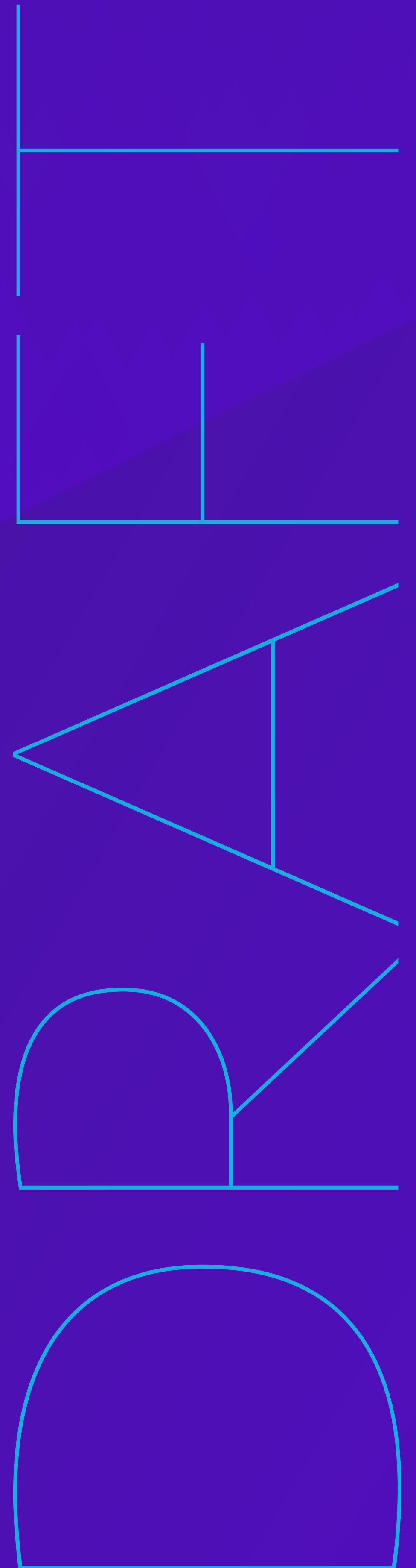


The experience layer of the decentralized Internet

WHITE PAPER



DISCLAIMER

Nothing herein constitutes an offer to sell, or the solicitation of an offer to buy, any tokens, nor shall there be any offer, solicitation, or sale of Cardstack Tokens (CARD) in any jurisdiction in which such offer, solicitation, or sale would be unlawful. You should carefully read and fully understand this white paper and any updates. Every potential token contributor will be required to undergo an onboarding process that includes identity verification and certain other documentation, which you should read carefully and understand fully, because you will be legally bound. Please make sure to consult with appropriate advisors and others.

This white paper describes our current vision for the Cardstack platform. While we intend to attempt to realize this vision, please recognize that it is dependent on quite a number of factors and subject to quite a number of risks. It is entirely possible that the Cardstack platform will never be implemented or adopted, or that only a portion of our vision will be realized. We do not guarantee, represent, or warrant any of the statements in this white paper, because they are based on our current beliefs, expectations, and assumptions, about which there can be no assurance, due to various anticipated and unanticipated events that may occur.

Please know that we plan to work hard in seeking to achieve the vision laid out in this white paper, but that you cannot rely on any of it coming true. Blockchain, cryptocurrencies, and other aspects of our technology and markets are in their infancy and will be subject to many challenges, competition, and a changing environment. We will try to update our community as things grow and change, but undertake no obligation to do so.

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Cardstack is the experience layer of the decentralized Internet. We believe that orchestrating cohesive user experiences across the blockchain and the cloud is essential to bringing decentralization to the mass market.

FOR MAKERS: FAIR DISTRIBUTION OF REWARDS

We propose a new economic model for funding and sustaining the software that runs the world. This model **distributes rewards fairly among the creators** of the software and the open-source communities supporting them. In this decentralized software market, a buyer of applications enters into a direct deal via smart contracts, which coordinate a diverse network of software development teams, cloud hosting providers, and app coin-backed protocols. The buyer offers to **cover all the material costs** of running the app, as long as the cost is directly linked to the usage. The buyer will **also pay a royalty** that is split between those who developed the software, as a reward for initially creating and continuously supporting all the components making up that particular application. In this arrangement, the application software can be considered **economically sustainable**, since every buyer covers his or her costs and the software does not deplete the limited resources (like venture capital or token sale proceeds). The software developers are rewarded through a **reward pool**, based on **properly designed incentives** that lead to improvements of the software over time.

FOR USERS: COHESIVE USER EXPERIENCES

Our model is based on blockchain technology, which presents us with a rare opportunity: We can **break down the silos** of apps defining the tech world today, in order to produce a Cohesive User Experience (CUE), which establishes a flexible design paradigm that can orchestrate all the moving parts in the user's digital life. With the **fluidity of token-backed applications**, we can move beyond the one-icon-per-app business arrangement of the current mobile and cloud world. Yet, for blockchain-backed applications to gain mass market adoption, we need to **bridge the gap between** the power of **blockchains and** the convenience of **the cloud**. Cardstack's application framework and token mechanisms combine the new possibilities provided by smart contracts, while leveraging the incredible global scale and cost efficiency of cloud computing, to deliver this user experience. Our technology **puts the power of decentralization into real-world use** and demonstrates how a crypto-driven economy, backed by current blockchain protocols, can enrich the world in an equitable manner. Blockchain needs a "full stack" application framework to reach mainstream users: **Cardstack**.

Our mission is to build an economically sustainable software ecosystem that fights back against the rampant lock-in mechanisms of centralized platforms.

1.2

PROBLEM: APPLICATION SILOS (1/3)

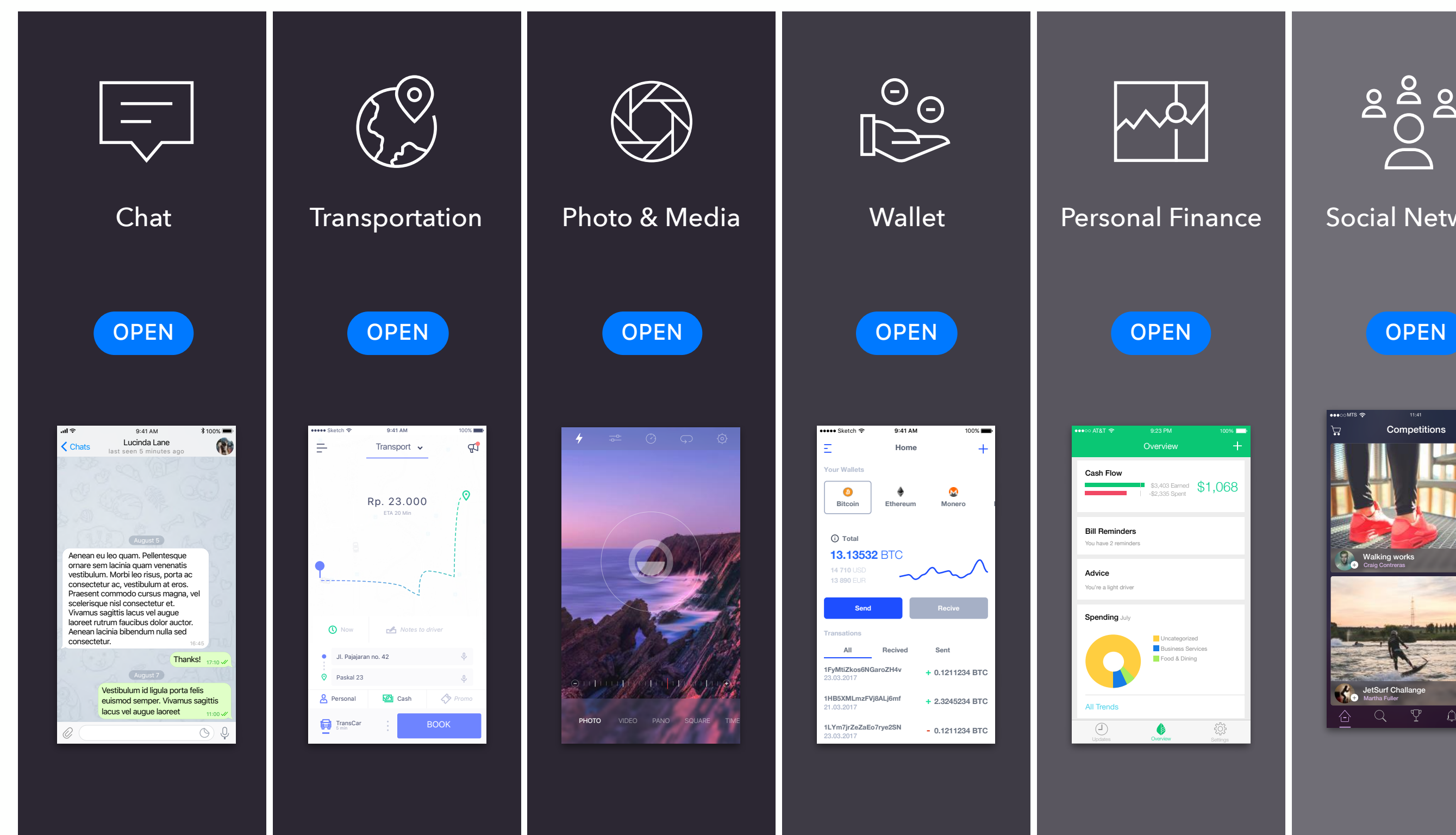
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The App Store era turns software features into standalone native apps, which usually do not communicate with each other and require users to choose between multiple overlapping features to form their workflows.

MOBILE SILOS: ONE APP PER SCREEN

Today, there is “an app for everything”. More than USD 70 billion have been paid out to developers of iOS apps in the last decade. When the iPhone was first introduced, there were 15 apps: iPhone, Mail, Web, iPod, Calendar, Camera, Maps, Photos, Stocks, Clock, Notes, Calculator, Weather, Text, and Settings. It allowed people to manage their lives on the go, facilitating communication and even giving directions, while their music collection served as the soundtrack to their new iLife.

But all's not well in today's app world. Outside the category of games and entertainment, most users refuse to pay for apps, which is why nearly all of today's apps are free. Additionally, the sequence of steps needed to use a native app — search, download, find the icon, launch, skip tour, register — has severely hampered the adoption of new apps. The result is that most iPhone users settle on a small number of apps (< 5) for daily habitual use. Many of these apps are supported by advertising. For a majority of development teams working outside of FAMGA (Facebook, Apple, Microsoft, Google, Amazon), the original business model for apps — “users pay money to buy app” — is effectively dead.



1.3

PROBLEM: APPLICATION SILOS (2/3)

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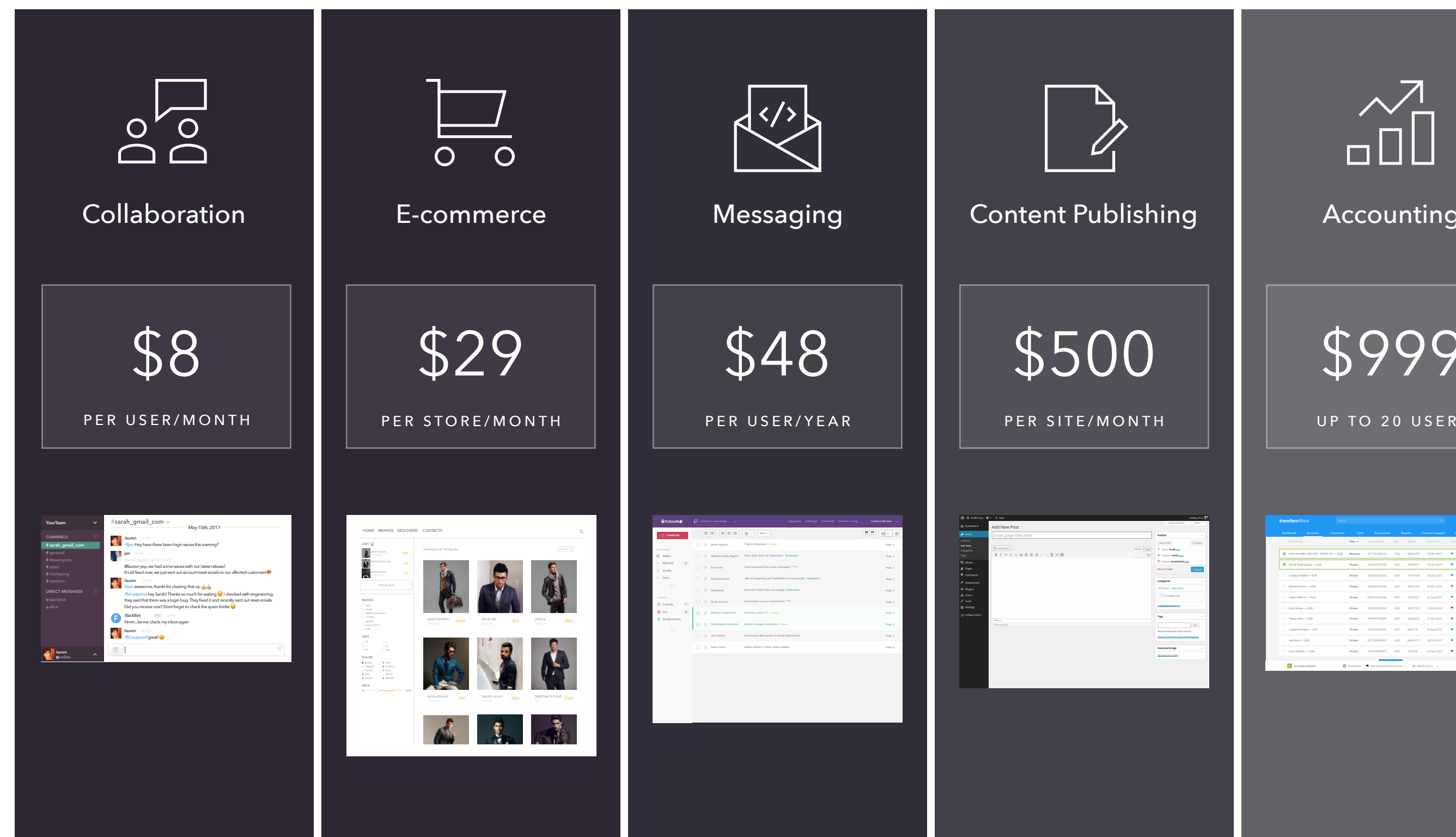
As software moves to the cloud, users need to manage multiple subscriptions to cloud-based software-as-a-service (SaaS) products and choose the right plan to optimize cost across all the needed features.

CLOUD SILOS: ONE SUBSCRIPTION PER APP

The monthly subscription model has taken over, as the revenue from subscriptions aligns well with the ongoing cost of developing and maintaining the software. Most small businesses need 5-10 apps to operate, large businesses need many more.

Each app requires a separate credit card, admin login, and password, which causes problems: Cards expire, logins must be reset, when the employee who signed up leaves the company, or customer support has to be called. Not to mention how costly these apps are. And there is always the risk of the team behind an app suddenly being acquired by a bigger player or shutting down because the funding has run out. Then, you have 60 days to download all the data you and your team painstakingly entered into the app as one giant zip file.

Many of these apps have duplicative feature sets, just to remain competitive and be able to retain customers. This is a natural result of uncoordinated yet competitive markets. For end users, this is expensive and painful.



1.4

PROBLEM: APPLICATION SILOS (3/3)

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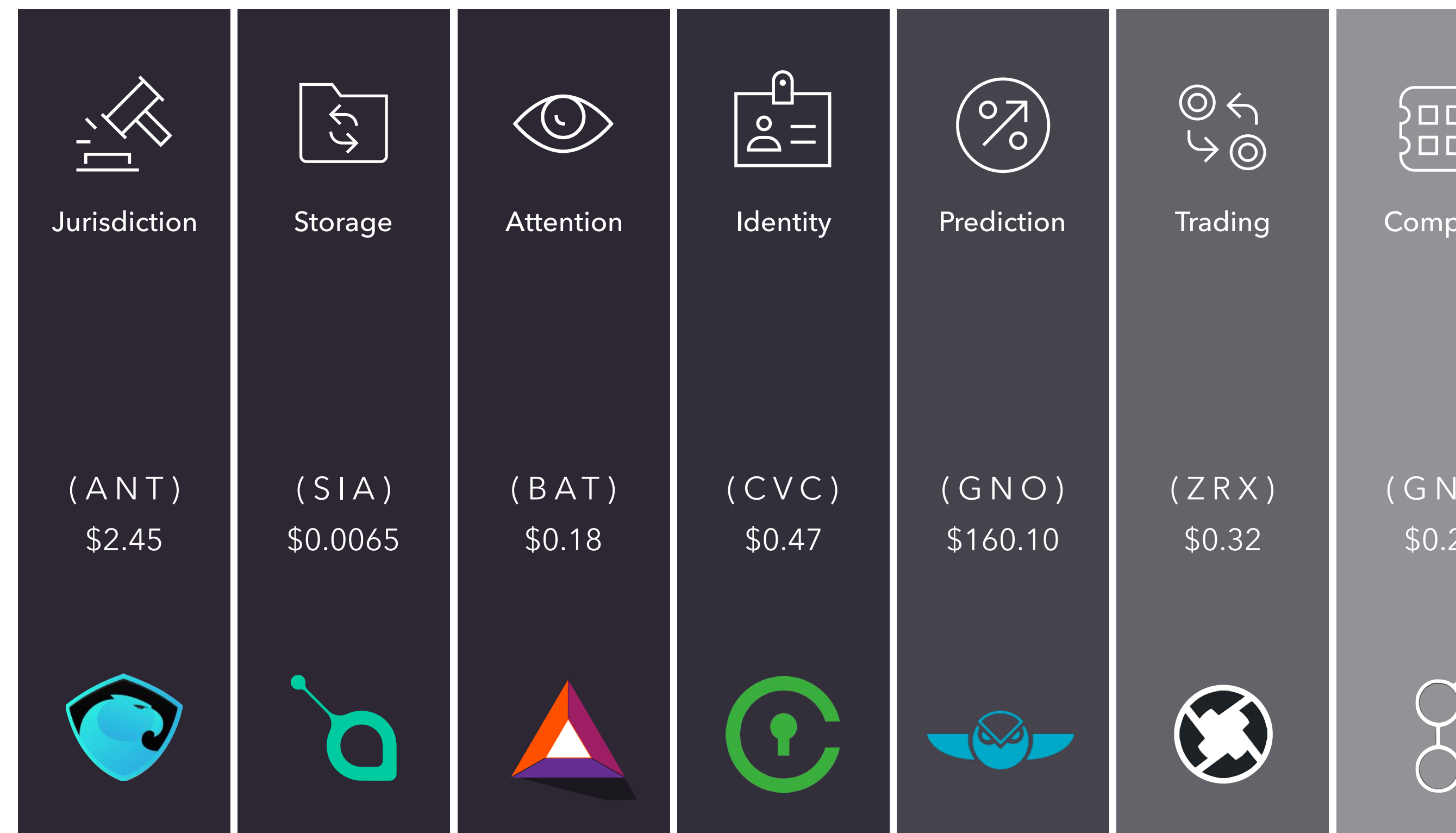
The emergence of blockchain and decentralized apps (dApps) exasperated the situation by requiring users to acquire and manage the supply of utility tokens for each of the functions making up their software stack.

EMERGING BLOCKCHAIN SILOS: ONE TOKEN PER APP

Most of the first-generation user interfaces for dApps are built as standalone web applications that interact with a blockchain via browser plugins, a system tray, or a menu bar program. The user opens one app at a time — in a series of familiar browser tabs, most likely.

Each dApp works independently, looks distinctive, and moves assets on its preferred blockchain decisively. We get a glimpse of the power of decentralized, permissionless innovation.

We also see the perils of fragmentation, where the simple ideal of dApps — all powered by Ethereum — turns into a complex web of different app coins on different smart-contract platforms with different approaches to user interfaces and different levels of peer-to-peer requirements. Even for a savvy web-app user, this is certainly more challenging than managing 15 different SaaS subscriptions. This is more like setting one's own Linux desktop to host everything — from one's own blog to one's email account, chat server, key management server, and so on. This complexity will increase with the growing ambition of the blockchain community.



1.5

IDEA: FROM SILOS TO LAYERS

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The reorientation of the vertical silos to horizontal layers allows native apps, cloud apps, and blockchain dApps to form a future software stack combining the best qualities of each of the software era's approaches.

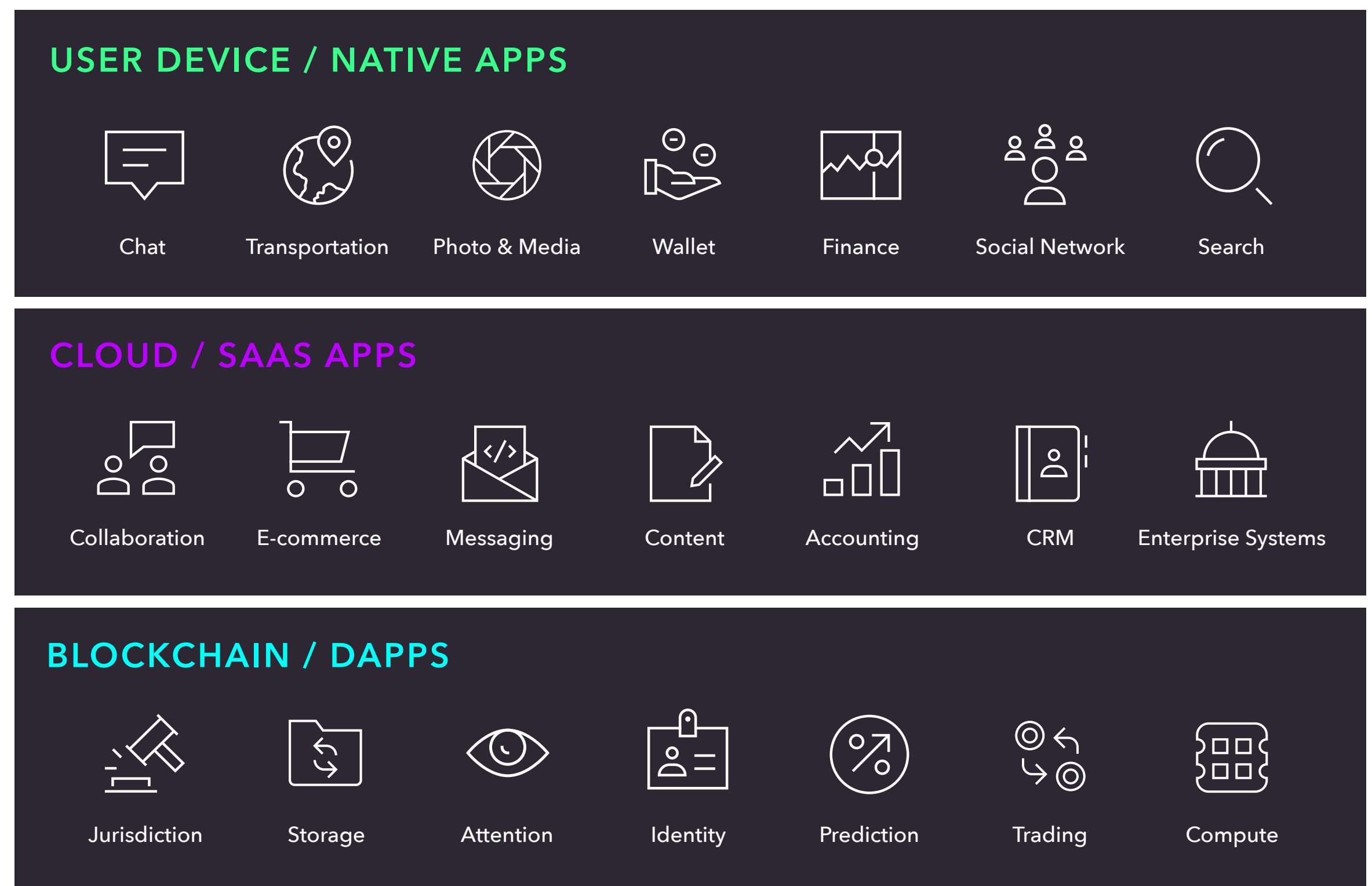
THE PARTS KEEP GETTING BETTER

The problems of silos are actually a consequence of the bounty of technological progress, funded by the growth in the global, Internet-enabled marketplace.

In the user's pocket, every new generation of mobile phones provides a new baseline of capabilities that begs to be incorporated into the user's workflow. The competitive landscape of mobile operating systems means that last year's striking innovations become this year's commodity features.

On the cloud, all SaaS vendors want to add features, in order to attract a new segment of customers or simply keep current customers from migrating to a competing suite that is starting to encroach on their feature set.

While the blockchain-based dApps vendors are all new to the game, most of them not having shipped any working code yet, the land grab for mindshare and potential use cases is already in full force. With each white paper and smart contract design published, we see the potential for blockchain dApps to compete or to augment the powerful tools that are available on the market as native apps or cloud subscriptions.



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IDEA: HUMANS AS ORCHESTRATORS

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Savvy users are already learning to work with multiple apps across their devices, cloud, and blockchain to fulfill their needs. Human ingenuity will continue to close any gaps left between the technologies.

PEOPLE WILL “MAKE IT WORK”

Early adopters of blockchain technologies know how difficult it is to make a basic transaction to send bitcoins or ether to someone, let alone transact with smart contracts and handle app tokens. Yet, the ever-growing volume of daily transactions in the cryptocurrency space shows that people are finding their way around wallets like Coinbase or TREZOR, exchanges like Kraken, social networks like Reddit, and centralized messaging systems like Slack, to participate in this exciting new world.

The largely manual workflows pioneered by these early adopters (see dotted lines on the diagrams on the right) criss-cross the boundaries between their devices, various cloud-hosted apps, and the many blockchains. For them, the theoretical debates about the merits of purely decentralized systems give way to practical concerns of getting the deal or the trade done. These trails left by the pioneering users should deliver inspiration and guidelines for designers and developers of the next generation of user experiences. They should serve to make these steps easier and quicker or, if possible, eliminate them altogether through a streamlined process.



