

Tokenizing Corporate Capital Stock

Representation of Corporate Capital Stock via Cryptographically Secured Blockchain Tokens:

Motivations and Potential Implementations

by

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ABSTRACT

This article analyzes the potential motivations for representing corporate capital stock via cryptographically secured blockchain tokens and explores potential legal/technological implementations of systems that could do so. Tokenization of corporate capital stock is situated within a broader discourse regarding “tokenization of assets,” which refers to using blockchain tokens as a means of representing ownership interests in assets. It is argued that digitization of ownership interests is beneficial but can be achieved without blockchain technology; however, blockchain technologies are uniquely suited to enhance the *individual asset sovereignty* of stockholders. The article summarizes, at a high-level, some of the history and evolution of securities instruments, explores how that history has led to the current market dynamics for publicly held and privately held corporate capital stock in the United States, and diagnoses the resulting risks and inefficiencies. Various methods of representing capital stock on blockchains are explored, including those reflected in recent amendments to the corporate law statutes of Delaware and Wyoming. It is argued that, among these alternatives, a “tokenized stock certificate” approach whereby blockchain tokens are imbued with the legal status and functional dynamics of old-fashioned paper stock certificates would be best suited to leveraging blockchain technology’s potential to enhance stockholders’ sovereignty over their ownership interests in their stock.

OVERVIEW OF THE ARTICLE

First, I will provide a brief introduction to the concept of asset tokenization on blockchains and the potential benefits that are generally seen as being offered by such tokenization. I will situate the problem of tokenizing corporate capital stock as a sub-problem of tokenizing securities or rights/interests in assets more generally. I will argue that there are already numerous ways of representing rights/interests in assets, including electronically; therefore, for “tokenization” to be revolutionary, there must be something unique about the blockchain medium that is fundamentally different from what has been offered previously. To explore that, I will analyze the “unique selling point” (USP) of blockchain technology and argue that the USP of blockchain technology is that it furthers the values of individual asset sovereignty by creating the technological predicates necessary for ordinary persons to hold, manage and transact with assets in an environment that is trust-minimized while also being secure.

I will then provide a typology that divides securities instruments into their traditional dichotomies—bearer vs. registered and, among registered instruments, certificated vs. book-entry—and allude to the history and policy reasons leading to the dominance of registered instruments in contemporary finance. I will argue that the benefits of tokenization in light of individual asset sovereignty values exist along a

spectrum, at one end of which are the (maximal) benefits of tokenizing assets (or interests in assets) via “bearer tokens” that can almost always trade freely on a peer-to-peer basis on any ledger without becoming detached from the assets they represent, and at the other end of which are the (de minimis) benefits of tokenizing assets (or interests in assets) via “book-entry tokens” that can only trade via an intermediary or a canonical ledger set up by a ‘consortium’ or a limited number of permissioned nodes that collectively function as a new (albeit distributed) intermediary. Therefore, the more an asset is (legally and practically) susceptible of being represented via bearer instruments or quasi-bearer instruments, the more reasonable it is to think that tokenizing that asset can open new markets or increase market activity by facilitating peer-to-peer transfers on open networks. Alternatively, the closer an asset is to being one that (legally and/or practically) needs to be tracked via a canonical ledger tied to real-world identities, the more there will be pressure to tokenize that asset only in a “walled garden” type of distributed ledger that does not go as far as possible in embodying the true open vision of blockchain technology as a means to enhance private ownership rights and peer-to-peer market transactional freedom.

Next, I will turn more specifically to the issues around tokenizing corporate capital as a sub-type of securities. I will review the distinguishing features of corporate capital stock as compared to other types of securities. We will explore how the ‘pre-blockchain’ status quo for contemporary stock markets divides those markets into markets for *publicly traded* stock and markets for *privately held* stock, each of which suffers from different problems that can be addressed using blockchain technology. The public stock market suffers from costs and risks arising from a high degree of reliance of securities intermediaries. On the other hand, the private stock market suffers from lack of automation, poor administration and lack of liquidity/price discovery.

Having established areas for improvement in contemporary stock markets, the article makes a high-level case for how blockchain technology might help with some or all of the relevant issues. The article cites the work of Vice Chancellor J. Travis Laster of the Court of Chancery of the State of Delaware to illustrate the manner in which blockchain technology can eliminate the difference between record stock ownership and beneficial stock ownership that lies at the root of most public stock market issues. The article builds on this work by detailing at greater length how blockchain technology can be helpful in the private stock markets as well.

The article next explores two potential methods of implementing a blockchain technology stock system. The first approach involves a corporation opting to treat its stock as *uncertificated* shares and uses permissioned distributed ledger technology to make a particular blockchain or set of blockchains the canonical statutory stock ledger for a corporation (the “PDLT approach”). The second approach involves a corporation opting to treat its stock as *certificated* shares, where the stock certificates are blockchain tokens, and is better suited to operate on unpermissioned peer-to-peer blockchain technology networks such as Ethereum (the “tokenized certificate approach” or “TCA”). I will summarize how, in recent years, amendments have been made to the corporation statutes of Delaware and Wyoming to facilitate a new, blockchain-permissive framework for capital stock tracking and transfers, but that such amendments have primarily been oriented toward allowing implementation of the PDLT approach. I will argue that the TCA solves most of the same problems with public stock markets as does the PDLT approach, while also creating greater asset sovereignty for stockholders by allowing them to trade their stock in reliable ways on any open blockchain, without necessarily worrying whether whatever blockchain the corporation deems “canonical” has been updated—just like is possible with paper stock certificates.

In the conclusion, I will note some of the questions that remain unanswered (or unasked!) and issues that remain unresolved in my article, will suggest topics for additional research and development and will provide a call to action for those who may be interested in lobbying the governments of Delaware, Wyoming or other states or nations to adopt legislative amendments that would facilitate the tokenization of corporate capital stock.

Tokenization of Assets—What Is It And Why Does It Matter?

Mad Hype for Asset Tokenization

“Tokenization of assets” has been broadly touted as an impending revolution in contemporary finance and markets. A great deal of ink (of wildly varying quality) has been spilled on its merits[1]. Some of such ink has been nothing short of effusive. For example:

- “Every asset in the world will be tokenized.”[2]
- “[T]he SEC will eventually mandate the adoption of tokenized securities.”[3]
- “Tokenized securities will be the first quadrillion dollar market cap asset class of crypto.”[4]
- “Blockchain’s ability to tokenize assets is pretty much limitless...Tokenization promises to [...] democratiz[e] the process of owning everything from ideas to paintings [...] Via the blockchain, ownership is slowly taking on new meaning.” [5]
- “[The] particularities [of DLT-based securities tokens] solve a whole bunch of pain-points in Capital Markets, including liquidity, undervaluation of assets and barriers to entry in term of investors base (the legendary “entry ticket”)...[and] [d]estroy all barriers to entry in a Global 24/7 free Market exposure.”[6]

So, What is Asset Tokenization, Really?

So, what exactly is this process of “asset tokenization” that has people waxing so lyrical? Frankly, I believe many people are confused about that. For example, here are some definitions/descriptions from the top Google results for “tokenization of assets”:

- “...[T]okenization is the process of **converting some form of asset into a token** that can be moved, recorded, or stored on a blockchain system...[T]okenization **converts the value stored in some object**...into a token that can be manipulated along a blockchain system...”[7] [emphasis added];
- “...[T]okenization refers to the **digitization of an asset**.”[8] [emphasis added]

Although many casual descriptions like this loosely characterize tokenization as if it involved *converting* a physical asset into a digital token or automatically imbuing a token with exactly the same value as a physical asset, no alchemy will be involved. More careful and thoughtful writers have offered better definitions of “tokenization.” The best I’ve noticed so far is this one by Stephen McKeon given in a CNBC interview: “you can represent an ownership stake on any asset with a token.”[9] A distant second place would go to Addison Cameron-Huff’s: “Tokenization is the process of converting rights to an asset into a digital token on a blockchain.”[10] Basically, “tokenization of assets” refers to using a person’s ownership and control of a blockchain token as a proxy or a means of representing that person’s ownership interest in a particular asset—just like someone holding a paper bank check from another person made out to the first person’s name represents that first person’s claim on dollars in an account, or someone holding a paper stock certificate made out to their name represents that person’s ownership of the shares of stock identified on the certificate.

To get more precise still, here is what I believe to be a relatively clear and distinct (although not perfect) definition of “asset tokenization”:

To “tokenize an asset” in the context of blockchain technology means to establish a technological, contractual and regulatory framework in which: (a) a person’s lawful possession of a particular blockchain-based token[11] (i.e., lawfully holding/having knowledge of the private keys that govern that token’s transferability at a given time) generally will be treated as representing or symbolizing the holder’s legal rights to or economic interests in a particular asset; and (b) lawful transfers of such

legal rights/interests can and generally will be consummated through lawful transfers of that token from the prior holder of the rights/interests to the new holder of the rights/interests.

This definition is still somewhat imprecise and question-begging, but it's progress. Under this approach, to "tokenize an asset" implies using a blockchain token as a kind of abstract financial *instrument* that represents an abstract set of financial interests or ownership rights relating to the asset. I contend that this is the only logical way of understanding "asset tokenization" for almost all practical purposes. Although in many cases such tokens will be *securities* under the law (at least in the U.S.), they may alternatively represent *titles* to physical property, play a role in an implementation of *proplets* for controlling physical property[12] or have other relationships to assets. Thus, to avoid getting bogged down in a securities law analysis and to keep the analysis as generic as possible, I will not be calling such tokens "securities tokens" in this article. Rather, I will simply call them "asset-right tokens" or "ARTs".

SKEPTICAL INTERLUDE #1

One very interesting and relevant fact must be pointed out here: As a society, ***we already have many instruments and other representations of ownership/interests in assets.*** For example, we already have:

- Traditional stock certificates, which represent claims for payment out of the issuer's equity/net assets
- promissory notes, which represent claims for payment out of the issuer's gross assets
- leases, which represent tenancy claims on the issuer's real property
- deeds of title, which represent ownership of various properties, ranging from automobiles to real estate
- licenses, which represent claims to the use of intellectual property

Furthermore, ***some of these instruments or representations are already digital or could readily be made digital without use of blockchain technology.*** For example, some privately held corporations issue stock certificates in PDF form rather than paper form, and, for years, the online platform Carta (formerly eShares) has been (without the need for blockchain technology) helping corporations issue and maintain both: (1) digital certificates for stock that is supposed to be "certificated" and (2) digital ledgers/book-entry representations for stock that is supposed to be "uncertificated"—and even got a legal opinion from DLA Piper saying this complied with Delaware corporate law (*before* the "blockchain amendments" thereto that I will summarize later in this article).[13]

So, if we already have lots of representations of the kinds of things ARTs could represent, and if actually plenty of those representations already are digital, would it not be fair to ask (in a politely skeptical intonation):

- Why/how are ARTs "revolutionary" when those other digital representations weren't or aren't or their revolutions already happened long ago?
- Why/how will ARTs dramatically democratize capital, increase liquidity and enhance price discovery more than those things could/already have?
- Isn't this whole "asset tokenization" thing basically like 90% hype and 10% reasonably cool but fairly modest improvements to traditional infrastructure?

Rest assured, we will grapple with these questions more in the remainder of the article.

FIN SKEPTICAL INTERLUDE #1

What are the (Supposed) Benefits of Asset Tokenization?

Now that we know what tokenization is, we can see that, at its core, tokenization is one form of digitization. As such, we can begin to see how tokenization might have some of the benefits people have touted. The benefits of digitization—be it digitization of hardcopy library books or medical records into searchable and endlessly reproducible PDF files, or digitization of payment channels so that people can pay for transactions over the internet—are no-brainers. All the more so, digitization implemented on a public, open permissionless blockchain network is particularly valuable in that it offers what the kids call “security guarantees”. It is thus thought that by providing a particularly attractive form of digitization, tokenization can bring many benefits to the markets for both “hard assets” (like real estate, fine art, etc.) that trade and are priced only infrequently by appraisers or at auction and traditional securities, as well as more abstract, financial assets such as derivatives which already have thriving markets and thus good price discovery but may still carry significant transaction costs and other inefficiencies.

For traditionally illiquid or low-liquidity, indivisible assets with the potential for significant price appreciation like real estate, fine art, rare collectibles and numismatics, tokenization would work something like this: the record owner of the asset (e.g., Van Gogh’s “Starry Night”) could form a limited liability entity (e.g., an LLC) and assign ownership of the asset to that entity. Equity securities (e.g., membership interests) representing fractional ownership of that entity—which, indirectly, would represent ownership interests in the entity’s one and only asset (“Starry Night”), could be sold to other investors, who would receive “tokens” representing their ownership of those membership interests (and thus, indirectly, their ownership interests in “Starry Night”). While such “securitization” of assets is possible today without tokens, there currently is no thriving, liquid public market for such securitized interests the way there is for, say, the common stock of public companies. The hope (which, as we will see in ‘Skeptical Interlude #2’ below as well as later parts of the article, may be different from the reality) is that by representing such securities in token form, you will make them cooler and more convenient to own—“eliminating the frictions of capital markets” as the tokenization hypemeisters might say—and that thus you would encourage more people to buy them, trade them and hold them more often, thus creating more of a market for them and improving price discovery and investment interest in these assets.

Even when it comes to traditional securities (which are intangible to begin with and thus already relatively liquid and transferable, but to varying degrees depending on the type of the security), proponents of tokenization will argue that it can provide many benefits. For example, the market for securities of privately held companies is currently very shallow, leading to poor price discovery that is mainly driven by the at times esoteric and idiosyncratic valuation methodologies of traditional venture capital funds. Tokenizing the corporate stock of privately held companies, the thinking goes, could make that stock—or fractional interests therein—more convenient and attractive to hold, track and trade on alternative stock exchanges, thus leading to greater liquidity, market depth and price discovery and increasing efficiency of the private equity markets—on the other hand, as we will discuss, the potential for improvement is very bounded so long as the corporation does not want to “go public”. For companies that are *already* public and thus already have highly liquid stock, tokenizing the stock could offer benefits by reducing the need for or importance of traditional institutions and intermediaries that are otherwise necessary for stock administration and trading, such as Cede & Co, The Depository Trust Company, brokerages, Broadridge (a major corporate services company) and others. Eliminating or reducing the importance of such intermediaries could reduce transaction costs and trade settlement times—and thus, again, encourage participation, increase liquidity and improve price discovery.

SKEPTICAL INTERLUDE #2

For any given illiquid or not maximally liquid asset, there are a variety of factors other than the mere lack of digitization that have caused such asset to be illiquid or not maximally liquid. Advocates of tokenization (and I include myself among them) should be willing to ask themselves hard questions about these issues and about how, whether and to what extent tokenization really helps fix them. For example, we should ask why ownership interests in a particular tract of real estate tend to be less liquid

than, for example, shares of common stock in Apple Inc.—which anyone with a brokerage account can buy and sell a dozen times in an hour. And if we do ask such questions, in most cases it turns out there are good reasons for the difference, and that digitization generally (and thus also tokenization as a specific form of digitization) does not necessarily make a radical difference to that aspect of things.

To illustrate this by continuing with the real estate example, it is worth noting that real estate (particularly developed real estate) is notoriously non-fungible. For that reason, prospective real estate buyers typically conduct (or hire experts to conduct) extensive on-site due diligence, requiring actual trained people to physically travel somewhere and literally look at some soil, some borders and often some buildings. One can trust in third parties to evaluate the real estate, and such third parties might publish their reports for a price, but the reports have a limited shelf life and require trust, and economically it will not make sense for every single tract of land to have its own report—only very valuable tracts of land will warrant the investment of time, money and expertise by the report-writers. Dividing ownership of a piece of real estate into a million fractional interests represented by tokens instead of being a single interest represented by a paper deed really does nothing, in and of itself, to address these fundamental constraints on liquidity. Moreover, real estate investment trusts (REITs) already have made fractionalized interests in real estate available to the investing public. Thus, while tokenization of real estate might have some benefits such as making actual closing of a sale easier (e.g., by creating digital escrows, eliminating the need for escrows through private-key signatures and/or digitizing land titles to allow for faster registrations of ownership changes), there are real upper bounds on the social/legal lawyer to how much it can help.

Similarly, with traditional securities, there are impediments to liquidity that have absolutely nothing to do with the fact that securities have not been fully digitized or that securities transactions are often filtered through brokers and other intermediaries. For example, I would love to buy stock in The Boring Company (which is a privately held entity). I haven't done so, not because there is no "Boring Stock Token," but because no one wants to sell me The Boring Company stock—least of all The Boring Company itself. Why? Even though I am an "accredited investor," The Boring Company will eventually be deemed an "Exchange-Act-reporting company" (i.e., a company that has effectively gone "public" without a big underwritten IPO event) if it ends up having more than \$10 million in assets and either 2,000 record stockholders or 500 record stockholders who are not "accredited investors"[14]; going public in this manner would be extremely costly and inefficient for most early-stage companies. And since lots of people who are "higher quality" investors than me would like to invest in The Boring Company—people who are more sophisticated, richer, more patient and well-connected—there is no incentive for The Boring Company to take money from me instead of them. Indeed, The Boring Company almost certainly has contractual agreements with its stockholders that prevent such stockholders from selling to smaller investors even where legally possible—instead, the current stockholders of The Boring Company will likely be compelled to sell The Boring Company stock to each other, back to The Boring Company or to other very large, sophisticated investors. That just makes sense—it's easier for The Boring Company to deal with a small number of very wealthy and influential investors than it is to deal with a bunch of "cat-and-dog"/"mom-and-pop" investors (even if they are technically "accredited"), unless and until it decides to go public. Not to mention the fact that if The Boring Company wants to raise money from everyday Joes like me, it can do so by selling us things other than that sweet, sweet, endlessly appreciating equity: for example, it can sell us those sweet, sweet, endlessly depreciating flamethrowers.

As much as we might hate to admit it: ***None of these particular issues will be solved, or even mitigated, by tokenizing assets.*** Rather, these issues are caused by a combination of regulations and market forces that will not be changed at all by the fact that one happens to choose to represent a security in token form rather than paper form. However, as we will see, tokenizing assets (including stock) via ARTs can solve or mitigate other problems.

FIN SKEPTICAL INTERLUDE #2

Since we already have lots of representations of rights/interests in assets, and since actually plenty of those representations already are digital or easily digitizable, to make the case for ARTs we should focus on what distinguishes them from other ways of representing rights/interests in assets. If representing stock via digital tokens stored/tracked on a blockchain technology network is to be materially better than representing stock via digital tokens stored/tracked on Carta's servers (as summarized in "*SKEPTICAL INTERLUDE #1*"), then it must be due to the "blockchain technology network" part of the equation—because everything else is basically the same. To do that, though, we first need to take a brief detour into the unique virtues and benefits of blockchain technology more generally.

Blockchain: This Machine Kills Fascists

Given the vast amount of material that has been published explaining the design, promises and perils of "blockchain technology," it would be hubristic of me to think I could explain blockchain better. Therefore, I'm going to assume a basic familiarity of how blockchain technology works and its by now well-established capabilities. Instead of rehashing that familiar ground, I'm going to focus on a question that often gets obscured in discussions of blockchain: that is, what is blockchain technology's USP? What is it that blockchain's not just *capable* of doing (which is practically anything), but that it actually *does better* than any other technology?

"Blockchains" in the most well-known sense—open-source, decentralized, public, peer-to-peer networks like Bitcoin and Ethereum—are some of the slowest and least efficient network technologies. Because they live on open, peer-to-peer networks where nodes can come and go but still need to all agree on the facts that constitute the state of the network, they face unique challenges in simultaneously maintaining "byzantine fault tolerance" (i.e., convergence on consensus despite the possibility of 'dissent') and "sybil-resistance" (i.e., defense against ersatz consensus created through spam formation of identities and/or transactions). Achieving byzantine fault tolerance and sybil resistance on an open peer-to-peer network imposes serious costs in both time and value.

Basically, from a pure performance point of view, blockchains suck. Worse still, there is nothing that blockchain technology can do that *can't* be done on a network utilizing a so-called "client-server architecture" or "master-slave architecture"—i.e., a network that is built and updated by reference to a particular owner's server and only needs to follow that owner's rules to decide on its state. Worse worse still, since these "client-server/master-slave" architectures can rely on centralized coordination mechanisms to achieve byzantine fault tolerance and sybil resistance, they are faster, cheaper and easier to use.

