in the physical world.

The Geo Web offers a finite, contiguous navigation space. Content discovery is orderly, natural, and frictionless–mirroring how we navigate and experience our physical world. The Geo Web uses place and time to present relevant digital content rather than relying on interaction from a user. Most importantly, Geo Web content exists in deterministic, shared space rather than in siloed apps or disparate operating system ecosystems.

The user interface for the Geo Web can resemble a web browser (without a URL bar) initially. Using GPS or another suitable navigation system,[5] an active browser continuously references the DLR. Look-ups can be private and seamlessly resolve content corresponding to digital land parcels.

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[4] Digital land is implemented as a non-fungible token (NFT) under the ERC-721 standard.

[5] GPS is subject to spoofing, interference, and technical limitations indoors. FOAM is an example of a Web 3.0 project that aims to overcome these challenges. The Geo Web architecture can remain agnostic to the navigation system used.

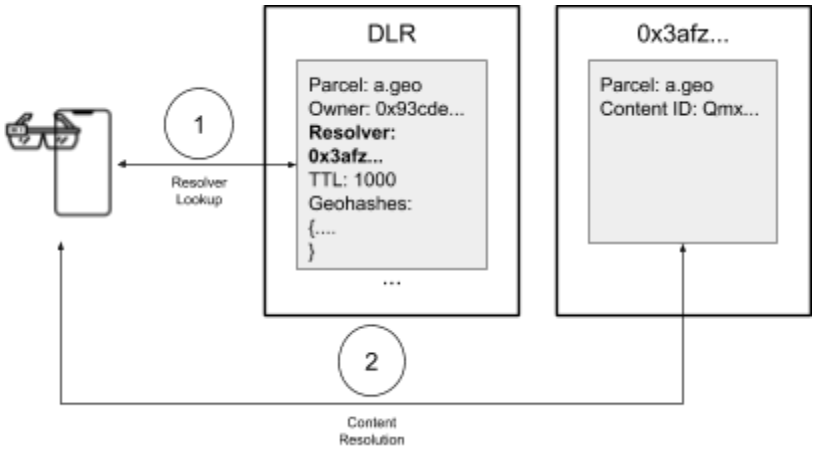
As the dominant browsing device transitions from a smart device with a screen (e.g., phones) to one without a screen (e.g., glasses), Geo Web browsers will take on a different format. The canvas for content will become transparent and gain depth. Field of view will define the content displayed rather than just a set of geo coordinates. The field-of-view browsing experience can leverage rich user context including angle of viewing, altitude, velocity, and machine vision to create immersive experiences.

The DLR itself will not have the ability to filter, algorithmically promote, or censor content. It will remain neutral infrastructure. Publishers will retain the right to free speech. Users will retain power to control what they do and do not see. Scarcity of digital land (opposed to practically infinite URLs & IP addresses), identity, and information sharing can make user-controlled content filtering highly effective on the Geo Web (see *Section 6 - Market & Network Design* for exploration of this topic).

4. CONTENT RESOLUTION & TRANSMISSION

Geo Web content will not be directly linked from the DLR. The DLR will maintain only the core attributes of digital land plus a link to a secondary reference table such as a resolver smart contract or mutable, verifiable document.[6]

This approach provides efficiency, scalability, and flexibility. Changes in linked content won't require sending a transaction to the global registry and incurring the associated gas fees. Different templates can be implemented to accommodate different content types and transmission methods (client-server and peer-to-peer) without changes to the DLR's structure.