1.7

SOLUTION: THE EXPERIENCE LAYER

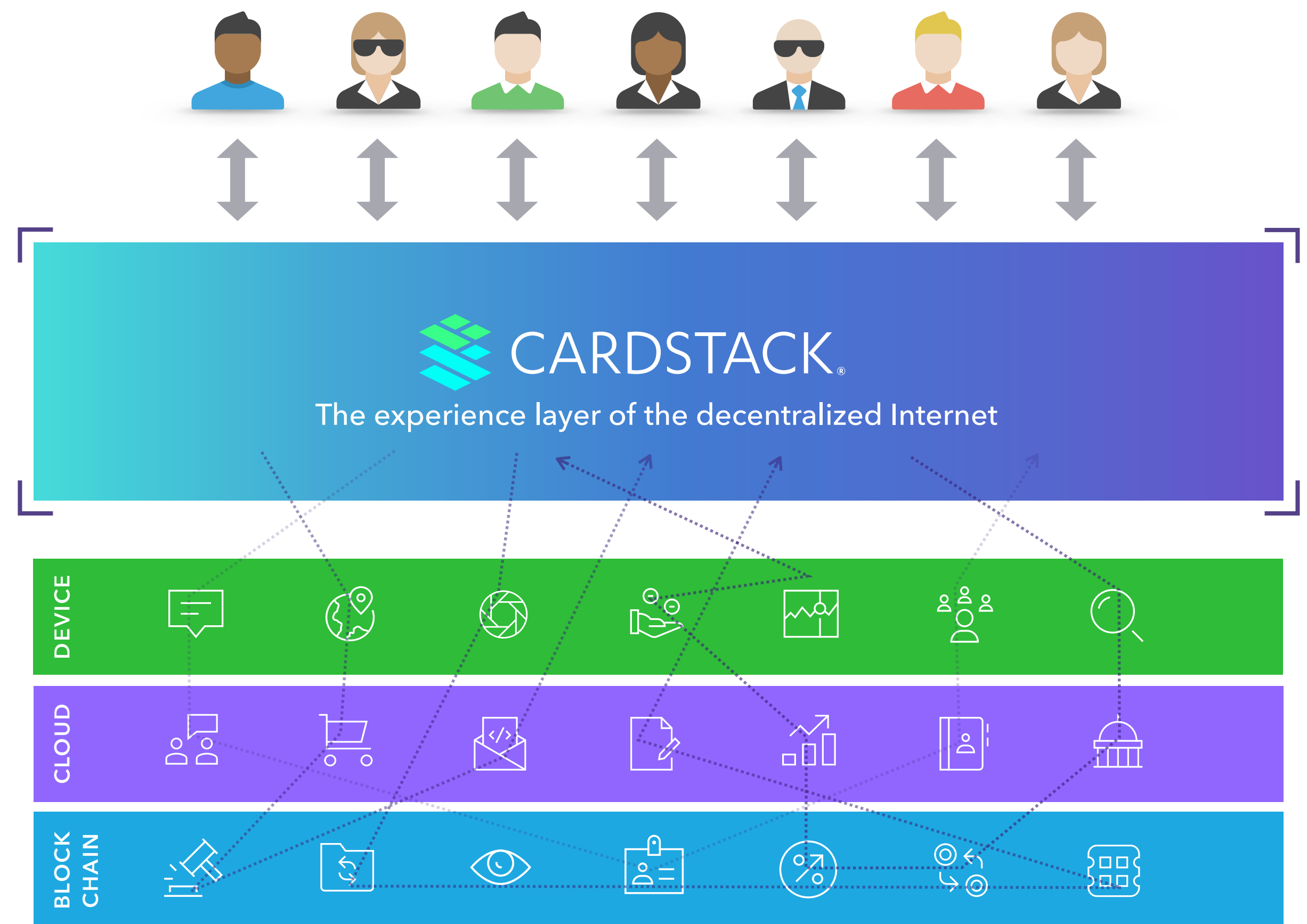
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Cardstack is building a new experience layer that helps users orchestrate their interactions across the (d)Apps they use, ushering in the age of mass market adoption of decentralized technologies in an open ecosystem.

BUILD IT OPEN. KEEP IT OPEN.

The World Wide Web was architected by Sir Tim Berners-Lee as a decentralized network of individually operated web servers. It was built with open-source tools and brought forth the era of home pages under construction. But building it open in 1989 was not enough to keep the Web from falling back into an uncomfortably centralized architecture in 2017. To search the Web, we still rely on the relentless crawlers from Google. To stay informed, we submit to the algorithms of Facebook, trying to find things that may trigger our interests. The crypto community is not immune to these recentralization vectors; hosted, closed-sourced wallets like Coinbase have captured a big portion of recent crypto converts.

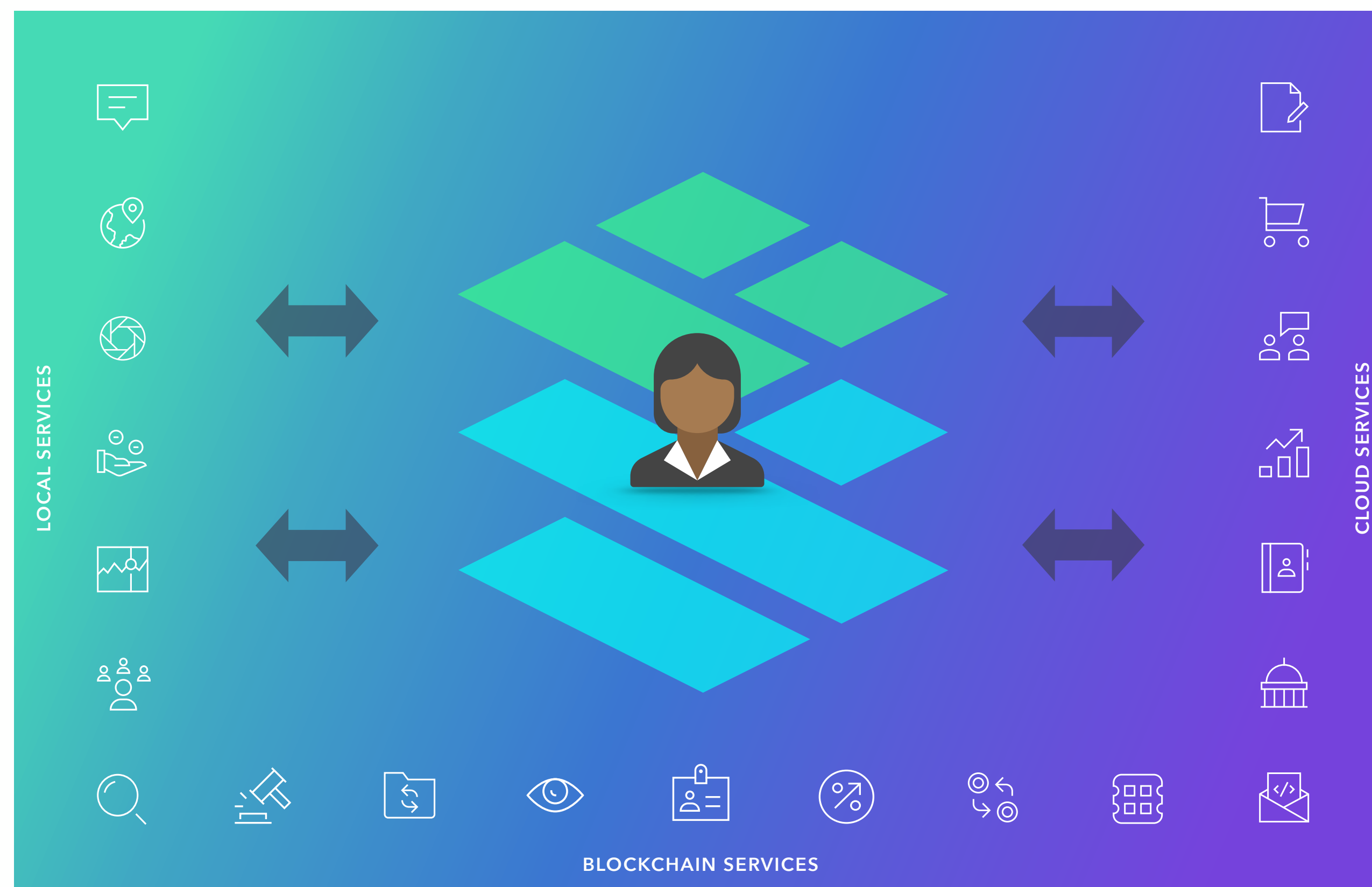
The nascent movement towards blockchain-enabled decentralization is a great opportunity. Builders can learn from the past and lay a more resilient technical, social, and economic foundation, ensuring that a powerful, beautiful, and convenient layer of great user experience is kept open — as forkable open-source software, coordinated via open governance of decentralized protocols, and available for open participation from all around the globe.



2.1 CENTERING THE INTERNET AROUND THE USER

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The new approach to orchestration must put the users at the center and let them act as their own hub, so that interactions with applications and services flow through a software stack controlled by the users.



DECENTRALIZED USER EXPERIENCES

Decentralization can be thought of more concretely as the recentralization of workflows around a user. The user can initiate, orchestrate, and make decisions about transactions that are coordinated locally (i.e. over the counter) via cloud-based market makers or through the logic and consensus mechanisms of various blockchains. Parity with traditional, single-function apps is not enough. The vision of multiple apps and dApps working in harmony demands a generational leap in user experience in terms of composable and interoperability.

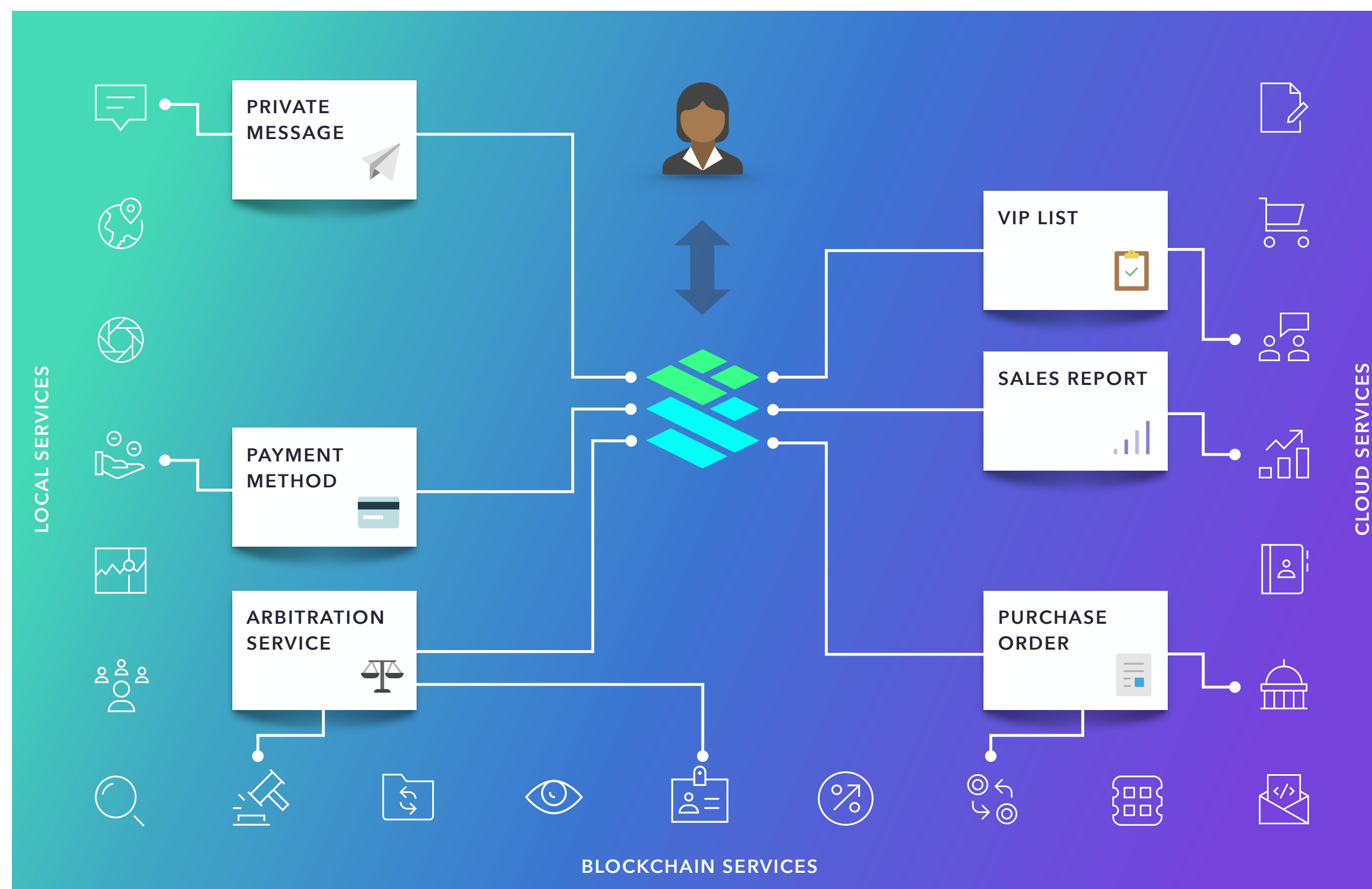
As the use cases expand beyond crypto trading and finance, this general pattern of user orchestration can be used to recentralize the data locked behind cloud-based subscriptions through integration hooks. With the right architecture and design system, a user-centric, decentralized UX can exhibit the fluidity of a consumer social network, while facilitating structured transactions like a line-of-business system.

2.2

TURNING SERVICES INTO TANGIBLE CARDS

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The necessary orchestration can be made intuitive by turning each state of an application into a “card”, which is a visual embodiment of the key information, suggesting the next course of action via chaining of related cards.



THE RISE OF CARD-BASED UI

To enable this breakthrough, we need to break the problem space of complex user interfaces and workflows into manageable pieces. Each piece is bite-sized, encapsulated, and happens to look like a physical card, which can be embedded, chained, auto-filled, attached, triggered, expanded, versioned, cloned, rescinded, and approved as part of a cohesive user experience; it floats effortlessly on top of multiple cloud environments and blockchains.

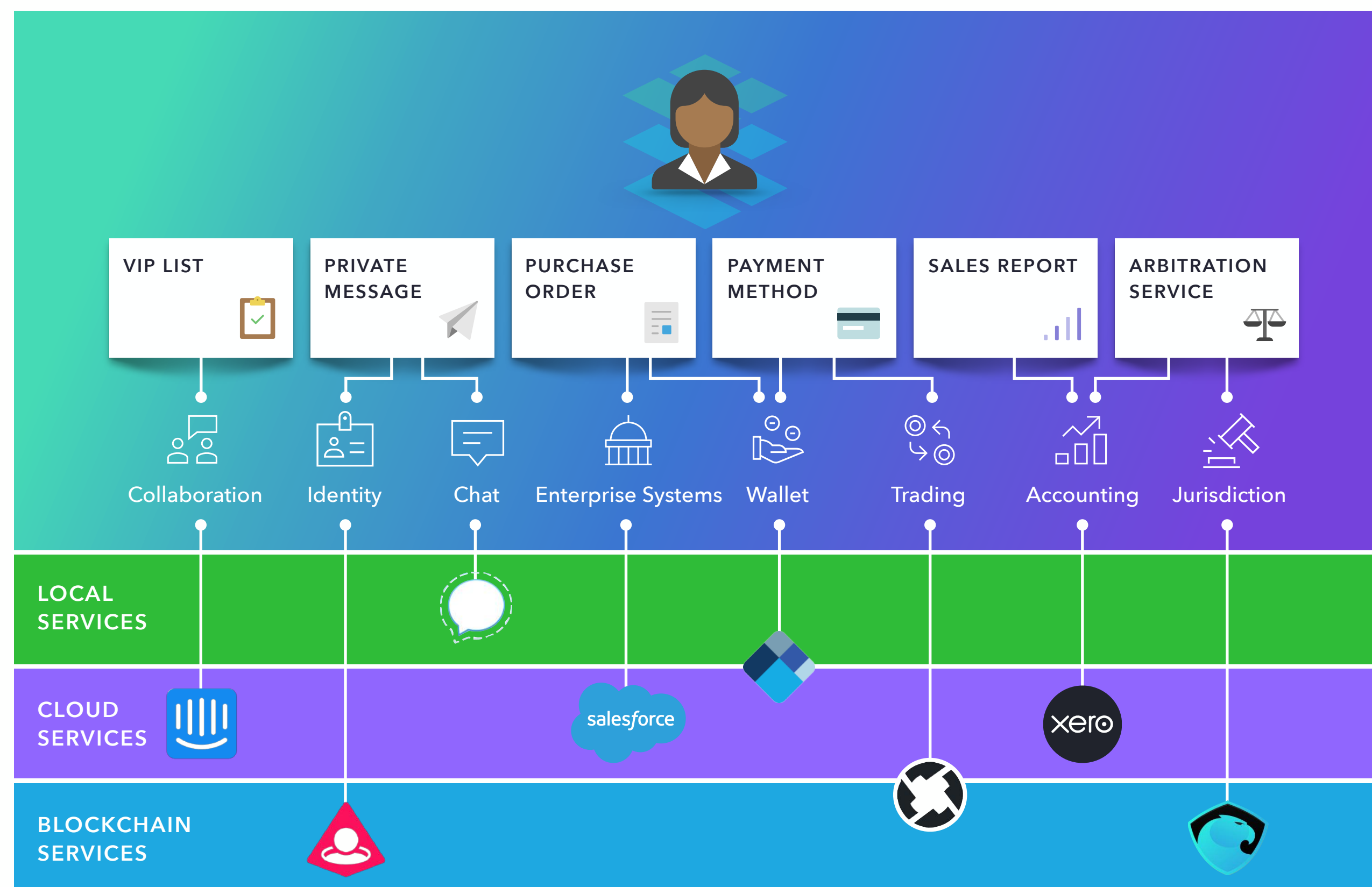
At the same time, we also need to zoom out and establish a new set of rules, working out how these cards can stand on their own, be embedded in other apps, and act as hosts for other cards when called upon to do so. We can then use the rewarding power of the blockchain, streamlined through a card-based ecosystem, to make features that were previously offered in proprietary and expensive silos pervasively available to millions of people around the world as bona fide open-source software.

2.3

BRIDGING BLOCKCHAIN AND CLOUD SERVICES

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These cards become the primary unit of interaction between the users and many variants of competing services, which run locally, in the cloud, or on a blockchain and fulfill the different aspects of users' needs.



(UN)CHAIN THE LEGACY DATA

We need to break up the antiquated concept of the “almighty app” into smaller building blocks, which are in turn chained back together through the user’s choices or the system’s recommendations. Once you turn data into cards, you own them forever.

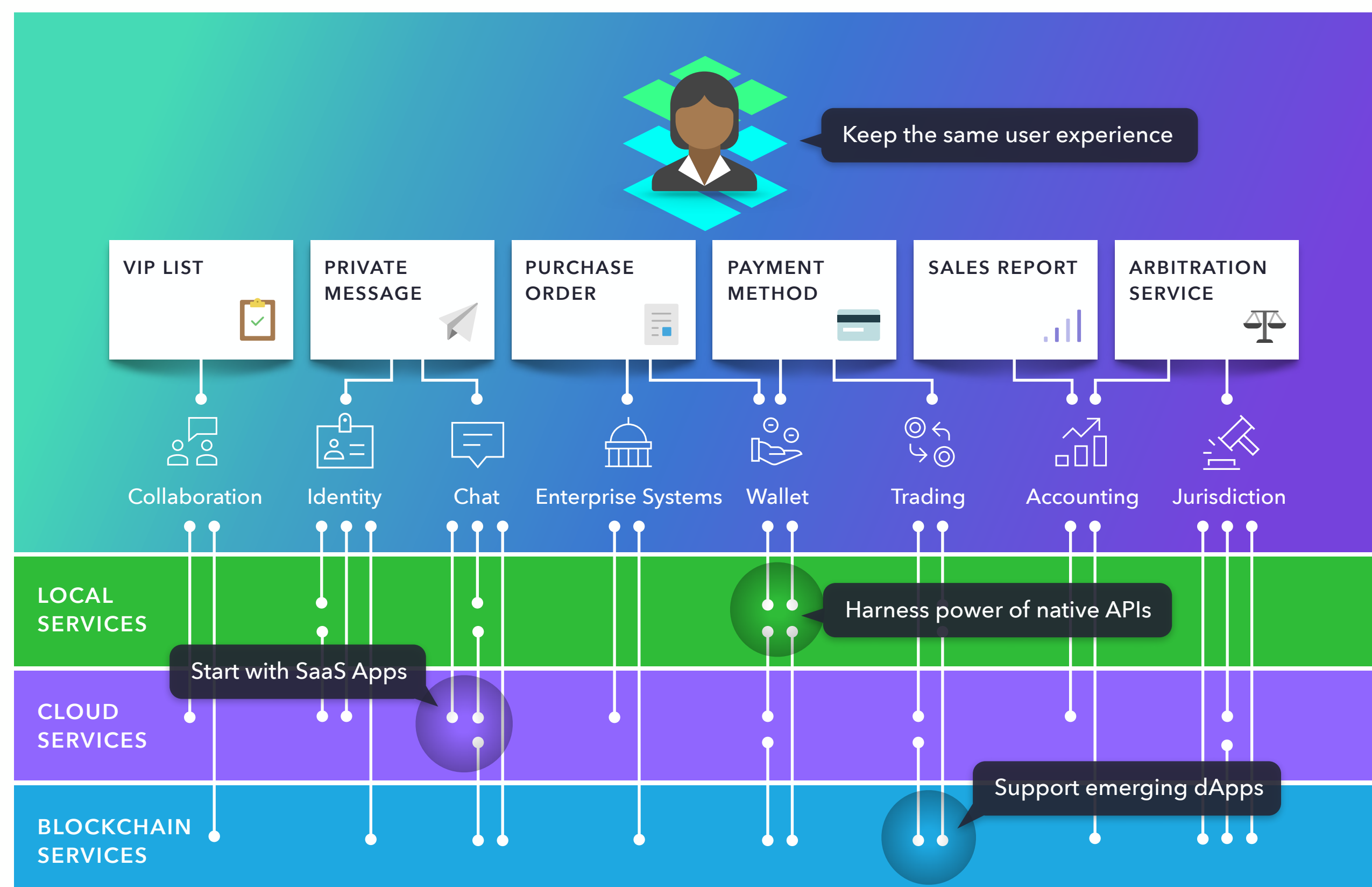
Still, no person is an island. With the right syndication hooks — some based on blockchain technologies — data in the user’s personal cloud can be replicated and redacted as necessary, to contribute to a collective view in another user’s or organization’s cloud. After all, blockchain is really a coordination mechanism between a group of participating peers. Everybody is free to do what they will with the blockchain-delivered data. Whether you choose to participate directly via a computer you control, instantiate a personal cloud that runs 24/7 solely on your behalf, or let a third-party website do it for you in a multi-tenant way — that is entirely up to you.

2.4

ENABLING PROGRESSIVE DECENTRALIZATION

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Behind the facade of cards, the process of decentralizing the software ecosystem can be done piecemeal, allowing for drop-in replacement of common cloud services when blockchains are ready to act as substitutes.



WHAT USERS NEED TO KNOW

Users need to understand how to interpret the encapsulated information presented to them via these cards; they need to choose the appropriate action to take in order to complete the transaction, persuade another person, or grow into a greater authority. What they don't need to know is what happens behind these cards: whether the transaction is transmitted through a cloud-based service or a blockchain protocol; whether the counterparty is another human or an autonomous agent represented by a smart contract; or whether the proof of identity and thus authority is provided by a blockchain ID or an on-device face ID.

The quest to move the majority of value-bearing interactions on the Internet from centralized but extractive counterparties to decentralized but accumulating networks of mutual benefits will take time. As dApps mature to compete for users' interactions, all they need to do is plug into the system behind a card-based facade and show the user a better way with minimal friction.

3.1

DIFFERENT LEVELS OF DECENTRALIZATION

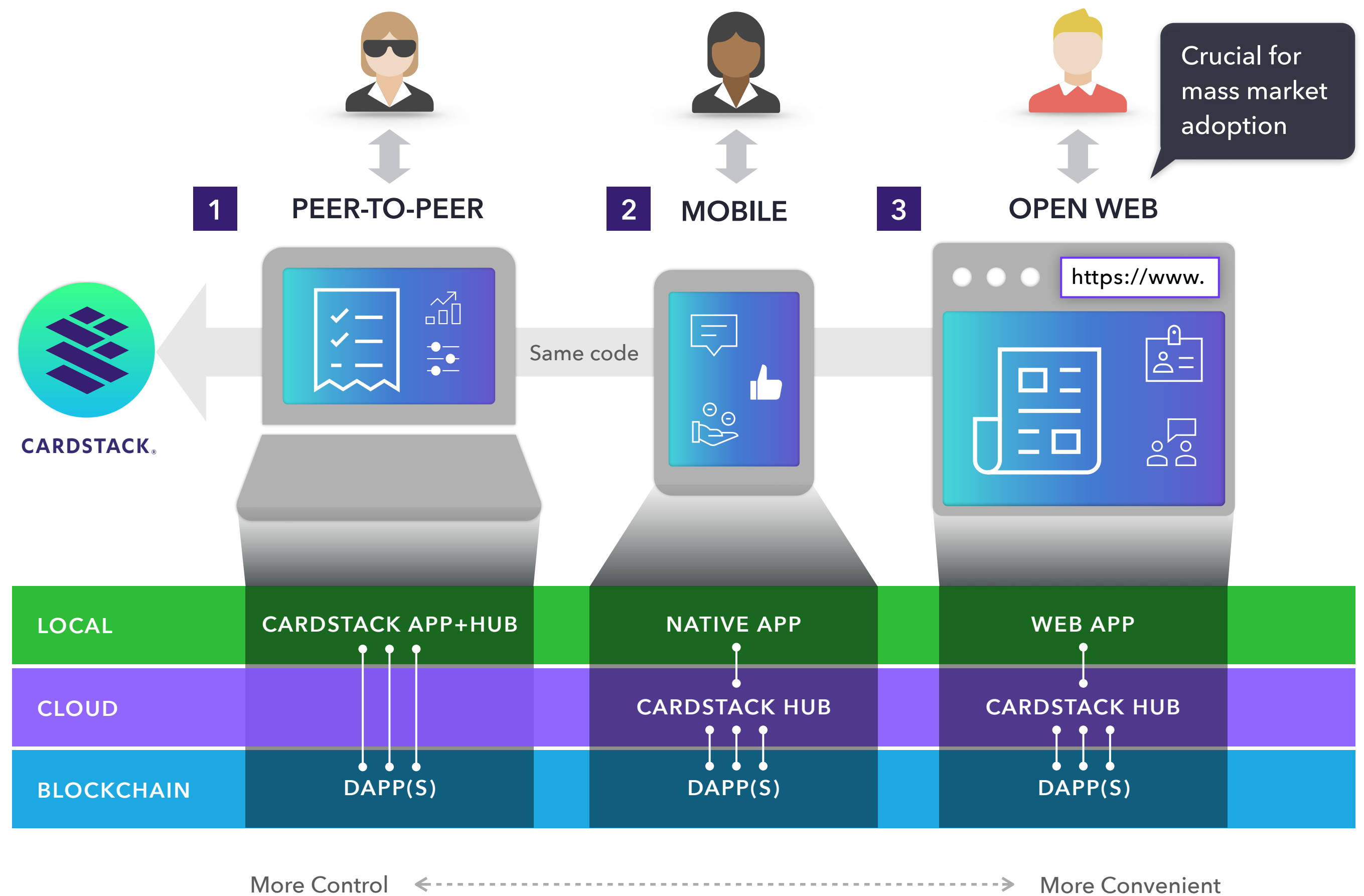
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Mass market adoption of blockchains can be accelerated if we reach the users via the familiar platforms, such as mobile devices or the open Web, and invite them to participate as peers with greater sovereignty.

SAME CODE ACROSS ON-RAMPS

The software tools developers use to build peer-to-peer apps are different from the ones used for hosted web apps. While there are web apps that speak with blockchains (e.g. cloud wallets like Coinbase) and peer-to-peer apps that connect to the cloud (e.g. secure chat apps that depend on cloud-based identity graphs), apps that are flexible enough to run in both topologies are rare.

To reach new users, the open Web is a great place to start, as it bypasses the friction of an app install — through an app store or a direct download — and allows users to begin interacting and gaining value immediately. With this user adoption pathway in mind, Cardstack's software and protocols are architected to enable developers to deploy their card-based experiences to the Web and reach users where they are today. In addition, developers learn to package that same code as a peer-to-peer app for users who are ready to take full ownership of their digital life.