Thus, blockchain technology's USP for most applications is not "doing the same exact thing as centralized technologies, but materially faster, cheaper and more conveniently." In other words, blockchain is not just a new and better platform the way "smart phones" were new and better platforms as compared to PDAs or PDAs were new and better platforms as compared to simple flip phones. If blockchain represents an improvement on traditional solutions, it must be for other reasons. Many leading blockchain technology thinkers and technologists are clear on this fact and have thus criticized so-called "distributed ledger technologies" (DLT) that cherry-pick aspects of peer-to-peer open blockchain technology and apply them in the context of "permissioned networks" where consensus is achieved by "trusted nodes" in order to pretend to achieve the same things as blockchain but at "client-server/master-slave" speeds.^[15]

Blockchain's USP, then, lies not in "performance" but in performing in a way that furthers certain values better than other technologies. What are these values? In this regard, I'd like to let some other authors and thinkers speak for me by providing a series of quotes from some leading thinkers about the two leading open, public blockchains: Bitcoin and Ethereum:

- “What is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party.”[16]
- “The secret to Bitcoin’s success is certainly not its computational efficiency or its scalability in the consumption of resources[...] Rather than reduce its protocol messages to be as few as possible, each Bitcoin-running computer sprays the Internet with a redundantly large number of “inventory vector” packets to make very sure that all messages get accurately through to as many other Bitcoin computers as possible. As a result, the Bitcoin blockchain cannot process as many transactions per second as a traditional payment network such as PayPal or Visa. Bitcoin offends the sensibilities of resource-conscious and performance-measure-maximizing engineers and businessmen alike. Instead, the secret to Bitcoin’s success is that its prolific resource consumption and poor computational scalability is buying something even more valuable: social scalability [...] Whereas the main social scalability benefit of the Internet has been matchmaking, the predominant direct social scalability benefit of blockchains is trust minimization. A blockchain can reduce vulnerability by locking in the integrity of some important performances (such as the creation and payment of money) and some important information flows, and in the future may reduce the vulnerability of the integrity of some important matchmaking functions. Trust in the secret and arbitrarily mutable activities of a private computation can be replaced by verifiable confidence in the behavior of a generally immutable public computation.”[17]
- “The essence of bitcoin is the ability to operate in a decentralized way without having to trust anyone. The essence of bitcoin is to be able to use software to authoritatively and independently verify everything yourself—without appeal to authority... It is the first market-based security model, in which a series of incentives and punishments ensures what the ultimate result is: you can trust the platform itself, as a neutral arbiter that is not controlled by anyone, without third parties, without intermediaries.”[18]
- “Whereas most technologies tend to automate workers on the periphery doing menial tasks, blockchains automate away the center. Instead of putting the taxi driver out of a job, blockchain puts Uber out of a job and lets the taxi drivers work with the customer directly.”[19]
- “The design behind Ethereum is intended to follow the following principles...5. **Non-discrimination** and **non-censorship**: the protocol should not attempt to actively restrict or prevent specific categories of usage. All regulatory mechanisms in the protocol should be designed to directly regulate the harm and not attempt to oppose specific undesirable applications. A programmer can even run an infinite loop script on top of Ethereum for as long as they are willing to keep paying the per-computational-step transaction fee.”[20]
- “On a blockchain, you can ultimately build anything that you can build on top of a computer. From a computer science theoretical point of view, in terms of what it provides, you can think about it as being a computer. But what it provides on top of that is these extra trust guarantees: the guarantee that the computer will run in the way that you expect it to run, and that a few people can’t make that guarantee fail by going out of business, getting hacked, dying, having their company go bankrupt, deciding to be evil one day, deciding they have some monopolistic interest to start acting differently one day, and all of those different issues.”[21]

The above quotes reflect a vision of blockchain technology as furthering what I will call “individual asset sovereignty values.”[22] Blockchain technologies enhance individual asset sovereignty by empowering users to hold, and engage in transactions with, units of value in a manner independent of, and relatively resistant to intervention by, established institutional and governmental intermediaries and authorities. Importantly, these quotes also acknowledge that “freedom isn’t free”—i.e., that open blockchain software architectures impose costs and inefficiencies that “client-server”/“master-slave” architectures do not—but that these costs are worth paying to achieve individual asset sovereignty. Critically, then, blockchain is not a “value-neutral” technology: if you do not value individual asset

sovereignty, then for most applications[23], there is simply no reason to prefer a blockchain-based technological solution to a “client-server/master-slave” one—and, on the contrary, there would then be many reasons to prefer the “client-server/master-slave” solution, since it will be faster, cheaper and more convenient. Blockchain is like Woody Guthrie’s guitar, which he famously labelled with the phrase: “*This Machine Kills Fascists.*” Simply put: **Individual asset sovereignty is, in my view, the USP and primary *raison d’être* of blockchain technologies.**



Woody Guthrie's guitar

Armed with a vision of what blockchain technology is supposed to achieve, we are now in a better position to assess the relative technological benefits of ARTs over preexisting methods of digitizing asset ownership rights. However, to fully assess and understand such tokenization, there is one more piece of background we need—namely, the corporate-law and corporate-finance background in the history of types of securities instruments and how they represent asset ownership rights. That is the subject of our next section.

HISTORY OF ASSET RIGHTS INSTRUMENTS

Overview

Historically, representation of rights in assets and other securities has taken three main alternative forms. We can refer to these as *types of securities instruments*. I will briefly summarize them and their main distinguishing features in the table below, then go on to explain them in somewhat more depth. The green-highlighted cells show features that are particularly conducive of individual asset sovereignty. **Note:** For convenience of reference, I am here using the term “securities instrument” somewhat loosely to capture different methods of representation, whereas the term is often reserved for transferable securities instruments and thus “book entries” for book-entry shares would not ordinarily be considered “instruments.” As such, there is one type of securities instrument (or form of representation of securities ownership, to be more precise) that I will be ignoring in this section—the so-called “securities entitlement” that was recognized in fairly recent amendments to the UCC. A good discussion of that requires understanding how the market for publicly traded corporate stock works, so we’ll get back to that one later in the article after we have covered that topic.

*Asset Sovereignty
Properties*

Bearer Certificates

Registered Certificates

*Registered Book
Entries
(Uncertificated)*

<i>Can be Owned Anonymously</i>	Yes	No	No
<i>Can be Transferred and/or Pledged Anonymously</i>	Yes	Generally no. Potential exception if “endorsed in blank”.	No
<i>Can Be Issued Anonymously?</i>	Yes	No	No
<i>Can be Transferred or Pledged Peer-to-Peer (without issuer mediation)</i>	Yes	Yes	No
<i>Can Be Transferred Without Generating a “Chain of Title”</i>	Yes	Generally no. Potential exception if “endorsed in blank”.	No
<i>Can be Reissued to Owner if Stolen</i>	No (or very unlikely, since will be very hard for owner to prove it was stolen vs. transferred for value)	Yes	Yes

Bearer Instruments

Bearer instruments are typically heavy-stock pieces of paper anonymously made out to “the Bearer” (i.e., whoever happens to “bear” (i.e., hold—or HODL if you like) the instrument at a given time). They make “the Bearer” the owner of the relevant right. The concept of a bearer instrument is that whoever physically possesses it is *ipso facto* the rightful owner thereof and is entitled to exercise the relevant rights associated therewith, such as the rights of a stockholder to receive dividends from the issuing corporation. There is no *registry* or *ledger* of bearer instruments identifying who owns which shares or what series of transfers the shares have gone through over time^[24], and thus there is no readily ascertainable “chain of title” for bearer instruments. Accordingly, if someone holds and presents a bearer instrument (for example, a bearer stock certificate), they are entitled to exercise the rights represented by the instrument, and the relevant third party (for example, the issuing corporation) is both entitled and required to rely upon the fact that the holder possesses the bearer instrument as sufficient evidence of the legal rights and entitlement of the possessor with respect thereto, absent special circumstances, such as the issuer being on notice that the instrument was stolen.



Panamanian Bearer Certificate

While “bearer instruments” were once the standard and preferred method of representing most securities, they are rare in contemporary finance, having been largely regulated out of existence. For example, all 50 U.S. states, including the blockchain-friendly states of Delaware and Wyoming, expressly prohibit corporations from issuing stock certificates “in bearer form”^[25]. The United Kingdom and most of the European Union have also prohibited bearer shares. Even Panama, notorious for making a cottage industry out of tax evasion, has recently amended its corporate law statutes to require that bearer shares be custodied with trusted authorities who maintain a register of the names and other relevant information of the shareholders. Similarly, tax rules (e.g., the U.S. Tax Equity and Fiscal Responsibility Act of 1982) have been imposed in many countries that make issuance of debt instruments in bearer form (such as the infamous “bearer bonds” of spy movie lore) impracticable by imposing excise taxes and other sanctions on entities that issue them. Thus, to the limited extent bearer instruments are still legal, they are highly frowned upon by regulators, who view them as facilitating anonymous ownership and thus tax evasion and money laundering. Sound familiar? Yes—not coincidentally, cryptocurrencies are very similar to bearer instruments and have come under fire from many regulators for the same reasons.

Registered Instruments

Most financial instruments in contemporary markets are not permitted to be issued on a “bearer basis,” and instead are *legally required* to be issued on a “registered basis”. This requirement is sometimes direct (e.g. under the corporate law statutes of U.S. states, which prohibit issuing stock certificates in bearer form) and sometimes indirect (e.g., through tax sanctions on bearer bonds). Issuing an instrument on a “registered basis” means that the issuer knows who originally bought the instrument from the issuer, issues the instrument in the name of that person and endeavors to keep a record of the chain of title for the instrument, tied to the legal names (and usually also addresses and other identifying information) of each successive transferee.

There are two main methods of issuing securities on a “registered basis”: in certificated form and uncertificated form. The issuer of the security elects what form of instrument to issue.

For example, if The Boring Company issues “certificated stock”, then if you buy stock in The Boring Company, it would issue you an official “The Boring Company” paper stock certificate showing your legal name and the number of shares you bought, signed by two officers of The Boring Company. At the same time, The Boring Company would add your name, mailing address, the number of shares you bought and your stock certificate number to its official stock ledger—which it is required to maintain by the corporate statutes of the state in which it is incorporated (likely Delaware). By contrast, if The Boring Company issues “uncertificated stock” then you won’t receive a paper certificate—but the same book entry will be made in The Boring Company’s stock ledger, and that (along with the stock purchase agreement you signed to buy the stock) will be the sole evidence that you own The Boring Company stock.

Both approaches are similar in that they require the corporation and the stock purchaser to know who each other are and to be in contractual privity with each other. However, they differ in one crucial respect: With “certificated” shares, it is possible for the initial holder of such shares (and any successive transferee) to sell the shares to a third party in a kind of “peer-to-peer paper transfer” without the issuer being informed of the transfer—i.e., a transfer may be completed (with the transferee having perfected rights in the stock) without the issuer knowing about the transfer, who the transferee is or having the opportunity to update its stock ledger with that information[26]. By contrast, with “uncertificated shares,” the transfer is not complete (the transferee cannot perfect its rights in the stock) until the issuer updates its stock ledger with a record of the transfer, including (at least for Delaware corporations) the transferee’s name and mailing address.[27] The rules for “stock pledges” are essentially the same as for “stock transfers”—if I want to pledge my shares in The Boring Company to a lender as security against a loan, then if the shares are certificated, the lender can take possession of the stock certificates to perfect its rights in the shares as collateral; by contrast, if the shares are uncertificated, then in order to perfect its security interest the lender will need to get the borrower to have the issuer add a notation about the pledge to the issuer’s official stock ledger.

Interestingly, there are loopholes whereby certificated instruments issued in “registered form” can be effectively converted into bearer certificates. Let’s go back to The Boring Company and assume for the moment that The Boring Company is incorporated in Delaware. Delaware (like all other U.S. states) forbids corporations from issuing stock certificates “in bearer form.”[28] However, that prohibition applies only to the *corporation* issuing the stock certificates—it does not apply to stockholders who may wish to effectuate secondary transfers of the stock. Thus, a stockholder may “endorse in blank” his stock certificate by signing transfer language on the back and leaving the name of the transferee blank—voila, the stockholder has just turned his “registered” certificate into a ‘blank check’ of sorts—in other words, into something very similar to a “bearer” certificate. The stock certificate, “endorsed in blank” by the original holder, can change hands in bona fide transactions any number of times without the name being filled in. Crucially, the Uniform Commercial Code—which governs the rights of transferees in stock—provides that a transfer of *certificated* stock is complete when the transferee receives *possession* of an endorsed stock certificate (assuming certain other conditions are satisfied, including that the transferee does not have notice of an adverse claim)—it does not require that the transferee’s name actually be filled in. No such possibility is available for *uncertificated* stock, which can only be fully transferred if, as and when the corporation makes a book-entry on its stock ledger.

So then, is there really any difference between a “registered certificate” and a “bearer certificate”? Well, yes—potentially. In order for a transferee to be a “protected purchaser” under the UCC, the transferee must “not have notice of an adverse claim” on the security. Because registered certificates are designed for a chain-of-title type system where transfers are tied to names, in any dispute about whether a given transferee really had good rights to certificated stock, it is possible that a court would view with suspicion that a given transferee did not undertake due diligence to confirm the chain of title. That is to say, if Alice buys stock from Otto via a stock certificate “endorsed in blank” from the original holder, “Bob,” and there were any doubt about Alice’s rights to the stock, a judge could view with skepticism Alice’s failure to confirm that Otto bought it from Bob, or if he did not buy it from

Bob, that he bought it from someone who bought it from Bob. On the other hand, some courts have found that mere “endorsement in blank” is not sufficient to raise suspicion of an adverse claim.^[29] In any event, such questions would typically not arise with fully fledged bearer certificates, which are anonymous by design. Still though, outside of such corner cases, registered certificates “endorsed in blank” are practically identical to “bearer certificates”.

Now that we know what tokenization of assets is about (representing asset-related securities via ARTs), what blockchain is all about (furthering the values of individual asset sovereignty) and the main types of securities instruments that have existed in the modern financial world, we can revisit the purpose of ARTs and discuss how best to achieve those purposes.

Tokenization of Assets—Why Does it Matter (Redux)?

As we observed above, digital securities instruments are possible without, and in fact preexist, blockchain technologies. A digital security instrument can be as simple as a digitally signed PDF stock certificate or PDF warrant issued by a corporation, or as sophisticated as an electronic stock certificate, stock option or convertible note issued through a platform like Carta, which even features “smart contract” functionality of a sort by tracking the vesting status and conversion conditions of securities and offering holders the ability to exercise, convert, or sell (e.g., in a private tender offer) their securities. Thus, if ARTs are to live up to their revolutionary potential, they must offer something beyond these already well-established features. But what?

The answer lies in the USP of blockchain—individual asset sovereignty. If ARTs could provide meaningfully superior individual asset sovereignty relative to other digital securities instruments, then they would represent a significant improvement over the *status quo*. I don’t know how Carta works “under the hood,” but it’s reasonable to assume that it utilizes a traditional “client-server/master-slave” architecture. Let’s assume that is the case and proceed to compare a hypothetical “e-share” issued on Carta, a hypothetical electronic PDF stock certificate and a hypothetical ART issued as an ERC20 token on Ethereum, each representing a share of common stock of a publicly held corporation whose stock trades freely^[2]. ***In setting forth the below comparisons I will be provisionally making some assumptions, omitting certain caveats and qualifications and simplifying certain details—but we’ll loop back and ‘re-complicate’ the important ones later in the article.***

<i>Functional Properties</i>	<i>ARTs on Ethereum</i>	<i>Carta e-Share</i>	<i>PDF Share Certificates</i>
<i>Network Architecture</i>	Decentralized/open/P2P	Centralized (client-server/master-slave architecture served through Web 2.0)	N/A (not confined to any network)
<i>Network Operation & Maintenance</i>	Decentralized—depends on miners/verifiers, users, voluntary software developers and independently existing Internet architecture. Network provides inherent incentives so	Centralized—depends entirely on the company owning the Carta platform remaining in business and either maintaining/operating its own servers or paying third parties to operate servers for it. Closed	N/A (not confined to any network)

	that it is likely to continue in existence and being maintained indefinitely. Open-source software allows any willing volunteer to potentially help maintain the network.	source software means that third parties cannot help maintain the network even if they had incentive to do so. [32]	
<i>Network Improvements</i>	Fairly centralized (upgrades depend primarily on the Ethereum Foundation), but may become more decentralized over time.	Completely centralized—the network will only improve if Carta improves it; no one else even has the ability to do so. Very unlikely to ever become less centralized.	N/A—neither centralized nor decentralized; there will be no improvements.
<i>Privacy Protections</i>	<p>user/user: very good, assuming public key not extrinsically associated with IRL identity, but weak once a public key is linked with IRL identity—future improvements using zksnarks etc. are possible</p> <p>issuer/user: depends on type of security instrument, but typically will be poor due to prohibited status of bearer instruments[33]</p> <p>admin/user: same as user/user (or arguably N/A as there are no “admins” as such—miners are a special type of user, etc.)</p>	<p>user/user: presumably very good, in the absence of hacks</p> <p>issuer/user: same as ARTs on</p> <p>admin/user: presumably poor; Carta and its employees can presumably view all user information</p>	<p>user/user: very good, if PDF not shared or hacked; otherwise very bad</p> <p>issuer/user: same as ARTs and e-Shares</p> <p>admin/user: N/A—no admin</p>
<i>Protection Against Transaction Censorship,</i>	Depends on implementation and type of security	Very low. If the issuer (paying customer of Carta) wishes to block a	Pretty good protection overall; similar to

<p><i>Confiscation and Theft</i></p>	<p>instrument, but potentially provides very good protection if the ARTs are deemed to be stock certificates (with the protection being extremely strong if they are bearer certificates and moderately strong if they are registered certificates) and the relevant smart contract does not have back doors and does not restrict transfers.</p> <p>If the ART is a bearer certificate, confiscation or theft will mean obtaining the private key. This may be more difficult than stealing a paper certificate (particularly if a multisig scheme is used), but the consequences will be very bad as the issuer will not have an “override mechanism” to cancel the stolen certificate.</p> <p>If the ART is a registered certificate, same thing. However, in the case of theft the issuer could refuse to honor the stolen ART and could issue a new ART to the rightful owner.</p>	<p>stock transfer, Carta would likely accept the instruction (subject to applicable law). If a government authority wished to stop a stock transfer, it could enjoin Carta from processing it. If a creditor of a stockholder wished to foreclose on stock that had been pledged to the creditor as collateral, the creditor could get a court to order Carta to enforce the foreclosure.</p>	<p>an ART implemented as a registered certificate.</p> <p>Weak protection against theft via fraud or counterfeiting (see below).</p>
<p><i>Protection Against Fraud/Counterfeiting</i></p>	<p>Excellent protection; benefit from all security</p>	<p>Good, assuming trust in and good behavior by</p>	<p>Very poor. PDF can easily be</p>

	guarantees of Ethereum against double-spends etc. Trust in agents/intermediaries not required, or only required in edge cases.	Carta. Very poor otherwise.	copied, counterfeited or altered.
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While we have had to engage in some assuming and hand-waving, the above table of comparisons illustrates that, yes, just as blockchain generally offers opportunities to achieve individual asset sovereignty that other technologies do not, so, too, ARTs on a blockchain offer opportunities to achieve individual asset sovereignty that other ways of digitally representing securities do not. The USP of ARTs is, like that of blockchain generally, the enhancement of individual asset sovereignty. *However*, as our assumption-making and hand-waving have hinted, ***not all ART implementations are created equal***. ARTs will only enhance individual asset sovereignty to the extent implemented properly, and, as we will see, there are potential implementations of ARTs that actually ***impair individual asset sovereignty***.