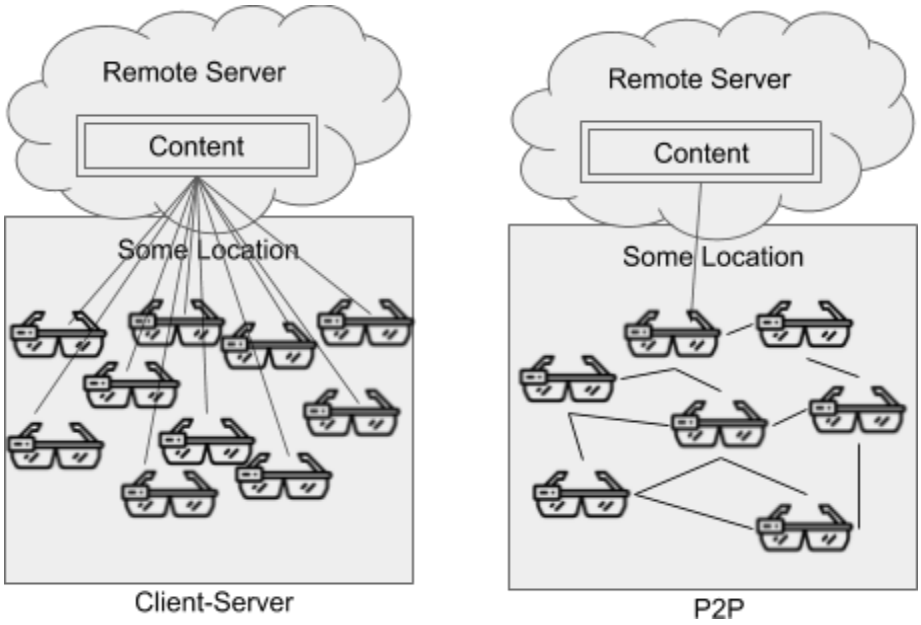
Example of the Geo Web's two part content resolution approach

Client-server transmission and legacy web architecture can be utilized on the Geo Web, but content addressing and P2P transmission of content is especially attractive for the network. There are ideological reasons (openness, decentralization of power, uncensorable/permanent data, etc.), but the technical case is even stronger. The

[6] ENS-like Resolvers (Johnson, 2019) and Ceramic Network Documents (Ceramic Network, 2020) offer two potential approaches on which the Geo Web can standardize its content resolution.

characteristics of the Geo Web can make the hypothetical efficiency, speed, and robustness gains of P2P networks a reality.

Geo Web users seeking the same content will for the most part be geographically clustered. This is an optimal environment for P2P transmission: reduced search radius for peers, shorter transmission distance, and network redundancy. As media on the Geo Web grows in volume and fidelity (especially with augmented reality), leveraging P2P transmission could significantly improve performance and network scalability.



Client-server vs. P2P architectures on the Geo Web

5. APPLICATIONS

Geo Web applications can primarily benefit by utilizing geolocation in two ways: 1) as a primitive on which to build a unique shared experience and 2) as a frictionless discovery mechanism. The Geo Web can offer a flexible model that supports application types and technologies not yet invented. As hardware, software, wireless connectivity, and design tools advance, the type of experiences enabled on the Geo Web can become higher fidelity and more immersive.[7] Like the World Wide Web, successful initial use cases will likely be focused and simple, but the possibilities are endless:

> **Web 2.0 Discovery** - Simply copying what was done (successfully) in Web 2.0 doesn't take full advantage of the new paradigm, but existing website and smartphone app functions can be linked to digital land on the Geo Web. This provides a new discovery mechanism that is useful for infrequent and/or high-value interactions. The UX improvement over existing models (no new app downloads or

[7] Geo Web applications may beget improved infrastructure and not the other way around (Grant & Grossman, 2018). Regardless, the insight for development of the Geo Web is that new applications and infrastructure capabilities co-exist. There's a feedback loop between them. Futuristic applications may not be entirely practical today, but their speculative creation can help spur the infrastructure innovation that makes them commonplace tomorrow.

URLs to know and type) can increase engagement and user value.[8] Walk-up reservations and contactless ordering for restaurants are example applications.

Data Feeds & Notifications - Data and notifications are sensitive to time and place—making the Geo Web a potentially valuable delivery mechanism. Useful information can be presented to users based on their environment with minimal distraction and effort. Examples are displaying wait times for lines, public transport arrival times, and schedule changes.