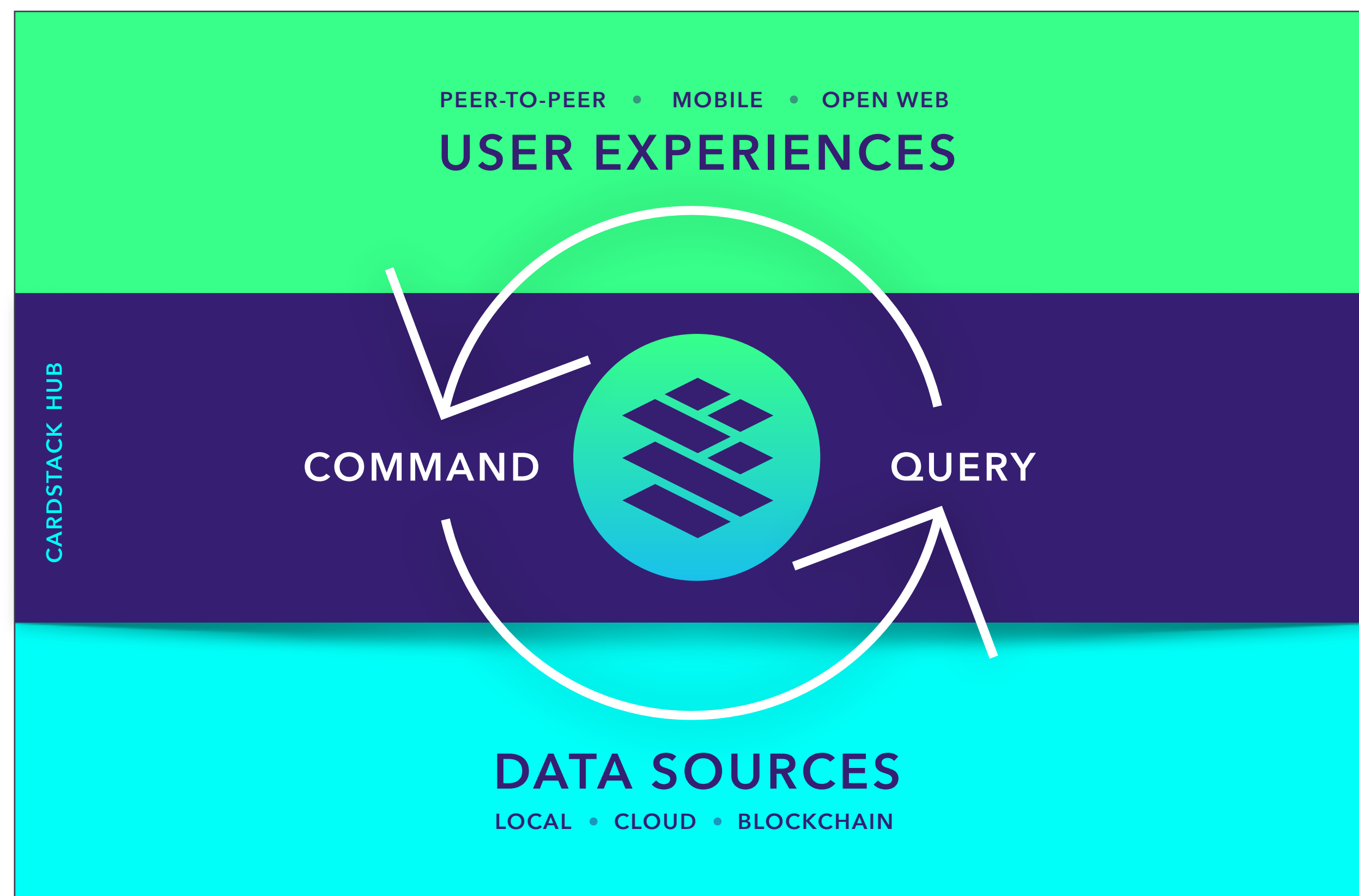


3.2

THE ROTATION POINT FOR EACH USER

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Acting as the orchestrator of the user's workflow, Cardstack Hub relays the user's commands to the right data systems and constantly listens for changes, while building a consistent, queryable view of reality.



YOU OWN YOUR OWN HUB

There are services on the Web, like IFTTT, that will help you wire up the different services of your digital life based on rules and conditions you set. In the crypto space, there are exchanges that will process limit orders automatically when you are asleep. Looking ahead, dApps promise to reallocate your digital tokens continuously to minimize risk and maximize portfolio value. The question is: Are you in command of these agents and do you know what they are doing on your behalf at all times?

Inside the Cardstack architecture, especially in peer-to-peer mode, all users remain in complete control of their data orchestration layer called Cardstack Hub, which sits between the user experiences they use and the data sources that persist and process the interactions. Even in a hosted model, where the plug-ins run inside the Hub in a multi-tenant configuration, the users are represented as themselves through well-defined boundaries of their commands and queries of their aggregated data collections.

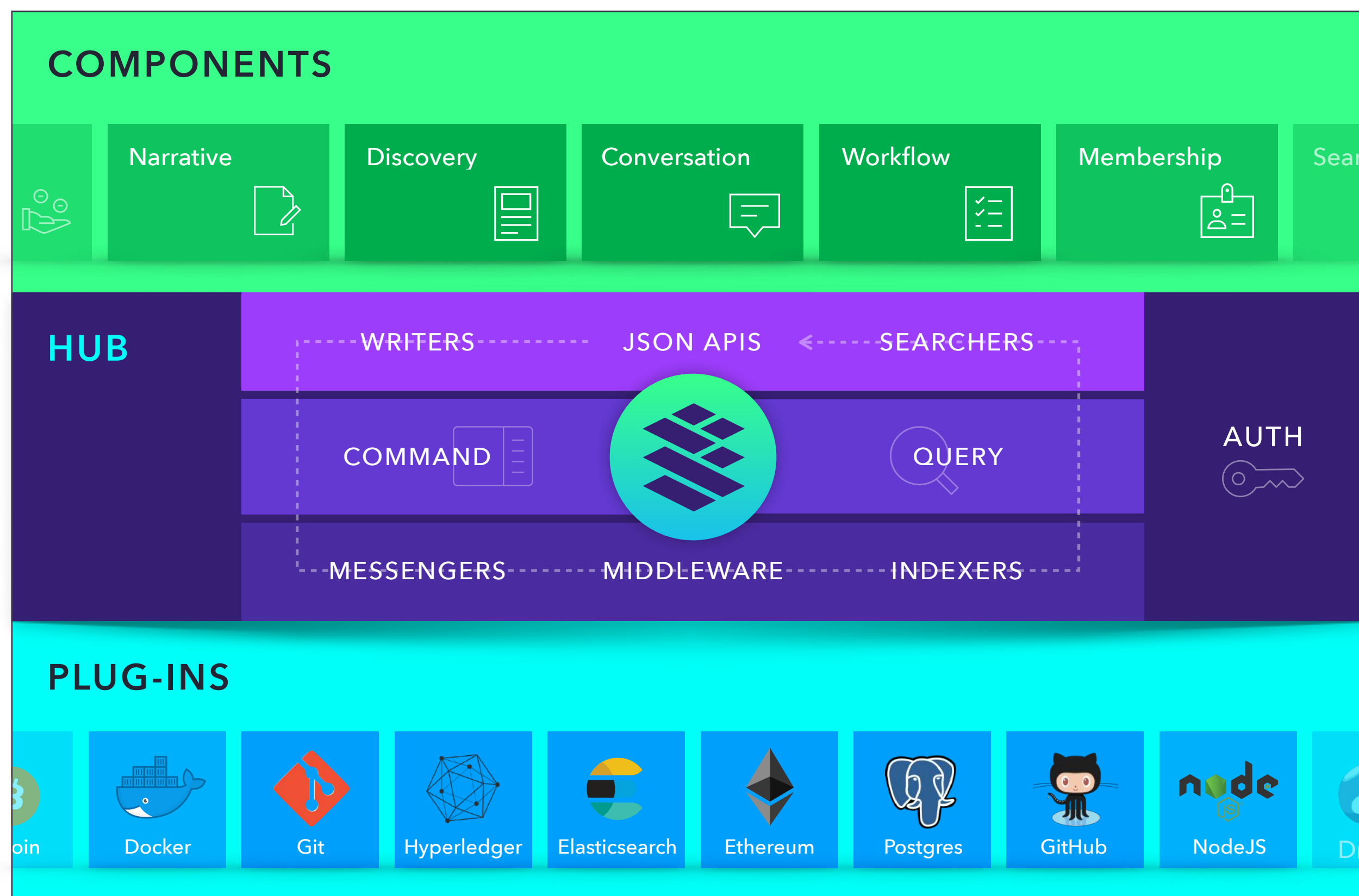
Cardstack Hub is architected based on the software design pattern popularized by Martin Fowler, called "Command Query Responsibility Segregation" or CQRS. The architecture model differs from the CRUD model (Create, Read, Update, Delete) common in database-driven applications, as it allows the integration of multiple, simultaneous truths, backed by a blockchain and a SaaS app, into a single, coherent query model.

3.3

CARDSTACK HUB ARCHITECTURE

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We have shipped a full stack that works with Git as the core. As decentralized apps mature, the well-typed plug-in architecture of Cardstack Hub allows dApps and their underlying blockchains to complete the vision.



DATA AND CODE LIVE TOGETHER

Cardstack is a pluggable, event-sourcing, search-first, open-sourced application framework for building distributed as well as decentralized application networks. At the core of Cardstack is the idea that data, content, and code in modern applications evolve and change in lockstep. When a social network introduces a new feature, call it *InstaStories*, the data schema, content authoring tool, mobile app templates, recommendation algorithms, and API endpoints all have to be updated to reflect this capability. On the code front, Git, the distributed version control system created by Linus Torvalds in 2005 for developing the Linux kernel, provides the foundation for rapid, parallel branching to test new ideas and merge them again when the time is right. We believe “The Git Way” deserved to be extended beyond code and become the standard way to manage the tracking and propagation of data and content. When combined with the consensus-making power of blockchains, a Git-based workflow, realized through Cardstack Hub, represents a return to local control without sacrificing value creation through network effects.

All the plug-ins listed above are available at github.com/cardstack as of Sept. 2017. We intend to support new blockchains and their dApps as plug-ins to the Cardstack Hub as their projects mature. Once a new plug-in is written, software designers and developers familiar with the Cardstack framework can easily write user-facing components and cards without knowing the low-level details of each dApp’s protocol.

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COMMON OPERATING ENVIRONMENT

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Blockchain- and cloud-based apps that are integrated with Cardstack Hub immediately get the benefit of common components to handle prioritized queues, searchable libraries, and field-level configurations.

BUILDING WORKFLOWS ACROSS APPS

With a unified orchestration layer provided by Cardstack Hub, (d)Apps that are built on this common foundation can work seamlessly to serve the users:

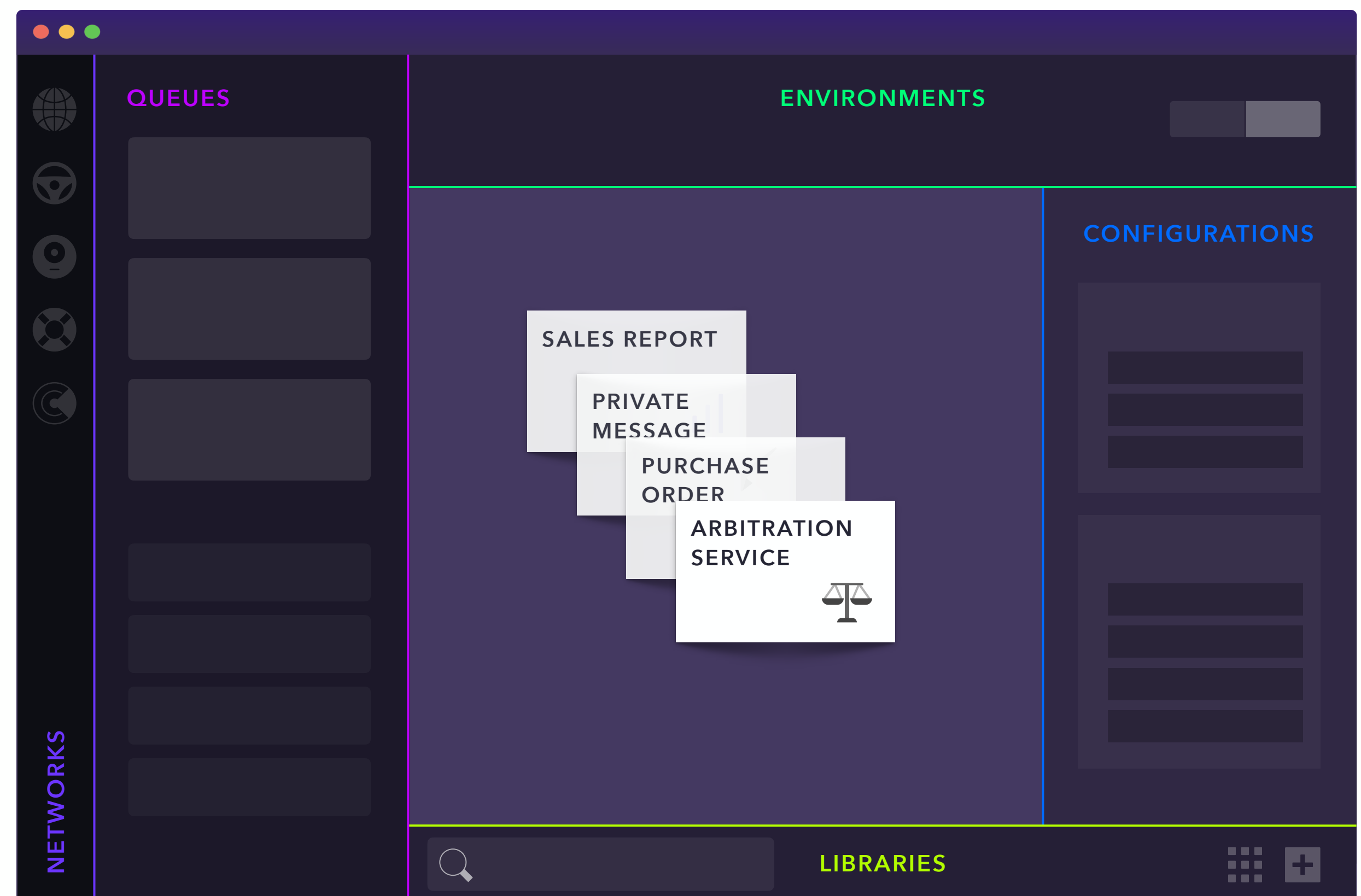
Networks are formed solely based on group affiliation and market participation, not because everyone uses the same application, e.g. Slack.

Queues aggregate and coordinate the flow of data and actions of multiple (d)Apps within the network, without needing to log in to multiple dashboards to check up on them.

Environments define the boundaries of what is a public forum, a private workspace, and an invite-only channel. Within that chosen context, all (d)Apps inherit the visibility and privacy controls, so there is no need for repetitive permission tweaks.

Configurations across dApps and the data and content they manage can now be made consistent, since the Hub is schema-aware and can offer reusable controls for fields.

Libraries provide a user-centric, searchable view of the collection of cards sitting inside each (d)App. It serves as the ubiquitous “camera roll” of the Cardstack experience.



3.5

OPEN-SOURCE CARD CATALOG

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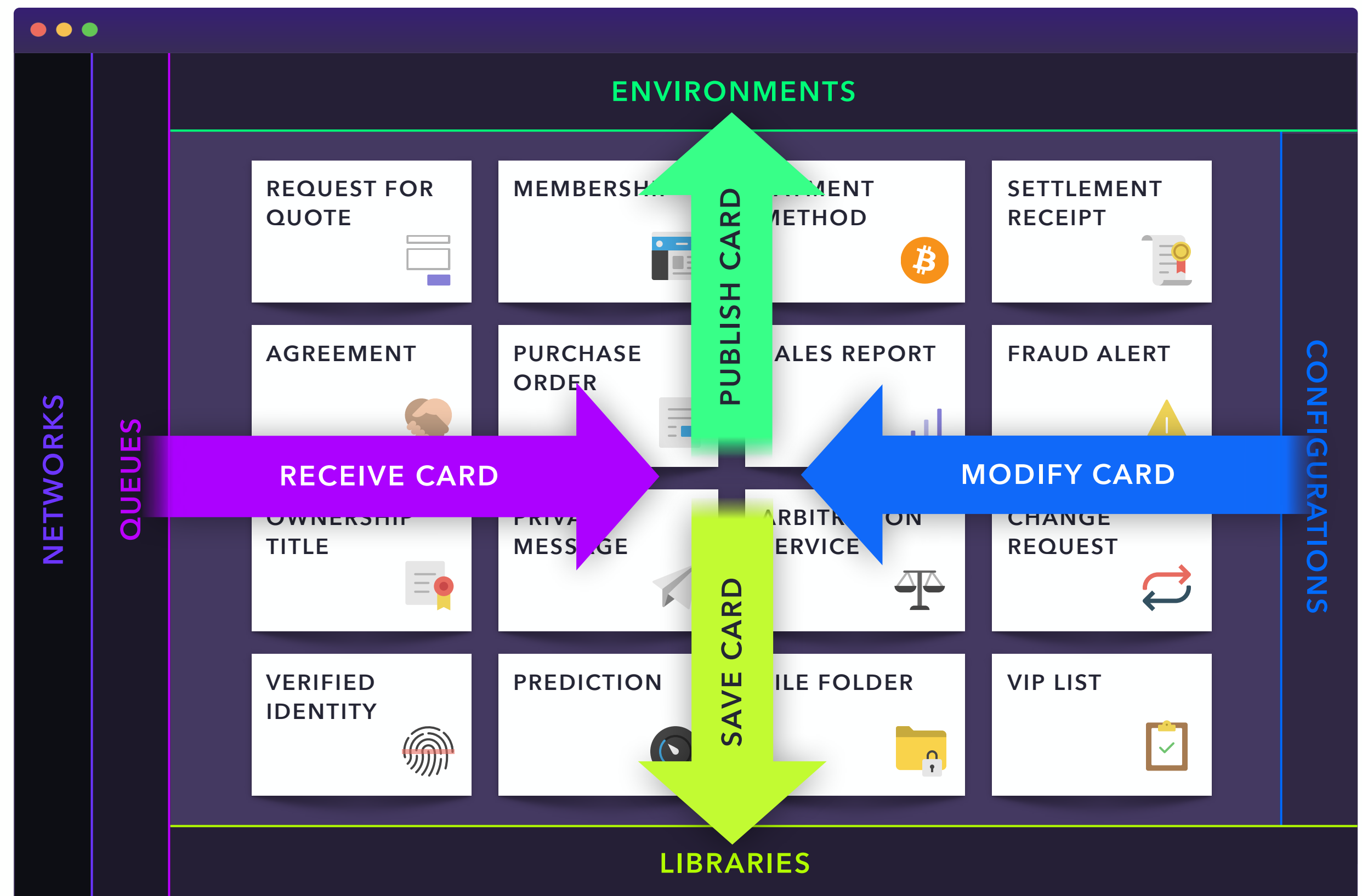
As the features of the card ecosystem fill out, common data elements and associated actions can be unified as open-source standard, creating a catalog of pre-built cards that are easy to use and reuse.

DESIGNING AROUND THE FOUR EDGES

There are enough open-source repositories on GitHub to provoke one's imagination regarding the possibility of a composable software ecosystem. Yet, if you want to quickly assemble even a simple web app, you'll find there aren't many ready-made features you can fork and include in your app without a significant amount of custom coding.

Looking at the success in the SaaS world — a dominant example being Salesforce.com — we realize that the key is a consistent application structure, so that new features and third-party extensions can be added to an existing installation by an end user with little to no code.

We created our design system, code-named "Four Edges", based on a similar theory: If we extract the common functionalities from web apps and provide them as part of the overall Cardstack operating environment, new apps built as a collection of cards can be created, received, saved, modified, published, remixed, and reused by end users — all within the user interface paradigm they have internalized. Developers and designers can focus their efforts within the edges of the card to make it the best card of its kind in this open catalog.



3.6

TRUE MOBILITY OF INFORMATION

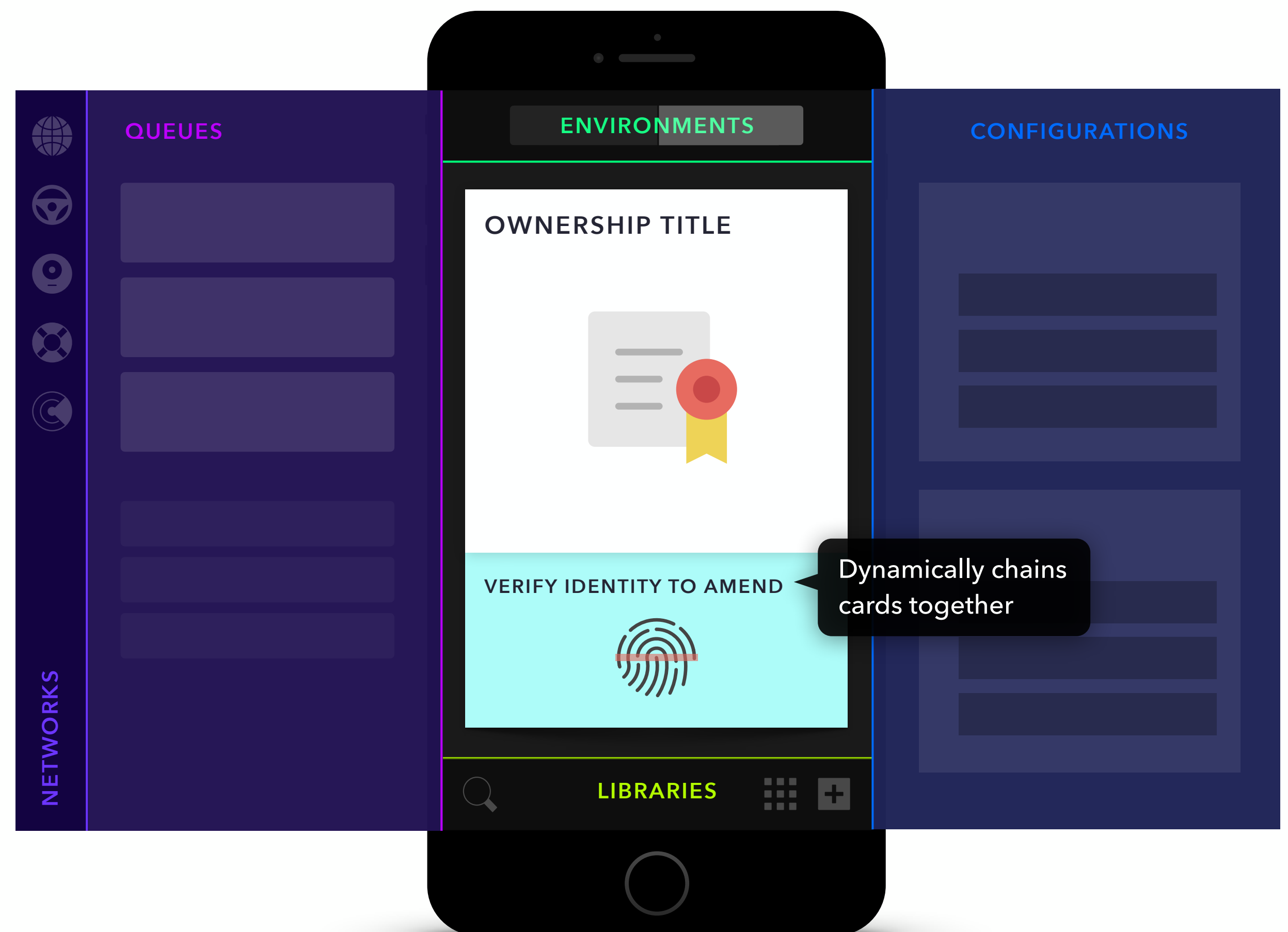
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Cards from different origins can be delivered via the same notification queue. They can be chained together to form workflows that tap into the power of mobile devices and move at the whim of the sovereign user.

A SYSTEM OF CARDS IN MOTION

The unique advantage of cards as a user interface paradigm is that they fit nicely into the four edges of the modern smartphone, much better even than the best responsive web sites. Beyond the factor of their bite-sized form, cards are embodied as physical objects: They can move into or out of view with the flick of a finger, be chained or tacked together with a related card and move in tandem, or get picked up and dragged into another area of the environment as naturally as you'd expect.

To make this illusion of a physical card feel real, tactile, and manipulatable, the Cardstack team has invested and will continue to invest in the creation of compelling motion design patterns and the improvement of performance animation primitives, ensuring the fluid movement of cards within this design system of edges in motion. We are working with the thought leaders in front-end engineering, to create a run-time compilation pipeline that allows cards written for the web platform to generate true native rendering and animation behaviors dynamically, without ever needing to deal with native SDKs and app store submissions. Our motto: "You write it good. We run it smooth."



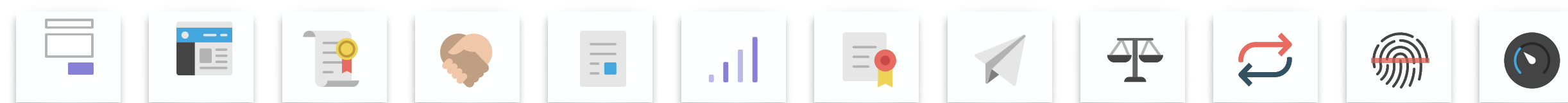
3.7

MIXING AND MATCHING CARDS AND CONTAINERS

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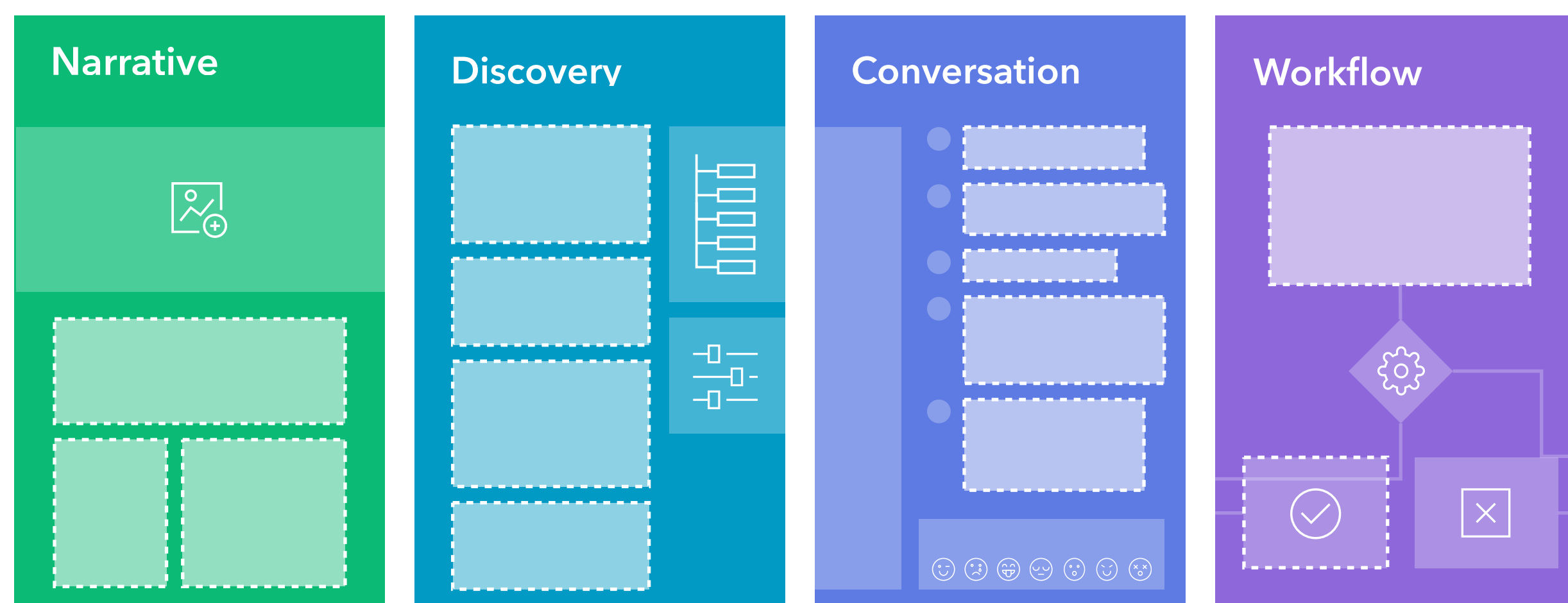
The value of the card ecosystem will increase exponentially, when the pre-built cards and containers of the catalog are combined by end users to organize decentralized networks without writing any new code.