SIGNIFIER VS. SIGNIFIED—MAINTAINING THE LINK BETWEEN AN ASSET RIGHTS TOKEN AND THE SECURITY IT IS SUPPOSED TO REPRESENT

Here is a law-school-style hypothetical that unpacks some of the question-begging and hand-waving we did in the prior section by illustrating a potential challenge to the feasibility and usefulness of ARTs:

- Block Corp. is a privately held Delaware corporation that issued “stock tokens” to investors in exchange for cash in a “private placement” compliant with Regulation D. Let’s say the private placement occurred at time
- Alice bought 100 tokenized shares of BlockCorp in the private placement, and is the sole person that controls the private key that controls transfers of the tokens—i.e., she is the legal owner of the shares, and also effectively owns/controls 100 tokens representing the shares—these tokens are a specific form of ART.
- Since BlockCorp sold the shares directly to Alice, BlockCorp lists Alice as the owner of 100 shares of stock on its official stock ledger in accordance with §219 of the Delaware General Corporation Law (“***DGCL*- By time $T + 1$, BlockCorp has become extremely valuable—in Silicon-Valley-jargon, it is a “unicorn”: a privately held technology company valued at over \$1 billion. As a result, Alice’s 100 shares in BlockCorp are now worth \$5 million, and are by far Alice’s most valuable asset.
- At time $T + 2$, inspired by the success of BlockCorp, Alice gets her own blockchain technology idea: to design, build and sell a special refrigerator that cannot be opened except if you send cryptocurrency to a smart contract owned by Alice. The refrigerator will be marketed as providing a cryptographic disincentive to breaking diet goals. Alice will adopt a “Freemium” approach and give away the fridges for free in the hopes of making a fortune off the “long tail” of the fees from opening the refrigerator by people breaking their diets. She calls it “BlockFridge”.**



Blockfridge

- At time $T + 3$, BlockCorp still has not IPO'd and thus its shares remain relatively illiquid and potentially undervalued (so Alice either cannot or does not want to sell them yet), but Alice has decided to quit her job and move forward with BlockFridge. To do this, she wants to take out a \$5 million loan. But the lender will not lend the money without collateral, so Alice pledges her 100 shares of BlockCorp to the lender as collateral.
- At time $T + 4$, BlockCorp still has not IPO'd, and Alice's business has become a disaster. She spent over \$5 million designing and marketing BlockFridge, only to find that almost no one was willing to even accept a BlockFridge for free—it turns out that people like to be able to open their fridges at will, even if they are dieting! She has missed several interest payments, and the lender has sent a threatening letter from its General Counsel that she must pay up or the lender will foreclose on the BlockCorp stock Alice pledged as collateral. On the plus side, BlockCorp just completed its Series D round at an even higher valuation, and Alice's BlockCorp stock is now worth \$6 million. Thus, Alice is not “bankrupt” (in the casual sense) or insolvent (in the strict sense), since her assets exceed her liabilities.

- At time $T + 5$, the lender has not yet foreclosed on Alice's BlockCorp shares, and BlockCorp finally IPOs. Alice immediately sells her shares to Bob for \$6 million. As part of selling her shares, Alice, of course, also sends her 100 BlockCorp share tokens to Bob's wallet. Bob knows nothing about the lender, Alice's debt or the fact that the stock has been pledged to the lender.
- At time $T + 6$ (which we will posit is immediately after $T + 5$), instead of paying back her loan, Alice converts all of the \$6 million from Bob into untraceable Monero, calls up her local vacuum repairman and orders a dust filter for a Hoover Max Extract 60 Pressure Pro. Just like in *Breaking Bad*, she is given a new identity and whisked off to the Midwestern United States to live out the rest of her days working at the local Cinnabon and sleeping with one eye open in a sort of self-imposed witness protection program where the lender and his goons can never find her. That may be extreme, but maybe the lender is Tony Soprano.



Cinnabon Gene, soon to be joined by Cinnabon Alice

Now, in true “Socratic fashion,” here is the law-school-style question: ***At time $T + 6$, who legally owns the 100 shares of BlockCorp that used to be Alice's: Bob, who ponied up \$6 million at $T + 5$ and holds the tokens, or the lender, who ponied up \$5 million at $T + 3$ and received a “pledge” of those same 100 shares as collateral, but does not hold the tokens?*** Before you read on, try to think about what you think the result should be and why.

Here is what would be the best result for people who want ARTs to be useful: since Bob received the tokens (i.e., control of the tokens was transferred to a private key possessed/known by Bob), Bob is the legal owner of the stock, and the lender is completely out of luck. The lender should've held the tokens or required them to be escrowed in a smart contract if the lender wanted to perfect its rights. Call this “Result #1”.

Call the alternative “Result #2”: lender owns the stock despite not holding the tokens. Result #2 would be a disaster for fans of asset tokenization. The last thing anyone wants is to buy a token thinking that makes them a stockholder of BlockCorp, only to find out that they own a valueless token—a proverbial “promise not worth the paper it's written on”—because a prior creditor is the rightful stockholder. If it is possible that Bob can receive the ARTs from Alice yet not end up being the legal

owner of the rights represented by the ARTs, then all of the nice asset sovereignty features of blockchain that we thought ARTs could add to traditional securities actually go out the window. On the contrary, for ARTs to materially enhance asset sovereignty, it must not ordinarily be possible for ownership of the ARTs to become separated from ownership of the underlying right the ARTs represent—the ART and the right, the signifier and the signified, must always “travel together” so that someone who acquires the ART and thus takes advantage of all the wonderful peer-to-peer and other asset sovereignty features of blockchain can rest assured that he is the lawful owner of the right the ART is supposed to represent. In other words, ARTs must represent the correlative rights very, very tightly, or ARTs are just not very useful.

How can we make ARTs represent the correlative rights sufficiently tightly to avoid result #2? Recall the discussion under “*History of Asset Rights Instruments*” above and now consider how different results are possible depending on whether ARTs are implemented as *bearer certificates*, *registered certificates* or *registered book entries*:

- If the ART is a ***bearer certificate***, it can almost never become detached from the underlying right: except in the situation where a bona fide owner of the ART can prove his private keys controlling the ART were stolen, whoever happens to hold the ART will have all the legal rights and entitlements of the owner of the right that is supposed to be represented by the ART. If the ART is a bearer certificate, we get Result #1 – Bob owns the BlockCorp shares, because he holds the BlockCorp tokens; Alice’s lender is out of luck.
- If the ART is a ***registered certificate***, the relationship between the right and the ART is slightly looser than for bearer-type ARTs, but not by much.
 - The relationship is *looser* because:
 - If, before Alice transfers the tokens to Bob, Oscar steals Alice’s private key to gain control of the ART, Alice can call up BlockCorp, let them know not to honor the ARTs, and have BlockCorp issue a new token representing the same shares. (I am assuming that BlockCorp has set up its system to allow these possibilities, which would be legally necessary for ARTs that are registered certificates). After all, BlockCorp *knows* Alice; it doesn’t know Oscar at all. Only if Oscar could prove that Alice voluntarily “endorsed” the ART over to Oscar would Oscar be entitled to treatment as the rightful owner. (Again, I am here assuming that BlockCorp has not set up its system in a stupid and/or illegal way—so that more is required for an “endorsement” than just happening to possess the private key for the address where the ARTs sit).
 - If Alice loses her private keys, she can similarly let BlockCorp know, and BlockCorp, since it knows who she is, can simply issue her new ARTs representing the same shares.
 - The relationship is nonetheless still *pretty tight* because, to fully protect its security interest in a *certificated* security, a creditor will need to *take control* of the certificate. Practically speaking (again, assuming that BlockCorp has set this up in a legal/non-stupid way), this means that in our hypo we would again get Result #1, not Result #2. Bob ended up with the ARTs, which means the lender didn’t “control” them, which means Bob has a better claim to ownership of the stock than the lender does. The lender’s lawyer messed up, and the power of ARTs triumphs again—serving the asset sovereignty rights of blockchain-savvy Bob (as the token holder) over those of blockchain-stupid Tony Soprano (as the lender who failed to hire a good lawyer to advise that he should hold the tokens as collateral).

- If the ART is implemented via a *book-entry* approach, then we will land on one of two types of possible implementations, each of which would have a disastrous impact on the proposition that ARTs further individual asset sovereignty, because one makes the relationship between the ART and the right *too tight* by removing all individual asset sovereignty and the other makes the relationship between the ART and the right *way too loose*.
 - Book-Entry Possibility #1: BlockCorp maintains a permissioned, enterprise style ledger as the only blockchain network on which its stock tokens can trade. BlockCorp declares—as is legally possible under the corporate law of Delaware after the 2017 “blockchain amendments” to the DGCL—that this blockchain itself just *is* BlockCorp’s “stock ledger,” such that every transaction recorded on that blockchain is the same as an entry on BlockCorp’s official stock ledger.
 - Book-Entry Possibility #2: BlockCorp allows its stock tokens to trade *freely* (or *semi-freely*) on a public network like Ethereum, but does not deem that blockchain to *be* its own stock ledger—rather, BlockCorp still maintains its own separate stock ledger (which could be a separate blockchain, or excel spreadsheet, or physical book—doesn’t really matter).

Making ARTs bearer certificates would be our best bet if we wanted to come as close as possible to achieving the vision of tokenized assets that maximizes the potential of ARTs to aid individual asset sovereignty. By classifying ARTs, legally and contractually, as bearer instruments representing rights in a particular asset, we could ensure that transfers of the ART are almost always, legally and functionally, tantamount to transfers of the right itself. As noted above, even existing non-security blockchain assets—bitcoin, ether, you name it—have many similarities to “bearer instruments”—and thus have provoked similar concerns regarding money laundering, criminal financing and tax evasion.

Indeed, blockchain technologists have breathed new life into the notion of “bearer instruments.” Early thinkers on digital currencies and digital currencies were very conscious about this—for example, Nick Szabo discussed treating the term “digital bearer certificate” or “token” as a generalized concept encompassing digital cash^[38]. While those early writings don’t receive as much attention as they should in the post-bitcoin era, many blockchain enthusiasts nevertheless reflexively think of tokens and cryptocurrencies as being bearer instruments and instinctively use bearer-instrument-logic in discussing them. One simple but ubiquitous example is the common tendency of writers and others to conflate whoever possesses the private key corresponding to a particular public blockchain address with the legal owner of the tokens or cryptocurrencies controlled by that key.^[39] While convenient for reference purposes and more often true than not, this language obscures that “bearer instruments” fit into a very specific legal and contractual framework, and that most blockchain tokens do not fit into that framework on the social/legal layer.^[40]

However, from the standpoint of the blockchain network itself (as opposed to the standpoint of the social/legal layer), *cryptocurrencies essentially are bearer instruments*. From the standpoint of the bitcoin network, if I hold the keys controlling the spending of a particular UTXO, I am treated as the owner of that UTXO, without having to prove who I am, who I bought it from or that my ownership is lawful—yes, the “chain of title” is built into the blockchain, but at no point am I required to prove who holds the private keys and that they justly do so—my control of the private keys is treated by the network as tantamount to me owning the relevant UTXO. Just as if I owned a bearer instrument, where if I lost the certificate I would not be likely to be able to get the issuer to give me a new one, if I lose the private key for my bitcoin, the bitcoin are likely lost forever.

However, as we discussed above under “History of Asset Rights Instruments,” bearer instruments have become some combination of illegal and/or unfeasible—so, in many if not all cases (and certainly for some of the most powerful cases—bearer corporate stock certificates and bearer debt instruments),

deeming ARTs to be bearer instruments is not going to work for parties wishing to comply with the law.

The next best thing is to deem ARTs to be registered certificates. As we saw in our hypo, it will be hard for Bob to acquire ARTs styled that way and still lose to a prior claimant—the relationship between the ART and the underlying security will be relatively tight. And with certificated securities, peer-to-peer transfers are possible, and the issuer and various institutions neither need to know about nor give permission for every transaction in which the security is pledged or sold. This means that the ARTs being on a blockchain can actually contribute to the holder's individual asset sovereignty, and actually represents a material improvement over the current status quo. Thus, deeming ARTs to be equivalent to something as old-fashioned as paper stock certificates turns out to be the best way of “tokenizing securities” within a legally cognizable framework. For what it's worth, certificated securities have been the norm for most of the history of markets, and are still recognized as superior for many purposes[41]. It is only with the advent of public stock markets at scale that the use of paper certificates became infeasible, and in getting rid of them we created many other problems—all of which will be summarized below. Now that we have blockchain, the answer is emphatically **not** to move everything over to book-entry—rather, it's that we can now go back to a radically improved certificate-type system, only now without any of the inconveniences and intermediations that previously ensued from it.

The least good option from the standpoint of individual asset sovereignty is making all securities book-entry and calling the blockchain the official ledger. As we observed above, there are two main possibilities for implementing such a system. Both of them have significant drawbacks.

PARTIAL RECAP AND NEXT STEPS

We've covered a lot: the promise and perils of tokenization, the promise and perils of blockchain, the history of asset rights instruments and how the choice of instrument type in your asset token implementation will affect its usefulness. Where does all that leave us? Basically here:

- tokenization of assets is not best conceptualized as “digitizing” or “converting” assets in some metaphysical way
- instead, tokenization of assets is best understood as a new way of doing something that humans have been doing for several centuries—that is, representing rights or entitlements to, or interests in, assets with instruments, which in this case happen to be digital tokens and live on a blockchain—we call them asset rights tokens, or “ARTs”
- digital representations of asset rights are possible without blockchain tokens; thus, for ARTs to be super cool/useful/revolutionary, it must be because we're adding “teh blockchainz”
- blockchain is mostly a slow, inefficient, expensive technology, but it does have one USP: it is better than any other technology at enhancing individual asset sovereignty, and thus this must also be the USP of ARTs as compared to other ways of digitizing securities
- historically there have been three major types of securities instruments: bearer certificates, registered certificates and registered book-entries
- an ART will deliver, or fail to deliver, on the promise of achieving individual asset sovereignty based in large part on what classification it has as a securities instrument—it would deliver maximum individual asset sovereignty if it were a bearer instrument, but those are mostly illegal or otherwise infeasible due to regulations—treating ARTs as registered certificates is the next best thing and is still pretty good—treating ARTs as book-entries on a ledger run by the issuer or a consortium of institutions is the worst and actually can *reduce* individual asset sovereignty as compared to non-blockchain systems involving certificates.

But the title of this article refers not just to tokenization of securities generally but a specific type of security—corporate capital stock. It's taken us a while to get here, but now we can finally turn

from the general topic of ARTs to one specific type of ART: stock tokens.

Stock vs. “Securities”—Differing Rights and Regulations

The issue of tokenizing corporate capital stock is one (relatively narrow) instance of the broader issue of tokenizing securities. “Tokenizing securities” has become one of the biggest blockchain buzzwords in 2018: simultaneously representing a promise of future horizons and a call to arms. However, it is less common that the buzzword is broken down to discuss the nuanced challenges of tokenizing a particular *type* of security, which is one of my goals for this article.

A “security,” broadly (and somewhat loosely) speaking, is any right or instrument that potentially entitles the holder to profit based on the success of an enterprise managed by others. Thus, the concept of “securities” encompasses an incredibly broad range of different kinds of instruments, arrangements and agreements such as bonds, asset-backed securities, contingent value rights, partnership interests and, yes, capital stock. But because different categories of securities implicate different and at best only partly overlapping risks, benefits and regulatory regimes, speaking of “tokenizing securities” generally does not facilitate deep thinking or discussion into the topic. Part of my hope for this article is that, by focusing on one type of security—corporate capital stock—and the very idiosyncratic challenges associated with tokenizing that type of security, I can help illuminate the need for greater specificity and more research and development on the issues surrounding tokenization of securities generally.

“Capital stock” is a specific kind of security issued and sold by a corporation (often for cash, but sometimes for services or property), which typically confers upon a stockholder the following cluster of default rights:

- the right to receive a pro rata share of the “equity” (i.e., the excess of assets over liabilities) of the corporation in specified circumstances, such as a liquidation of the corporation
- the right to receive dividends or other distributions from the corporation in specified circumstances
- the right to vote on, among other things, the election or removal of directors, amendments to the corporation’s certificate of incorporation and certain extraordinary strategic transactions (such as mergers or sales of all or substantially all assets of the corporation)
- the right to generally be shielded against responsibility for liabilities of the corporation beyond the capital the stockholder put at risk to purchase the stock (this is called “limited liability” and historically is seen as the preeminent benefit conferred by the “corporate franchise” in the evolution of finance)
- the right to have the directors and officers of the corporation act as fiduciaries of the stockholders who are charged to act with the duties of loyalty, candor and care toward the stockholders^[42] and
- the right to receive certain kinds of disclosures from the corporation, including copies of the corporation’s books and records and notices of impending events such as stockholder votes or dividends.

This cluster of default rights is generally unique to corporate capital stock. Although other equity securities (e.g., membership interests in a limited liability company, or partnerships in a limited partnership) may share some or all of these rights, it is only corporate capital stock has them by default. All the more so, debt-based securities such as bonds, debentures and asset-backed securities will have very different features from corporate capital stock—for example, debt-based securities typically represent the right to receive specific payments denominated as “debt” rather than a potentially uncapped equity interest, typically do not entitle the holder to vote on general governance issues of the issuer, and typically do not entitle the holders to treat the corporation’s directors and officers as fiduciaries.^[43]

Just as capital stock may confer different rights than other securities, so too, capital stock may be subject to different laws, rules and regulations than other types of securities. While in some cases the differences may be accidents of history or flukes of path dependence, there are also good policy reasons why regulations should differ from security to security. For example, lenders to a corporation have the opportunity—pursuant to the Uniform Commercial Code (UCC) as adopted by the corporation’s state of incorporation—to file “UCC financing statements” as public claims against the assets of a corporate borrower, which in most cases will establish the seniority of the lenders’ claims against both the corporation’s prior lenders who failed to file UCC financing statements and the corporation’s later lenders who may or may not themselves file UCC financing statements. By contrast, for example, stockholders have no such protections against claims on the corporation’s equity by later stockholders, and so need to be protected in another way: namely, by having the right to vote on amendments to the certificate of incorporation that would authorize new, potentially more senior classes or series of capital stock.

Therefore, for purposes of the remainder of this article I will focus on legal issues that are specific to corporate capital stock rather than those that apply to securities as such more generally. In the United States, this means dealing with state-specific corporation statutes and commercial codes. By far the most popular U.S. state for incorporations is Delaware, which has turned corporate law into its primary export and become the preeminent corporate law jurisdiction not just in the United States, but the world. Also of interest, Wyoming has recently passed a highly ambitious set of blockchain-enabling amendments to its corporation and commercial statutes. Accordingly, in discussing the laws around corporate capital stock, my main points of reference will be the DGCL and the Wyoming Business Corporations Act (the “*WBCA*”), as well as on the UCC, versions of which have been adopted by each of those states. I will *not* focus on (and in most cases will ignore) more general securities laws, be they at the state level (Delaware’s and Wyoming’s respective “blue sky” laws) or at the federal level (the Securities Act of 1933, the Securities Exchange Act of 1934, the Williams Act and the rules and regulations promulgated by the SEC thereunder). Of course, securities laws *do* apply to corporate capital stock, but they do not apply to them much differently than they do to other types of securities—thus, it is less interesting to discuss securities laws as such in an article about tokenizing a specific kind of security, corporate capital stock.

To summarize, the tokenization of capital stock is worth talking about separately from the tokenization of assets generally or even the tokenization of securities generally because:

- capital stock confers a unique cluster of default rights that differs from the rights associated with owning other securities or other assets;
- capital stock is subject to a U.S. state corporate statute such as the DGCL or WBCA, as well as the common law of a U.S. state, in addition to being subject to securities laws generally;
- there are both historical and sound policy reasons why capital stock is treated somewhat differently from other securities
- it is the basis for the vast majority of significant legal entities in the U.S.

MODERN STOCK MARKET DYNAMICS

The most fundamental division in the market for U.S. corporate capital stock is that between *privately* held corporate capital stock (or stock of “private corporations”) and *publicly* held corporate capital stock (or stock of “public corporations”). The concepts of “private” and “public” are somewhat fuzzy, but for most purposes it would be fair to say that a U.S.-based corporation (and its stock) is public if its stock trades on a national securities exchange such as NASDAQ or NYSE or the corporation is otherwise required to file periodic and annual reports with the SEC under the Securities Exchange Act of 1934—i.e., is a so-called “Exchange-Act-reporting company”. Otherwise, the corporation (and its stock) is “private.” There are nuances that make that definition not completely adequate (for example, corporations with stock offered pursuant to a Reg A+ exemption are technically

private but quasi-public because their stock is freely tradeable, and they are required to file some periodic and annual reports), but it is good enough for purposes of this article.

The situation with *privately held* corporate capital stock is fairly simple. Individuals and institutions invest in privately held corporations through unregistered “private placements” and receive capital stock in exchange for cash or services. Whether the private stock is issued in book-entry or certificated form, it is typically subject to various transfer restrictions—usually a mix of both voluntary contractually agreed restrictions such as rights of first refusal in favor of the corporation or its other stockholders and legally required restrictions such as those imposed by Rule 144 under the Securities Act of 1933. Because the issuing corporations are not required to file reports with the SEC, they are generally not widely followed by the public and their stockholders may have far less information about them than the average public investor has about a public company—accordingly, their stock rarely, if ever, trades, and thus there is not much of a secondary market for privately held corporate stock.^[44] Generally speaking, the value of private stock is at once highly speculative and quite stable, with valuations typically changing only when the corporation does a major financing round driven by venture capital investors applying their unique valuation methodologies. Thus, outside investors in private companies are holding their stock while awaiting a major “exit event”—such as an initial public offering or acquisition—that will create immediate and broad liquidity for all stockholders.