Games - Scavenger hunts, gamified check-ins, and other location-based games (including desktop map ones) can leverage the DLR to create shared, decentralized, and global experiences. The Geo Web would allow for new integrations and collaborations across experiences that could separate them from existing location-based apps/games. The Geo Web is Web 3.0 native, so naturally Geo Web gaming would leverage concepts like NFTs and user-owned data to further differentiate from comparable Web 2.0 games.

File Sharing - The fact that Geo Web users seeking content will tend to be geographically clustered lends itself to peer-to-peer sharing. This can be leveraged to efficiently and simply share large files in places like classrooms (e.g., data sets), restaurants (menus), and sports/concert venues (photos/videos). This can limit the cost of and reliance on the wide area network (WAN).

Augmented Reality - Augmented reality (AR) is a content type that itself has nearly unlimited uses, especially as smart glasses and supporting software advance. The Geo Web offers a way to create *shared* AR experiences across different hardware without forcing users to download another app or software package. The frictionless Geo Web UX means that location-anchored AR begins to function, at least visually, like physical architecture. Atoms can be swapped for bits to create new types of entertainment, art, and experiences that blur the lines between our physical and digital worlds.

6. MARKET & NETWORK DESIGN

Bitcoin succeeded where previous digital currencies fell short because of its economic mechanism design. Bitcoin's proof-of-work consensus mechanism and resulting blockchain incentivized self-interested individuals to act in a way that reliably achieved the network's design goals.

While wildly successful from a technical perspective, the World Wide Web has become more centralized and less democratic over time because its protocols did not include comparable mechanisms to ensure the network evolved true to its founding ethos.

These two scenarios illustrate the heart of the Web 3.0 movement.

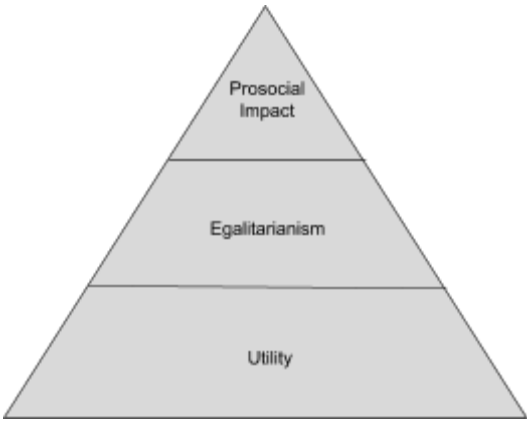
The Geo Web leverages the Ethereum blockchain to create ownerless network infrastructure. This is a powerful concept and technically necessary to create the Geo Web. However, it is not sufficient for the Geo Web to achieve all of its network design goals.

[8] Apple announced App Clips as a part of iOS14 (Apple Inc., 2020). App Clips shares UX goals with the Geo Web (streamlined user interaction & discovery), albeit through an extension of Apple's proprietary ecosystem. The Geo Web could be used to replicate similar functionality in an open, extensible ecosystem.

The unique attributes of digital land must be accounted for in the Geo Web's market design. The challenges presented by digital land call for relative optimizations rather than objective answers. The Geo Web's economic mechanism designs will emphasize three core values:

1. **Utility** - How can the network be designed to create more economic value assuming purely self-interested actors?
2. **Egalitarianism** - How can that value be distributed widely and fairly?
3. **Prosocial impact** - How can the network encourage mutually beneficial outcomes in and outside of the network?

Each of these values builds upon the foundation of the previous to achieve higher aims.



6.1. Digital Land Market Implementation

Land in Times Square is not interchangeable with land in Siberia. It follows that the Geo Web's digital land is a non-fungible token.

Landowners are not created equal either. Owners of physical land have different physical-digital design opportunities and potential utility than digital-only ones. Every potential publisher has unique incentives and capacity to utilize the digital land.