OPEN-SOURCE CARD CATALOG



REUSABLE CONTAINER COMPONENTS FOR (D)APPS

The Cardstack team has already released a narrative container that matches features of a web content management system, as well as a discovery container that can form the basis of a personalized recommendation system. We are currently working on the conversation and workflow containers to facilitate distributed workflows between parties of varying levels of trust in a hybrid on/off-chain network.



Curated ←-----> Emergent

CHALLENGING THE INCUMBENT PLATFORMS

Most successful platforms in the cloud era initially did one thing well, and then expanded to copy competitors' features when those use cases gained traction with users. Facebook is the most famous example of a hyper-competitive, fast-following copier.

In an open ecosystem like the one Cardstack is building, every new network can reuse the tools in the shared card and container catalog, so that the duplication of effort is reduced at the macro level and the time to market is improved at the micro level.

Considering the entrenched network effects of the digital superpowers in their dominant position, the only way to unseat them is to fight back with even greater network effects. The decentralized challengers' sharing of code and design will be a defining advantage in this important fight.

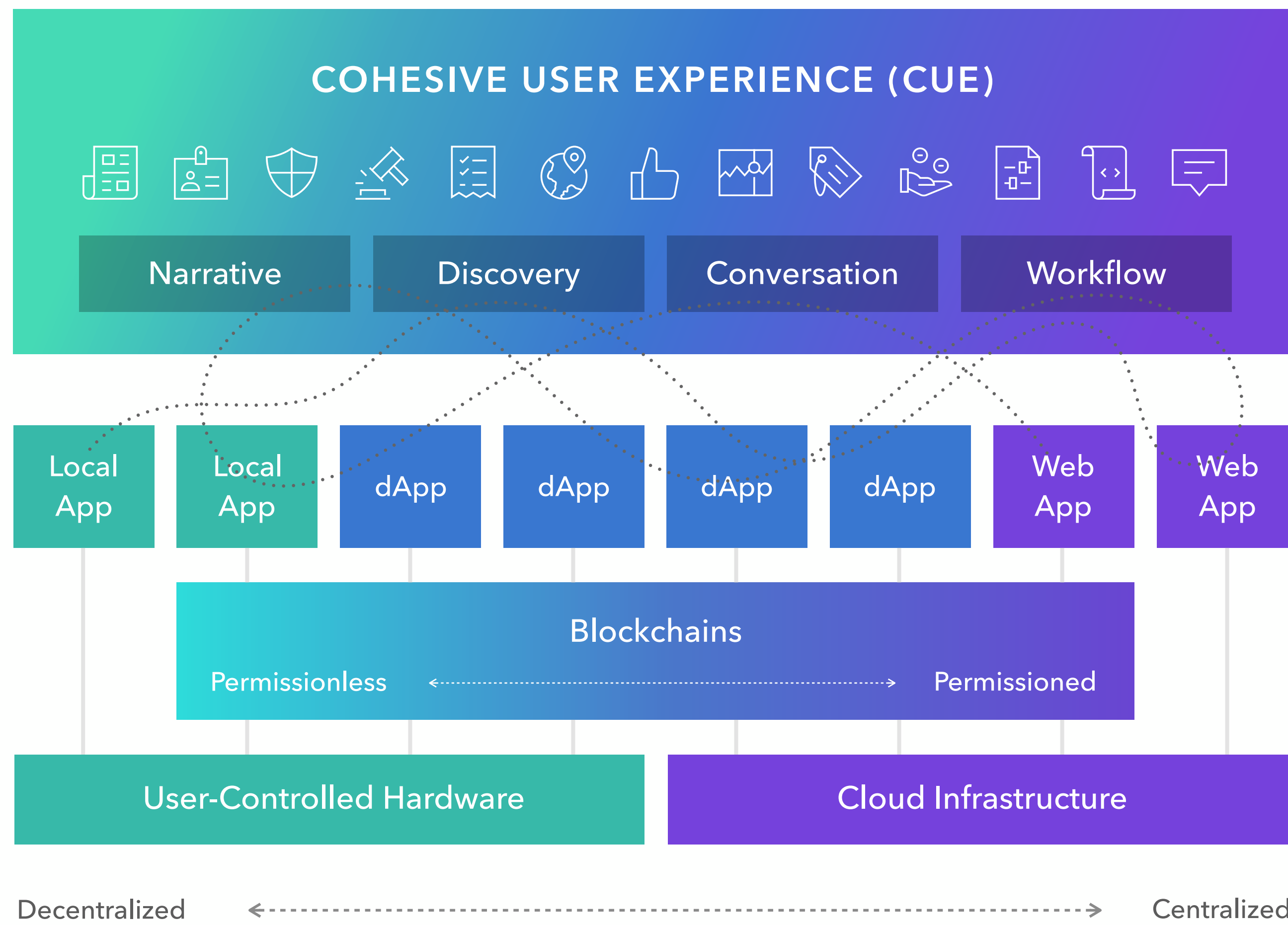
3.8

TOWARDS COHESIVE USER EXPERIENCES (CUE)

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In summary, with the foundation of Cardstack as the base, the decentralization movement will finally have the tools to deliver the promise of blockchains to people around the world via on-ramps of their choice.

CARDSTACK: THE EXPERIENCE LAYER OF THE DECENTRALIZED INTERNET



The Internet is due for a swing back in the direction of decentralization. The ingredients are there:

- The technology behind the open Web, JavaScript, and the browser runtime in particular, has closed the gap and blurred the boundaries with native apps.
- The growing collection of open-source software and libraries means that most of the features and functionalities offered by big cloud players can be easily replicated and improved upon with a few days of coding.
- The design community has caught up with and surpassed the design patterns and user experience approaches of the popular apps from Silicon Valley.

Cardstack — the application framework and the team behind it — is ready to organize this community, in order to build an alternative app market with Open Web technologies, guided by the open-source ethos and enabled by a one-in-a-generation breakthrough of blockchains.

4.1

TRADE-OFFS BETWEEN INTERNET BUSINESS MODELS

- 1 OVERVIEW
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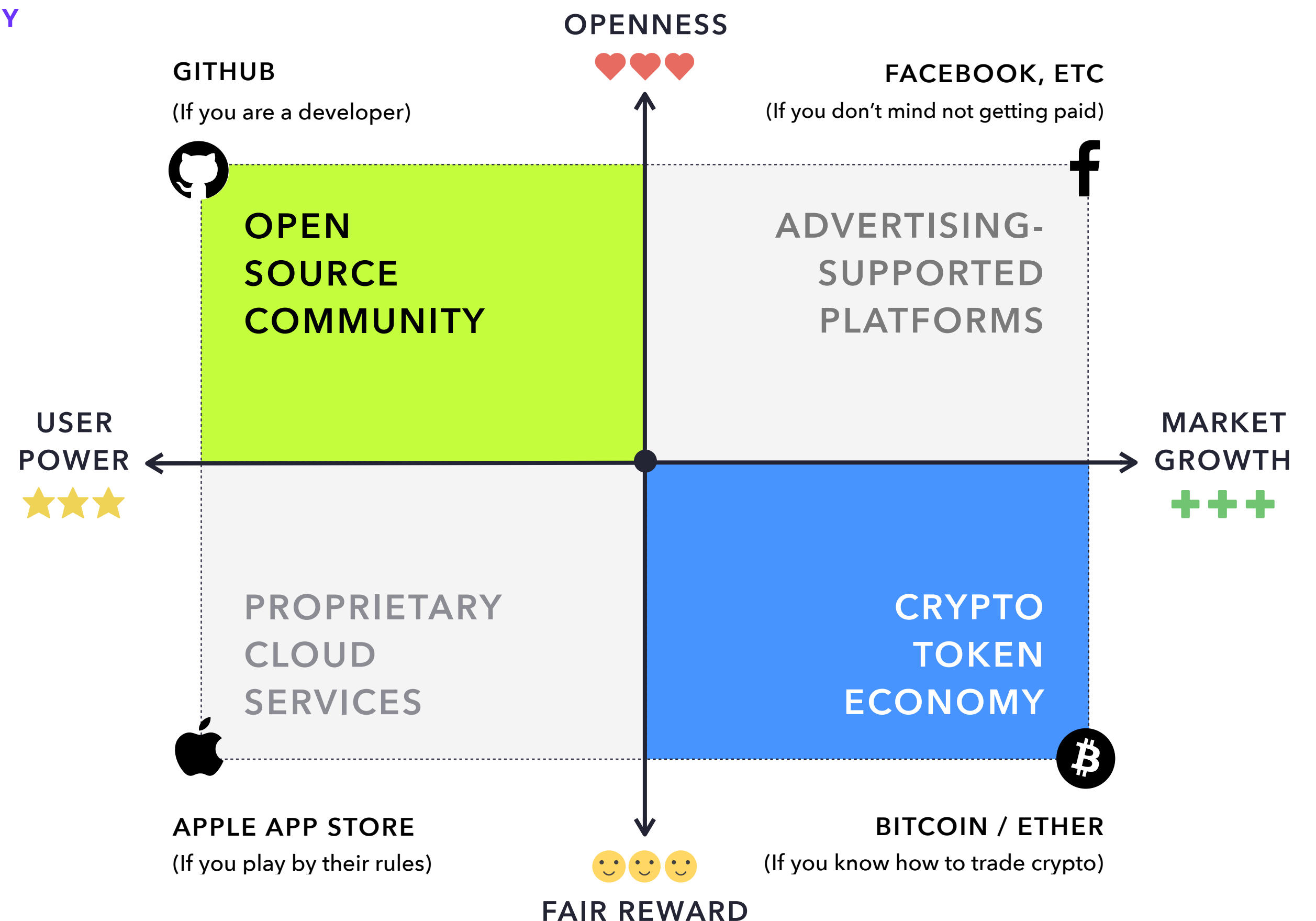
In the current software economy, the drive for openness often requires people to give up their fair share of rewards, while tools promising to return power to users keep losing out to centralized, growth-hacked platforms.

THE CORNERS OF THE NETWORK ECONOMY

While the Internet seems like one continuous space, most users actually live within corners, which are defined by the business model and incentive structure of the underlying platforms.

In the corner of ad-supported networks like **Facebook**, users are drawn into an algorithmic network of seemingly open sharing, fueled by viral growth and ad dollars wanting to be part of that market. In the opposite corner sits the tech industry patriarch, **Apple**, promising and delivering a perfectly synchronized experience, which gives customers who are willing to pay a premium great power and developers who play by Apple's rules a fair chance to earn money.

Out of view of the masses lie the other two corners brimming with new energy. If you are a developer, you can fork and modify any piece of open-source software on **GitHub** to create your own digital reality, not limited by arbitrary rules and policies set by others. But you'll probably be quite lonely in your personal realm. Yet, if you've paid attention to the ascendancy of **Bitcoin** and **Ether**, you've seen a certain strain of forkable code — cryptocurrencies — transcend into a faster growing global phenomenon than even Silicon Valley's largest "unicorns".



4.2

CONNECTING OPEN-SOURCE AND CRYPTO ECOSYSTEMS

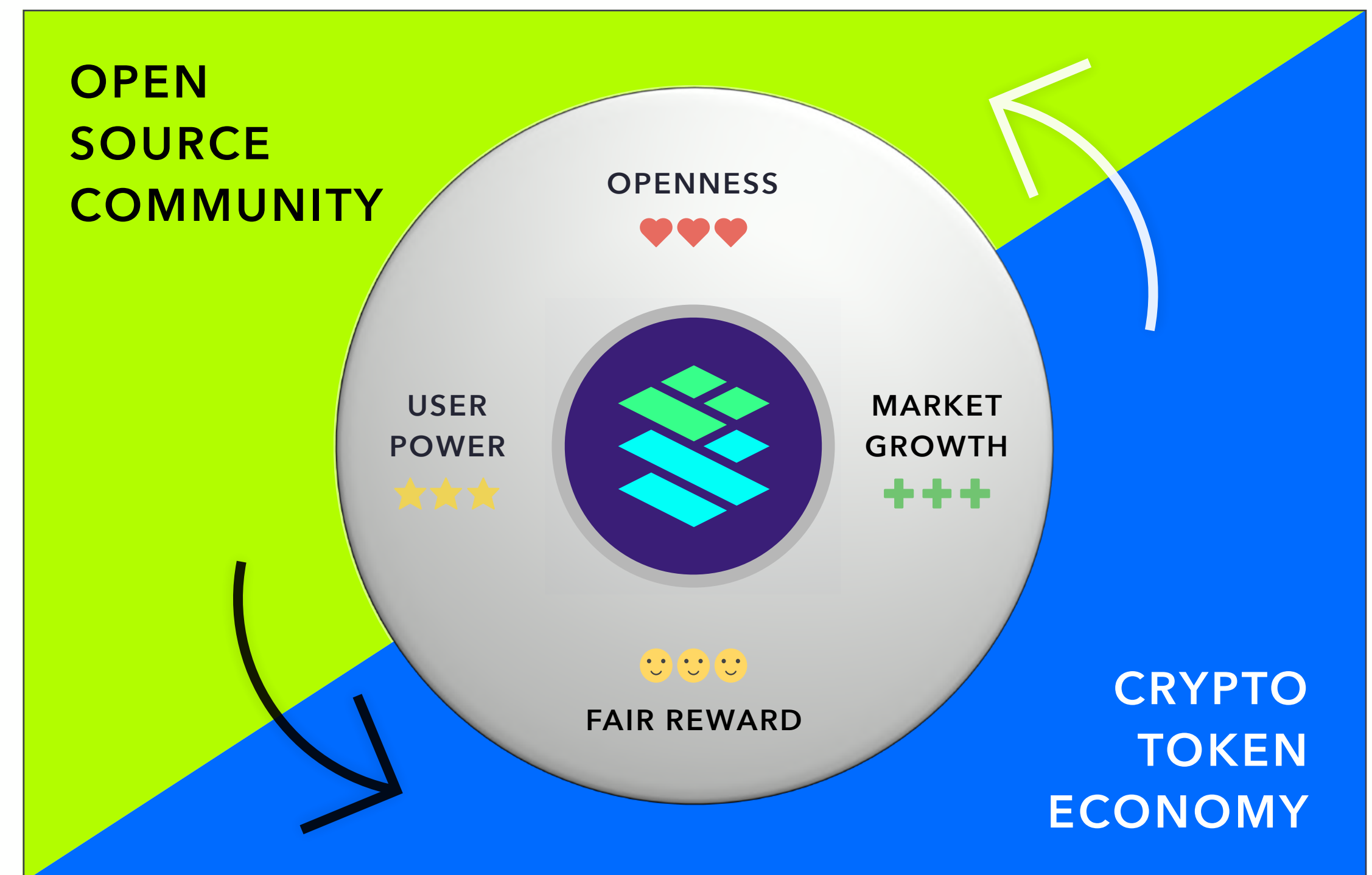
- 1 OVERVIEW
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The success of early cryptocurrencies shows that a network of economic participants, when given the right incentives, can fuel improvements of open-source software and protocols and spawn supporting ecosystems.

BUILDING UP SPEED WITH THE FLYWHEEL

The evolution of the software ecosystem behind Bitcoin and Ethereum shows that open-sourced software development can be fueled by a growing token-backed economy, where any person or organization is free to join and participate. As the overall network value grows — which is often measured by metrics like CoinMarketCap — there is an ever-growing incentive for new developers to build upon this codebase or architecture, and then deploy the new innovation as a piece connected to the existing network, instead of starting a new network from scratch in a lonely corner. Each “if you can’t beat them, join them”-decision made by an independent participant adds momentum to the “flywheel”, a term coined by Jim Collins in the book Good to Great. Decentralized organizations rely on a gradual build-up of speed when it comes to the flywheel effect, aiming to gain sustainable momentum, to compete with incumbents and challengers alike.

Looking beyond the specialized software for cryptocurrency mining and trading, is there a way for this flywheel effect at the fulcrum of open source and crypto to extend to other application areas — so that decentralized software, architecture, and protocols can start competing directly with the services offered by ad-supported platforms and proprietary cloud services? Deep network effects are the only way to fight entrenched networks. Open source and crypto have these effects.

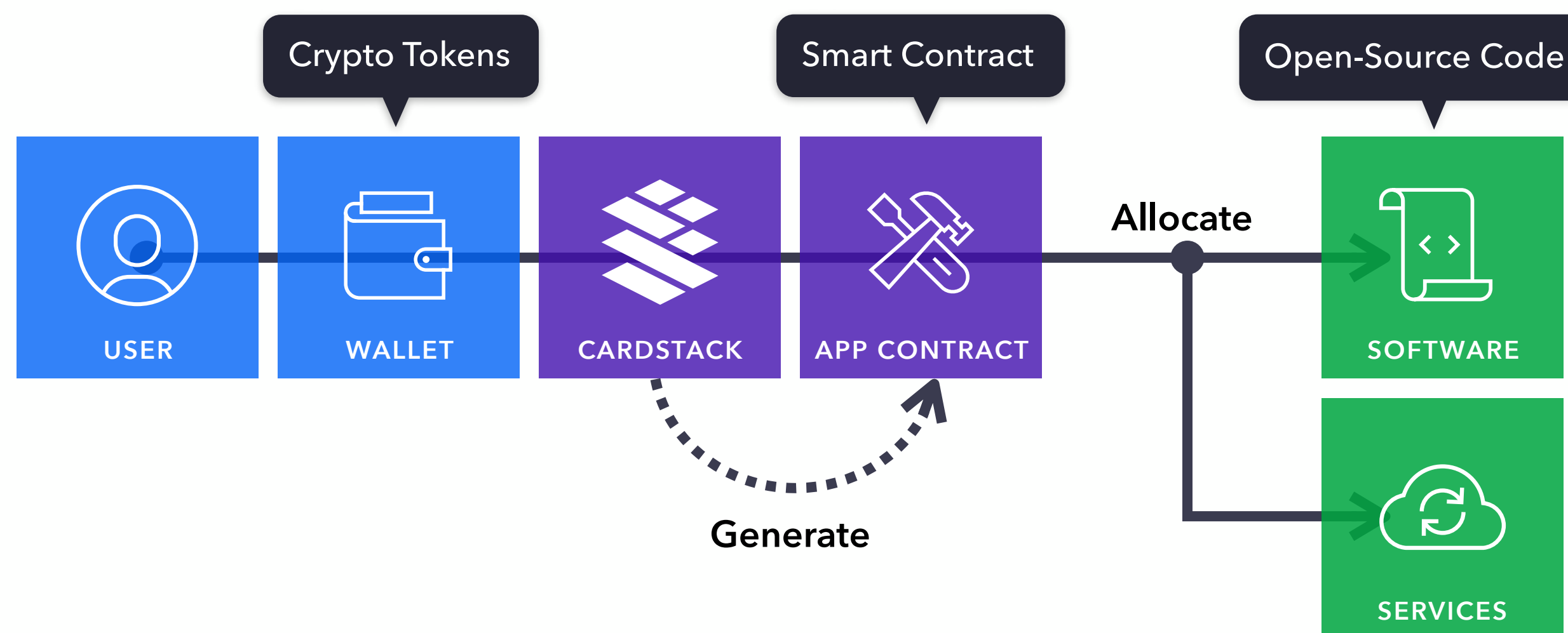


To connect open-source software with the crypto token economy, we have to solve two problems that have thus far prevented mainstream adoption of either. For open source, we need to acknowledge that the current philanthropic orientation, whether through corporate sponsorships or Patreon supporters, severely devalues the code upon which a firm builds its business. For crypto, we need to start obsessing about the humans behind the addresses — their needs, their journeys, and their experiences — as much as about the consensus algorithms. In this section, we delve into our proposal on how to fund open source while creating wealth for all who make the flywheel turn.

4.3 FUNDING SOFTWARE AND SERVICES WITH TOKENS

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Users spend tokens in their wallet to get access to an app. A smart contract, acting as the billing agent for the app, allocates a portion of these tokens to the creators of the open-sourced code or the provided services.



STARTING WITH REVENUE

When every user is a paying customer, the relationship between the user and the team behind the app changes for the better. With the introduction of a wallet containing various crypto tokens, the users can now pay for software and services directly through their wallet. And they know that the teams behind the scenes will like to keep this revenue flowing by providing new features, upgrades, attentive support, etc.

Cardstack's open-source framework and token mechanism help development teams tap into this new source of revenue; they generate the smart contracts needed for a new app, using simple configuration files checked in to the app's GitHub repository. These smart contracts can be deployed to a public blockchain — starting with the Ethereum network — and upgraded with new logic or updated terms to reflect the latest pricing tiers or bundles.

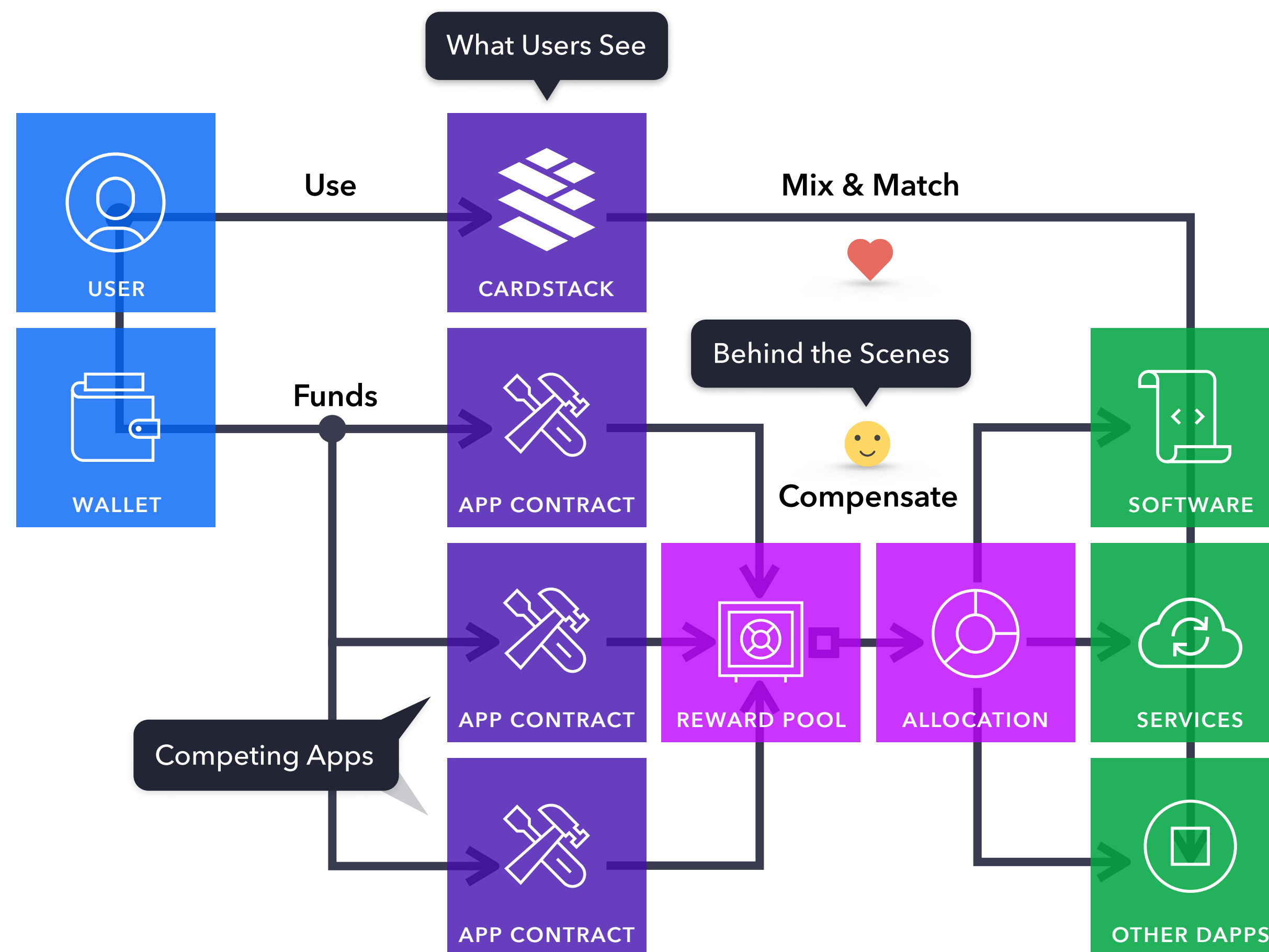
For a more in-depth explanation of how software and services can be billed for and settled via a set of blockchain-based smart contracts, we invite you to read Chapter 4: Sustainable Software of the Cardstack Vision Paper. It is published on the Cardstack website at <https://cardstack.com/vision/chapter-4>

4.4

ALLOCATION OF FUNDS ACROSS MULTIPLE (D)APPS

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Going beyond a single app, token-driven application contracts allow multiple (d)Apps to pool resources and let mutual customers mix and match features to fit their needs, while the reward function does its work.



USERS PAY FOR WHAT THEY USE

Inside the cohesive user experience provided by the Cardstack framework, users have access to all the cards they need to complete their workflows, without having to make separate billing arrangements for each app in the catalog. Behind the scenes, app contracts generated by the Cardstack framework connect with a network-wide **reward pool**. The pool analyzes the usage data, which is collected by each of the participating apps, to determine a fair allocation of tokens as compensation for the teams offering the software and services — the “makers and miners”.

Since any distribution of tokens on a public blockchain incurs transactional fees (known as “gas” in the Ethereum network), the reward pool is designed to accumulate tokens for a defined period of time and then disperse them to the makers and miners in an aggregated manner. For dApps requiring their own native tokens to function, the reward pool can initiate an external exchange, acting on the user’s behalf to acquire and deposit the needed tokens to fund the transactional activities. In essence, it is simply a piece of “software” providing a custodial token exchange “service”.

4.5

HIGH-LEVEL TOKEN LIFECYCLE

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In a nutshell, end users dedicate a portion of their tokens to form a retainer agreement with an app, which permits them to use that app and any of its dependent services. When the app is used and the service redeemed, the makers and miners are compensated with tokens.