The situation with public stock/public corporations is very different. Public stock trades freely and daily on large public exchanges. The presence of institutional market makers willing to buy and sell publicly traded stock at current market prices makes it highly liquid. Publicly traded stock is subject to significant price volatility based not just on fundamentals or institutional valuations, but also news, quarterly performance of the corporation, general market trends and, yes, sheer speculative trading by both institutional and retail traders. Finally, public corporations are subject to the highly exacting disclosure standards of the Securities Exchange Act of 1934, the rules and regulations promulgated thereunder and the watchful eye of the Securities and Exchange Commission—meaning that, when the system functions as intended, there is rarely an item of material information about the corporation or its prospects that is hidden from the public for long.

Both public and private corporations issue their stock on a “registered basis”; however, there is a key distinction between how they do so.

Because private stock is held by a relatively small group of persons, rarely trades and is subject to transfer restrictions, most private corporations know all of their stockholders by name and address and are in direct contractual privity with them through stockholder agreements. Any transfers of private stock that do occur are typically known to, and approved in advance by, the corporation and recorded on its stock ledger. Even when private stock is of the certificated variety and thus theoretically could be transferred on a purely peer-to-peer basis, the stockholders of private companies are typically party to contracts that require them to notify the corporation of the transfer and require the new transferee to sign onto those contracts. Also, since the shares are unregistered, the issuer typically must be brought into the loop to provide current information regarding the corporation’s financials in order for a transfer to be permitted under Rule 144. As a result of all these factors, there is rarely much of or any difference between a private corporation’s “stockholders of record”—i.e., the persons listed as owning the shares in the corporation’s stock ledger—and the private corporation’s “beneficial stockholders”—the persons who legally own the stock and are entitled to exercise the voting and economic rights associated therewith.

By contrast, public corporations typically have only one or a few “stockholders of record,” with one being the largest and most important: viz., Cede and Company (“*Cede*”), a New York partnership. But Cede is not a *real* stockholder—rather, Cede is a “nominee”: i.e., an entity that exists for the specific purpose of being named as a record stockholder on the books of most public companies. However, Cede is not the nominee of the actual beneficial stockholders—no, rather, Cede is the nominee of yet another intermediary, The Depository Trust Company (“*DTC*”).

Like Cede, DTC has no economic or voting interest in the stock—it has no “skin in the game” with respect to the stock in question. Rather, DTC is a limited purpose trust company which custodies stock certificates representing substantially all of publicly traded U.S. corporate stock. These are not just any stock certificates, but are so-called “jumbo” stock certificates. Typically, for a given corporation, DTC holds one single stock certificate representing the entire number of issued and outstanding shares of that corporation, and that stock certificate is made out to the name of Cede (or, alternatively, if the shares are “book-entry” rather than “certificated,” there is one giant book entry on the issuing corporation’s stock ledger, showing Cede as the owner of the entire number of issued and outstanding shares). Certain DTC employees are partners in Cede and thus are authorized to instruct DTC on behalf of Cede on how these jumbo certificates, and the shares they represent, should be held and transferred. Thus J. Travis Laster has described DTC as “the ultimate central intermediary,” noting that “[o]ver 75 percent of the shares of publicly traded companies are held by DTC.”^[45]

Since DTC functions as a trust, the natural question arises—who are the trust’s beneficiaries? Here, one might be tempted to suppose that the beneficiaries would be persons we typically think of as corporations’ actual stockholders—i.e., everyone from Wall St. floor traders, to hedge funds, to mom & pop retail investors. If that were the case, the system would already be pretty complex. But unfortunately, the complexity does not end there. Rather, the beneficiaries and owners of DTC are not really the beneficial stockholders as such—but “DTC Participants”. And who are DTC Participants? “Over 800 custodial banks and brokers...”^[46]

It is the banks and brokerages which will have customers—both institutional and retail investors—who are the true “beneficial owners” of the corporate stock: i.e., the persons who buy the stock and are entitled to exercise its economic and voting perquisites. At a minimum, these beneficial owners are at least three removes away from a given corporation of which they are stockholders.

But DTC and DTC Participants are not the only intermediaries in this system. SEC rules require brokers and banks to honor the choice of their customers as to whether those customers will be “objecting beneficial owners” (OBOs) or “non-objecting beneficial owners” (NOBOs) of corporate capital stock. If you are a NOBO, the financial institution that holds your shares will inform the corporation’s transfer agent of your identity. If you are an OBO, however, it will not do so—and, indeed, it is *prohibited* from doing so. As a result, not only do stockholders need various intermediaries such as Broadridge to communicate with the corporation about how they wish to vote their shares, but also, the issuing corporation needs agents and intermediaries to communicate with its stockholders. These intermediaries include Institutional Shareholder Services (ISS) (to which many institutional investors have largely delegated their stockholder voting decisions), Broadridge (an “investor communications firm”), and various so-called “proxy solicitors” and “proxy advisors.”

Taken together, the net effect of this system is to convert certificated shares that are issued on an aggregate basis by a corporation to one entity (Cede/DTC) into book-entry shares that are issued somewhat more broadly to other entities (the DTC Participants) (as recorded on DTC’s ledger), and to convert *those* book-entry shares into *more* book-entry shares issued very broadly to the public (as recorded on the individual ledgers of the various DTC Participants). Effectively, it’s a complicated and heavily intermediated—and, yes, in certain respects *decentralized* and *distributed*—distribution network or “ownership waterfall” for stock. But because the beneficial stockholders must ultimately be the ones exercising the voting rights with respect to the stock, the water must also flow *back up* the waterfall: from the beneficial holders, to the brokerages, to DTC, to the record holder Cede and finally to the corporate issuer. And although there are additional intermediaries known as “transfer agents” which attempt to maintain a comprehensive ledger of data collected from all these sources, it is imperfect both because there are many participants and because some of those participants (the OBOs) are legally entitled to anonymity. And, of course, at every fork of the network, every splitting of the fall, there is an intermediary with its hand out taking its “cut” of the action in the form of fees and/or commissions.

In effect, this system creates a fourth type of security instrument to add to our list of instrument types: the “security entitlement”. Securities entitlements were enshrined into law through the 1994 amendments to the UCC, which defined a security entitlement as a property right that a person obtains in the contents of a “security account” with a “securities intermediary.”^[47] The DTC Participants are securities intermediaries for their clients, and DTC is a securities intermediary for DTC Participants. When you buy a share of stock in Apple from a broker like E-Trade, your ownership of that stock is represented via the instrumentality of a “security entitlement”—an ownership interest in an E-Trade’s account with DTC, which in turn connects up with DTC’s ownership interest in the “jumbo certificate” of Apple shares held by Cede. In order to make sure that, despite the several degrees of separation between you and that Apple stock certificate, you can exercise meaningful ownership rights over the shares, the UCC has put in place special rules for “securities entitlements.” For example, if you, like Alice in our hypo above, would like to pledge your interest in Apple shares to a lender—you can do so. And the lender would not be crazy to accept this arrangement, because the UCC says the lender can get priority with respect to your interests in E-Trade’s account over E-Trade’s, DTC’s and Cede’s creditors. In effect, commercial law treats you as the owner of Apple shares, even though, from Apple’s perspective, Cede is really the owner and you are not.

Despite all its apparent complications and inefficiencies, it is important to recognize that, up until very recently, this system was far more efficient than the available alternatives. Prior to the DTC/Cede nominee system, trading stock involved a picturesque ‘system’ of having various bank and brokerage employees run to and from one bank or brokerage to another with satchels stuffed with stock certificates, neckties figuratively flapping in the wind behind them as they hustled and bustled to complete trades before close of market. The DTC/Cede nominee system is certainly more efficient than that.

However, since the days of daily paper transfers are long behind contemporary equity markets, what looms largest today are the numerous and serious shortcomings and inefficiencies of the DTC/Cede nominee system, including that:

- the roles of Cede, DTC, banks/brokerages, transfer agents, investor communication agents, proxy solicitation agents and others as intermediaries and agents necessary to effect stock trades and stock votes, each of which must be:
 - compensated, via fees and/or commissions, for its work;
 - insured against the risks it incurs by virtue of performing such services;
 - trusted to hold, transfer and vote stock accurately and non-fraudulently; and
 - trusted with confidential and potentially market-moving information;
- because of all the intermediaries involved in stock trading:
 - settlement of stock trades is not even close to instantaneous—indeed, it is, by information-age standards, incredibly slow;^[48]
 - stock markets cannot be open 24/7, cabining them by time zone and resulting in information asymmetries that are used and abused by issuers and sophisticated traders
- there is ongoing, systemic risk of mistakes such as those described Laster in the anecdote above; and
- the heavily mediated relationship between corporations and their beneficial stockholders makes it difficult for each to comply with legal requirements necessary to fulfill their respective obligations toward one another and exercise their respective rights against one another.^[49]

One more point worth noting: Although under the nominee system much of Wall St. has moved to electronic accounting, and thus from a stockholder's perspective shares increasingly function as *book-entry*, nevertheless Cede still holds shares in certificated form—albeit those certificates just don't matter a whole lot, since they rarely change hands. Moreover, many private corporations continue to issue stock certificates to all of their stockholders—indeed, even as a M&A lawyer in Silicon Valley, where I was involved in scores of deals involving young technology companies, I can count on one hand the number of privately held companies that issued only book-entry, rather than certificated shares. The phenomenon of book-entry-only shares is relatively new: as described by the Uniform Law Commissioners: “When the concept of uncertificated security was included in Article 8 [of the UCC] in 1977, it was a **totally new** idea.” We will loop back to this issue of certificated vs. uncertificated securities later in the article, but please keep it in the back of your mind as you continue through the article.

To summarize:

- public corporate stock and private corporate stock are subject to different norms and requirements
- the mechanics of the holding, voting, trading, clearance and settlement of public corporate stock are highly complex and require the involvement of numerous intermediaries and agents standing between corporations and their beneficial stockholders, including:
 - Cede (the record stockholder of most public stock)
 - DTC (the custodian of most public stock and a maintainer or a private ledger for banks and brokerages)
 - banks and brokerages (each of which maintains a private ledger for their customers, some of which are OBOs (objecting beneficial owners) and others of which are NOBOs (non-objecting beneficial owners))
 - transfer agents of the corporation, which attempt to keep comprehensive lists of record and beneficial stockholders (excluding the OBOs)
 - an investor communication firm, Broadridge
 - proxy solicitation firms
- these complex public stock mechanics:
 - result in stock trades being relatively slow (T + 2 business days);
 - create risks of error, legal foot-faults and disenfranchisement and delays
- although most daily trades of public company stock occur in book-entry form, the shares themselves are still represented by stock certificates held in the name of Cede by DTC, stock certificates remain prevalent with privately held corporations, and the notion of uncertificated stock is a relatively recent innovation in corporate law.

MO' STOCK, MO' PROBLEMS: HOW BLOCKCHAIN MIGHT (OR MIGHT NOT) HELP

Above, in the section entitled “*Tokenization of Assets—What Is It And Why Does It Matter?*” we briefly explored why tokenization of interests in assets may provide several advantages. It is now time to make that same inquiry specifically about corporate capital stock. Yes, all the same reasons why asset tokenization can be a good thing apply just as much to corporate capital stock. But tokenization of corporate capital stock can additionally solve some problems that are quite specific to corporate capital stock and not shared in common with most other types of assets, whether they be securities like bonds or tangible assets like fine works of art—namely, tokenization of corporate capital stock can reduce the mediation and inefficiencies described above under “Current Market Mechanics for U.S. Capital Stock”. I also believe that, beyond mitigating or solving current problems and inefficiencies,

tokenization of corporate capital stock can create the opportunity to do new things in new ways with corporate capital stock, particularly when combined with smart contracts.

Problems with the Status Quo Markets for Capital Stock

The markets for both privately held stock and publicly traded stock suffer from a variety of problems and inefficiencies; however, they are not the *same* problems and inefficiencies. With privately held corporations, the record stockholders are typically the same as the beneficial stockholders, and so there is not as much need for securities intermediaries; however, the market for the stock of private corporations suffers from low liquidity and thus poor price discovery. Additionally, the capitalization structure of private corporations—particularly technology corporations—tends to be extremely complicated, with multiple classes (and multiple series per class) of types of capital stock having different features, as well as any number of options, warrants, convertible notes and other instruments with complicated vesting schedules, differing tax treatments, and other complexities, and the current status quo requires that these complexities be administered by various intermediaries through mostly manual and error-prone processes. On the public corporation side, the complex system of securities intermediaries we ran through above solves one problem—the problem of how to trade stock quickly and freely—but does so by creating a separation between a corporation’s *record stockholders*—the ones who hold stock certificates and have their names on the corporation’s book (typically really just one—Cede) and its *beneficial stockholders*—the persons holding real economic interests in the corporation, the ones with “skin in the game”. This separation between record and beneficial ownership spawns problems for both the corporation issuing the stock and the beneficial stockholders: Let us run down the list of some problems and see how each problem affects (or fails to affect) private corporations and public corporations. This will help us explore whether and how different methods of tokenizing corporate capital stock can help, fail to help, or even exacerbate these problems.

- ***Problem #1: Transaction Fees.***

- Public Corporations. Due to the separation between record and beneficial stock ownership with public corporations, to trade in, vote or hold the stock of public corporations, a variety of intermediaries are needed basically every step of the way. These intermediaries all need to get paid for their services and, directly or indirectly, it is the stockholders and the corporate issuer who are paying.
- Private Corporations. Although the existence of a direct relationship between the corporation and its record and beneficial stockholders dramatically reduces the need for securities intermediaries, thus also meaning there are fewer transaction fees, transaction fees still arise in other forms. The extreme complexity of the capitalization table and governance structure of many private corporations (particularly Silicon Valley technology companies) creates a need for day-to-day management on capitalization management platforms like Carta and, for strategic transactions like tender offers and mergers, specialized payment agents and stockholder representatives (such as Nasdaq Private Market and Shareholder Representative Services; these intermediaries undertake the costly and mostly manual process of contacting individual stockholders to chase down their stock certificates, pay them dividends and deal consideration, and get them to sign transaction documents; they also can be needed to track the complicated vesting schedules and liquidation waterfalls of the corporation’s complicated equity securities—when needed, those intermediaries can and do charge sizeable transaction fees.

- ***Problem #2: Delays.***

- Public Corporations. Securities intermediaries enable transactions that are faster than two people who live on opposite sides of the country physically exchanging

a stock certificate, but, because they are intermediaries, they inevitably introduce settlement delays as compared to a peer-to-peer transaction where two people could transact instantly. Currently, settlements for public stock trades are only required to be completed within T + 2 business days. Markets can change wildly, and thus it is quite undesirable to hold unhedged risk even for two business days; thus, this can be considered another type of transaction cost.

- Private Corporations. In the private company context, delays can be significant—less because of intermediation (there isn't that much) than because of poor recordkeeping, complexity and lack of automation. For example, in the context of a merger of a privately held corporation, it can take weeks or months to distribute the stockholder consideration to all stockholders. This is because, if the stock is certificated, the stockholders are required to either track down their stock certificates and turn them over to the Payment Agent, or to sign an affidavit and indemnify the Payment Agent, the corporation and the acquirer regarding their lost, stolen or destroyed stock certificates. Sometimes the corporation's records are wrong—for example, it has recorded the wrong stock certificate number for a given stockholder—which introduces further delays. On the other hand, some delays are “on purpose”—for example, most private company stock is subject to contractual rights of first refusal that give the corporation and/or the existing stockholders 30-60 days to buy stock from an existing stockholder before a third party is allowed to buy that stock.

- ***Problem #3: Trust and Lack of Privacy.***

- Public Corporations. Beneficial holders must rely on/trust in individual brokers, the brokerage firms they work in, stock exchanges, clearing houses, Broadridge, proxy holders, et. al. to accurately transmit their messages (e.g., a stock vote) to the corporate issuer, and the corporate issuer must similarly trust the same institutions and individuals to accurately flow information and dividends down to the beneficial holders. By the same token, information that a beneficial holder would like to keep private—such as that the holder is buying or selling a large, potentially market-moving chunk of stock or voting a particular way on a transaction—can leak out to many persons having potentially conflicting interests. This trust and lack of privacy is also a form of cost, which theoretically should depress the value of the stock.
- Private Corporations. For private corporations, it is possible that stockholders may enjoy a relatively high freedom from having to trust intermediaries and a relatively high degree of (at least temporary) transactional privacy. Since such corporations typically sell stock directly to the beneficial holders (so that the beneficial holders are also the record holders), no intermediaries are necessary to buy and hold the stock. Moreover, if the stock of the private corporation is certificated (as, in my experience, most still tends to be), peer-to-peer stock transfers via transfer of a duly endorsed stock certificate are theoretically possible without the corporation knowing anything about them until much later on. However, many corporations limit peer-to-peer transfers of certificated stock by requiring stockholders—particularly the largest stockholders—to join rights of first refusal and co-sale agreements that require a stockholder to notify the corporation and the other (large) stockholders of the impending transfer and give them a chance to participate (either as buyers or sellers). Corporations that have “book-entry-only” shares will not afford much transactional privacy, since, under the UCC, a stock transfer must be recorded on the corporation's official stock ledger before the transferee's rights in the stock can be assured. As mentioned above, when it comes time for a private corporation to have a strategic transaction, intermediaries may be necessary or desirable, but their

roles are more secretarial than anything—they can gate certain functions, but they do not stand between the beneficial stockholders and the corporation itself; rather, the beneficial stockholders typically still have a direct relationship with the corporation. Thus, there are fewer ways these intermediaries can do serious damage.

- ***Problem #4: Disenfranchisement and Forfeiture.***

- Public Corporations. Sometimes trust is misplaced, or someone you trust tries to perform but makes mistakes. This can and does occur with securities intermediaries. For example, in the anecdote relayed by the Honorable Vice Chancellor J. Travis Laster below, T. Rowe Price instructed the relevant agents to vote its stock in a corporation against a merger of the corporation. Due to mistakes, delays and confusion, the stock was voted in *favor* of the merger. Not only was the stock mis-voted, which is bad enough in itself, but since voting against a merger is prerequisite to exercising appraisal rights in a merger under Delaware law, T. Rowe Price also lost its appraisal rights.
- Private Corporations. Because of the limited role of intermediaries for private corporations, this is not much of an issue for private corporations.

- ***Problem #5: Inability to Verify Ownership.***

- Public Corporations. Since your beneficial ownership of shares of Apple is a “claim on a claim on a claim” to the Apple shares held of record by Cede, one could argue that you are not in a good position to verify that you actually have any beneficial ownership of Apple stock. Personally, while I do think tokenizing securities can help with this issue, I don’t really consider it to be a material problem; but since others in the space appear to[\[50\]](#), I am noting it here for the sake of completeness. The reason why I don’t think it’s a material problem is that there are very heavy regulations and economic incentives making your *indirect beneficial ownership* of Apple stock through intermediaries *just as real* as Cede’s *direct record ownership* of Apple stock; most notably, the UCC rules around securities entitlements ensure that the claims of creditors of the intermediaries to their assets cannot trump your claims to the economic and voting interests in Apple stock that flow through the intermediaries. So there is good reason why you don’t see stock investors sweating bullets and engaging in metaphysical contortions because they ‘might not *really* own’ their investments. But, while this issue may be overblown, it’s part and parcel of the other issues, and there is no doubt that closing the gap between record and beneficial ownership can improve verifiability and thus enhance individual asset sovereignty.
- Private Corporations. This is not much of a problem for stockholders of private corporations, since there is rarely any separation of beneficial and record ownership of stock.

- ***Problem #6: Lack of Programmability.*** This is less a “problem” and more “the absence of a feature,” but for the sake of having one list I’m going to slightly bastardize English and refer to it as the former anyway. The issue here is that exercising the rights and receiving the benefits of a stockholder is still a rather archaic, highly manual process—almost unbelievably so. As a deal lawyer I have seen this countless times—every deal, there is some junior associate not trained in accounting who has to become an Excel wizard overnight and slap together a complicated merger consideration waterfall for \$500/hr, and then usually get it wrong anyway. On every deal, people are worried about the fact that some stockholder might have lost their stock certificates, and what bonds and indemnities

will the parties and the paying agent require when that happens. Why are we still dealing with this stuff in 2018? There should be apps and automatic tracking processes that handle all of these things and prevent these very preventable problems from happening.

Admittedly, this “problem” is more acute for private corporations, since they often have complicated capitalization structures. By contrast, public corporations typically only have one class of simple common stock outstanding. However, programmability could still remain relevant to public corporations to effectuate stock buybacks, distribute dividends, activate poison pills, consummate mergers, etc.

- ***Problem #7: Lack of Liquidity/Price Discovery.***

- Public Corporations. There’s not much of an issue here to solve. Public stock is very liquid and easily tradeable in modern markets—almost as good as cash. Consequently, price discovery is also very good, though of course could be improved on the margin by lowering transaction costs.
- Private Corporations. As mentioned above, the stock of private corporations trades very thinly and thus liquidity is low and price discovery poor. As we will see (and as we previewed above under “*Skeptical Interlude #2*”), there are deep legal and corporate-governance-related reasons for these circumstances, and thus personally I do not see how or why tokenization would be especially likely to change them.