In many situations, there is no substitute for a specific land parcel (i.e., your neighbor's digital land parcel provides no utility toward enjoying the content you want to anchor in your living room).[9]

[9] The registry and digital land of the Geo Web are analogous to DNS and domain names of the World Wide Web in many ways. There are many allocation challenges for domain names (i.e., squatters, shared company names, etc.), but there are also better substitute goods and services–different TLDs, alternate spellings, abbreviated/full names, and search engines–which make nonoptimal allocation less destructive to overall network utility.

The importance of these considerations are compounded at the network level. Users and publishers will adopt (or not adopt) the Geo Web based on the utility it offers in aggregate. Increased marginal network participation leads to additional marginal network utility. These network effects will make or break the Geo Web.

Having the "right" party control digital land is paramount for the Geo Web. So, who is the "right" party? There is no universal answer.[10]

The Geo Web solution focuses first on establishing a strong foundation of utility and can be subsequently optimized for higher-level values.

The Geo Web's digital land market will be administered through a system known as *Self-Assessed License Sold via Auction* or *SALSA* (RadicalxChange Foundation Ltd., 2020). This system reimagines private property and creates a more efficient market with two basic rules:[11]

1. *Self-Assessed License* - Market participants license digital land by paying an recurring fee calculated based on the licensor's self-assessed value of the property.
2. *Sold via Auction* - Anyone can force transfer of the license by paying the self-assessed value for the property.

SALSA is part free market and part collective ownership. Digital land is best thought of as being created and owned by the network. Market participants license digital land rather than owning it outright. Licensors have full control over the usage of their land as long as they are the highest bidder in the continuous auction and pay their network fees.

Utility

A SALSA system can be implemented within an Ethereum smart contract to create a dynamic market for digital land with minimal centralization. Fees based on the self-assessed value prevent licensors from pricing their land too high. The threat of a forced transfer prevents licensors from pricing their land too low.

Parties that have greater economic interest in the land (i.e., they can generate more utility) can justify higher self-assessed values and fees. They can always secure and utilize digital land parcels through a forced, but fair

[10] The owner of physical land may be a good place to start, but what about tenants? What about public lands? How would ownership be determined where land ownership records are fragmented, unreliable, or nonexistent? What is the solution for countries where there is no concept of private land ownership? How could a system based on identity verification be efficiently, scalably maintained? Solutions that create enforceable digital land ownership, but don't deal with allocation effectively (e.g., founder determined, first-come/first-serve, one-time auctions, centrally verified) are fatally flawed. They fail to grapple with the complexities real-world. Economic self-interest leads them astray rather than strengthening them.

[11] This scheme is also known as a Harberger Tax. It is named for economist Arnold Harberger who outlined the basic scheme and was formally proposed by Nobel Prize-winning economist, Maurice Allais. We chose to use the alternative terminology of SALSA because "taxes" are associated with governments and often have a negative connotation. These associations would be misleading and unhelpful in framing this novel asset (digital land) and the market to new adopters.

transfer. The network outcome of individual economic self-interest is more allocative efficiency and more productive land usage.[12]

The Geo Web's answer to the "right" licensor of digital land starts with "Whoever can produce the most value from it."

Egalitarianism

A SALSA system is also egalitarian. Forced transfers and the idea that physical land ownership doesn't automatically convey control of the corresponding digital space may seem unfair to some. The arguments against the system are often based on feelings of entitlement and bias to the status quo. Our current market solutions and technology have led to soaring economic inequality. The Geo Web is a blank slate opportunity to reverse rather than exacerbate that trend.

On the Geo Web, those that gain the most from controlling property also pay the most in fees. There are no preferential tax breaks, offshore accounts, or accounting "optimization" to avoid paying a proportionate share back to the network.

The SALSA market structure creates a level playing field based on a party's magnitude of economic interests and ability to realize them. Economic interest is amoral though. Spam, cyber attacks, competitive sabotage, and surveillance capitalism can be profitable for the practitioner, but at the expense of someone else.