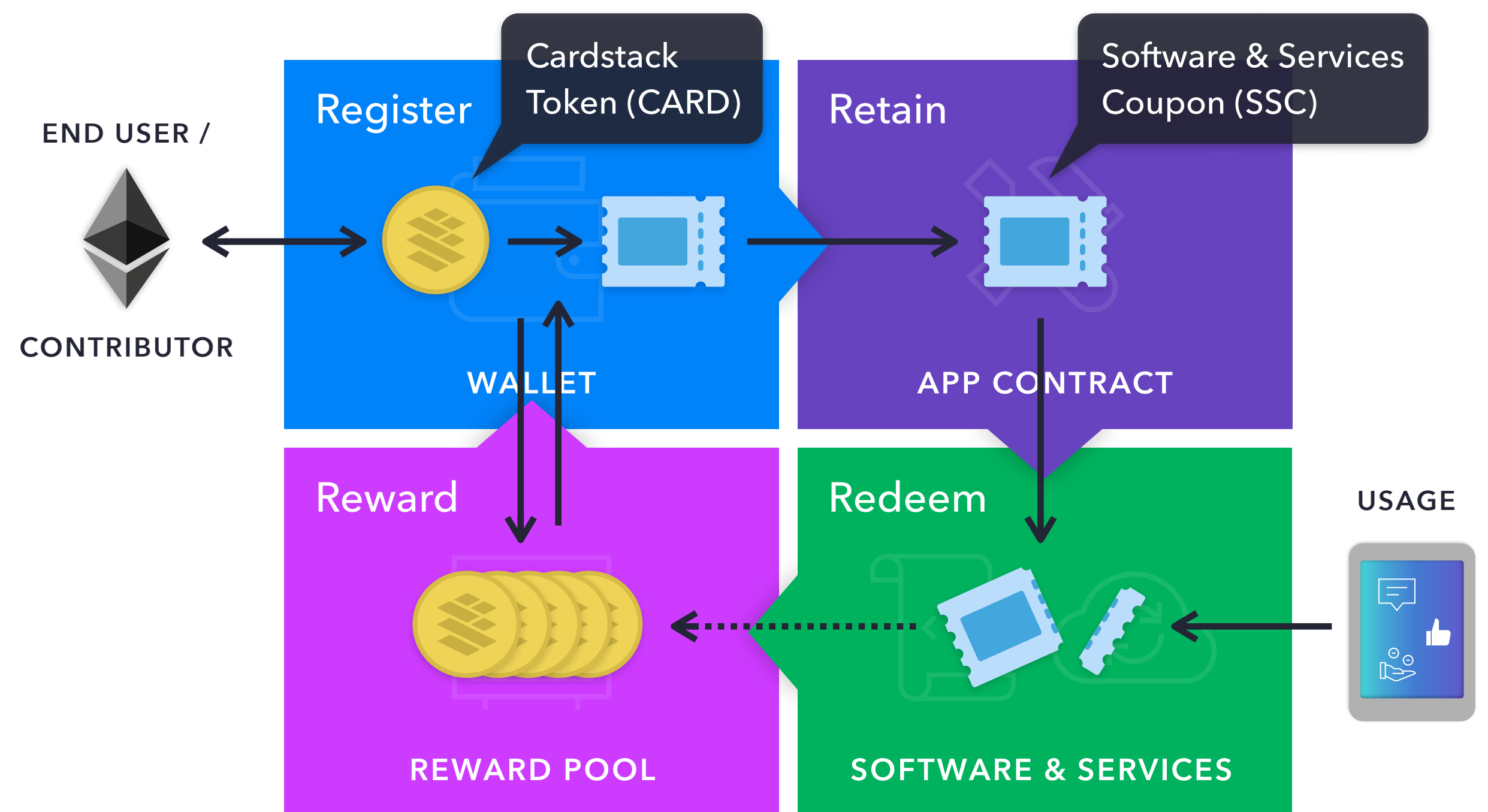
HOW IT WORKS

End users and contributors can **register** their interest in acquiring Cardstack Tokens (CARD) by depositing ether from their wallet during the Token Generating Event (TGE) or afterwards through peer-to-peer transactions.

As needed, CARD can be converted into Software & Services Coupons (SSC), which are in turn sent to an app contract to establish the **retainer** agreement. Converted CARD are locked in a reward pool until the next reward allocation cycle, which is triggered by a block-based timer.

When a user starts using the app(s), usage data on- and off-chain are collected and periodically reported to the app contract, as proof that this particular user has **redeemed** a portion of the balance of the retainer.

The history of redemption events, combined with other aggregated data sets and statistical analyses, helps the network-wide **reward pool** smart contract determine a fair attribution and allocation of rewards to makers and miners in the Cardstack ecosystem. These cover material costs as well as fees and royalties owed to the teams who helped deliver the cohesive user experience.

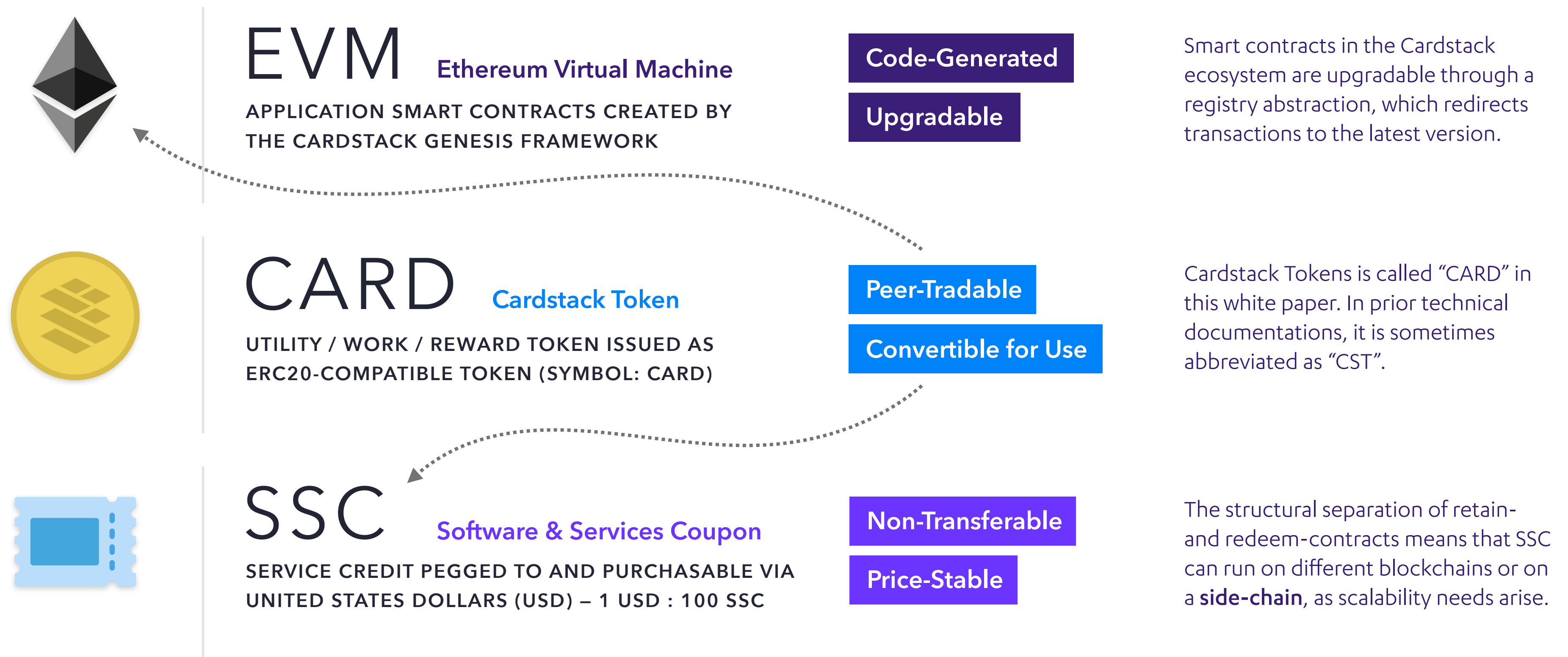


4.6

CARDSTACK TOKENS AND SMART CONTRACTS

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The initial implementation of the Cardstack token mechanism is written in Solidity and is currently on the Ethereum testnet. We will open source all 20+ smart contracts via GitHub and look forward to the community's feedback.

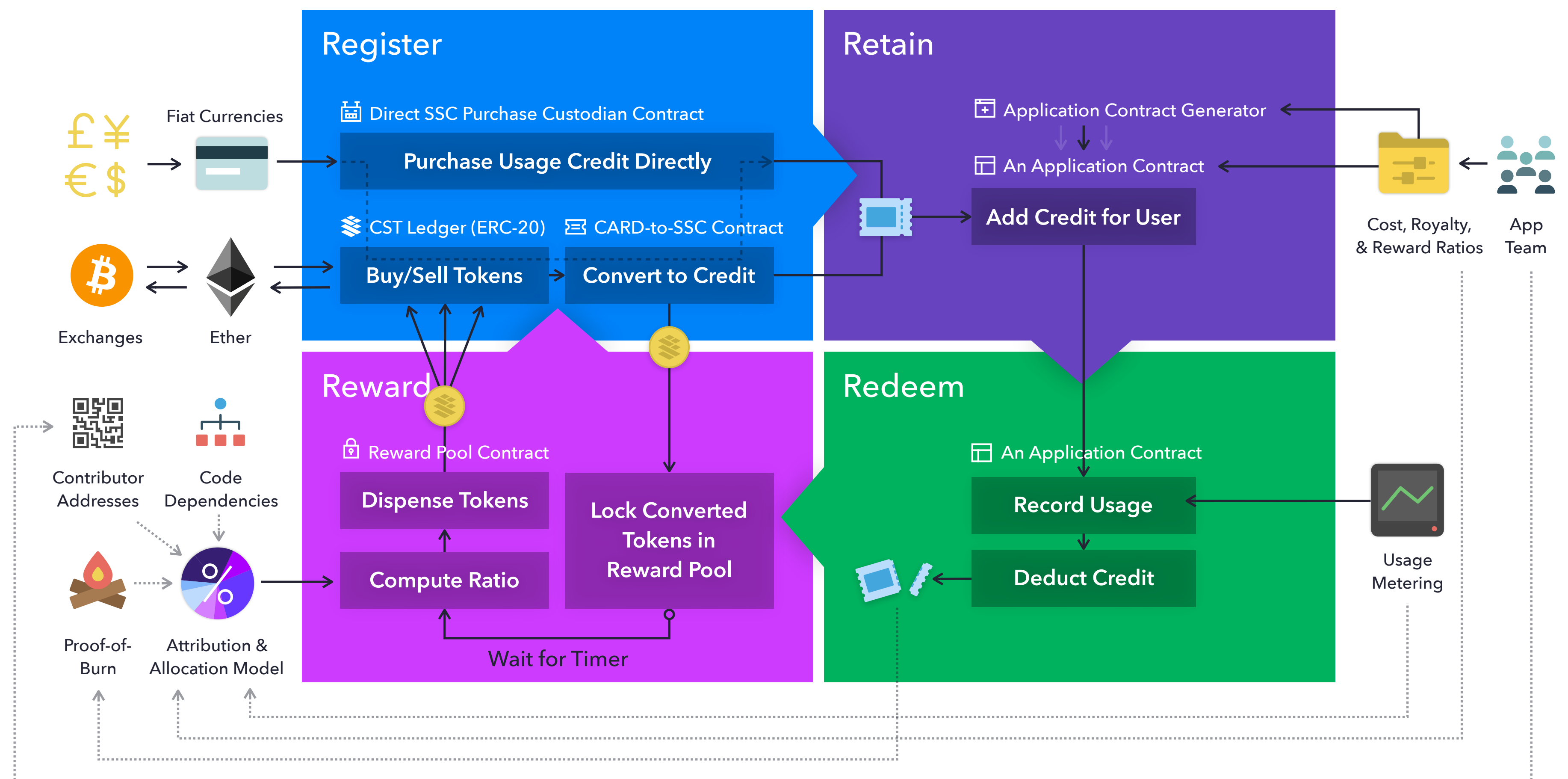


4.7

DETAILED TOKEN MECHANISMS FOR CARD AND SSC

For a more detailed description of the thinking behind this token design, please review the **Cardstack Token Mechanism Paper**.

With Cardstack Tokens, users purchase credits to use software in the ecosystem, while makers and miners are rewarded proportionally, based on usage data, etc.



CARDSTACK TOKENS (CARD)

CARD are the tradable tokens based on the ERC20 standard of the Ethereum network. When CARD are converted into SSC, they are locked in a reward pool and distributed to makers and miners based on a multi-variable model.

SOFTWARE & SERVICES COUPONS (SSC)

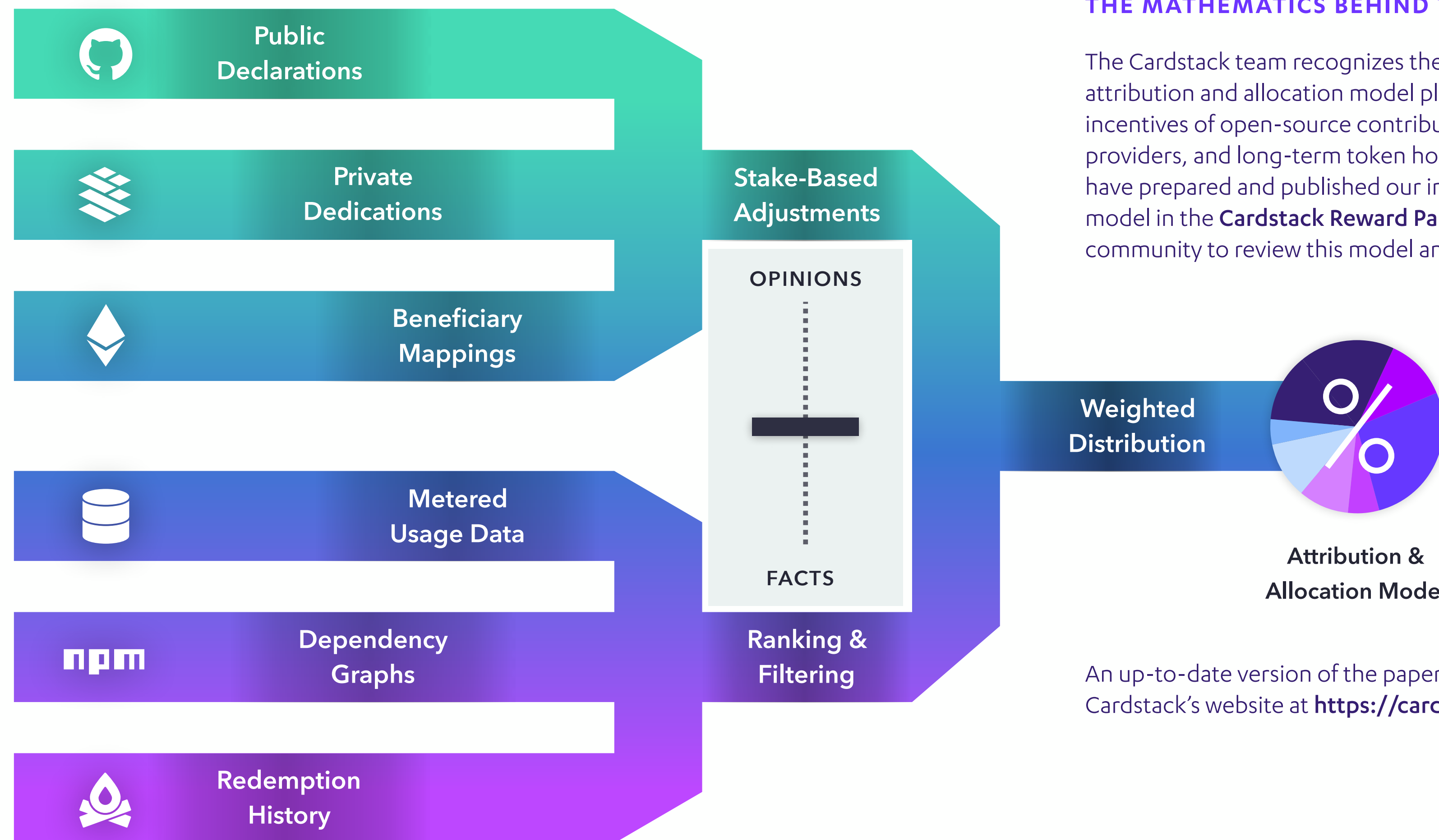
SSC are non-transferable entries in each of the application contracts. They act like store credit that can be redeemed by a user within a specific period of time (e.g. 1 year). As usage is metered, SSC are deducted and burned.

4.8

BALANCING FACTS AND OPINIONS

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The network-wide reward function consults the output of the proportional attribution and allocation model, which takes many factors, both on- and off-chain, into account to determine a fair distribution of rewards.



THE MATHEMATICS BEHIND THE MODEL

The Cardstack team recognizes the critical role this attribution and allocation model plays in aligning the incentives of open-source contributors, service providers, and long-term token holders. Therefore, we have prepared and published our initial mathematical model in the **Cardstack Reward Paper**. We invite the community to review this model and give us feedback.

An up-to-date version of the paper can be accessed via Cardstack's website at <https://cardstack.com/reward>.

4.9

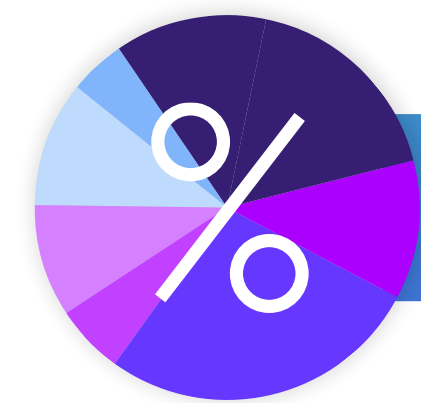
REWARDING MAKERS AND MINERS IN THE ECOSYSTEM

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The reward function works like a “wealth trickle”. Once a graph of makers’ and miners’ input is built in an analytic node, the model iterates through network branches until each path has been weighted locally and globally.

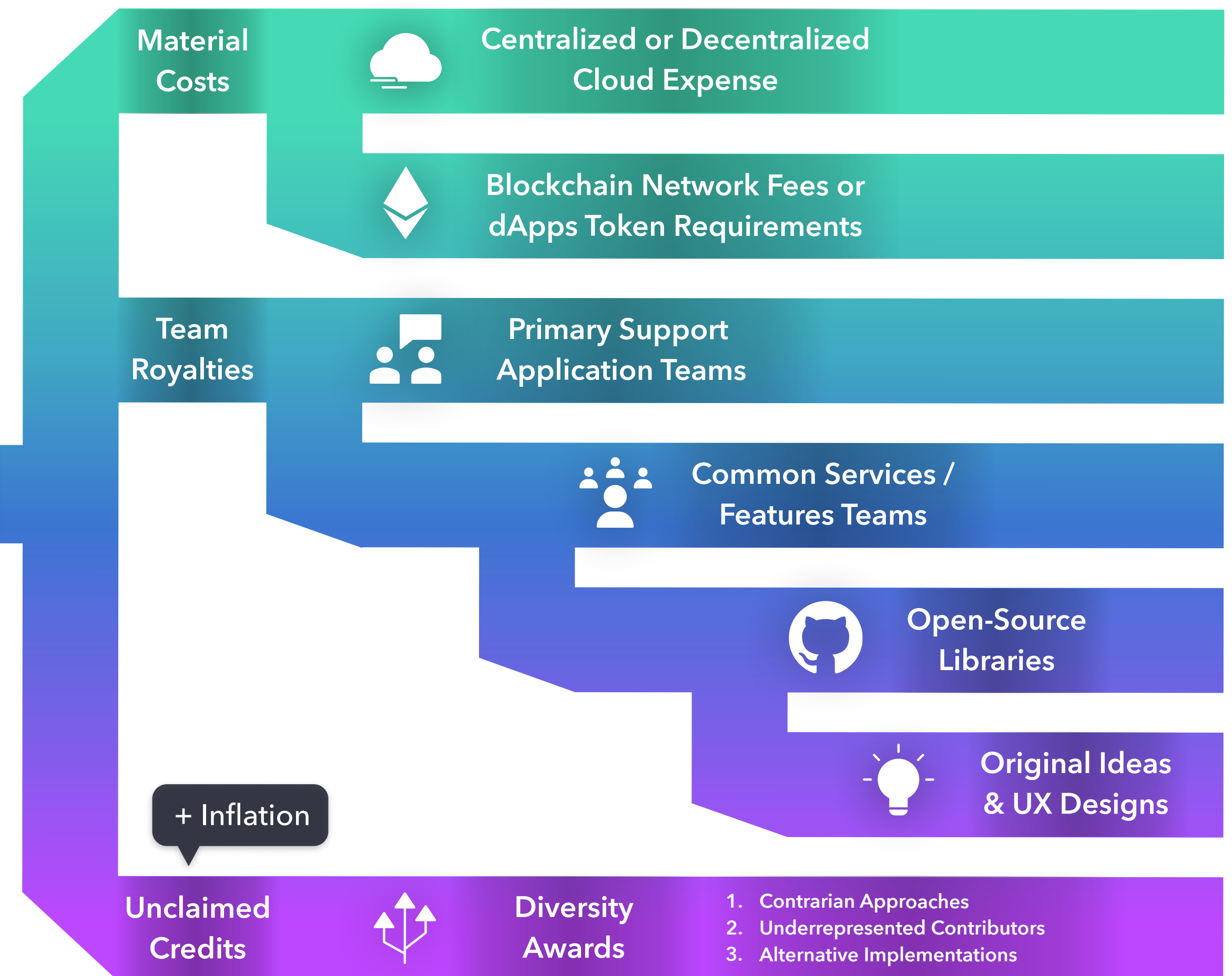
SPREADING WEALTH WHILE SAVING GAS

The attribution and allocation model is iterative and has an algorithmic similarity to Google PageRank. Those operations are done via an off-chain process as part of a scheme we call **Proof-of-Analytics** (See section 6.5). The outputs of these off-chain oracles are sampled by the reward contract. The dispersion of tokens is completed through a one-pass procedure within the smart contract.



Attribution & Allocation Model

Reward Function

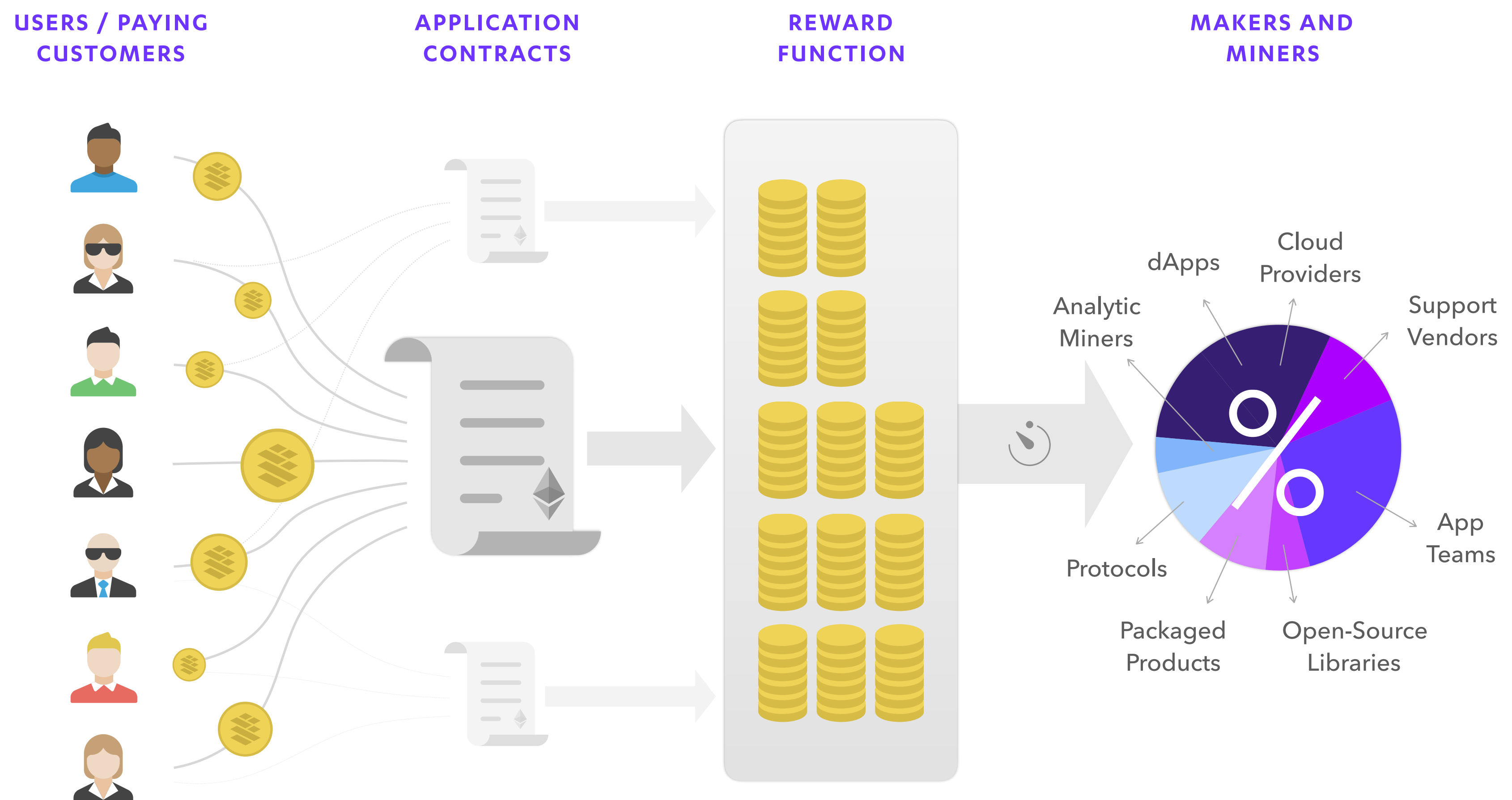


4.10

SUMMARY: BLUEPRINT FOR SUSTAINABLE SOFTWARE

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Cardstack is creating a sustainable software ecosystem, where a network of smart contracts coordinates the revenue coming in from paying customers and the rewards going out to makers and miners who have contributed to the software and services.



5.1

ABOUT THE CARDSTACK PROJECT

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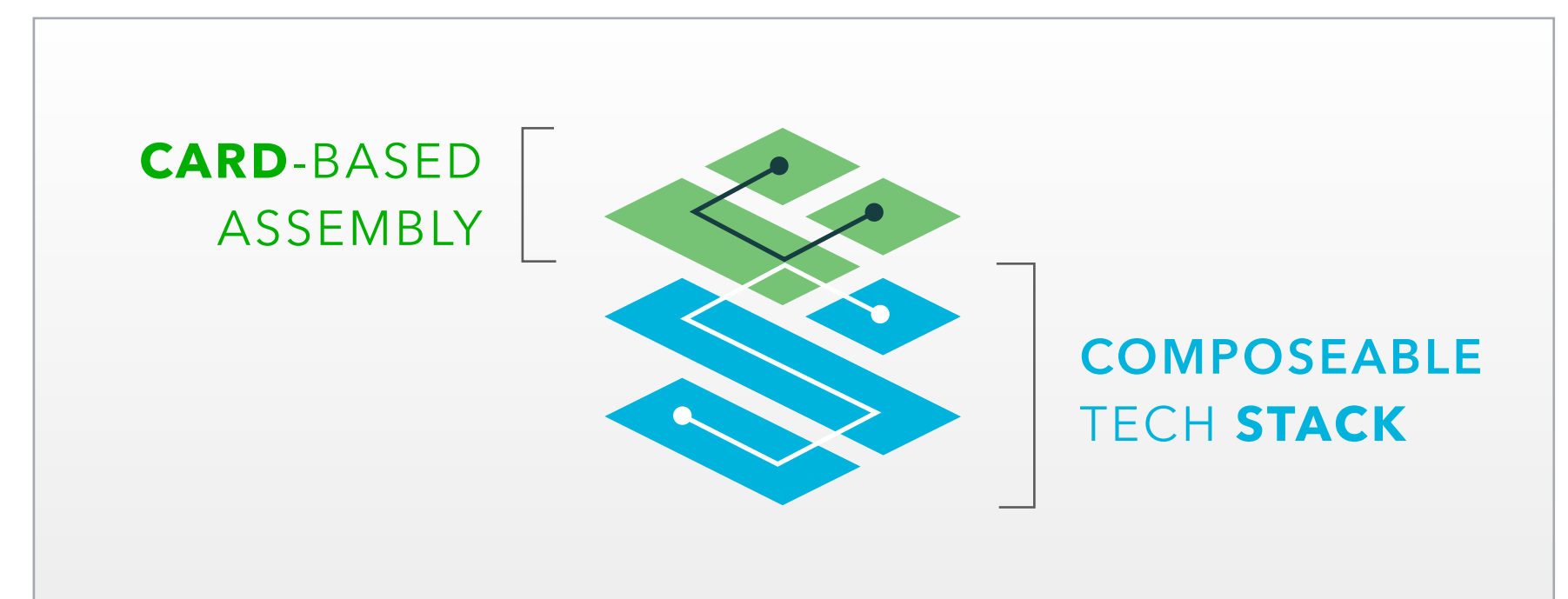
It all started with the idea of “composeability”, which was synthesized from the fields of design, technology, and social sciences. We have since translated it into an open-sourced platform, where the next million makers can work together to reshape our digital future.