Vice Chancellor J. Travis Laster of the Delaware Court of Chancery has been a vocal critic of the *status quo* for holding, trading and voting corporate capital stock, and in recent years he has emerged as a champion of the potential for blockchain-based technology solutions to rectify the shortcomings of that system. For those who have not read his thoughts[\[51\]](#) on the subject directly, I would highly recommend doing so. But in the meantime I will summarize some of the issues he has identified and how he thinks blockchain technology can help solve them.

Take stockholder voting with public corporations as an example: because of the separation of *record stockholders* from *beneficial stockholders*, the process of stockholder voting requires a complicated “daisy chain of authorizations” from the corporation down to the beneficial stockholder, and from the beneficial stockholder back up to the record stockholder. Cede Here is one example of how this chain of authorizations can unfold—and go wrong—described by Laster as a veritable comedy of errors:

Rowe Price was the beneficial owner of several million shares for which Cede served as the record holder. T. Rowe had the right to vote its shares as it wished, and DTC had an obligation to ensure that it voted T. Rowe’s shares accurately. But DTC has to fulfill this obligation through a daisy chain of authorizations.

Recall that under Delaware law, a record holder is the party entitled to vote. But under federal law, beneficial owners must direct how shares are voted. To get T. Rowe’s instructions, DTC first had to transfer its state law voting authority to T. Rowe’s participant, State Street. It did this by executing an omnibus proxy in State Street’s favor.

Next, State Street outsourced to Broadridge Financial Solutions the task of collecting and implementing voting instructions from T. Rowe. To carry out that task, State Street gave Broadridge a power of attorney that authorized Broadridge to execute proxies on State Street’s behalf.

Now that it had the authority to vote, Broadridge needed to obtain voting instructions from T. Rowe. T. Rowe used an additional party, Institutional Shareholder Services to help transmit its voting instructions.

[...]

Rowe entered voting instructions to vote against the merger. It checked that instruction not just once, but at least three times. Then, because of a meeting adjournment, ISS sent a new record that replaced T. Rowe's first vote. T. Rowe did not know this happened. So T. Rowe's system issued its default response: to vote in favor of the merger. ISS received those instructions and transmitted them to Broadridge. Broadridge received those instructions and abided by them in executing its proxies. Through Broadridge, Cede voted T. Rowe's shares in favor of the merger. T. Rowe did not know this happened. Despite being a vocal opponent to the merger, T. Rowe wound up voting for it. And it lost standing to seek appraisal.^[52]

A Vision for Blockchainizing the Corporation to Address the Securities Intermediaries Problems

Laster has a vision of how blockchain technologies might help address the problems identified in the preceding section. He summarizes it as follows:

“With distributed ledgers, a central accountant like DTC becomes unnecessary. Ownership lies only with beneficial owners. A single distributed ledger would allow straight-through accounting. It is a utopian vision of a share ownership system where there is only one type of owner: record owner.”^[53]

“[With smart contracts,] issuers could provide for automatic transactions to take place in the ledger in response to a specific corporate action or market event, such as the payment of a dividend or a coupon payment. Or, an issuer can send out proxy statements to beneficial holders, as defined by the ledger, at a pre-determined time before an annual meeting.

“Smart contracts can also improve the voting system...[by] using the ledger to define voting permissions, and using consensus and ledgers to record votes.”

“By accurately programming different classes or series of preferred stock [to] carry different voting rights, conversion rights, payment rights, and other features...up front, a complex capital structure can be administered automatically, without human intervention. If, for example, the corporation wishes to issue additional shares, but a particular series of preferred stock has a blocking right, then the stock ledger could be coded to prevent the shares from being issued unless the requisite vote is received. Smart contracting technology also could be used to implement conversion provisions and would simplify the often difficult task of calculating conversion rates, particularly when anti-dilution formulas come into play. If the features were programmed accurately up front, then the calculations would take place automatically.”^[54]

Blockchain technology also potentially could enable the immediate or same-day settlement of securities (so called T+0)... Blockchain technology permits direct owner-to-owner transfers of securities, without the need for an intermediary. Equally important, blockchain technology also permits the direct, owner-to-owner transfer of funds, again without the need for an intermediary. Blockchain-powered stock ledgers could incorporate a requirement for contemporaneous transfers of value via bitcoins (or some other coin), thereby bypassing the central intermediaries for both the share transfer and the clearance of funds.

This is a great vision for “blockchainizing the corporation.” However, technically inclined readers will know that, when it comes to blockchain, concepts are often high-and-mighty and implementations lacking. On the other hand, my readers who are lawyers will know that corporations are a function of legal structures, and will wonder whether and how the above vision can be implemented in a legally compliant way under current law. Both technologically and legally, the devil is in the details. Thus, we must start to ask some more detailed questions about how a blockchainized corporation might be implemented.

The Permissioned Distributed Ledger Technology Approach to Tokenizing Corporate Capital Stock

1. Overview of the PDLT Approach

Laster summarizes, at a high level, his vision for implementing aspects of the above system using Ripple's blockchain protocol. As we will see, this vision also appears to be the driving force behind certain blockchain-enabling amendments to the DGCL and WBCA that have been made in recent years. Those familiar with different types of blockchain systems will immediately observe the presence of certain design choices and the absence of others—and we will discuss the pros and cons of those choices in later sections of this article.

As an illustrative example, let's imagine a distributed ledger for trading securities based on a protocol known as Ripple. Imagine that a pension fund wants to buy 100 shares of Microsoft. The pension fund and its counterparty propose that the shared ledger update to credit the pension fund with 100 dollars of Microsoft stock, and the counterparty with \$100 in cash. The pension fund selects a group of actors it trusts, called nodes. Those nodes may be other pension funds who use this system. The pension fund then initiates a transfer, i.e., it proposes making a change to the ledger. The nodes then verify that the transaction is authentic by solving a mathematical problem that will be solvable only if the pension fund and the counterparty have the assets they claim. The nodes do this by evaluating the public and private keys associated with the assets. If a supermajority of nodes solve the problem, then the ledger gets updated. If no consensus is reached, the transaction fails. This happens almost instantaneously. Once successful, the ledger updates to show the pension fund owns 100 shares of Microsoft. At that point, the pension in fact owns 100 shares of Microsoft.

This is a promising vision, but it suffers from technical and substantive flaws. Without belaboring all of them, it's worth observing the most material one: Since it is based on the Ripple Consensus Protocol, it imports the notion from that protocol that transaction validation will rely on a whitelist of "trusted verifying nodes" to validate transactions, produce blocks and build the chain. Most robust blockchain protocols such as that of Bitcoin do *not* rely on a whitelist of "a group of actors it trusts" to validate transactions and build the chain. Peter Todd has also shown that the Ripple protocol is technically flawed from a decentralization perspective because it introduces many chain split vulnerabilities[55]. While some might call this approach "decentralized" because it relies on various potentially unaffiliated nodes, "decentralization" as such does not always correlate with increases in individual asset sovereignty; only *disintermediation* does.[56]

The 'permissioned ledger' approach—built on off-chain trust of on-chain institutional nodes—does not lend itself from an ordinary stockholder's perspective to the USP of blockchain—the enhancement of individual asset sovereignty—and thus from a stockholder's perspective it fails to justify the costs and inefficiencies that are incurred by a blockchain architecture as compared to a master-slave/client-server architecture that also relies on trust but is much faster and cheaper. Simply put, if you are going to rely on off-chain trust for security, you might as well just use a traditional database rather than a blockchain. On the other hand, as we will discuss, this type of approach can solve some trust problems for the corporate issuers: for example, it can avoid trusting its stockholders not to make transfers prohibited by securities law, and it can avoid trusting any one particular securities intermediary, opting instead to trust the majority action of a group of intermediaries who operate permissioned nodes. However, in light of the inefficiencies of blockchain technology one might argue if that the issue is that you trust 10 of your friends but not 5 or fewer, a better solution would be to set up a joint venture governed by 10 of your friends to run an ordinary style of database—blockchain's attendant inefficiencies mean other solutions that can address the same problem may be preferable.[57]

Unfortunately, I believe the permissioned ledger approach has dominated most efforts of corporate lawyers to make progress in enabling blockchain technologies under the law. It has colored the substance of the DGCL amendments, the WBCA amendments and the thinking and commentary by many establishment lawyers and governmental officials on these topics. For example, the vision of a trusted verifier whitelist imported from the Ripple Consensus Protocol and various enterprise-blockchain software providers has resulted in a widespread opinion by the corporate-law cognoscenti

that corporations can only reasonably be blockchainized on so-called “permissioned blockchains” where only “institutional nodes” and “regulatory nodes” should be admitted as decisionmakers and not all network participants necessarily have access to all data.^[58] This is because they believe the way to make blockchains useful for stock trading etc. is for issuers to declare *that the blockchain is itself the corporation’s statutorily required stock ledger*. Because no corporation will want to make the entire Ethereum blockchain its stock ledger, permissioned “walled garden” style blockchain networks are inevitably required under this vision. But those blockchain networks deliver only limited asset sovereignty gains to ordinary stockholders, because they still require users to trust the “permissioned nodes,” which are typically envisioned to be the exact institutions that blockchain is supposed to disintermediate. Hence, this approach calls into question the validity and soundness of tokenizing securities at all—which is likely why the word “token” is nowhere to be found in the DGCL amendments and why Delaware law insiders have expressed doubt over whether the DGCL permits stock tokenization^[59].

This type of thinking, and the limitations that ensue therefrom, will be seen as we describe the DGCL amendments and WBCA amendments.

The Delaware Blockchain Amendments

In 2017, Delaware passed a number of amendments to the DGCL intended to enable corporations to take advantage of blockchain functionality. These amendments embody a particular set of expectations and assumptions regarding how corporations can best be blockchainized, and thus it is worth discussing them in some detail.

The 2017 amendments primarily addressed themselves to the *stockholder listing* and *stock ledger* formalities imposed on corporations by the DGCL. They worked as follows:

- eliminated all requirements that stockholder lists and stock ledgers be produced or maintained by a particular natural person (such as an officer) or in a particular form reducible to paper
- expressly allowed delegation of stock ledger administration to third parties and
- expressly allowed storage of stock ledgers on, and the transmission of stockholder notices through, “one or more electronic networks or databases (including one or more distributed electronic networks or databases)”.

These changes opened the door to the corporation outsourcing stockholder list preparation and stock ledger maintenance in any number of ways—to an officer, to a transfer agent or even to some automated (and potentially blockchainized) process. The idea, of course, is that a Delaware corporation can now use a blockchain *as* its stock ledger. However, such a stock ledger must still meet the legal requirements for a stock ledger in Delaware, which means, among other things, that the stock ledger must record the legal names and mailing addresses of the stockholders. This in and of itself is sufficient to preclude the use of public blockchains like Ethereum for such purpose, since they rely on pseudonymous hexadecimal public keys rather than legal names and no one would be particularly pleased at the privacy implications of storing their legal names and home addresses on a public blockchain. Of course, as we already have discussed and will continue to discuss, that is not only the reason why a corporate issuer would want to avoid making Ethereum its official statutory stock ledger, but it is an important one, and means that the DGCL blockchain amendments really only enable “enterprise style” PDLT blockchain implementations. As we will see, it is also in this regard—the use of legal names versus blockchain-network addresses—that Wyoming’s blockchain-oriented amendments go much farther than, and improve upon, those implemented in Delaware.

The Wyoming Blockchain Amendments

In 2018, House Bill No. HB0101 of the State of Wyoming was passed as one of a number of ambitious legislative amendments designed to make Wyoming a welcoming regulatory environment for blockchain technology companies. Not all are of direct relevance to tokenizing corporate capital stock; therefore, this will not be a comprehensive summary. Rather, this will focus on H.B. No. 0101, Wyoming's equivalent to the DGCL blockchain amendments.

The 2018 amendments made a number of changes designed to enable Wyoming-incorporated corporations to use blockchain technology. Broadly speaking, the changes fall into two groups: (1) changes that are very similar to Delaware's ledger-focused amendments summarized above; and (2) additional changes focused around accommodating public/private key numerical addresses in lieu of legal names and addresses. At a high-level, then, the WBCA amendments would be described as adding all of the new technological permissions that the DGCL amendments added, and then adding further permissions that result in even greater capability of Wyoming corporations to utilize blockchain technology.

The record-keeping-related amendments as such do not warrant much attention here. They are broadly similar to Delaware's, including in that they allow that records be kept "by or on behalf of the corporation" and enable recordkeeping and communication via "one or more distributed or other electronic networks or databases."

More interesting are the ways in which Wyoming's amendments go significantly beyond Delaware's to enable deeper blockchain functionality. These include:

- supplementing the definition of "Shareholder" to include "the owner of a private key that is uniquely associated with a data address that facilitates or records the sending and receiving of shares"
- adding a new defined term, "identity," defined as "the name of a shareholder or the data address for which the shareholder has knowledge or possession of the private key uniquely associated with the data address"
- adding a new defined term, "data address," defined as "the string of alphanumeric characters on one or more distributed or other electronic networks or databases that may only be accessed by knowledge or possession of a private key..."
- adding a new defined term, "network signature," defined as "a string of alphanumeric characters that when broadcasted by a shareholder to the data address's corresponding distributed or other electronic network or database provides reasonable assurances to a corporation that the shareholder has knowledge or possession of the private key uniquely associated with the data address," and counting a "network signature" as a "signature" for many purposes of the Act and
- eliminating the requirement that a list of the corporation's shareholders include the names and addresses of the shareholders entitled to vote, and instead required that the list contain only the "identity" of each shareholder (as defined above)—in other words, the list of shareholders may contain the name of the shareholder *or* the shareholder's "data address" (which could be, for example, a hexadecimal Ethereum address); a physical mailing address is only required if the shareholder's chosen "identity" is a legal name.

Taken together, the effect of these amendments is to enable a Wyoming-incorporated corporation to maintain a stock ledger *with no knowledge* of the legal names and mailing addresses of its stockholders. As far as Wyoming corporate law is concerned, a Wyoming corporation could theoretically have a stockholder list and ledger consisting entirely of a list of hexadecimal addresses and blockchain transactions. When a notice needs to be sent, the Wyoming corporation could theoretically send that notice to the blockchain address, and when the stockholder needs to provide a signature, the stockholder could do so by using the private key corresponding to that blockchain address. *Pseudonymous* stock ownership is now possible under Wyoming corporate law. Of course, how compatible that position is with other areas of Wyoming and non-Wyoming-law (such as money

transmitter requirements, IRS reporting requirements, UCC provisions regarding stock transfer, etc.) and how feasible it is for a corporation to actually interact with stockholders pseudonymously via blockchain addresses are separate questions. So, too, is the question of how allowing pseudonymous stock ownership based on blockchain address comports with the public policy that led Wyoming and other states to expressly prohibit issuing stock certificates in bearer form. We will explore these questions later in the article.

How Well Does the PDLT Approach Solve the Current Market's Problems?

Having explored the PDLT approach in some detail, let us now look at our set of “problems” and see how well it solves them:

- **Problem #1: Transaction Fees.** It is somewhat unclear whether PDLT will result in lowered transaction fees. The nodes permissioned to verify the transactions and build the network will need to have *some* reason for doing so, and they will also incur some *costs* in doing so. Whether and to what extent the *reasons* would need to include ‘profit-making by fees’ and how these nodes would pass on their costs really cannot be determined in the abstract; one needs to set up such a network, run it at scale, and then see who is willing to keep participating and on what terms. So how well PDLT fares on the “transaction fee” problem for public companies is anyone’s guess for now. On the private company side, however, *it fares worse* than the status quo—whereas it is at least theoretically possible for someone holding a stock certificate from a private company to trade that stock peer-to-peer and thus not incur any transaction costs arising from use of a blockchain network, if all stock is book-entry (as PDLT envisions) then this person will be forced to trade “on-chain,” which likely will involve at least some (direct or indirect) transaction fees.
- **Problem #2: Delays.** While the details of how the network is designed, who the nodes are and how they reach consensus will matter, here I think we can be safe in assuming that Problem #2 will be substantially mitigated—i.e., that it is possible to design a PDLT system that settles stock trades much faster than on current public markets and that automates and simplifies administration for private markets.
- **Problem #3: Trust and Lack of Privacy.** For public corporations, PDLT either requires the same amount of trust in third parties as the current status quo system, or more trust. For private corporations, PDLT requires more trust than the current status quo system. With PDLT, stockholders will be reliant on a whitelist of permissioned nodes to verify transactions and keep adding blocks to the chain. Trust in these permissioned nodes takes two forms: (1) trust that the nodes will keep performing their job on the system rather than losing interest and quitting—since permissioning additional nodes will take time, likely will not be in stockholders’ control and (to the extent that transaction fees indeed have been kept low) it might be difficult to find capable and willing replacements; and (2) trust that the nodes will keep performing their job *correctly* and *non-maliciously*. Also, if the PDLT system is closed-source and licensed by the issuer from an “enterprise software provider” then the entire system and all its users face risks of rent extraction by the licensor, as well as enterprise risk from the licensor since if the licensor goes out of business the system could become unusable (though a source code escrow arrangement can help with the latter issue).
 - Private Corporations. Let’s take the example of a private corporation, The Boring Company. Let’s suppose that the permissioning of nodes on the PDLT system is done by The Boring Company[60], and, consistent with the PDLT approach, the ledger PDLT ledger is the official statutory stock ledger of The Boring Company, all of the shares of which are book-entry-only. In such a PDLT system, stockholders must trust the corporation to “permission” good trustworthy nodes; that’s kind of okay, because stockholders must trust a corporation anyway in a book-entry-only system: every time the stockholder

requests a transfer, it must tell the corporation about it and it must trust the corporation to honor it by recording it on the ledger. Now, though, the stockholder must also trust additional entities (individually or in the aggregate), to whom the corporation is *delegating* its obligations to maintain the stock ledger. Why are these nodes more trustworthy, individually or in the aggregate, than the corporation itself? Advocates of PDLT have never, to my knowledge, adequately asked, no less answered, this question. In my opinion, if I am a stockholder in The Boring Company, and The Boring Company delegates its stock ledger upkeep to (or to a majority of) JPMorgan, Goldman Sachs, Shareholder Representative Services, Nasdaq Private Market, et. al.—the trust required of me has not been “minimized” the way it is supposed to be by blockchain, it’s been “maximized” (or at least *increased*).

- o Public Corporations. Currently, holding and trading the stock of public corporations requires a great deal of trust in intermediaries. Thus, requiring stockholders to vest a similar type of trust in similar intermediaries in the context of a blockchain-based ledger may be no worse from the standpoint of trust—and it could even be slightly better, since by requiring a majority of those intermediaries to have visibility into and the opportunity to validate any given transaction, such a system may eliminate single points of failure (or “be more antifragile,” in blockchain lingo). However, two other issues have been created or exacerbated: (1) in the current system, stockholders at least have a choice of who their most direct intermediaries are—they can choose their own brokers; and (2) in the current system, stockholders can maintain a high degree of privacy from the corporation and from the upstream intermediaries by being “OBOs” whose identities are known only to their brokers, while all the trades they order are done in their broker’s name. All of that privacy would either be nonexistent in a PDLT system or would depend upon technological breakthroughs that simultaneously allow the use of natural identities on-chain and keep those on-chain identities private—technological breakthroughs which, again, PDLT advocates never even seem to mention the need for, no less to be on the verge of achieving.

- ***Problem #4: Disenfranchisement and Forfeiture.*** Here, PDLT could substantially help, *assuming an honest majority of nodes and properly programmed rules*. Because there would no longer be a gap between record and beneficial ownership, stockholders could exercise their voting rights directly, on chain, and would not have to worry that the instructions they give to intermediaries fail to be honored. Of course, unfortunately, the assumption of an honest majority of nodes and proper programming is questionable. In this type of PDLT system, it’s very possible that a majority of nodes could collude to either censor transactions (including votes) from a given stockholder or to effectively burn the stockholder’s stock by refusing to let the stockholder transfer it or receive the economic benefits from it. In some situations—like ones where, as in Laster’s vision, the nodes consist of various pension funds and the relevant corporation is the subject of a hostile takeover—there could be major conflicts of interest—for example, nodes that oppose the hostile takeover could band together to censor the votes or tenders of a large activist stockholder who supports it. It’s easy enough to say, “we’ll program the network so that’s not possible,” but that actually is going to be quite hard. A possible alternative is to lean more on off-chain guarantees—contracts between the issuer and the operators of the permissioned nodes that would give the issuer legal rights if the nodes behave badly. But that just becomes one more aspect in which the system depends on off-chain mechanisms that stockholders do not directly control. As with so many of the problems with PDLT I’m pointing out, I have yet to see this potential roadblock even acknowledged by PDLT advocates, no less solved.