Prosocial Impact

For the Geo Web to achieve its prosocial aspirations, interactions between content publishers and consumers should be positive sum. Geo Web usage should create joy and value without hidden, subversive motives. Both publisher and consumer can derive positive utility from transparent, informed transactions.

In the real world, sports bars don't make money from advertisers by showing sports. They pay for the privilege of showing the entertainment, but more than offset the cost by selling more food and drinks in an atmosphere their patrons value. The transactions are explicit and both parties benefit. The Geo Web's inherent tie to the physical world makes this type of monetization scenario plausible for many business types. At private residences, publisher and consumer are one in the same. Personal enjoyment of digital content can be enough. Private residences don't need to sell their family and friend's attention to justify their economic interest.

The Geo Web can advantage these types of economic interests by giving users effective tools to assess and share information regarding the nature of content and its publisher. The world is too complex for fixed definitions of good and bad content/publishers. Well-designed market mechanisms provide the most robust solution.

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[12] The dynamics of the market will be sensitive to the "tax" rate(s) used. All else equal, lower rates lead to higher self-assessed values and more opportunity for speculation (i.e., it's less expensive to price land higher). Higher rates lead to lower self-assessed values and more turnover. 7% is cited as a reasonable starting annual rate (Posner & Weyl, 2018). The Geo Web's rate(s) will be studied and adjusted with transparent disclosure during the early phases of the adoption.

The Geo Web can implement protocols and standards that provide context to users to filter and block content without undue burden.[13] These tools can grow shared context over time. Users can navigate their Geo Web experience with freedom according to their values and informed choices. Combined with fees assessed under SALSA, adversarial action can become less economically attractive relative to prosocial interactions through the market. Here are examples of dimensions on which informed context can be built:

- **Identity** - Pseudonymous or real name decentralized identity provides a starting point for evaluating a publisher's trustworthiness. Are they just a bot? Are there linked, external accounts which point to a real human behind the actions? Per-device proofs could create healthy friction to over-proliferation of identities used for adversarial action.
- **Nature of licensing** - Is this digital land licensor also the owner or tenant of the physical space? Or is it a competitor looking to leverage the digital space adversarially? Is it an advertiser taking advantage of a busy public space? The nature of content, incentives, and trust varies greatly depending on the relationship between the party or parties that control the physical and digital land.
- **Reputation** - There are legitimate reasons to change or keep separate identities, but it's also reasonable for others to place their trust in identities that have shown over time to be good actors. The Geo Web can leverage external and internal network evaluations of participants' historical actions.
- **Duration of licensing** - As with reputation, past actions are a good indication of future actions. Long-time digital land licensing (and the resulting fee payment history) can indicate durable interest and commitment on which to base trust.
- **Content categorization** - Regardless of the publisher, there are times and places where certain types of content may or may not be desired. Content that functions like digital architecture or landscaping imposes less cognitive load on users than something that calls for interaction. The former may be OK while driving a car, the latter not. Advertising goods and services offered at a location differs from the display of third-party ads. Adult content should be transparently and enforceably identified for adult consumption only.

With these layers of context and others like them, Geo Web users can tune their browsers to automatically filter content based on their current environment, activity, and preferences. Adversarial content can be largely avoided while prosocial publishers can consistently engage with users and create value.

Finally and perhaps the most obvious way the Geo Web can achieve its prosocial aims is through its use of the SALSA fee revenue—investing in people, causes, and organizations that make the network and the world better. Easy to say. Harder to execute. The next section, *Governance*, explores how the Geo Web will manage this responsibility.

7. GOVERNANCE

The Geo Web is enabled by a type of bottom-up, permissionless network innovation that wouldn't have been feasible until a few years ago. There is no government or corporate stamp of approval establishing its credibility.