STATEMENT FROM CHRIS TSE, FOUNDING DIRECTOR

I founded the Cardstack project in 2014, when I first noticed the increased level of lock-in imposed on users by the large apps and dominant networks that people rely on in everyday life. In my prior roles, leading research & development and digital product teams inside a Fortune 500 media company in New York, it became obvious to me that the power center had shifted to Silicon Valley. Our millions in R&D budgets can't compete with their billions. The cards are stacked. The fight has to be taken out into the open. I vowed to use the power of open-source software and collaboration tools, guided by the ethos of the open Web, to organize the creation of a decentralized alternative to the centralized clouds that are looming over our heads.

As a technologist by trade, a designer in practice, and an entrepreneur at heart, I knew that I had to recruit experts and makers from many subject areas to work together, in order to design and build something this ambitious and contrarian. So, I put a team together and got to work. I bootstrapped the development of open source with revenue-generating projects. These projects aligned with our overall goals and allowed us to iterate on the design, technical, and economic ideas that shaped the constitution of this new open, decentralized, and composeable stack.

Time passed and Cardstack grew along with our partners, clients, investors, and the open-source communities that we supported and that supported us. We were fortunate to be introduced to the blockchain pioneers, which gave us the chance to get “on-chain” early and sharpen our understanding of what blockchains do well. I am proud of how our team made this work, getting real users to use our tools daily and give us feedback, while we sketched our project and determined how the whole stack should come together.



Make no mistake: Decentralization of the software ecosystem means revisiting many of the basic assumptions about the way in which the software that runs the world is architected, designed, developed, secured, distributed, deployed, orchestrated, bundled, unbundled, priced, analyzed, monetized, financed, adopted, supported, upgraded, decommissioned, and preserved. Any substantial change to one of the aforementioned factors could shake up the market and lead to a rise or fall of fortunes and power dynamics.

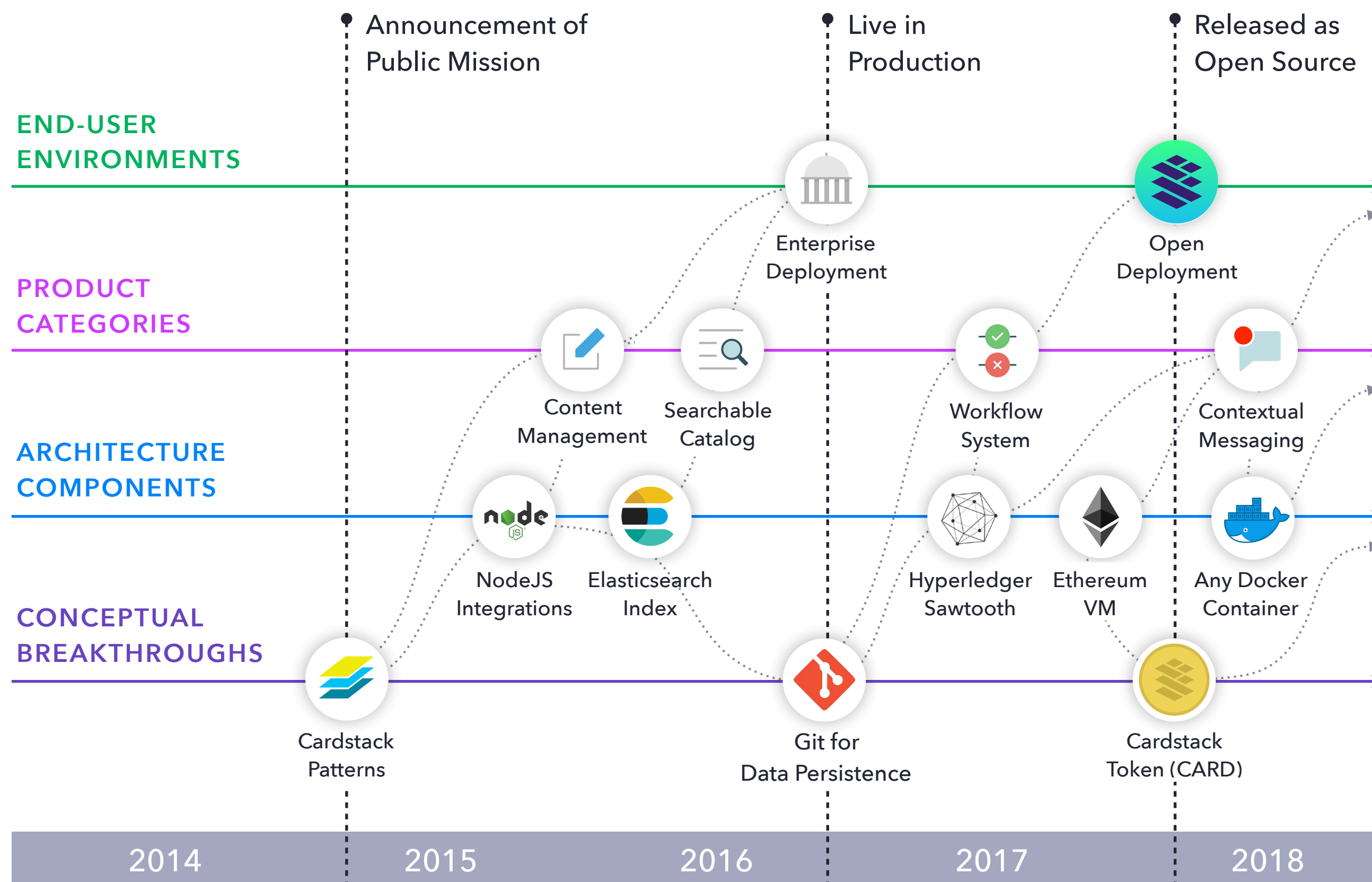
Cardstack's approach for layering a composeable user experience and data orchestration hub on top of both the centralized and the decentralized infrastructures allows this shift to happen progressively but assuredly. You can build an ambitious, networked ecosystem with our card-based assembly and composeable tech stack today. When the underpinning of the decentralized Internet is ready for prime time, just flip the switch inside Cardstack, and your network will be fully updated for the world of tomorrow.

5.2

PROJECT HISTORY & KEY MILESTONES

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The core architecture and components of Cardstack have been under continuous development for 3+ years. They have been deployed in production in both enterprise and open network environments.



FRAMEWORK EXTRACTED FROM REAL-WORLD USE

After we announced the public mission of Cardstack — to build an open ecosystem with a card-based architecture and design system — we knew that a vision as expansive as ours would need continuous validation against real-world use cases to stay on track. This is why we narrowed our focus to a subset of the problem, which led to the creation of a content-centric, search-first, and plug-in-based application framework that looks and feels like a next-generation CMS (content management system), but is actually a whole lot more.

This core orchestration architecture was then extracted and refactored in late 2016 to add support for a Git-style branching and merging of a mix of data, content, and code. This distributed versioning approach allows the framework to quickly plug in to various blockchains, private or public, as a means to synchronize state across a set of participating peers.

5.3

USE CASES IN DEVELOPMENT

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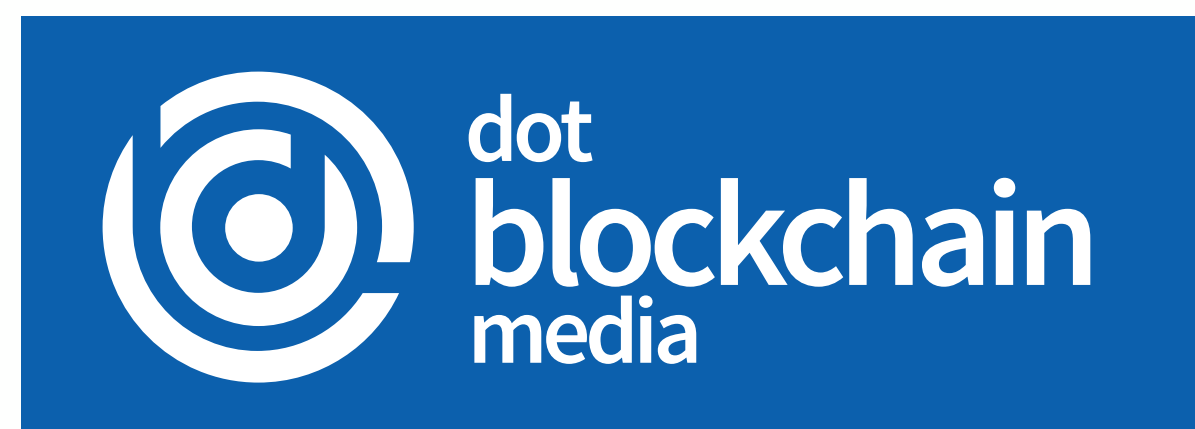
Leveraging our open-source framework, the Cardstack team collaborates with ambitious projects to deliver the promise of decentralized ecosystems to communities around the world: in media, art, publishing, and more.



card.space

DECENTRALIZED CONTENT AUTHORIZING & WORKFLOWS

We need a better way to disseminate knowledge and insights than following the algorithmic whims of Facebook and Google. Independent journalism and publishing upstarts need networked content management tools that give them room to experiment with new syndication, monetization, and amplification topologies. Cardstack is building the engine for a multi-publisher content network that can become the blockchain age's WordPress, Associated Press, membership card press — all in one.



dotblockchainmedia.com

DECENTRALIZED MUSIC METADATA REGISTRY

The music industry is growing again, thanks to streaming services like Spotify and Apple Music. Yet, musicians, especially songwriters and composers, are getting less money through their royalty checks than ever before. The problem in the music industry — which also occurs in other industries, like TV, film, and publishing — is that nobody knows who actually owns what. Cardstack is working with Dot Blockchain Media Inc. to create a decentralized network, which tracks and versions song metadata on a blockchain, built on Intel's Hyperledger Sawtooth, while connecting to the enterprise systems that run the music business via plug-ins through the Cardstack Hub architecture.



monegraph.com

DECENTRALIZED DIGITAL-ART TRADING SYSTEM

Monegraph Inc., a New York-based art/tech startup, pioneered the use of the Bitcoin blockchain to register and track provenance of digital art. Cardstack is working to port the current Bitcoin-based OP_RETURN scheme to an Ethereum-based smart-contract approach, so that exclusive or limited-edition artwork in the existing Monegraph catalog can be bought, sold, or traded as ERC20 on the next generation of decentralizing trading protocols. Artists: Get ready to tokenize your work.

5.4

CARDSTACK FOUNDATION

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The Cardstack Foundation exists to conceptualize and realize the software-driven ecosystem that offers users a cohesive user experience while rewarding makers and miners through a fair allocation of value created.



ABOUT THE CARDSTACK FOUNDATION

The Cardstack Foundation is a non-profit foundation based in the Canton of Zug, Switzerland. Its goal is to promote and develop the Cardstack software, architecture, protocols, and applications. The Foundation can support and finance research and development activities that promote the Cardstack software, architecture, and protocols. It will be responsible for the planned fundraiser and ensure that the funds raised are budgeted and allocated to fulfill its founding charter.

The Foundation is overseen by the Foundation Council, consisting of three members at the time of publication: Chris Tse, who acts as the president, Justin Thong, and Guido Schmitz-Krummacher. The Foundation Council is expected to expand as the ecosystem grows, to ensure that the composition of the council reflects the diverse perspectives of the community.

FOUNDATION CHARTER

1. Act as steward for the continual development and improvement of the Cardstack software, architecture, and protocols
2. Encourage the publishing of open-source code, data formats, and documentation within the Cardstack ecosystem
3. Facilitate a well-functioning market that encourages adoption and usage of the Cardstack software, architecture, and protocols
4. Develop and refine economic and statistical models, which guarantee a fair allocation of rewards to the participants of the Cardstack ecosystem
5. Educate the world on the value of the Cardstack approach through advocacy, training, events, and all other means of communication
6. Fund pioneering research initiatives that can unlock the potential of the ecosystem
7. Support the Foundation's continuous operation through direct or indirect contributions from users
8. Design and implement cryptography-based trust models that reward good-faith actors and resist attacks from bad actors
9. Foster an inclusive, welcoming community of contributors who believe in tolerance, respect, inclusion, and hard work
10. Delegate the responsibilities to carry out the functions of the Foundation through the selection of competent agents around the world

5.5

CARDSTACK SYNDICATE

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Since 2014, the Cardstack Syndicate has shepherded the growth of the ecosystem. It will work with the Foundation to expand the core development framework as well as the end user experiences.



ABOUT THE CARDSTACK SYNDICATE

The Cardstack Syndicate is a New York-based product design studio that was founded in 2014 by Chris Tse to build the underlying framework and align with real-world use cases, so as to realize the Cardstack vision in an incremental manner. Through the Syndicate, the Cardstack ecosystem has coordinated over USD 3 million worth of research and development efforts, which have resulted in the open-source codebase as well as partner projects that have gone live into production.

After the fundraiser, the Cardstack Syndicate will engage the community to find areas of shared interest, in order to continue expanding the development, design, and product management expertise across the spectrum of use cases. Our goal is to develop a feature-rich, out-of-the-box experience for Cardstack, so that developers from both the cloud and the blockchain world will gain leverage and greatly accelerate the timeline of their projects, if they choose to build on the Cardstack ecosystem.

FUNCTIONS OF THE SYNDICATE

The members of the Cardstack Syndicate serve as leaders of the open-source software stack, design systems, and product architecture.

Software Development: The Syndicate coordinates the open-source development work via GitHub. It will work with both paid and volunteering open-source contributors to increase the breadth and depth of the Cardstack software, architecture, and protocols in a collaborative manner.

Crypto-Economic Design: The Syndicate will research and propose enhancements to the token mechanisms and the reward allocation model, based on empirical analysis as well as sound economic principles. Research will be published with academic rigor and be available for peer review.

Interaction Pattern Library: The user experience team of the Syndicate will create, refine, and catalog a reusable library of interaction and orchestration patterns for building cohesive user experiences that span the blockchain and cloud infrastructures. The patterns will be available as open-source code, to ensure ease of integration for developers and designers who have experience with traditional web development.

Training and Events: The Syndicate will work with local organizers to plan training workshops and educational conferences. It will promote the Cardstack vision and tools to teams around the world.

Media Creation and Advocacy: The Syndicate will continue to produce a wealth of materials, ranging from videos to articles, documentation, marketing collateral, etc. The goal is to help people understand the offerings in the Cardstack ecosystem and encourage participation from makers and miners, end users, and customers.

5.6

CARDSTACK CONTRIBUTORS (1/3)

- 1 OVERVIEW
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- 5 ORGANIZATION
- 6 FUNDRAISER
- 7 RESOURCES



CHRIS TSE

- Founder & Head of Product, Cardstack Project
- Co-Founder, Monegraph & Dot Blockchain Media
- Previously: Head of R&D, McGraw-Hill E-Labs; Sr. Dir. of Innovation, BusinessWeek
- BSc in Computer Science, Columbia University



ED FAULKNER

- Lead Developer, Cardstack Project
- Core Team Member, Ember
- Creator of Liquid Fire
- Previously: MIT Media Lab; Akamai
- MSc in Computer Science, MIT



HASSAN ABDEL-RAHMAN

- Sr. Blockchain Developer, Cardstack Project & Monegraph
- Previously: McGraw-Hill Education; Sun Microsystems
- BSc in Mathematics and Computer Science, Colorado School of Mines



JUSTIN THONG

- Data Scientist, Cardstack Project
- Author of the paper titled “Proportional Attribution and Allocation Model”
- MMath in Mathematics (First Class Honors), University of St. Andrews



KEN ROSSI

- Lead UX, Cardstack Project
- Previously: Creative Director, USTA/US Open
- BA, John Jay College, City University of New York



CHRIS GARDELLA

- Lead Designer, Cardstack Project, Monegraph & Dot Blockchain Music
- Previously: Huge; R/GA; Area 17; Apple
- BA in Graphic Design, University of Michigan

5.6

CARDSTACK CONTRIBUTORS (2/3)

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- 7 RESOURCES



WILFRED CHAN

- Managing Editor, Cardstack Project
- Formerly: Social Editor, Gizmodo Media Group; Writer / Producer, CNN
- B.A. in Political Science, Columbia University
- Freelance Writer / Editor



WILL BAGBY

- Sr. Developer, Cardstack Project & Monegraph
- Previously: Bloomberg L.P.
- BSc in Computer Science, City University of New York



ISLA BELL MURRAY

- Interaction Designer & Producer, Cardstack Project
- Previously: Bustle; The Bold Italic; Findery
- BSc in Psychology, University of Edinburgh



VENKAT DINAVAHI

- Contributing Developer, Cardstack Project
- Previously: Coderly; WhoWentOut
- MSc in Management Science & Engineering, Stanford University; BSc in Computer Engineering, University of Maryland



ALEX SPELLER

- Contributing Developer, Cardstack Project
- Previously: Nature Publishing Group
- BSc in Artificial Intelligence & Computer Science, University of Birmingham



MAXIMILLIAN KIRCHOFF

- Interaction Designer & Producer, Cardstack Project
- Previously: Lifon, ADP; Google; The Bold Italic

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CARDSTACK CONTRIBUTORS (3/3)

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- 7 RESOURCES



BALINT ERDI

- Contributing Developer, Cardstack Project
- Author of Rock and Roll with Ember
- MSc in Information Technology, Budapest University of Technology and Economics



JACQUELINE THONG

- Head of Operations, Cardstack Project
- Previously: Vestadia International; Advisoray
- BA in Sustainable Development & Economics, Columbia University



KATRIN NUSSHOLD

- Editor, Cardstack Project
- Previously: Pluto Vermögensverwaltung GmbH
- MA in English, University College London; BA in English & Comparative Literature, Columbia University



STEVE BOBROV

- Sr. QA Engineer, Cardstack Project
- Previously: BusinessWeek; Bear Stearns; Citigroup
- BA in Computer Science & Psychology, Stony Brook University



ANNE WRIGHT

- Event Producer, Cardstack Live
- Previously: Women in the World Media / Tina Brown Live Media; NBA Entertainment
- BA in Ancient History, Middlebury College



AARON SIKES

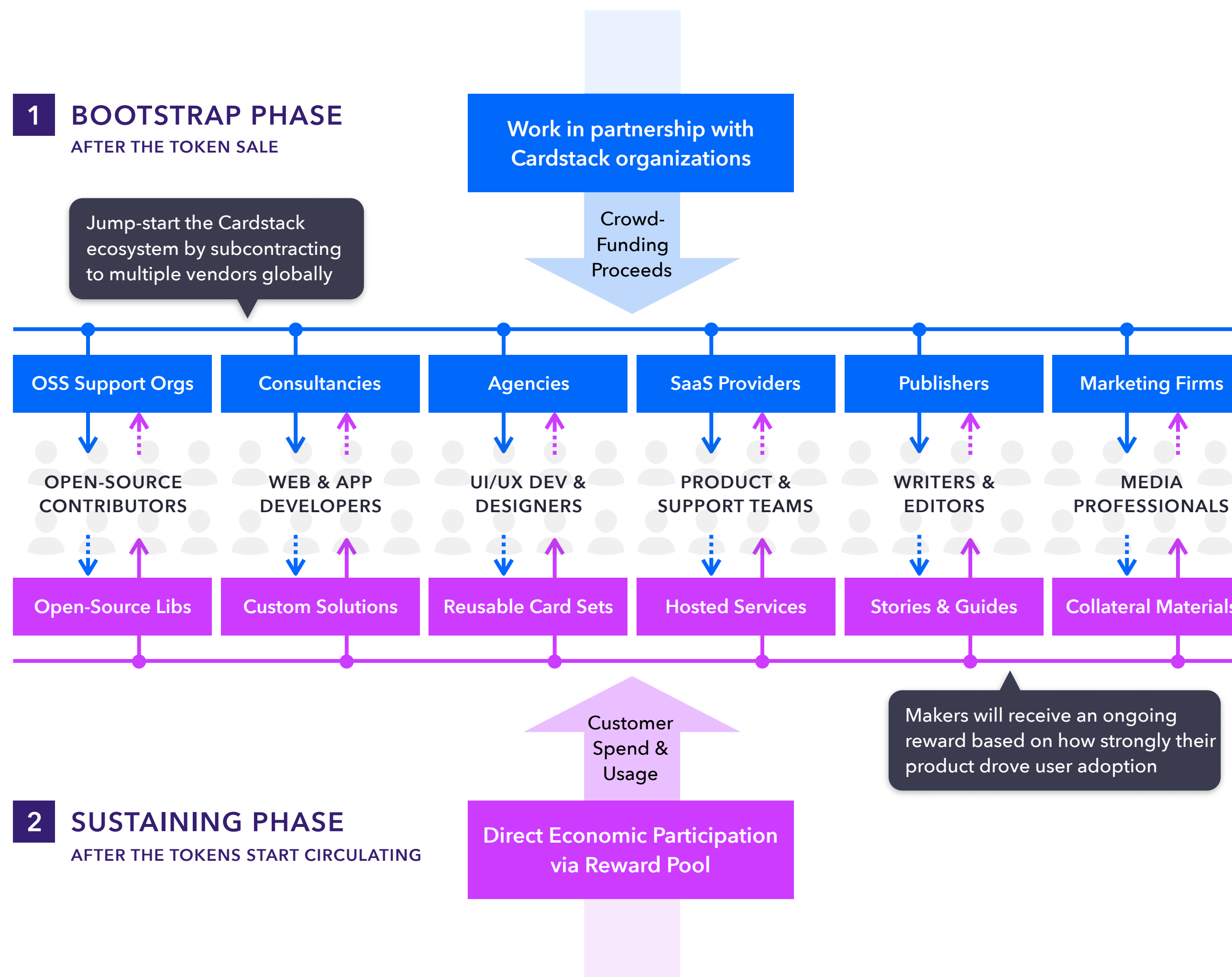
- Sr. Developer, Cardstack Project
- Previously: Dockyard; MOTU; Hubspot; HedgeServ

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ORGANIZING THE MAKERS

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A growing ecosystem needs input provided by makers from many disciplines to work in synchrony. Early cooperation, coordinated by Cardstack organizers, will make way for healthy competition down the line.



GETTING A RUNNING START

Since our team works at the interesting intersection of the blockchain and the cloud, we have met many talented makers who are intrigued by the promise of decentralization, but do not know where to start their journey. They are developers, designers, product managers, writers, storytellers, videographers, data scientists, and digital strategists. For many of them, there is no clear path from their current positions within the firms that employ them to the blockchain. We see this as a great opportunity for Cardstack to become the on-ramp to the blockchain world for these makers. We want them to join the Cardstack movement and offer their expertise, energy, idealism, and practical knowledge to move the project forward. We will recruit, hire, subcontract, partner, educate, promote, and collaborate in any way we can to channel the work of these makers into the base of the ecosystem that, in turn, rewards them through a virtuous cycle.

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REGULATORY COMPLIANCE

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At Cardstack, we have worked closely with top legal and tax advisors in the blockchain space, in order to design our token mechanisms and structure our fundraiser in compliance with regulations in Switzerland and the United States.



MME LEGAL | TAX | COMPLIANCE

MME is the advisor for the Switzerland-based Cardstack Foundation and is helping the Foundation to structure and conduct the Token Generating Event (TGE) for the Cardstack ecosystem. MME will continue to advise the Foundation on legal, tax, and compliance matters going forward.



MCDERMOTT WILL & EMERY

McDermott Will & Emery is the legal counsel for the US-based Cardstack Syndicate Inc. They will advise the organization during and after the Token Generating Event in regards to its operations, business arrangements, and regulatory compliance.



BITCOIN SUISSE AG

Bitcoin Suisse is the pre-allocation partner for Cardstack Foundation and will conduct the Know-Your-Customer (KYC) and Anti-Money-Laundering (AML) due diligence for early contributors ahead of the crowd-fundraiser.



DEBEVOISE & PLIMPTON LLP

Debevoise & Plimpton has analyzed the Cardstack Token Mechanism for compliance with US regulations around Securities Law, FinCEN regulations, and other applicable laws.

6.1

FUNDRAISING SCHEDULE

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The Switzerland-based Cardstack Foundation will initiate a fundraiser, followed by a series of airdropped awards, so as to distribute tokens to interested participants of the Cardstack ecosystem.



TOKEN DISTRIBUTION

The Foundation will distribute **40%** of the total of Cardstack Tokens (CARD) that will be generated at the Token Generating Event (TGE) to the public. These tokens will be distributed through a series of batches to ensure a fair allocation to our community of contributors, while maintaining compliance to applicable laws and regulations.

Early Contributors (Batch A): The first batch of tokens will be distributed to teams and individuals who have been active in the Cardstack community and have plans to continue to support and grow the ecosystem. This process is conducted manually and is subjected to **KYC/AML** (Know-Your-Customer / Anti-Money-Laundering) rules during on-boarding processes. Contributors in this batch will be offered a bonus of 20%.

Pre-Allocation (Batch B): The second batch of tokens is available on a first-come-first-serve basis to members of the Cardstack community who wish to obtain an allocation of up to \$50,000 USD equivalent of CARD and receive a 10% bonus. Interested parties will need to complete an on-boarding process operated by our pre-allocation partner, Bitcoin Suisse, prior to the start of the pre-allocation period. Approved participants will be able to contribute Ether or another cryptocurrency or fiat currency supported by the Bitcoin Suisse platform. For further details, please visit www.bitcoinsuisse.ch.

COMMUNITY BUILDING

To encourage the adoption of Cardstack software, architecture, and protocols, the Foundation aims to distribute the remaining tokens to the broadest network of participants possible.

Crowd Fundraiser (Batch C): The next batch of the tokens will be distributed directly through an open registration process on cardstack.com, where contributors who fulfill the KYC/AML requirements can contribute from a whitelisted Ethereum address up to an individual cap. For the first 6 hours of the crowd fundraiser period, the cap will be set at a relatively low number, ensuring that all approved contributors will have enough tokens to redeem Cardstack-based software and services.

To show our appreciation for those community members who have joined our community in its early days, contributors with validated email addresses showing early participation will be granted a higher cap during these first 6 hours. See Section 6.3 for more details.

After these first 6 hours, all contribution caps will be raised.

Airdrop Awards (Batch D): Following the TGE, the Foundation will announce and conduct a series of airdrops that will further distribute tokens to potential, interested, and active participants of the Cardstack ecosystem.