- **Problem #5: Inability to Verify Ownership.** PDLT does quite well here simply by virtue of eliminating the difference between record and beneficial ownership. Of course, as I mentioned above, I'm not sure this is really that big of a problem to begin with—nevertheless, credit where credit is due.
- **Problem #6: Lack of Programmability.** PDLT does quite well here also, for obvious reasons—smart contract functionality can be built into the platform that facilitates automated distribution of dividends, vote-counting, etc.
- **Problem #7: Lack of Liquidity/Price Discovery.** It is hard to see how PDLT would make any material difference (either positive or negative) in liquidity and/or price discovery for private or public corporation stock. Public corporation stock is already about as liquid and priceable as possible—at most, by significantly reducing settlement times, PDLT might make the market for public stock *a little more liquid and a little bit more efficiently priced*, but since there's no major problem now, it's hard to imagine the improvement being particularly material. On the other hand, with private corporation stock, nothing about putting the stock on a blockchain is going to make it trade more often or with more efficient pricing—it mostly can't trade due to securities law restrictions, and, even when it can, it greatly behooves private corporations and their stockholders to enter into stringent rights of first refusal and co-sale arrangements that dramatically impede secondary market activity. One might argue that tokenizing private corporation stock will make it, IDK, like sexier? And therefore people will be more excited about trading it and therefore they will do so? To whatever extent that argument makes sense, I think PDLT is the wrong thing to apply it to—people might get psyched if The Boring Company trades on Ethereum or on a Bitcoin sidechain. I have my doubts that they will be super psyched that it trades on a “walled garden” enterprise-style blockchain run by a consortium of permissioned institutional nodes. There just ain't a lot of hawtness there.

Where does this leave us? How well does the PDLT approach solve our seven problems?

- Problems 2, 5 and 6: mostly quite well;
- Problems 1, 4 and 7: unclear if it does solve these problems: there's some potential to help solve or mitigate them, but *also* some potential to exacerbate them, all depending on implementation details;
- Problem 3: it makes this problem materially worse

We can see that a PDLT stock system is better than the status quo system in several ways. Thus, the question becomes whether there is any other approach that can do better? I believe that there is.

The Tokenized Certificate Approach to Tokenizing Corporate Capital Stock

Overview of the Tokenized Certificate Approach (TCA).

Here is my idea for how corporate capital stock could best be tokenized in order to solve or mitigate the problems we have identified in a manner that enhances individual asset sovereignty: Since we're already familiar with the PDLT approach, I'll mostly define this new hypothetical approach by how it differs from that one:

- No “walled gardens”—we're going to do this on an open, un-permissioned, fully peer-to-peer, decentralized blockchain network—i.e., one which comes as close as possible to the “non-discrimination” and “non-censorship” values articulated in the Ethereum whitepaper in our quote earlier in this article. For the sake of argument, and because there are many stock-oriented protocols already developed or under development for it, let's actually use Ethereum itself in our hypothetical. Yes, it's an imperfect embodiment of asset sovereignty ideals, but it's still a whole lot closer to them than a distributed ledger run by permissioned institutional nodes.

- No “using the blockchain as the corporation’s official stock ledger.” No corporation will want the Ethereum mainnet to be its statutory stock ledger—the risk of an unauthorized or illegal transaction being recorded on that ledger, and thus becoming official in a way that unnecessarily implicates the corporation itself, is simply too high. And, for corporations that need to make their stock ledger include legal names and addresses instead of blockchain addresses (which is every corporation outside of Wyoming), there will be major privacy concerns with such an approach. Instead, the corporation can keep its official statutory stock ledger however it wants, just like corporations do now—on an excel spreadsheet, a piece of paper, Carta, or, yes, even an enterprise blockchain. And it can be plenty slow and deliberate in the way it chooses to vet any transactions before they are recorded on that ledger.
- The issuing corporation allows some or all of its shares to be represented in *certificated* For Delaware corporations, since stock certificates are the default (again, showing how natural and well established they are), this simply means that the board of directors refrains from adopting resolutions to the contrary.
- Ideally (but not critically), the corporation is incorporated in Wyoming (or in a jurisdiction that is similarly permissive in allowing stockholder ledgers to identify stockholder by *blockchain address* rather than natural name/mailling address).
- Tokens—let’s not worry for now about whether they comply with the ERC20, ERC884, ERC1404 or R-Token-standard, or some yet-to-be-defined standard—have a meaningful, and indeed critical, role. *They are electronic stock certificates*. Yes, we’re going back to basics—old-fashioned, time-tested stock certificates—but in digital form with some blockchain technology twists.
- Each single undivided “token certificate” represents one single undivided share of a given class/series of stock (1:1). When stock certificates were paper, it would be super inconvenient to do this and it made much more sense to issue certificates representing many shares (1:n), but now that the stock certificates are tokens, one certificate per token will be far more convenient. As we will see below, it will still be possible to group certificated shares into groups having various properties by associating them with the same metadata in an ERC1410 “tranche”—similar to how a paper stock certificate representing many shares can be stamped with a transfer restriction that applies to all of them.
- Corporations, stockholders and regulators are free to define among themselves whether, how and to what extent the stock can trade. The answer will differ depending on the particular corporation involved, the particular *type* of corporation involved (public vs. private), the particular stockholders involved and the particular regulators (legal jurisdiction) involved. However, tokenizing corporate stock will be most useful in situations where the relevant law allows, and the corporation and its stockholder agree upon, a relatively *pro-stockholder-freedom* state of affairs. Such a *pro-stockholder-freedom* system could go as far as having the following features (though, as I will explain, I would never recommend that a corporation go quite this far in the direction of libertarianism—and they do not need to do so in order to implement the TCA):
 - Making secondary market stock trades compliant with securities law and other laws is up to the selling stockholder (rather than the issuing corporation) as much as possible—i.e., whenever the law does not require the issuing corporation to ensure compliance.
 - In many circumstances, this is exactly how things are now. When a private corporation sells its stock, it imposes contractual commitments on the stockholder not to transfer the stock in violation securities laws. It also stamps the stock “certificate” with a legend noting that the stock is subject to such transfer restrictions because it hasn’t been registered. However, actual compliance with those restrictions is up to the stockholder—the stockholder is not

necessarily required to “pre-clear” transfer of stock with the corporation.

- If trading restrictions do not apply (for example, if the stock is publicly traded due to being registered with the SEC), then stockholders are free to trade the stock on markets or on a peer-to-peer unmediated basis, however and whenever they want, by accepting payment and “endorsing” the certificate over to the new owner—these transactions don’t need to be recorded on the corporation’s official stock ledger in order to become legally finalized. Of course, since they’ll be happening on a public blockchain, the corporation can monitor that blockchain—e.g., through an event listener in the token smart contract—to learn about transactions on a post-hoc basis—but it doesn’t necessarily need to be in a position to stop them or slow them down on a priori basis.
- Smart contracts have been deployed on chain by the corporation to facilitate the receipt of stockholder benefits and the exercise of stockholder rights—for example, for a private corporation with multiple classes or series of preferred stock, there is a smart contract that accepts funds from the corporation and distributes them to the Ethereum addresses corresponding to the private keys that control the stock—in the right amounts and at the right times. Similarly, there is a vote-counting smart contract that accepts and counts votes signed by the right private keys. Importantly, as a counterbalance to the stockholder freedom that is granted on the front end, the corporation has good administrative controls over these smart contracts on the back end—meaning that the corporation is free to deny the benefits of stockholder rights where it is legally entitled to do so—for example, where the stock certificate tokens were sold in violation of transfer restrictions or to a person subject to government sanctions, so that the transfer is void. The corporation is also as free to issue new stock certificate tokens corresponding to new stock, or replacement stock certificate tokens corresponding to stock certificate tokens that have been lost due to private key loss or theft.

The intuitive appeal and historical pedigree of this approach should be undeniable. Consider the following:

- For most of corporate law history, it was the norm, not the exception, that shares of corporate capital stock be represented by stock certificates.
- Almost all current corporate law continues to reflect the assumption that corporate capital stock will be (and certainly that it *can be*) certificated; book-entry-only stock is allowed, but you can easily see in the relevant statutes that it is a “bolt on”—and, indeed, uncertificated securities were not introduced into the UCC until 1978.
- As we saw above, the natural way to understand how tokenization of an asset works is to view the token as *representing* rights in the asset—that is *exactly* what stock certificates do with corporate capital stock—they represent the certificate holder’s ownership interest in the stock.
- As we saw above in our review of the inefficiencies around the market for public corporate capital stock, almost all of such inefficiencies arose from the historical accident that paper certificates were very hard to move around physically; by contrast:
 - with certificates in token form on a blockchain, that will no longer be the case—certificates will be very easy to transfer, *rapidly, peer-to-peer, and with finality*
 - as a result, the separation between record and beneficial owners that currently plagues public markets will be eliminated, not, as in the PDLT approach, by imposing the relatively newfangled approach of uncertificated book-entry shares on everyone and making a permissioned blockchain the ledger—but by undoing

the root cause of the separation—the difficulty of transferring stock certificates and

- as a result, the entire Cede/DTC/Brokerage apparatus will be completely unnecessary—which is not, however, to say that all intermediaries will become unnecessary and undesirable; for example, stockholders may still wish to vote by proxy and thus proxy solicitation firms and Broadridge may still have roles to play.
- Unlike with the book-entry/stock-ledger approaches taken by the DGCL and WBCA amendments, calling tokens digital stock certificates does not open a Pandora's box of questions about how things work with or what changes need to be made to the UCC—the UCC already has a robust set of rules for dealing with certificated securities, and thus at most only a few changes would be needed—such as supplementing the definition of “certificate” and supplementing the definition of “delivery” with respect to certificated securities.
- Although corporations and their stockholders would need to decide many interesting implementation details, they can do so and do so flexibly through a combination of the *chain layer* and the *contract layer*; different corporations and different stockholders will experiment with different implementations, and the market will decide which implementations are good in which contexts so that standards can emerge.
- The entire system would plug-and-play with existing law and precedent that provides an understanding of how and when ownership of a share of stock tracks with ownership of a stock certificate—creditors could take control of a token to perfect their security interests, recipients of a token could be confident that they were protected purchasers, etc.
- Tokenized stock could become blockchain-agnostic and chain-interoperable (e.g., via atomic swaps), and thus escape the “walled garden” logic that would be involved in a particular blockchain or PDLT system representing a given corporation's stock ledger...this would be because not every transfer of stock would need to occur on the corporation's designated ledger in order to be legally valid...just as a stock certificate can be signed over to a transferee without the corporation knowing a thing about it.

Having said all that, let's take a deeper dive into why traditional stock certificates are cool, why (short of bearer certificates, which aren't politically or legally feasible) they are the most ‘individually financially sovereign’ way to hold corporate stock, and whether and how putting them on a public open blockchain in tokenized form might solve or mitigate our seven big problems with corporate stock.

The Superiority of Certificated Shares to Book-Entry Shares Under the Uniform Commercial Code

In addition to federal and state securities laws and state corporate law statutes, corporate stock is also regulated by various commercial laws—including, where applicable, the Uniform Commercial Code (UCC) as adopted by the corporation's state of incorporation. From the standpoint of corporate law, the UCC can be seen as performing a supplemental or gap-filling function regarding stock transfers—i.e., it adds some extra rules and details that corporate statutes are silent on. It so happens that the UCC gives preferential status to certificated securities in several respects. Let's untangle how the UCC governs security transfers and pledges, and why the way the UCC works makes representing securities in certificated form superior for most purposes, all else being equal.

The Uniform Law Commissioners summarized the special abstract status of stock, and the need for special transfer rules relating thereto, very well in the following quote:

A share of stock in a corporation is a share in an abstraction that primarily gives the owner a right to share in the income of the corporation. There is nothing that the owner can see, feel, or otherwise experience that constitutes the corpus of his or her interest. The corporation's tangible property is the

corporation's, not the property of any shareholder. The shareholder's rights have no corporeal existence. The intangibility of investment securities has meant historically that their transfers from one person to another require some special rules.[61]

What are these rules?

Recall how above we discussed that the stock of U.S. corporations is issued and transferred in "registered" form and that thus there are two ways in which stock ownership can be represented: uncertificated, book-entry form (i.e., the corporation keeps a record of which persons own which shares) and certificated form (i.e., the corporation issues paper certificates representing the shares in the name of the original stock purchaser). The UCC likewise distinguishes between these ways of representing stock ownership, and prescribes different rules depending on the particular form of representation that has been selected. The UCC also prescribes rules for certificated stock held in "bearer form," but since no U.S. states and very few foreign countries currently permit stock certificates to be issued in such form, we will ignore those rules for now.

Recall further that we described how most beneficial stockholders in public corporations actually hold neither book-entry nor certificated shares, because their shares are held in "street name" through a "daisy chain" of nominees and nominees-of-nominees. In modern public corporations, as the Uniform Law Commissioners aptly express, it, "there is no relationship between investor and corporate issuer. Therefore, without some further recognition of the indirect system in Article 8 [of the UCC], rights are uncertain." Thus, the UCC also contemplates a third way of representing stock—as "securities entitlements." However, since, as described above, a fully-fledged blockchain-enabled stock tokenization system would close the gap between record and beneficial ownership by eliminating the nominee system, we need not worry about these special UCC "securities entitlement" rules in this article.

That leaves us with just two rules to worry about: the rule for transfer of registered uncertificated/book-entry shares and the rule for transfer of registered certificated shares. To explore those rules, let's think about the situation where Alice is buying a share of stock from Bob in exchange for cash. Alice wants to know at what point she will be deemed the legal owner of the stock, and Bob wants to know at what point he will be deemed to have delivered the stock and thus be the legal owner of the cash.

- If the stock is certificated:
 - Bob has fulfilled his obligations to deliver[62] the stock when he puts Alice in possession of the stock certificate
 - Alice acquires[63] all of Bob's rights in the stock that he had (or had power to transfer)[64] if the stock is delivered to Alice as described above.
 - Alice additionally acquires the stock "free of any adverse claim" (i.e., Alice is a "protected purchaser"[65] of the stock) if Alice:
 - pays the cash to Bob[66]
 - does not have notice of any adverse claim to the stock[67] (e.g., an adverse claim on the stock by a bank that has loaned Bob money and has a security interest in the stock as collateral)
 - obtains "control" [68] of the stock, which in the case of certificated stock issued in registered (rather than bearer) form means either
 - **OPTION #1:** that she has possession of the stock certificate and the stock certificate has been endorsed by Bob over to her name (or endorsed by Bob in blank for to her to fill out with her name),[69] or

- **OPTION #2:** that the corporation has registered Alice as the owner of the stock on its books/stock ledger[70]
- If the stock is uncertificated
 - Bob has fulfilled his obligations to deliver[71] the stock when the corporation registers Alice as the owner of the stock on its books/stock ledger
 - Alice acquires[72] all of Bob’s rights in the stock that he had (or had power to transfer)[73] if the stock is delivered to Alice as described above.
 - Alice additionally acquires the stock “free of any adverse claim” (i.e., Alice is a “protected purchaser”[74] of the stock) if Alice:
 - pays the cash to Bob[75]
 - does not have notice of any adverse claim to the stock[76]
 - obtains “control”[77] of the stock, which in the case of uncertificated stock generally means that the corporation has registered Alice as the owner of the stock on its books/stock ledger[78] (i.e., same as “OPTION#2 for certificated stock)

A large part of the reason for such rules is the role in our economy of secured creditors and other types of claimants who might have a financial or ownership interest in stock nominally owned by someone else. Suppose that, years before Bob meets Alice, Bob gets in financial trouble and needs to take out a loan. As a condition to granting the loan, the bank requires a security interest in valuable collateral, and thus Bob “pledges” his interest in his stock to the bank in order to secure the loan. What then happens when Bob sells his stock to Alice? If Bob defaults on the loan such that the bank theoretically has the right to foreclose on the stock, but Alice also paid Bob cash for the stock and thus is entitled to the stock in another way, who wins and gets the stock—Alice or the bank?

Covering these situations—and establishing who wins between Alice and the bank in our hypothetical—is one of the main reasons why the UCC stock transfer provisions were enacted. That is why, for example, even after paying Bob for the stock, Alice cannot be sure that she owns it unless she meets the definition of being a “protected purchaser,” which requires, among other things, that she “does not have notice of any adverse claim to the stock”. An “adverse claim” is “a claim that a claimant has a property interest in [the stock] and that it is a violation of the rights of the claimant for another person to hold, transfer, or deal with the [stock].”[79] What constitutes “notice of an adverse claim”? Here again, the rules differ depending on whether the stock is certificated or uncertificated:

- if the stock is certificated or uncertificated, Alice will have “notice of an adverse claim” if she:
 - knows of the adverse claim[80] or
 - roughly speaking, ‘turns a blind eye’ to the probability of the adverse claim[81]
 - or
 - “has a duty imposed by statute or regulation to investigate whether an adverse claim exists, and the investigation so required would establish the existence of the adverse claim”[82]
- if the stock is certificated, Alice will also have “notice of an adverse claim” if the stock certificate has been marked “for collection,” “for surrender” or for some other purpose not involving a transfer to Alice or to Bob;

Importantly from the lender’s perspective, certificated stock represents better collateral than uncertificated stock. With certificated stock, the lender will have a better chance of making sure its claims to the stock will defeat the claims of a later purchaser like Alice. This is because:

- First, if the lender **takes possession** of the stock certificate, Alice cannot obtain “control” of the stock under the UCC and thus cannot be a “protected purchaser” of the stock under the UCC and thus cannot defeat the lender’s claim to the stock. Even if Alice paid the purchase price to Bob, it will be “tough luck” to her—she should have known that the stock was certificated[83] and that she would not own the stock “free and clear” without the certificate.
- Second, even if the lender **does not take possession** of the stock certificate, the lender can require Bob to endorse the stock certificate as collateral and can confirm that Bob has done so. Thus, if Alice buys the stock and this time actually receives the stock certificate, it will again be “tough luck” to her—she will be under a duty to examine the stock certificate and, if she does so, will see that it is endorsed as collateral and that thus she cannot acquire the stock “free and clear” from Bob.

For the same reasons, buying certificated stock is *also* better for Alice—all she has to do in order to be a “protected purchaser” is acquire the stock certificate, confirm by visual inspection it is not endorsed over to a third party or for another purpose (such as collateral) and pay Bob the money. By contrast, to be sure she is a “protected purchaser” of uncertificated stock, she needs to contact the issuing corporation, “doxx”/“KYC” herself with the corporation to let it know who she is and that she has acquired the stock and ensure the corporation makes a change to its records to show her as the new owner. This process of dealing directly with a corporation to effect a stock transfer, unlike the process of dealing with intermediaries to effect a transfer of a “stock entitlement” representing an interest in a share of stock held in street name, is not subject to any settlement/clearance rules requiring that the corporation complete the transfer in a particular amount of time or with particular standardized processes. Thus, transfers of uncertificated stock on the books of a corporation will take unpredictable and non-standardized amounts of time and involve unpredictable and non-standardized interactions with the corporation, which in turn can be viewed as imposing a degree of illiquidity on the stock and illiquidity discount on the price of stock, dragging down capital efficiency.

Some Specs and Technicalities Involved in Implementing the TCA

Let’s explore a little bit how tokenized stock certificates might work on a public open blockchain, sticking with our example blockchain network of Ethereum. Of course, I am a lawyer, not an engineer—thus this sketch will necessarily be preliminary, mostly high-level and suggestive. My hope, though, is that it has sufficient detail to persuade the non-technical reader that a technical implementation of the tokenized certificate approach is possible and to inspire technical readers to pick up the torch, fix my mistakes, and carry the work forward into a functioning implementation.