[13] As previously mentioned in *Section 3. - Browsing*, the DLR will not have the ability to filter, censor, or algorithmically promote content. Providing user control at another level of the stack is what enables the registry to remain neutral while the network retains usability.

Satoshi Nakamoto's 2009 Bitcoin whitepaper ushered in a new era in which networks could be built on trust in math/code rather than trust in third parties (whose interests may or may not diverge from the network at-large). The Geo Web network can harness this concept while also acknowledging its limits. The Geo Web can start with minimal, necessary centralization and responsibly transition to more decentralized governance as the network and supporting mechanisms mature.

7.1. Multi-Signature Authority

The initial authority of the Geo Web can be a multi-signature group. They will hold root keys for the DLR, SALSA smart contract, and associated depository wallets. The keyholders would be publicly identified and be trusted, leading members of the Geo Web community.

The multi-sig authority would have have three core responsibilities to the network:

1. Facilitate planned upgrades and changes to Geo Web smart contracts
2. Authorize fund distribution to support network development, adoption, and social impact
3. Take actions in the interest of the network in extraordinary circumstances

The multi-sig authority can remain in place until decentralized mechanisms are designed, tested, and implemented to address these three areas of responsibility.

7.2. The Future

The potential proceeds from SALSA fees are significant. With moderate adoption, they can far exceed the needs of the maintaining organization. Security and robustness of the Geo Web's infrastructure will always remain the priority of the organization, but with time the code should stabilize. The organization's new challenges will be optimally distributing funds and shepherding the network to a decentralized means of governance.

As the network matures, the scope of use of funds should expand: internal development, external grants for ecosystem projects, and funding for global issues outside of the network. The Geo Web straddles our physical and digital worlds. Use of proceeds shouldn't be limited to funding software development. The Geo Web can fund advancements that benefit all of its global participants: climate change, health, education, food/water security, science/technology ethics, and human rights.

When imagining the impact and reach that the Geo Web can have in the real world, it becomes even more apparent that decentralization of governance and decision making is paramount. In the last several years, there has been tremendous progress in the technology and mechanisms that enable decentralized governance: decentralized autonomous organizations (DAOs), quadratic voting/funding, governance tokens, etc. The multi-sig authority should explore incremental and wholesale methods for responsibly relinquishing their power to the network at-large.

8. CONCLUSION

The Geo Web combines concepts from the World Wide Web, the Web 3.0 community, and mechanism design to create a novel, open web experience for the next era of the internet. Its straightforward, authoritative

geographic namespace is a narrow-waist protocol—enabling innovation throughout the hardware and software stack. It creates a frictionless user experience to blend the best of our digital and physical worlds. It provides a technical foundation to scale billions of users and across currently unimaginable use cases.

Smart glasses, embedded computing, augmented reality, and a ubiquitous internet are inevitable. Our society's relationship to the enabling technology, however, is not yet written. The social implications of the Geo Web may be the determining factor in its success. Incumbent powers and inertia will make the Geo Web's attempt to bend the future toward a better version of itself a difficult one. But, its prosocial aspirations can be an advantage that the incumbents cannot credibly match.

The Geo Web will be governed transparently as a public good with a path to sustainable decentralization of power. It can harness self-interest and informed user control to create prosocial network utility. The SALSA system levels the economic playing field by reimagining private property. It helps combat income and wealth inequality typically associated with software and network effects. Finally, the Geo Web establishes a shared, open reality instead of allowing ad-targeted filter bubbles and monopolistic digital control to escape into three-dimensional space. In important ways, the Geo Web can mimic the natural world that our brains have evolved to comprehend—supporting a healthier relationship with our technology. The Geo Web can become technology that people love not just by creating joy through great design or seemingly magical powers, but because it is a recognizable source of good in the world. Afterall, that's what early builders of the internet and the Web always believed technology could and should be.

9. ACKNOWLEDGEMENTS

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11. HIGH-LEVEL ARCHITECTURE