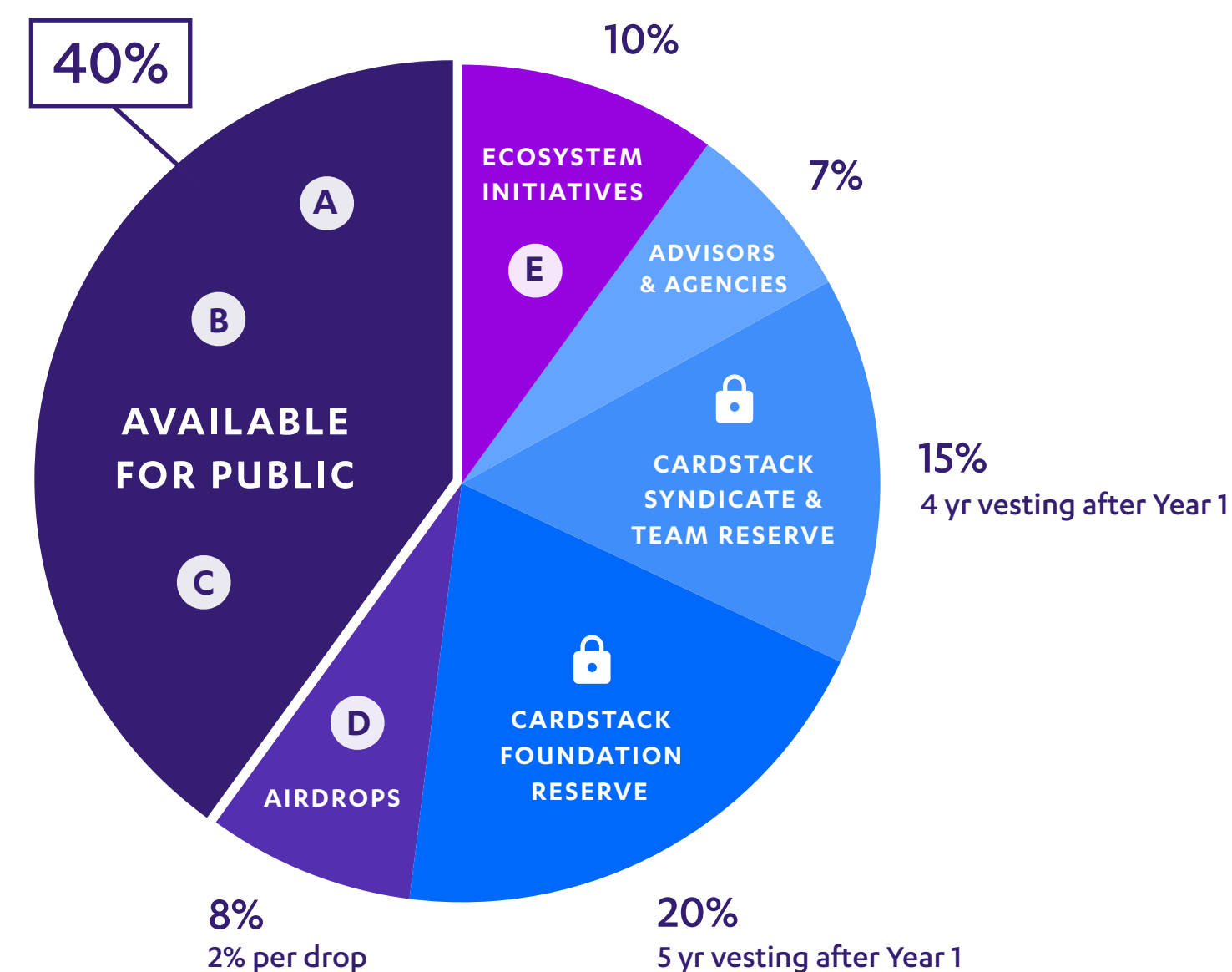
The information in this section is subject to change. Please visit cardstack.com to access the most up-to-date version.

6.2

TOKEN ALLOCATION

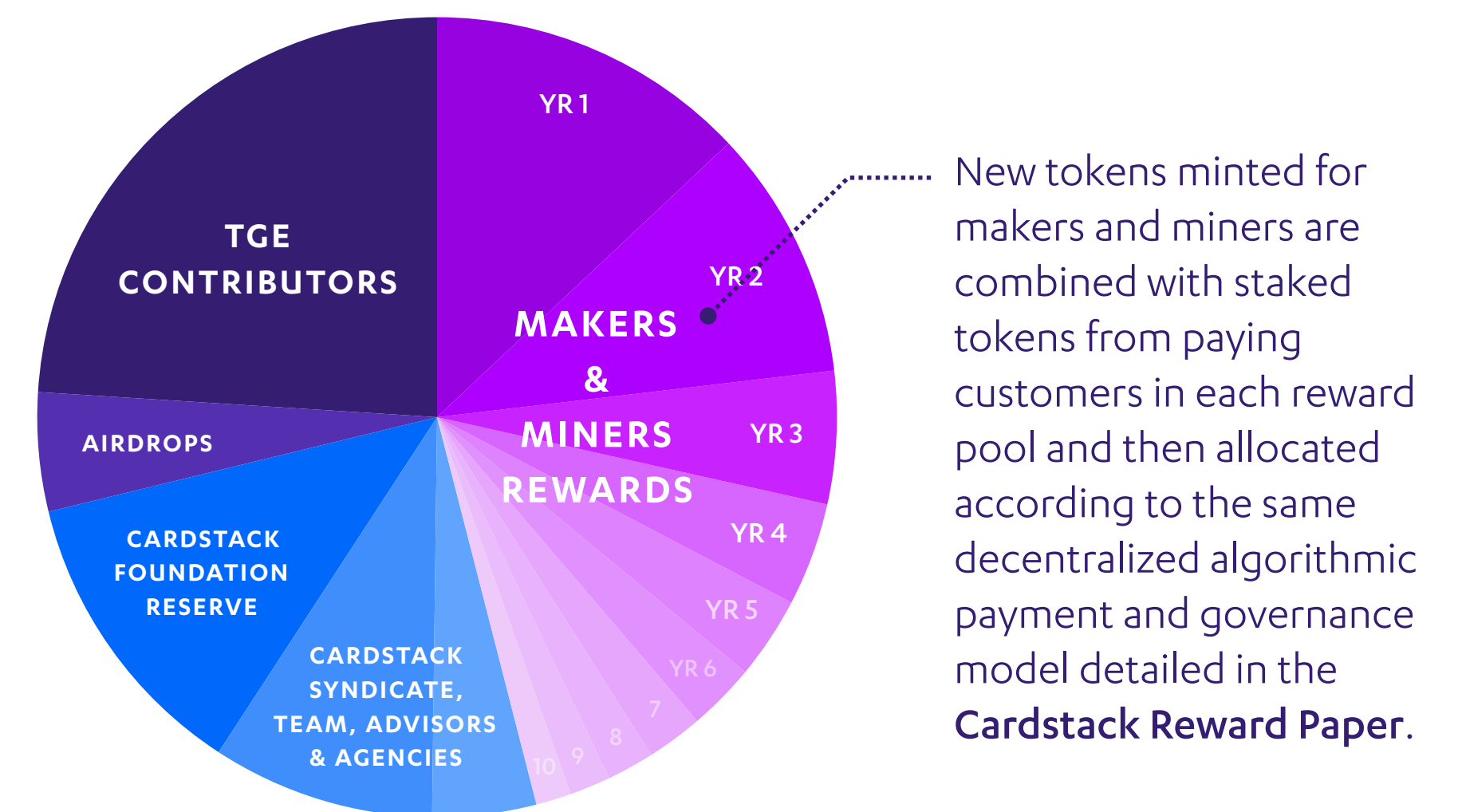
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The majority of Cardstack Tokens will be distributed to end users, makers, and miners of the ecosystem. A portion of the tokens will be reserved for the Foundation and the Syndicate, which will vest on a linear schedule.



TOKEN GENERATING EVENT (6 BILLION TOKENS)

The Cardstack Foundation will be generating **6,000,000,000** CARD during the Token Generation Event. **60%** of the generated tokens will be distributed in Year 1 through early contributor agreements (Batch A), pre-allocation (Batch B), crowd fundraiser (Batch C), airdrops (Batch D), Year 1 ecosystem initiatives (½ of Batch E), and advisors/partners allocations. Allocated tokens will be available for peer-to-peer usage at the conclusion of the crowd fundraiser, which will begin no more than 60 days from the conclusion of the pre-allocation period. The airdrop awards will occur throughout the first year, with each airdrop event limited to **2%** of the generated tokens. There will be a public announcement at least 30 days before each distribution event, allowing interested participants to prepare their prerequisites for the awards.



ULTIMATE TOKEN DISTRIBUTION IN 2028 (10 BILLION TOKENS)

The maximum number of Cardstack Token ever in circulation is **10,000,000,000** CARD. To encourage participation of software makers and analytic miners early in the Project's adoption cycle, especially before a meaningful number of paying customers arrive, the Cardstack Token smart contract will mint and allocate **4,000,000,000** additional tokens over 10 years, whereafter the smart contract will automatically stake newly minted tokens in reward pools and then allocate them to makers and miners that are actively offering software and services. During the first year, 1,000,000,000 tokens will be distributed incrementally over the course of the year. In subsequent years, the amount of distribution will be diminished, with cumulative distribution at the end of each year capped by this formula: $6,000,000,000 * (y/(y+5))$

6.3

CROWD FUNDRAISER

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We want to invite all who are interested in being part of the Cardstack ecosystem to register to participate in the crowd fundraiser. Approved contributors can contribute ether up to a statistically derived contribution limit.

REGISTRATION PROCESS

While the pre-allocation is done through a process conducted manually, the registration for the main crowd fundraiser is conducted directly on cardstack.com. Please check our website and our Telegram group periodically to learn when the registration process begins.

In order to comply with **KYC/AML** regulations in the various jurisdictions, we ask each potential contributor to create a unique user login and provide some basic level of identification information, which will be analyzed and scored through a risk management system operated by Bitcoin Suisse AG and/or IdentityMind Global, under vendor contracts with the Cardstack Foundation with strict confidentiality provisions.

Potential contributors will also need to provide an Ethereum address under their direct control, so that the Cardstack Token ledger and the smart contract can **“whitelist”** those addresses during the contribution period.

The Ethereum address for sending funds to the Cardstack Token ledger is viewable **only after a secure user login on cardstack.com**, once the crowd fundraising period has started. Along with the Ethereum address, all registered and approved users will see the contributor-specific data field for linking the user login with the contributor’s Ethereum address, as well as instructions on how to use an approved ether wallet to send funds.

Do not send funds to any Ethereum address you find elsewhere that claims to be from Cardstack: Not in any Telegram channel or DMs; not via email, text message, or social posts on Facebook, Twitter, or Reddit — basically, not through any other apps or websites. You need to come to cardstack.com to contribute funds. We will not actively reach out to you.

INDIVIDUAL CONTRIBUTION LIMITS

Before the contribution period: All potential contributors must register on cardstack.com to take part in our KYC/AML compliance process at least 72 hours prior to the start of the crowd fundraising period. No contributor will be able to join and participate after the registration is closed. We will publicly post the exact “Target Proceed Amount in Ether” and the “Individual Contribution Limit”, once the registration is closed. These two factors will be determined based on a statistical analysis of the registration data, cross-referenced with patterns in similar token generation events.

Start of the contribution period: When the crowd fundraising period officially begins, registered and approved contributors will have the opportunity to send funds to the Cardstack Token ledger. The amount must be within the Per-Address Contribution Limit, which is implemented as a smart-contract-enforced quota on all whitelisted Ethereum addresses. Transactions that are above either the contribution limit or the gas limit will be rejected by the smart contract or the Ethereum network, respectively.

Individual contribution caps will start out low during the crowd fundraising period to ensure broad participation. Contributors who have been a part of community early on may be given a higher contribution cap during this initial period. Caps will be raised for all contributors as the fundraiser progresses.

End of the contribution period: The fundraiser ends when the amount of ether contributed reaches the Target Proceed Amount in Ether or when 30 days have elapsed, whichever is earlier. At this point, funds will no longer be accepted; Cardstack Tokens will be allocated and they will be unlocked.

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The Cardstack project implements a payment and governance mechanism that facilitates the usage of the software and services via a hybrid token acting as a utility token, a work token, and a reward token.

TOKEN FUNCTIONALITIES

For end users, the project token is a **utility token** that allows them to mix and match multiple dApps and cloud apps. When users spend a project token, the smart contract forms a retainer agreement between the users and their chosen apps before the token is staked in a reward pool.

Software developers and service providers, whom we collectively call **makers**, can offer their dApps or cloud apps to users as part of the project's ecosystem; they register their apps by paying a fee, thus using the project token as a **work token**. The fees to be paid by makers are determined by the smart contract, so as to balance the goals of inviting new entrants and maintaining quality. Maker fees, once paid, are locked in a toll pool and taken out of active circulation.

Tokens staked in the reward pool by users are periodically distributed to makers as **reward tokens**, according to a decentralized algorithmic payment and governance model that rests in the hands of the community. This model is driven by anonymized usage data, which is aggregated and tracked by an on- and off-chain protocol called **Tally**. Analytic miners help calculate the reward function that determines who gets paid out what, while sifting out spam, therefore making the system fair and resilient. The miners' results compete in a sortition scheme we call Proof-of-Analytics, ensuring that the reward algorithms are never under a single party's control.

Analytic miners can register to participate in the Proof-of-Analytics scheme, in order to determine how the reward pool is split, by paying a fee for every life cycle of the reward pool. These fees are paid as work tokens and locked in a toll pool as well. If a miner is selected to report the final payment splits, that miner receives a portion of the tokens in the reward pool as **mining reward** for doing the useful work of number crunching and enforcing the community's payment and governance model.

The percentage of tokens in the reward pool to be paid to miners is determined by the same decentralized algorithms that aim to **minimize on-chain transactional fees** in aggregate for end users and makers, yet ensuring protocol security by giving a critical mass of analytic miners **incentives** to compete.

To increase their chance of being selected, analytic miners can stake additional project tokens in a **long-term stake pool** called the voting pool. The odds of being selected through the sortition scheme are proportional to the size of a miner's long-term stake. Miners who have tokens locked in this long-term pool can, however, have their **stake slashed** by the smart contract, if the results of their analytics are deemed to be fraudulent or out-of-consensus with the community.

Users and makers can also stake project tokens in the voting pool to influence the allocation parameters, smart contract upgrades, analytic algorithm changes, etc. For the purpose of allowing project token holders to influence the governance of the ecosystem, a variant of **quadratic coin lock voting**, which was proposed by Vitalik Buterin, is implemented in the smart contract. This way, voters who want to wield power through voting must live with their decisions for longer and align their interests with the long-term value of the ecosystem. Staked tokens in the voting pool can be retrieved after the lock-up period has elapsed.

Early on in the project ecosystem's growth, newly minted tokens are automatically staked by the smart contract, in order to **bootstrap the reward pools** with a meaningful number of project tokens, so as to attract makers and miners to participate. As more end users arrive, the new revenue these paying customers bring in becomes a major portion of these reward pools, allowing the ecosystem to transition into a sustainable marketplace.

6.5

MINING FUNCTION: PROOF-OF-ANALYTICS

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The reward function in the Cardstack token mechanism relies on the statistical properties of the underlying analytical model to randomly select, query, and reward multiple analytic miners through a sortition scheme.

SORTITION-BASED ORACLE SELECTION IN THE CARDSTACK REWARD FUNCTION

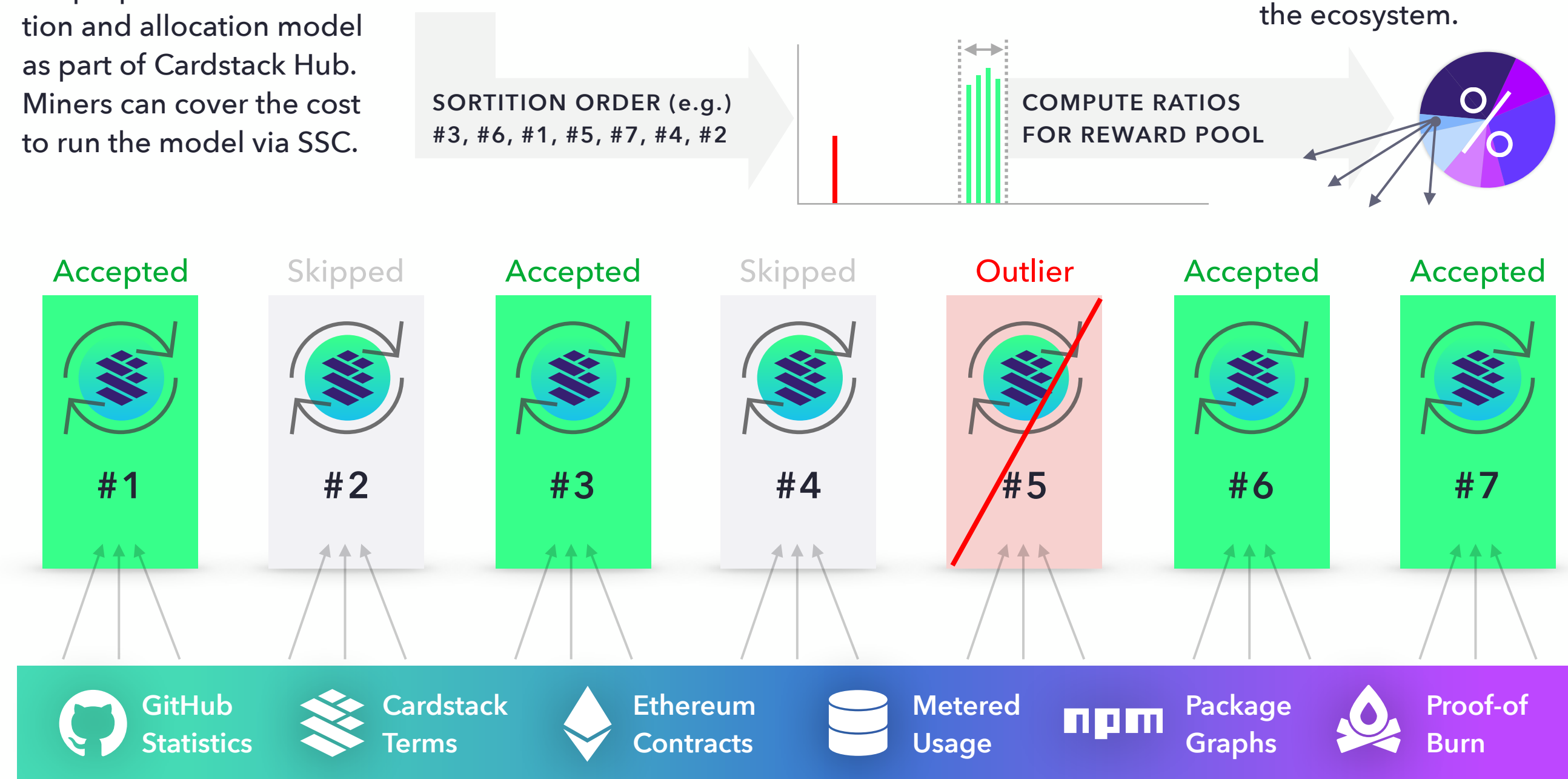
1 **Register** with a reward pool contract as an analytic miner.

2 **Extract data and run** the proportional attribution and allocation model as part of Cardstack Hub. Miners can cover the cost to run the model via SSC.

3 **Shuffle** the order of registered analytic miners to be contacted, using the previous block's hash as a randomization seed.

4 **Query** each analytic miner in the shuffled order as an oracle until the results converge. Discard outliers. Stop and skip the rest when the confidence interval is acceptable.

5 **Dedicate** a portion of the reward pool and/or inflation to the analytic miners who helped to fairly distribute rewards to the participants of the ecosystem.



ROLE OF DATA SCIENCE IN BLOCKCHAIN PROTOCOLS

Most deep data analyses of blockchain networks have been performed as off-chain processes, visualized as real-time charts, embedded as screenshots in academic papers, or presented as criminal evidence in court cases. The day-to-day functioning of Blockchain networks themselves, however, has not needed to tap into the power of data analytics, statistical models, or machine learning algorithms to “decide on the next block”.

As blockchain-backed value networks expand to encompass more real-world activities, the use of data science to synthesize and make decisions affecting on-chain value creation or transfer will become an increasingly important area of study and experimentation. We hope to collaborate with those interested in this emerging area of blockchain innovation.

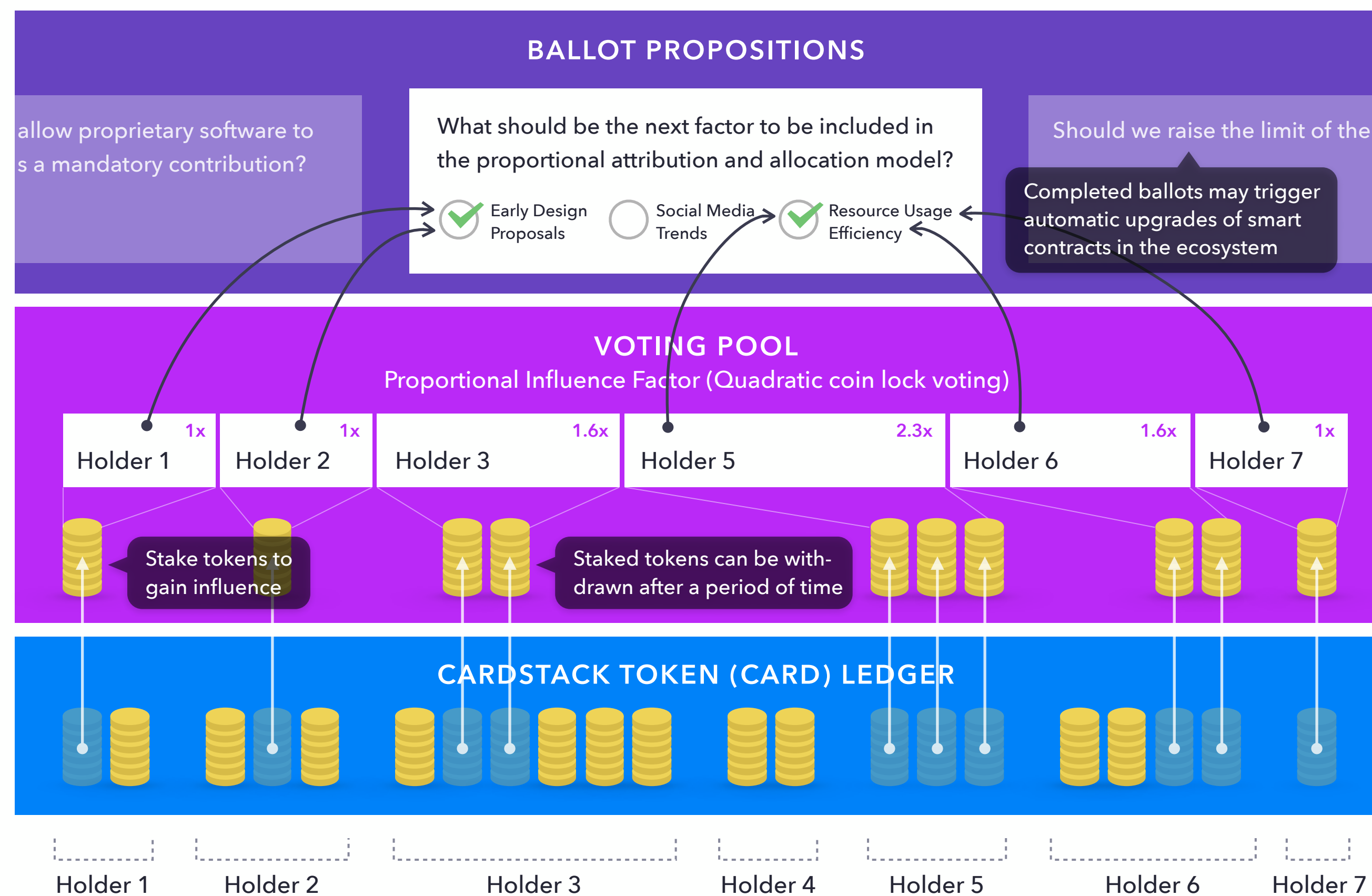
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VOTING POOL FOR LONG-TERM HOLDERS

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The governance of the ongoing operations as well as the periodic upgrade cycle of the reward function and other smart contracts in the Cardstack ecosystem will be gradually delegated to participants of the voting pool.

TOKENS NOT IN ACTIVE USE CAN BE STAKED IN THE VOTING POOL



Note: Participation in the voting pool does not grant any voting power over any Cardstack legal entities, nor do the tokens staked in the voting pool generate any interest payments or special inflationary rewards.

PROPORTIONAL INFLUENCE BASED ON "STAKE-TIME"

The Foundation will periodically offer ballot propositions, which the participants of the voting pool can vote on to guide the evolution of the Cardstack ecosystem. Some of these ballots are non-binding and serve as forum for stakeholder feedback. But some will trigger the automatic upgrade of smart contracts or change the key parameters governing the reward functions and other on-chain code upon approval by the voters.

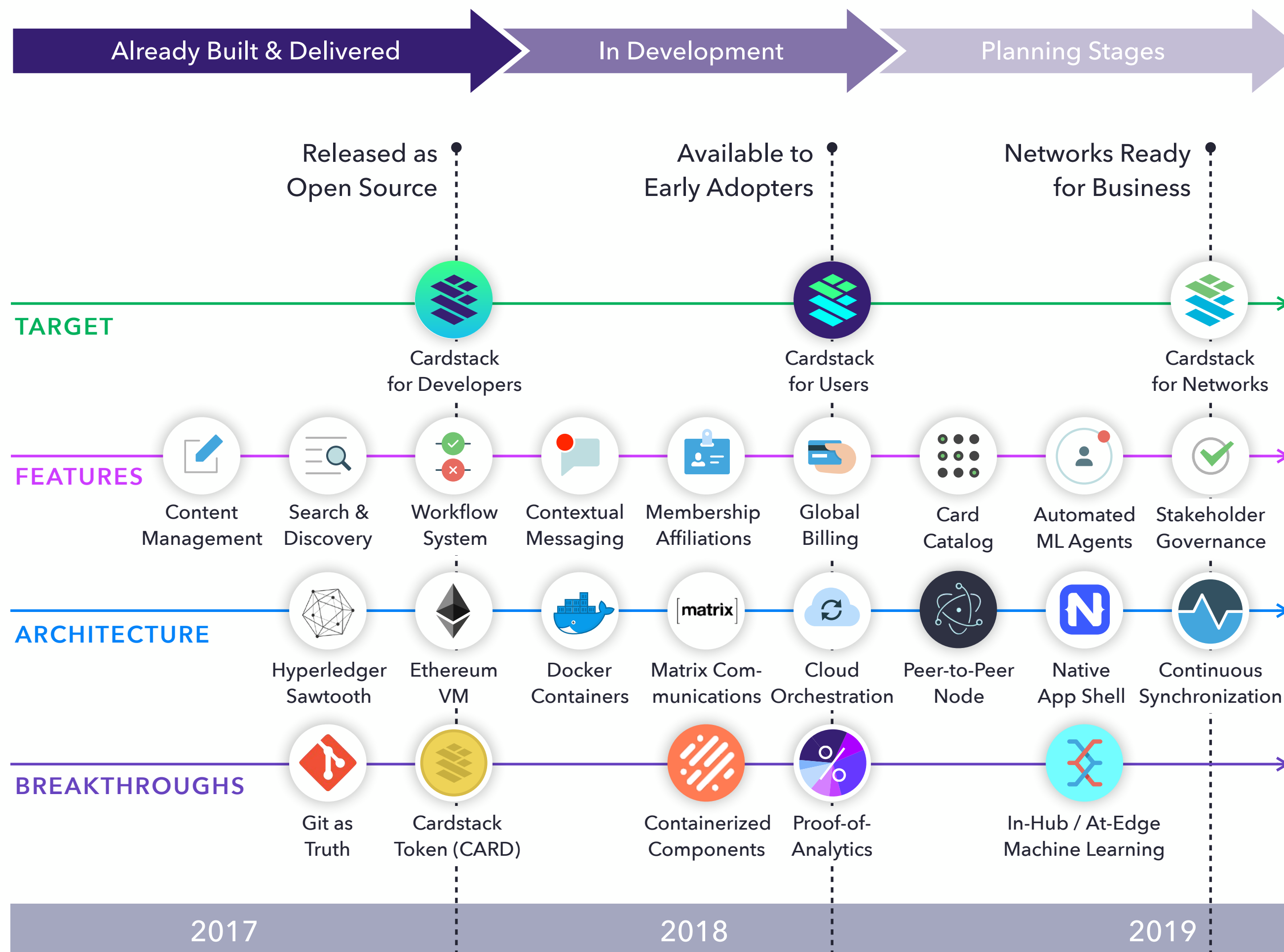
Participants need to stake a portion of their tokens, by adding them to the voting pool, to gain influence over ballot outcomes. Staked tokens are locked for a period of time, during which they cannot be converted to SSC, circulated through the reward cycle, or traded. The longer the tokens are locked voluntarily, the more influence the long-term holder gains. However, voting power is progressive. This means that every incremental token from larger holders has less voting power, giving smaller stakeholders more say in aggregate.