Most readers will be familiar with “ERC20 tokens”. ERC20 is a standard for specifying the address of a token-generating smart contract, the number of the tokens, the name of the tokens, the symbol for the tokens, and the divisibility of the tokens into fractions of a token. However, there are many ERCs that may be applied to tokens on Ethereum, and ERC20 is simply the most common and fundamental. A given token design may comply with any number of different, mutually complementary ERCs. A hypothetical token serving the functions of a stock certificate could comply with one or more of the following ERCs or extensions thereof. *Note: some of the ERCs below are overlapping or incompatible; the idea behind the list is to show how many potentially relevant standards are already out there and suggest ways they might be mixed-and-match to get relevant functionality for tokenized stock certificates.*

- ERC777 (ERC20-backward-compatible, general-purpose transferable token standard)
- ERC621 (which would allow the issuing corporation to increase or decrease the supply of the token-certificates, *critical* for stock certificates since they are representational and thus e.g., if the corporation redeems some stock, it must also get rid of the corresponding representations (the certificates) so that people are not misled into buying them, thinking they still represent stock)[84]

- ERC1410 (partially fungible token standard) or ERC1400 (security token standard), which allow
 - Tagging sub-groups of otherwise fungible tokens with metadata in order to divide them into “tranches” so that they may be treated as non-fungible relative to a given address—thus facilitating vesting functionality, transfer restrictions, and, perhaps most importantly for our purposes, *tracking* so that chain of title can be established *post hoc* even though not all trades are being cleared through the corporate issuer’s statutory stock ledger
 - in the case of ERC1400, supply decrease functions similar to ERC621 (thus ERC1400 and ERC621 are partially overlapping), whitelisting functionality, etc.
- ERC1404 (simple restricted token standard), which allows an issuer to check for transfer restrictions within ERC20 transfer methods and blocks the transfer if there is a restriction—restriction can come from another smart contract or an oracle

On the “contract layer” (the corporation’s certificate of incorporation, bylaws and stockholder agreements) a system of tokenized stock certificates could be implemented as follows:

- the corporation simply follows the default rule that shares of stock are “certificated” rather than passing resolutions or specifying in its organizational documents that they should be “uncertificated”
- as is typical, the corporation’s bylaws will have provisions prescribing the form and contents of its stock certificates; *however*, these will now be more complicated and detailed than the typical boilerplate for customary paper certificates; these provisions could provide, for example, that:
 - there is a “Designated Blockchain”
 - there is a “Designated Smart Contract” deployed on the Designated Blockchain (indicated by address)
 - there are “Token Certificates,” which are tokens issued on the Designated Blockchain out of the Designated Smart Contract
 - each Token Certificate represents one share of a given class of capital stock of the corporation
 - the “Designated Blockchain,” “Designated Smart Contract” and “Token Certificate” definitions may be changed, either based on the typical rules for amending bylaws (i.e., bylaws may be amended by action of a majority of the board of directors or by action of a majority of the stockholders) *or* more restrictive rules (such as that changes to these definitions must first be proposed by the board of directors and then approved by a majority of stockholders)—season to taste
 - optionally, there may be “Auxiliary Blockchains” and “Auxiliary Token Certificates” that are permitted to work in the same way for stockholders who lock up their Token Certificates on the Designated Blockchain pursuant to an atomic swap arrangement, creating an Auxiliary Token Certificate as kind of ‘certificate of a certificate’ on the Auxiliary Blockchain; side chain or plasma chain functionality could also similarly be permitted—again, season to taste (*NOTE: this is probably the single biggest advantage afforded by a tokenized certificate approach on an open blockchain over a book-entry approach on an enterprise-style permissioned distributed ledger*);
 - the corporation may have either very limited or very expansive powers to freeze, burn and issue Token Certificates: transfer restrictions can be enforced through the Designated Smart Contract or compliance with them can be left to the

- stockholder with reliance on contractual and regulatory enforcement mechanisms and incentives—again, season to taste
 - the board of directors and/or a committee thereof or certain officers of the corporation should have emergency powers in the event of a persistent hard fork, a material consensus attack, and similar technological disruptions—season the triggers and resulting powers to taste (potentially many broad triggers or few narrow triggers, potentially broad emergency powers or narrow ones)
 - the same emergency triggers would also result in the calling of a board of directors meeting, a stockholders’ meeting, or both so that a more permanent solution to the triggering problem can be found—for example, if there is a persistent hard fork (like old ETH forking into ETC and ETH), one side of the fork would need to be selected (or reaffirmed) as the Designated Blockchain hosting the Designated Smart Contract with the Token Certificates, and, to avoid tokens representing the same shares being traded differently on two different chains, Token Certificates on the losing chain would need to be permanently frozen, redeemed or otherwise burned
 - there would be procedures to help stockholders in the event they lose the private keys controlling their Token Certificates, or have the Token Certificates stolen from them, or deposit them into another smart contract that has a bug that locks them up—existing standards around the reissuance of lost, stolen or destroyed stock certificates would easily translate here—for example, the stockholder should typically be required to provide an affidavit and indemnity agreement and/or a bond as surety against the risk that the shareholder is effectively attempting a “double-spend” of the tokenized certificate
- the corporation would likely also want to modify some other provisions of its bylaws and certificate of incorporation to either be compatible with, or maximize synergies with, the tokenized certificate approach—provisions relating to stockholder voting, notices to stockholders, etc., are likely targets, with many opportunities to increase efficiency using automation (though, of course, all automation also carries risks and so, once again, there will be a need to “season to taste” until the market settles on a few viable, tested approaches)—I don’t want to get too detailed on these in this article, but Laster’s overall blockchain vision articulated above provides as good a preview of any of what these changes might entail
 - depending on exactly how the tokenized certificate system is set up—how it is “seasoned to taste”—various details may change with respect to the stockholders’ agreements (voting agreements, preemptive rights, rights of first refusal, drag-along provisions, etc.) that are typical of privately held corporations—one possibility, for example, is that the corporation could impose heavy on-chain transfer restrictions that enforce all those rules programmatically; if that were the path the corporation had chosen, then the typical agreements could become much shorter and simpler, leveraging deference on the ‘self-enforcing’ programmatic controls the corporation has implemented^[85]—another possibility is that the Token Certificates trade relatively freely on-chain and thus reliance on these traditional wet contracts is still necessary.

On the “regulatory layer,” because the DGCL and WBCA amendments cater to the PDLT approach rather than a tokenized certificate approach, various changes would be desirable. The WBCA would require the fewest changes because its blockchain-related amendments go farther than the DGCL’s. The main changes needed to the WBCA would be the following:

- The requirements in §§17-16-625(b)-(c) and 17-16-627(b) that each share certificate “shall [conspicuously] state on its face” or “on its front or back” various items of information, including the name and state of incorporation of the corporation, the name of the stockholder to whom it was originally issued, any applicable transfer restrictions, etc.,

would need to be amended to allow for such information to be contained in the metadata for the Token Certificate OR to allow for the satisfaction of these requirements by sending the same type of “information statement” that is currently sent by corporations for book-entry-only shares.. Since the WBCA now recognizes the concept of a shareholder “identity” that may alternatively consist of a name OR an alphanumeric blockchain address (a “data address”), the requirement that share certificates include the recipient’s name should be changed to a requirement that the share certificate (or in this case, the metadata for the Token Certificate) include the recipient’s “identity”; this would allow stockholders to realize the benefits of their tokens living on an auditable, trust-minimized decentralized database with less of a risk of exposing personally identifiable information (PII).

- The requirement in §17-16-625(d) that “[e]ach share certificate...[s]hall be signed, either manually or in facsimile, by two officers...or by the board of directors” (and the related “manually or in facsimile” language in the following clause (e)) should be amended to delete “either manually or in facsimile”. Thus, the broader general post-blockchain-amendment definition of “signature” that already exists in the WBCA would apply. According to the current WBCA, such a signature can be a “network signature,” which is “a string of alphanumeric characters that when broadcasted by a shareholder to the data address’s corresponding distributed or other electronic network or database provides reasonable assurances to a corporation that the shareholder has knowledge or possession of the private key uniquely associated with the data address”.
- Ideally, the prohibition on issuance of bearer certificates in §17-16-625(f), consistent with the WBCA’s new approach of allowing data addresses to serve as identities, should be amended to clarify that issuing a stock certificate to an ‘identity’ (rather than the narrower category of ‘name’) does not make the certificate a ‘bearer certificate,’ and/or to clarify that “endorsement” can refer to a token transfer function call that is “signed” (i.e., including signed by a private key corresponding to a previously known data address).

SKEPTICAL INTERLUDE #3 – Q&A

Q. Why don’t you just use ERC884—the DGCL Compatible Share Token Standard[86]?

A.

ERC884 was a great step away from the PDLT approach in that it facilitates the use of Ethereum rather than a permissioned ledger for stock tokenization by referring to an off-chain stock ledger as the corporation’s official statutory stock ledger storing stockholders’ natural names and mailing addresses[87] rather than requiring the blockchain itself to *be* the stock ledger and store that information. However (although analogizing ERC884 tokens to stock certificate in one comment in the code[88]), it is different from and partially incompatible with the tokenized stock certificate approach described herein. As a result, it does not go as far as is legally possible to enhance the individual asset sovereignty of stockholders—indeed, it potentially decreases such sovereignty as compared to some situations.

The main flaw in ERC884 from the standpoint of individual asset sovereignty is that the standard restricts transfers of the tokenized certificates—and thus, by implication, the stock itself—to a whitelist of Ethereum addresses that must be set by the administrator of the ERC884 contract (likely the issuing corporation or an agent thereof). Although there may be good reasons to use such a whitelist approach for some corporations some of the time, and albeit corporations should certainly have the ability to take a whitelist approach if necessary, it is *not* always necessary. For example, it is certainly not necessary for a corporation whose stock is registered on Form S-1 and thus legally trades freely to take such a cumbersome and centralized approach. Thus, even for purely practical reasons, ERC1410—which can be combined with whitelisting but does not require it—is a far more suitable standard.

Similarly, from a policy point of view, we should maximize opportunities for free transferability. The less freely stock trades—and the more off-chain activities (such as an admin manually instructing the contract to whitelist a new address) are required to facilitate stock trades—the less liquid stock will be and the more dubious will be the benefits to the market of using tokenized certificates on a blockchain rather than sticking with the current system. Thus, from the standpoint of the individual asset sovereignty of stockholders and from the standpoint of capital markets policy, it is preferable (all else being equal) to have as few transfer restrictions as possible, and we need a token standard for tokenized stock certificates that reflects those policy goals.

The design of ERC884 also seems to be based in part on the apparently common misconception that either corporate statutory law, or securities law, or both, require that a corporation “must be able to produce an up-to-date list of the names and addresses of all shareholders.”^[89] This is true in one trivial sense but very untrue in another, as I explain in answer to the next question.

Q. Aren’t corporations legally required to be able to produce an up-to-date list of the names and addresses of all of their stockholders at all times, and doesn’t your tokenized certificate approach create the possibility that the corporation is unable to comply with those legal requirements?

A.

Yes in a sense, but no in a more important sense. I could do a deep dive into all the applicable statutes and case law, but at the risk of seeming flip but for the benefit of my sanity, I’m going to short-form this one. Without getting into those details, it is obvious from the modern market dynamics for publicly held corporations we analyzed above that no such requirement exists. Indeed, public corporations are *legally prohibited* from knowing who many of their stockholders are, because the stockholders can opt to be treated as “OBOs” (objecting beneficial owners) and only be known to their brokers. This illustrates that corporations are *not* required to, and indeed publicly held corporations in the current system are not even *able* to, know the identities and addresses of all their stockholders at all times.

What the corporation must know (and record on its ledger) is the identity of anyone the corporation itself directly sells its stock to (in the case of a publicly held corporation, this is typically one stockholder: Cede—although of course that will be changing in our system and the corporation will sell certificated stock directly to many stockholders). If the corporation issues book-entry-only shares, then, yes, the corporation must know every current stockholder—because no one can become a stockholder (i.e., can have full legal title to the stock) unless registered as such on the corporation’s books (at least in Delaware—recall that Wyoming’s recent amendments technically mean that just knowing an Ethereum address is enough).

The situation is totally different for certificated shares, which, as we have discussed, can trade all kinds of ways without the corporation knowing. Of course, if and when the corporation learns that ownership has changed, it is required to bring its stock ledger up to date, whether the stock is certificated or book-entry-only—but that is very different from a requirement to always know who all of its stockholders are. Indeed, all of the legal requirements imposing obligations on the corporation to create stockholder lists or notify stockholders of certain events etc. are satisfied when the corporation creates a list of its *record* stockholders or notifies its *record* stockholders. If a stock transferee who has taken shares in certificated form wishes to the corporation to know who they are and keep them timely informed of goings-on, it will be incumbent on the transferee to notify the corporation so that the stock ledger can be brought up to date—and the corporation is not legally responsible for the fact that a given transferee may neglect to (or choose not to) do so and thus be a *beneficial* stockholder but not a *record* stockholder. The vast majority of stockholders of public corporations currently are beneficial stockholders without being record stockholders—think how crazy it would be if that meant all those corporations were all violating the law! It’s just not the case.

Q. You say the purpose of tokenizing stock certificates is to enhance individual asset sovereignty. However, your ideas for implementing such stock certificates include giving the issuer the rights to:

- *confiscate the tokenized stock certificates at will;*
- *increase the supply of tokenized stock certificates at will;*
- *subject transfers to pre-checks in the form of whitelists, transfer restrictions, etc.*

Doesn't this mean your solution is a centralized, authoritarian, trust-requiring one, and aren't you being hypocritical?

A.

First, some level-setting: Securities in general, and capital stock in particular, are subject to very different off-chain (social/contract layer) rules and regulations than native on-chain assets (like a UTXO on Bitcoin, or an account balance on Ethereum (more colloquially, “a bitcoin” or “an ether”)). Moreover, such a native on-chain asset does not *represent* anything else—it just is what it is, and, luckily for us, it has acquired some value on the social layer such that you can trade it for other things (including dollars).

Our tokenized stock certificates, by contrast, are very different. They have no independent “on chain” life in any useful sense. They are purely representations of the existence and ownership of an abstract *entitlement* or *right* that inherently exists only on the off-chain legal/social layer where it is governed by an extensive set of both governmentally imposed laws (e.g., securities laws) and privately agreed upon rights, obligations, liabilities, rules and procedures (e.g., in ‘wet contracts’). Moreover, the most ‘libertarian’ form that stock certificates can theoretically take—that of *bearer* certificates—is mostly illegal (or, what amounts to the same, so heavily penalized that it is undesirable).

As a result, it would be extremely naïve to think that even the most liberal of tokenized stock certificates will be even close to as liberal as the implementation of intrinsically on-chain assets like BTC or ETH.

Secondly, it is important to realize that what we need is a framework that can be adapted by market participants with varying needs and preferences. Some corporations—those having management teams with a very high amount of trust from or leverage over the stockholders to whom they are ultimately answerable—will prefer, and have the ability to adopt, rules that are most convenient and favorable for the corporation itself. Such corporations will end up with systems that operate either as book-entry, or as something very close to book-entry despite technically having stock certificates: they will want to monitor their stockholders’ compliance with securities laws, want the corporation and the other stockholders to have rights of first refusal over sales to third parties and want those rights enforced programmatically on-chain, etc. In other situations—particularly with publicly held corporations where the stock is not restricted under the securities laws and activist investors may exert significant influence over management to adopt pro-stockholder policies—the scales will tilt and the other direction, and stock will trade relatively freely and with relatively few—or possibly no—pre-checks on the part of the corporation or smart contracts it has deployed.

Although, as should be obvious from this article, I think it is important that blockchain provide a technological vehicle for asset sovereignty for stockholders, it is equally important that blockchain technology not preclude relatively issuer-favorable implementations. Freedom of contract is the core principle of corporate law and corporate finance—we need blockchain technology to be able to accommodate any number of possible arrangements, both pro-stockholder and pro-issuer.

Thirdly, it is important to understand that holders of tokenized stock certificates will have far more significant off-chain protections against censorship and forfeiture of their rights in their stock than holders of BTC or ETH have with respect to their rights in BTC or ETH. From this point of view, the

fact that the certificate tokens are merely *representations* is an advantage. If someone has a certificate-token stolen through a clever reentry attack, or loses the private key that controls the certificate-token, it will be an inconvenience, but it will not be the end of the world. Indeed, stockholders lose their stock certificates all the time. They do suffer costs because of the loss—for example, they may have to sign an affidavit and provide an indemnity agreement and/or bond to cover the potential break in the chain of title the loss has caused, but they do not simply suffer a forfeiture. The corporation will do its due diligence, cancel the old stock certificate, and issue a new one representing the same shares. The same is true in our new tokenized system, except the costs to everyone from loss are smaller because instead of an unrecoverable piece of paper, the stock certificate is now a token that can be traced all over the blockchain and burned by an administrator of the token smart contract. Also, because the managers of the corporation owe fiduciary duties to the corporation's stockholders under law and face liabilities if they breach that duty, the stockholder has off-chain legal protections against being deprived of his rights or property as a stockholder. Thus, all told, the stockholder has significant off-chain protections from bad conduct of both third parties and from the issuer.

For all these reasons, it is important to realize that blockchain technology solutions for stock ownership, administration and transfer can provide significant gains in individual asset sovereignty without turning stock into something that is treated just like ether or bitcoin. That would not only be unrealistic, but actually probably harmful.

Q. You say you want to put stock certificates on a public blockchain. But public blockchains are not in the issuer's control, and thus can fork. If tokenized stock certificates of The Boring Company are on Ethereum, and Ethereum forks, what happens? Does The Boring Company now have twice as many shares, so that it has potentially issued more shares than it has authorized in its certificate of incorporation and its stockholders have potentially been diluted? Have any laws been broken? How would The Boring Company prevent "double spends" occurring by 'spending' the stock two different ways on the two forks of the chain?

A.

Here, again, the social/legal/wet contract layer is critically important. I don't want to pretend that I have answered every question or provided a complete implementation in this article. One key element of any implementation will be that the corporation with tokenized stock certificates will inevitably need to add some special provisions to its certificate of incorporation, bylaws and potentially other contracts to deal with this novel technology. The threat of a fork is very real here, and in some sense much more damaging than for ordinary on-chain assets. When token-certificates are duplicated on two chains, the same certificate could be traded to two different people on the two different chains—essentially a cross-chain "double spend". While such a double spend is generally not possible (putting aside the issue of "replay attacks") for intrinsically on-chain assets like BTC or ETH—because, in a fork, one has effectively created a new set of BTC-beta and ETH-beta that are brand new, intrinsically on-chain assets—it is possible when the on-chain asset is supposed to represent an off-chain one. That is a whole new threat model that requires new tools to deal with. In this case, the solution is simple: the corporation should have a provision in its bylaws providing that, in the event of a fork, the corporation's management, or its board of directors, or its stockholders, or some combination of the foregoing, are required to pick one chain and burn—or refuse to honor—certificates on the other chain. Thanks to the ERC621 (or similar) functionality we would use to model the token-certificates and the fact that the corporation would have admin controls over the smart contracts on *both* chains, it will be possible for one side of the fork to be definitively chosen and all certificate-tokens on the other side burned, redeemed or otherwise disabled.

Q. You say you want to put stock certificates on a public blockchain, but anyone can download all the data on a public blockchain. This creates massive, unacceptable risks of exposing the issuer's secrets and the stockholders' personally identifiable information (PII). By contrast, a PDLT approach is superior because it can work a lot like Carta's e-shares—a given stockholder can see

information the stockholder has a right and need to know without also exposing the PII of other stockholders.

A.

This could segue into a far longer conversation that opens up into any number of rabbit holes, but I'm going to keep the answer short. While this question expresses a legitimate concern, here is why I don't think it presents anything close to a "deal-killer":

- As mentioned, the WBCA now recognizes the concept of a shareholder "identity" (which may consist of a blockchain-based "data address") in some of the places where it used to require use of a shareholder "name"—and part of my proposal is that the WBCA would recognize the concept of "identity" for purposes of issuing Token Certificates as well. Relatedly:
 - My hope is that other States (especially Delaware) will follow Wyoming's example in this regard.
 - Although data addresses provide pseudoanonymity rather than complete anonymity, pseudoanonymity is a very good protection against most adversaries, which is why many holders of BTC, ETH and other intrinsically on-chain assets feel that their ownership is at least somewhat more private than their ownership of traditional securities or fiat currency.
 - "Chain analysis" to correlate data addresses with real world identities is possible, but remains expensive, and often relies on the fact that most people 'get into crypto' via fiat on-ramps like bank transfers to crypto exchanges.
 - Many great teams are hard at work on additional privacy-protection tools for blockchain technology, including zK-Snarks on Ethereum.
- Comparatively speaking, it is unclear that non-anonymized data really is better off in the hands of permissioned nodes on a PDLT chain than pseudo-anonymized data is in the hands of the public. In that scenario, the database becomes much like the databases of Facebook, OkCupid, Experian, Yahoo and so many others—all of which have been hacked and exposed the PII of millions. There is nothing about slapping "permissioned blockchain" onto a database that materially lowers the risks of such hacks or the trust that users are required to vest in the operators of the network to use their data responsibly.

Q. I thought you had said that one of the benefits of your approach was that it dovetails with existing law. It doesn't! As you admit, statutory amendments would be needed to implement a tokenized stock certificate approach even for a Wyoming corporation, despite the fact that Wyoming has already passed extremely pro-blockchain amendments to its corporate code. Been there, done that! Wyoming and Delaware have already spoken on how corporations should put their shares on a blockchain, and they picked a different approach. We're not getting more amendments to facilitate your approach any time soon, so move along, buddy!