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PROJECT ROADMAP

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Ambitious projects are shipped one module at a time. Cardstack has been focused on delivering breakthrough ideas by building up the architecture and features incrementally. We expect this to continue and accelerate.



GET MORE OUT OF THE BOX

Cardstack aims to be one of the feature-r richest platforms for decentralized application development, with our support for smart-contract code generation, schema-driven data management, distributed versioning, as well as messaging and workflow facilitation. Our plug-in architecture makes it possible to build complex use cases that leverage multiple blockchains and consensus models, like blending a public ledger for tradable tokens with a private ledger for scalable transaction processing within one cohesive, user-facing environment.

Looking forward, we will work to make it easier to design, develop, and deploy Cardstack experiences to any channel where end users are active. We plan to introduce user-controlled machine learning plug-ins to Cardstack Hub, which will help users automate common workflow decisions, so as to increase the velocity of interactions on business networks that are built on Cardstack.

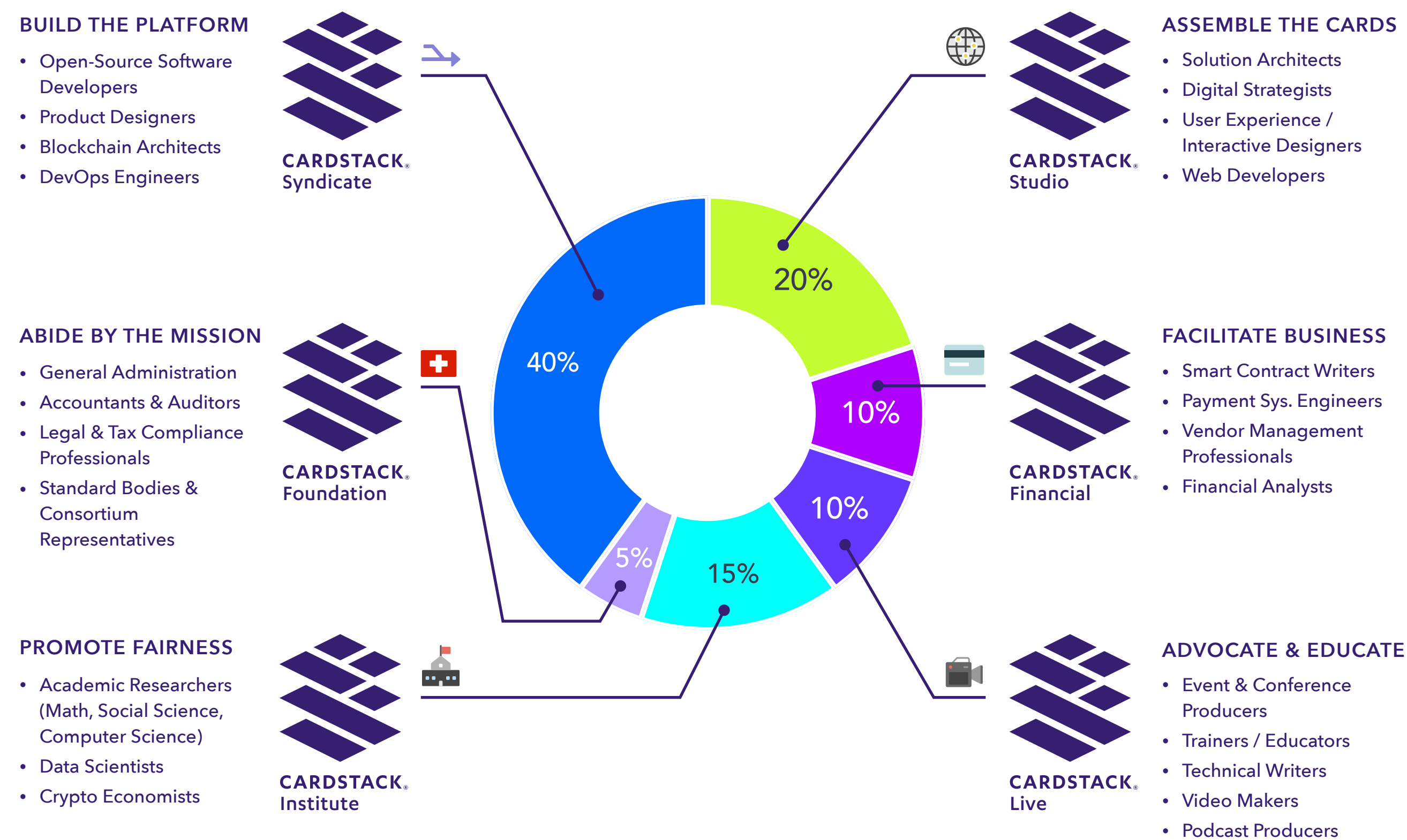
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USE OF PROCEEDS

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We have divided the work of building, growing, and governing the Cardstack ecosystem into 6 parallel tracks. Each track can be staffed with domain experts, who can engage their communities and spread the mission.

MULTI-ORGANIZATION APPROACH



ROLES & RESPONSIBILITIES

Cardstack Foundation is responsible for allocating the proceeds from the fundraiser in a way that is compliant with applicable legal and tax regulations.

Cardstack Syndicate serves as the primary research and development agency to continue to build the core platform and integrate other apps and services as plug-ins.

Cardstack Institute is a subproject of the Foundation, tasked to analyze how the ecosystem is functioning and to propose improvements for the reward function and other models.

Cardstack Studio helps clients and partners adopt and deploy Cardstack solutions and is primarily funded through consulting revenues.

Cardstack Financial works to make it easy to purchase Cardstack software and services with fiat.

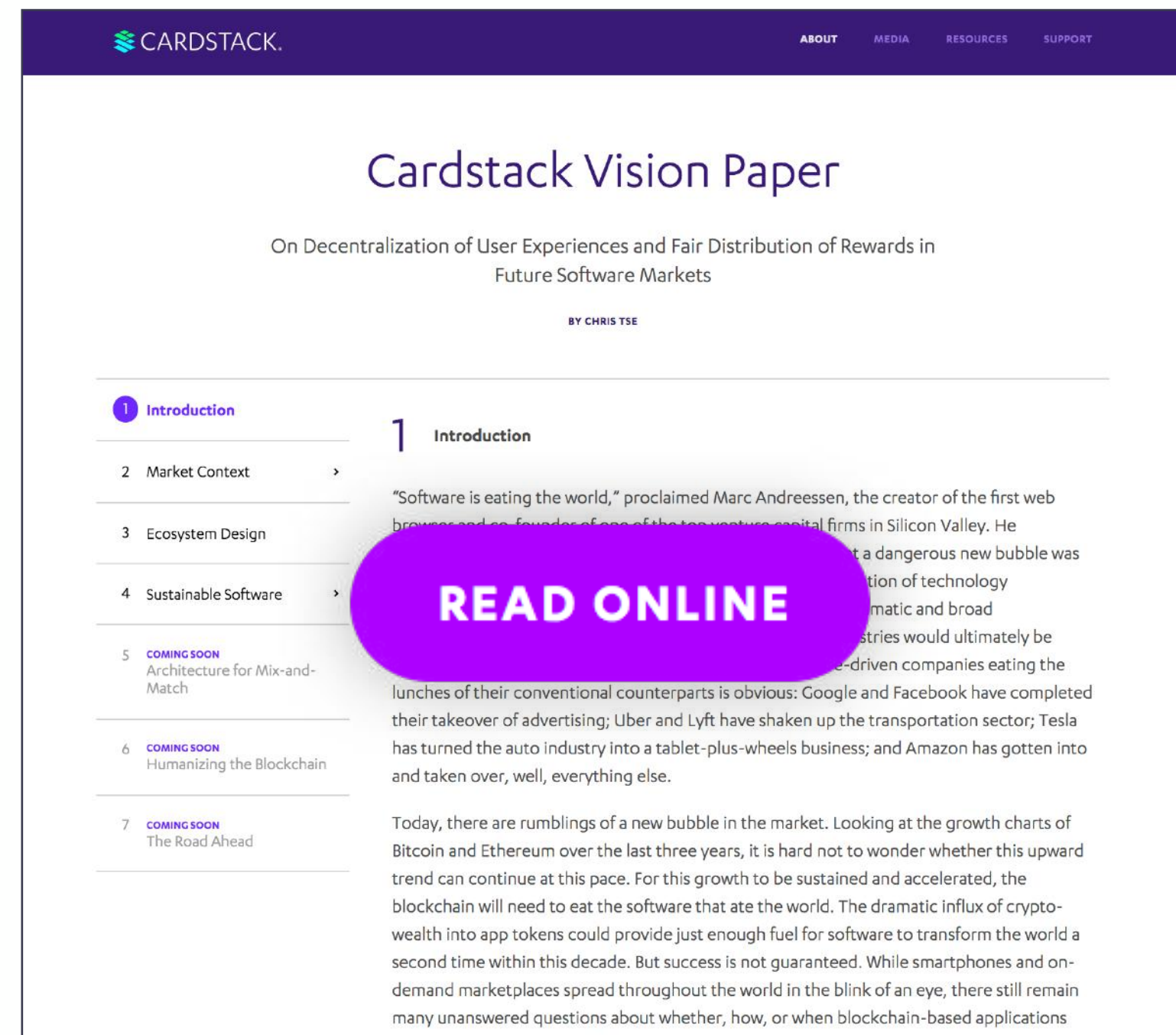
Cardstack Live is a subproject of the Syndicate and produces events, rich media, and education materials.

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To help you gain a deeper understanding of the Cardstack project, our team has prepared two additional papers: one to provide business context and one to illustrate the mathematics behind the reward function.

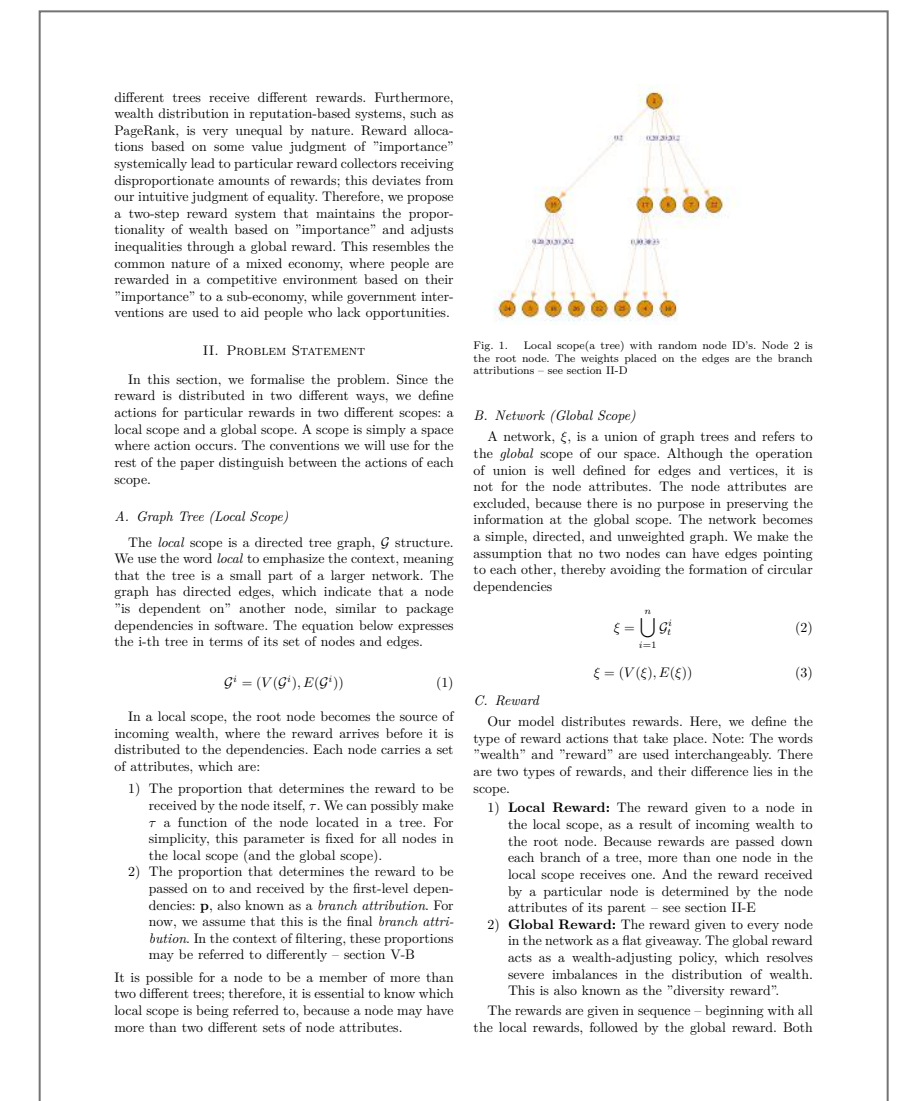
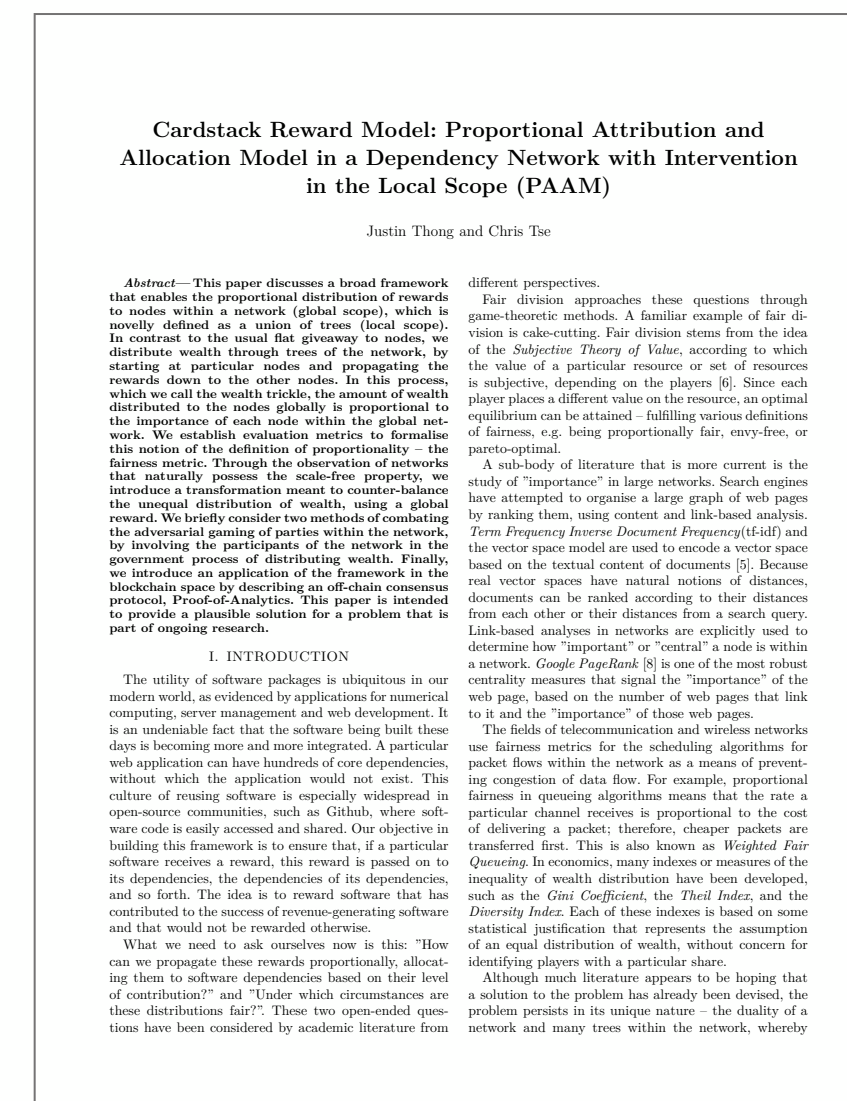
CARDSTACK VISION PAPER

This long-form position paper walks you through our perspectives regarding the current conditions in the software, cloud computing, and blockchain markets. It shows why a decentralized, token-driven approach will finally unlock the business value of open-source software and make way for the creation of a sustainable software ecosystem that will succeed the venture capital-driven business models.



CARDSTACK REWARD MODEL

This research paper, titled “Proportional Attribution and Allocation Model in a Dependency Network with Intervention at the Sub-tree Level”, provides an in-depth explanation of the way in which the value created in this ecosystem can be distributed fairly, using mathematical tools at the intersection of data science and crypto economics.



7.2

TALKS & PRESENTATIONS

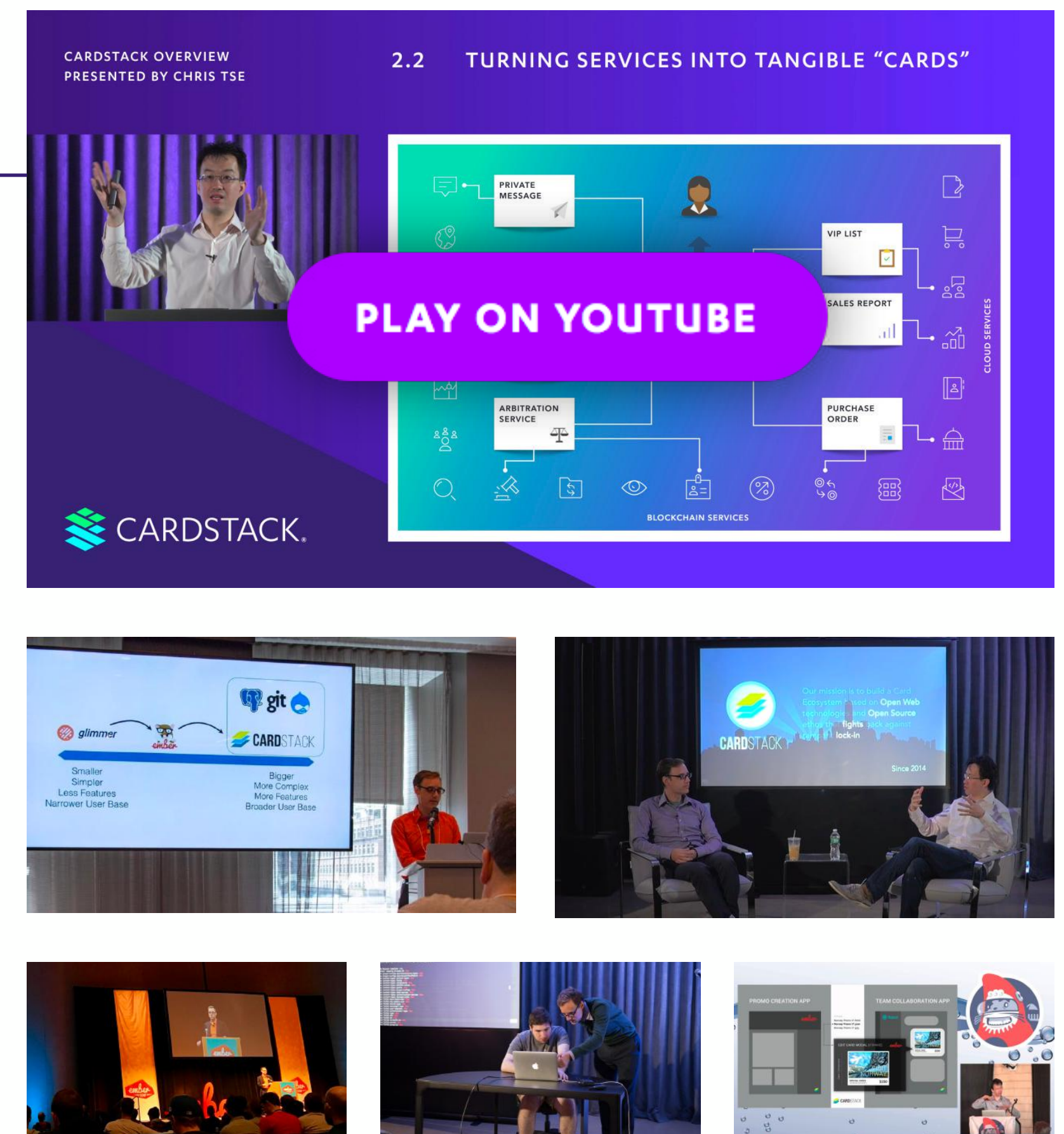
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Members of the Cardstack team have given a series of talks on the Cardstack software architecture, design systems, and project mission. See for yourself how our views and our software have evolved since 2014.

CARDSTACK TALKS & PRESENTATIONS

You can view our videos and slide shows under the “Media” tab at cardstack.com. Here are some of the highlights:

- **Cardstack Overview:** Chris Tse, the founding director of the Cardstack Project, walks you through a series of animations that build up to the information graphics included in this white paper. He shows how the concepts across technical, design, market, and crypto economics are connected to maximize the ongoing value creation in this new software ecosystem.
- **Cardstack Principles:** This talk is co-presented by Chris Tse and Ed Faulkner (Lead Developer of Cardstack). It presents the 10 core principles of the Cardstack architecture and explains why we need to uphold and embrace those principles — which are derived from the open-Web architecture and open-source ethos — in order to create a successful, blockchain-backed world that is an improvement on the centralized cloud regimes. This talk is technical in nature and recommended for those who want to get a deeper understanding of the stack of Cardstack.



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Developers contribute to open source to “do good”. With Cardstack, we hope that open-source contributors can “do well” economically too. Let’s get started.

OPEN-SOURCE CODE

- **Cardstack Hub:** Our core open-source repository contains the key components of Cardstack Hub as well as plug-ins to various components that connect the Cardstack-driven experience to different data sources running on the cloud or as blockchains.
- **Cardstack UX Add-ons:** The front-end components of the cohesive user experience are available for developers to use, fork, or enhance. While the Cardstack Hub infrastructure can be used stand-alone with our UX components, we believe that successful market adoption of this infrastructure will offer both a powerful (d)App integration and a consistent, polished on-ramp for users.
- **Cardstack Token:** This repository contains all the Solidity source code of the Ethereum smart contract that governs the Cardstack ecosystem. We will release this codebase to the open-source community after it has been reviewed by multiple external security auditors, to ensure that the propagation of robust code incorporates the security best practices. We hope to collaborate with other blockchain developers, so we can improve on the features, efficiency, and security of Cardstack smart contracts.

README.md

Cardstack Application Framework

This is the main repo for [Cardstack](#), an open source application architecture for building cohesive experiences on open, decentralized infrastructure.

Orientation

This is a monorepo. Each directory under `packages` is distributed as a standalone NPM package under the `@cardstack` NPM namespace. Each package is a Cardstack plugin. A family of Cardstack plugins comes together to provide both browser-side and server-side functionality of a Cardstack application.

Many Cardstack plugins are also [Ember addons](#), which is the standard way for a Cardstack plugin to provide client-side functionality.

Cardstack Plugin Features

A Cardstack Plugin is any npm package with "cardstack-plugin" in its `package.json`'s `keywords` list. It may export any number of *features*. Each feature falls into one of the following feature types.

Feature Type	Description
authenticator	Server-side functions and client-side components for authenticating users against some authentication source. Examples: <code>@cardstack/drupal-auth</code> , <code>@cardstack/ember-auth</code>
code-generator	Allows a Cardstack plugin to generate code that can be both precompiled into an app and dynamically loaded into a browser. Examples: <code>@cardstack/hub::environment</code> , <code>@cardstack/hub::models</code>
constraint-type	A logical constraint that users may configure and apply to their data models. Examples: <code>@cardstack/core-types::max-length</code>
field-type	Validation, formatting, and editor components for a scalar data type. Examples: <code>@cardstack/core-types::string</code> , <code>@cardstack/mobiledoc</code>
indexer	Indexes content from some arbitrary external data source into Cardstack Hub's fast cache. Examples: <code>@cardstack/git</code> , <code>@cardstack/postgresql</code> , <code>@cardstack/drupal</code>
messenger	Implements a way to send messages out to some arbitrary data sink. Example: <code>@cardstack/email</code>
middleware	Allows a plugin to install arbitrary server-side middleware. This is a fairly low-level feature -- often you can implement more specific feature types instead, relying on standard middleware like <code>@cardstack/jsonapi</code> . Examples: <code>@cardstack/jsonapi</code> , <code>@cardstack/authentication</code>
searcher	Provides deep searches in some data source (as opposed to an indexer, which pre-indexes external data sources for fast local searches). An example is the <code>@cardstack/elasticsearch</code> searcher, which is the default searcher used internally by Cardstack Hub.
writers	Writes content back out to some arbitrary external data source. Works in tandem with an indexer or searcher to provide full round-trip integration. Examples: <code>@cardstack/git</code> , <code>@cardstack/postgresql</code>

[VIEW README](#)

Cardstack Plugins in this Repo

While third-party Cardstack plugins are heartily encouraged, the plugins in this repo (and distributed under the `@cardstack/` NPM namespace) comprise the core Cardstack framework and are therefore subject to Cardstack's community governance and stability policies.

7.4

HOW TO PARTICIPATE

- 1 OVERVIEW
- 2 CONCEPTS
- 3 ARCHITECTURE
- 4 ECONOMICS
- 5 ORGANIZATION
- 6 FUNDRAISER
- 7 RESOURCES

Cardstack needs your help to become the decentralized counterbalance to the centralized superpowers of the digital age. We hope you will be our fuel and catalyst to bring about the decentralized Internet we all desire.

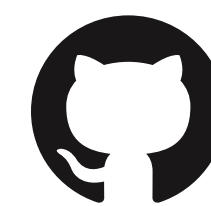
BECOME A PART OF OUR MOVEMENT

To learn more about our project, you can visit us on the channels listed below. We will continue to publish materials over time. If you have feedback, feel free to reach out to us on the most appropriate channel.



<https://cardstack.com>

Type our home page URL directly to avoid phishing attacks.



github.com/cardstack

Star the project to be invited to participate in the reward pool.



[telegram.me/cardstack](https://t.me/cardstack)

Join our community group and get updates on Telegram



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