A.

This is a very fair objection and a hard one to answer (in part because it's multifaceted). I don't have a devastating logical refutation of this objection like I do for some of the others. But I do have some softer, less definitive rebuttals:

- I happen to think that the changes I'm proposing to the WBCA are extremely modest and should be uncontroversial. Certainly, they are far less invasive than the broader set of blockchain-enabling amendments that already have been passed there. All they really do is modify some provisions of the WBCA that clearly contemplate a *paper* stock certificate

(i.e., one with a “front” and a “back” to write things on and which is susceptible of being signed “manually or in facsimile” but not electronically) to allow for the possibility of a certificate that exists in *token* form and can contain information via metadata linkages.

Then, additionally, they take some blockchain concepts that Wyoming has already recognized for its stock ledger rules (such as the concept that a shareholder’s “data address” can serve the same purposes as a shareholder’s natural “name” and “mailing address” on a corporation’s stock ledger) and extend them into the context of stock certificates.

- The changes that would be needed to the DGCL are similar, except that unlike Wyoming, Delaware did not add the concept of a shareholder identity based on “data addresses” instead of “names”—thus, Delaware’s amendments would have to adopt that concept as well as making changes similar to the more specific ones I am suggesting Wyoming adopt.
- I am not sure any changes would strictly be necessary for the UCC, although I would admit that the UCC could benefit from adding some “for the avoidance of doubt” type clarifications—e.g., to make clear that sending a token certificate to a creditor’s blockchain address—or, better still, depositing the token into an escrow-style smart contract that contains the loan logic and will release the token to the lender upon default and back to the debtor upon full repayment—constitutes “control” of the certificated stock for purposes of the protected purchaser and creditor priority provisions of Articles 8 and 9.
- For whatever reason (probably a host of reasons), I believe that the technical blockchain experts who were most influential in helping shape the DGCL and WBCA amendments came from the ‘enterprise blockchain’ world. It also separately appears that Laster read up on Ripple/XRP moreso than about unpermissioned blockchain frameworks and therefore based his articles on those technologies. In my opinion, this skewed the resulting approach in a certain direction. While I am not opposed to that approach existing as a possible pathway, and I do not mean here to disparage the people involved or their motives, I also think the pathway I outlined here could be a very productive alternative, and should be one that corporations can try if they want to. I personally think my approach better synergizes with the underlying value proposition of blockchain technology as enhancing individual asset sovereignty—which, to me, in this context, refers to the asset sovereignty of stockholders with respect to holding and transacting in their shares. The current DGCL and WBCA blockchain approach is a more issuer-oriented one that does not place stockholder liberty interests front and center. Because stockholders should prefer my approach—or at least having my approach as an option rather than not having it—I am confident that reason could prevail here, and that Delaware, Wyoming and other jurisdictions could be persuaded to adopt the necessary amendments. Admittedly, that could take time and persuasion—but I am patient.
- In the meantime, if there are any corporations out there that are particularly gung-ho to set up a production version of tokenized stock certificates in the short term, and have a medium-high or high tolerance for risks and uncertainties, then there is a kind of ‘interim solution’ available. Both Delaware and Wyoming permit the issuance of *scrip* representing *fractional shares* of corporate capital stock, AND, weirdly enough, they permit that scrip to be in either registered form or bearer form. Thus, a corporation could get rather close to the tokenized certificate model I have outlined here by issuing tokenized scrips representing fractions of a share and setting up various on-chain and off-chain parameters for dealing with them. That could also serve as a kind of proof-of-concept for the more robust proposal I have outlined here. Of course, this is just an idea, and, as previously mentioned, there are other areas of law—money transmitter law and securities law among them—that would be implicated here. Thus, I would caution people to consult an attorney before actually embarking on such an uncertain and potentially risky endeavor.

FIN SKEPTICAL INTERLUDE #3

How Well Does the TCA Solve the Problems?

Having explored the TCA in some detail, let us now look at our set of “problems” and see how well it solves them:

- **Problem #1: Transaction Fees.** Here, as with the PDLT approach, It is somewhat unclear whether the TCA will result in lowered transaction fees. Running transactions on a public blockchain requires payment of transaction fees in the native cryptocurrency, and such fees have proven volatile relative to their equivalent in USD, both because the underlying assets (such as BTC and ETH) can vary wildly in USD price on exchanges and because network traffic is subject to relatively unpredictable peaks and valleys that cause transaction fees to vary. There are also other costs that arise by virtue of the fact that we have disintermediated custodians and other types of agents that provide security by delegation; thus, each stockholder faces difficult-to-quantify incremental monitoring and security costs; the stockholder must (or at least *should*) learn how to generate and manage a private key, may wish to buy a “cold storage wallet” to store the key securely, etc. While these costs are not huge, they are also non-zero and worth considering. Since the transaction fees involved in a PDLT system are also uncertain, we’ll call this category a tie as between PDLT and TCA.
- **Problem #2: Delays.** TCA can clearly deliver better settlement times than current stock markets. However, because of the open nature of the networks involved, transactions are likely to be finalized somewhat more slowly than they would on a PDLT. Both TCA and PDLT represent far faster solutions than current markets, but, at least until additional scaling solutions are in place for public unpermissioned blockchains, the PDLT approach comes out slightly ahead in this category.
- **Problem #3: Trust and Lack of Privacy.** Because open public blockchains like Ethereum and Bitcoin are designed to be secure *without* whitelisting of nodes, the TCA requires significantly less trust (in the traditional sense) than the PDLT approach. Additionally, because most PDLTs would likely be not only write-permissioned, but also read-permissioned, so that only permissioned nodes can see all the data on the system and verify that it has not been tampered with, reverted, etc., PDLTs do not allow the average user to benefit from audit capability. By contrast, open public blockchains provide all of the data to anyone who has the computer resources to download it, and has been designed with such accessibility and auditability in mind from inception. Thus, the TCA is clearly superior to PDLT approach from the standpoint of trust dynamics. For the same reasons though, the TCA may be seen as inferior to PDLT from a privacy perspective—but the advantage is not clear. *See* the privacy-related Q&A above for more on this. Overall, while reasonable minds could differ on the subject and much depends on nuanced implementation details, my own view is that the TCA is far better at solving Problem #3 than PDLT is.
- **Problem #4: Disenfranchisement and Forfeiture.** As we explored in the Q&A above and elsewhere, when it comes to tokenized stock there is actually a strong need to give the issuer at least some ability to lock-up or burn Token Certificates and censor transactions. How much ability the issuer has in this regard will be very much a “season to taste” thing and could vary significantly from corporation to corporation and stockholder to stockholder. In this regard, the TCA is pretty similar to the PDLT approach. **However**, there is one critical difference—because validating nodes can join or leave unpermissioned blockchain networks at will, and because their participation is driven by cryptoeconomic incentives rather than institutional relationships, there is far less risk of a “corrupt majority” skewing transactions for ulterior reasons. Thus, there is an at least potentially material advantage to be found in this category for the TCA.
- **Problem #5: Inability to Verify Ownership.** Here, the TCA fares slightly worse than PDLT: while both allow stockholders to more easily verify their rights in their stock than does the heavily-intermediated modern market for public stock currently, the TCA imposes more burdens on an owner who wishes to do so, because under the TCA, it once again becomes possible for record and beneficial ownership to separate as stock certificates can trade peer-to-peer. I think this added complexity is a worthy price to pay for the resulting incremental freedom, but the point could be debated. In any event, while reasonable minds could differ

on the subject, I'm going to assume that PDLT fares slightly better on this problem because it eliminates all possibility of record ownership differing from beneficial ownership, and does so without imposing material due diligence costs on stockholders.

- **Problem #6: Lack of Programmability.** One could make a colorable argument that the TCA is better here because it allows certificate-tokens to interact with any number of smart contracts that exist on any number of public blockchains. On the other hand, similar smart contracts could also be built into whatever permissioned chain is being used under the PDLT approach. Let's not debate the issue too much and let's just call this category about even. Both the TCA and the PDLT approach *can* solve the problem of lack of programmable functionality for stock. I do anticipate though that due to the huge amount of developer enthusiasm for open-source projects like Ethereum, in the future the TCA will pull far ahead in this category—there will be so many software libraries, APIs and tools built around public blockchains that the possibility of building a comparable ecosystem in a permissioned “wall garden”—and, once you built it, actually getting third parties to come in and participate in it—would be daunting to the point of being preclusive.
- **Problem #7: Lack of Liquidity/Price Discovery.** Here I'd really have to make almost all the same arguments I did re: PDLT. Lack of liquidity/price discovery is not caused by the fact that shares of stock aren't represented as tokens on blockchains. It's caused by a mix of deep market dynamics and rules and regulations. Just as the PDLT approach won't intrinsically affect those deep causes, neither will the TCA. As I speculated above in the PDLT section, I guess it's possible that there is a certain ‘sex appeal’ in trading traditional securities in tokenized form, but I personally have a hard time believing that will materially affect the markets in the long term—at most, it's a novelty or gimmick factor that will lose its charm rather quickly. So, I'd call this category about even for PDLT approach and the TCA.

Thus, overall, the TCA solves pretty well all the same problems that the PDLT approach solves pretty well (problems 2, 5 and 6), *plus* it helps quite a bit with problem 3 (whereas the PDLT arguably exacerbates problem 3) and is better at the margins (but in material ways) on problem 4 though still not so much better that one would call problem 4 “solved.” The one area in which the TCA is likely to fare materially worse than the PDLT is with respect to ownership verification, but the TCA still very much facilitates a great audit trail for ownership—it's just that doing one's own audit, rather than trusting in others to do so, necessarily carries some costs and inefficiencies; that is the ‘pound of flesh’ that always is at least partially necessary in order to achieve improvements in individual asset sovereignty.

CONCLUSION

This article will not be the final word in how to implement trading and ownership of corporate capital stock on a blockchain. My hope, however, is that it suggests a new set of implementations, tied to the notion of tokenized stock certificates, that, to date, have received little attention from credible U.S. corporate lawyers and legislators who are interested in blockchain technology. At the moment, I see this new set of implementations as being the most promising approach to leverage the individual asset sovereignty potential of blockchain technologies—but I expect I will be hearing a lot of critiques and alternatives and am certainly open to changing my mind. Likewise, I hope it will suggest some creative approaches to, and invite collaborations with, developers who are working on tokenized security systems. Finally, I believe this may be “step 1” in a series of articles/projects I will undertake to “blockchainize the corporation.” Such projects may take the form of more detailed proposals of how to amend corporate law statutes, proposed forms of bylaws and certificates of incorporation for corporations with tokenized stock, and perhaps even simple DAPPs that achieve some of these objectives.

Acknowledgements: Special thanks to first and foremost to [Lewis Cohen](#), who acted as an eager sounding board for early ideas around these topics and then patiently waded through the ensuing series of semi-delirious manifestos that eventually became this article, providing valuable comments, ideas

and encouragement every step of the way. Thanks as well to my other colleagues at [DLx Law](#)—Angela Angelovska-Wilson, Greg Strong and Rodrigo Seira—for providing valuable feedback and support, to Mark D’Agostino and Alex Miller for providing encouragement and helping me fill in some of the technical blanks, William Lamb for corporate law review and the folks at “Gentlemen’s Analysis” for jogging my thinking on this topic and encouraging me to set pen to paper.

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[1] For some of the higher quality pieces that are out there, *see generally* Stephen McKeon, “[Traditional Asset Tokenization](#),” *Hacker Noon*, Aug 11, 2017, and “[The Security Token Thesis](#),” *Hacker Noon*, May 25, 2018 and Bruce Fenton’s series on “[The Future of Blockchains and Securities](#)”.

[2] <https://twitter.com/APompliano/status/968472948213473280>.

[3] <https://medium.com/@apompliano/the-sec-will-mandate-security-tokens-ee3312c6fea7>.

[4] <https://twitter.com/APompliano/status/973630796585152514>.

[5] Oliver Dale, “[What is Tokenization? Democratizing Ownership & Real-World Assets on the Blockchain](#)”.

[6] https://medium.com/@bilal.el_alamy/tokenized-securities-46a9247d1a06.

[7] Oliver Dale, “[What is Tokenization? Democratizing Ownership & Real-World Assets on the Blockchain](#)”, July 31, 2018, *Bloc Konomi*.

[8] FAQ, *Brickblock.io*, <https://blog.brickblock.io/faq-tokenized-real-estate-assets-24674ee47543>.

[9] Eric Jackson, “[How blockchain technology will reduce trade friction for everything from real estate to fine art](#),” *CNBC* Jan 29 2018.

[10] Addison Cameron-Huff, “[How Tokenization is Putting Real-World Assets on Blockchains](#),” March 30, 2017, *Nasdaq.com News*.

[11] Some pre-publication readers have suggested I define “token” here. That is somewhat difficult to do in technical terms, since it depends on the implementation—e.g., in Ethereum a token is an account balance, in Bitcoin it could be a UTXO or Counterparty-style metadata—but, very roughly, by “token” in this article I mean “an account balance, transaction output or transaction input that recorded on a blockchain in a manner that gives one or more private keys control over how that balance, output or input is subsequently transferred.”

[12] *See* Nick Szabo, “[Secure Property Titles with Owner Authority](#)” and “[Proplets – Devices for Controlling Property](#)”.

[13] “[eShares Makes First Move to Standardize Electronic Share Issuance: Electronic Stock Certificate Platform Receives First Legal Support for New Technology](#)”, Dec. 11, 2013.

[14] §12(g) of the Securities Exchange Act of 1934.

[15] *See generally* Andreas M.. Antonopoulos, “Blockchain vs. Bullshit” in *The Internet of Money Volume Two*. Merkle Bloom LLC.

[16] Satoshi Nakamoto, “[Bitcoin: A Peer-to-Peer Electronic Cash System](#)”.

[17] Nick Szabo, “[Money, blockchains, and social scalability](#)”

[18] Antonopoulos, Andreas M.. The Internet of Money Volume Two (Kindle Locations 230-232). Merkle Bloom LLC. Kindle Edition.

[19] Attributed to Vitalik Buterin; source not identified.

[20] Vitalik Buterin, [A Next-Generation Smart Contract and Decentralized Application Platform](#) (Ethereum Whitepaper).

[21] Vitalik Buterin, <https://medium.com/conversations-with-tyler/vitalik-buterin-tyler-cowen-cryptocurrency-blockchain-tech-3a2b20c12c97>.

[22] This term was inspired by Jameson Lopp’s use of the term “financial sovereignty,” but since some people view some assets (such as video game collectibles) and some transactions and apps as being “non-financial,” I have broadened the term to refer to “assets” (potentially encompassing non-“financial” use cases). See Jameson Lopp, “[Securing Your Financial Sovereignty](#)”

[23] I believe there are a few applications for which blockchain technology could be more efficient than client-server/master-slave architectures *purely from a cost point of view*. However, these are fairly limited in number and appear only where current mainstream systems are already heavily decentralized or distributed, creating excessive intermediation and transaction fees. As we will see, one example is existing public stock markets in the United States—because it is already “decentralized” and because blockchain can do decentralization better, blockchain could provide a better solution without necessarily enhancing individual asset sovereignty.

[24] Of course, I am speaking here of bearer instruments in their pure and intended form. As we will discuss below, since bearer instruments have come under intense political pressure, the few jurisdictions that still allow them (e.g., Panama) have attempted to strike a compromise by requiring them to be held by a custodian who maintains chains of title etc.

[25] See Delaware General Corporation Law, § 158, and Wyoming Business Corporations Act, § 17-16-625(f)

[26] See generally U.C.C. §8-303. Of course, as discussed later in the article, for the transferee to exercise rights against the corporation in respect of the stock the transferee will eventually have to “doxx itself” to the corporation and present the endorsed stock certificate as proof of ownership.

[27] *Ibid.*

[28] DGCL §158. Interestingly (by contrast), DGCL §155 expressly contemplates that corporations may issue *fractions of a share* “in bearer form (represented by a certificate),” which opens up another potential end-around the prohibition on issuing bearer certificates. But I digress. See “Skeptical Interlude #3” near the end of this article for more discussion of this path.

[29] See e.g. [Decker v. Yorkton Securities, Inc.](#), 131 Cal. Rptr. 2d 645 – Cal: Court of Appeal, 1st Appellate Dist., 5th Div. 2003.

[30] ERC20 is far from the best standard for a security token; however, for purposes of simplicity I am using it here to highlight the technological capabilities of a token on Ethereum.

[31] That the stock trades publicly is a simplifying assumption. Many additional complications arise for privately held stock, including mandatory legal transfer restrictions and optional (but highly standard) contractual transfer restrictions.

[32] Note: it is theoretically possible that Carta has “source code escrow arrangements” with its customers in order to enable them to keep a private version of the software going if Carta goes out of business. Many enterprise software arrangements do feature such a backup plan. While not as good as being open-source, this does provide users and issuers with some protection against corporate misfortunes that might be suffered by the platform owner.

[33] This is a deliberate oversimplification. As we will see below under “*Modern Stock Market Dynamics*,” ownership and trading of public company stock is actually fairly decentralized in contemporary markets—*without* any blockchain. As a result, the issuer typically only has one “stockholder of record”—Cede & Co., which holds the stock as the indirect “nominee” of all the ultimate beneficial owners; meanwhile, the stock is constantly trading on a quasi-peer-to-peer basis through various brokerages, with the issuer being mostly unable to determine the identities of who is involved in any given transaction. Nevertheless, the privacy concern mostly remains the same—although a given beneficial owner may not have to identify itself to the *issuer*, it will have to identify itself to *someone*—such as a brokerage which maintains its own mini-ledger. Additionally, the beneficial owner’s distance from the issuer carries some costs and penalties—transaction fees it needs to pay to intermediaries such as brokers—and potential delay or loss in exercising stockholder rights; *see generally* J. Travis Laster, “The Block Chain Plunger: Using Technology to Clean Up Proxy Plumbing and Take Back the Vote,” Keynote Speech, Council of Institutional Investors, Chicago, September 29, 2016 and J. Travis Laster and Marcel T. Rosner, “Distributed Stock Ledgers and Delaware Law.”

[34] N.B., since DGCL § 158 provides that “A corporation shall not have power to issue a certificate in bearer form,” we know that the stock must have been issued on a *registered* basis, and thus BlockCorp must know who Alice is.

[35] I am being deliberately vague here about the exact way this pledge goes down—but the details really matter and that’s why we’ll be exploring them.

[36] Here it is important to stress that that I have removed the hypo from the realm of bankruptcy law by assuming that Alice was financially solvent at the time of the stock sale made to Bob. I have done this because the hypo and related law are complicated enough, and I wanted one less issue to deal with. If Alice had been insolvent and if the lender-initiated bankruptcy proceedings, the lender might at least have an argument that the stock should be reclaimed in some way from Bob. But even then, probably not—Alice did not transfer Bob the stock to satisfy a debt—i.e., she did not pay Bob an “avoidable preference,” no less a “fraudulent conveyance”—but rather she sold Bob the stock for equivalent value.

[37] *See* 5A Del.C 1953 §§8-106, 8-112, 9-317(b) and *passim*. Note that under Article 9, because the security is *certificated*, Bob receives full rights in the security even if the lender has gone so far as to perfect its security interest by filing a UCC statement; all else being equal, Bob has no duty to go check the UCC records before he buys stock from Alice. That is why a smart lender will always acquire “control” of the certificate. This rule exists for important public policy reasons which value the ability of a buyer to just buy a certificated security without doing extensive due diligence in order to be sure it will really be his. That is why the certificate model for tokens is so much better than the “book-entry” model.

[38] Nick Szabo, “[Contracts with Bearer](#)”.

[39] See e.g., Andreas M. Antonopoulos, *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*, p. 41: “In simple terms, a transaction tells the network that the owner of a number of bitcoins has authorized the transfer of some of those bitcoins to another owner. The new owner can now spend these bitcoins by creating another transaction that authorizes transfer to another owner, and so on, in a chain of ownership.” See also RenMac: “[Bitcoin Is No Better than Bearer Bonds](#),” *Market Realist*.

[40] See generally Rob Henham, “[Bitcoin is not a ‘Digital Bearer Asset’](#),” June 4, 2016,

[41] E.g., taking securities as collateral to secure a debt: “The lender may also find it easier to obtain control of a certificated security (by taking possession of an indorsed certificate) rather than obtaining control of an uncertificated security. Control of an uncertificated security requires either registration of the security in the name of the lender (not likely to be an available means of holding an LLC or partnership interest) or a control agreement with the issuer of the security. While the issuer of the LLC or partnership interest may be willing to take the necessary steps for the interest to be a security (described below) and to issue a certificate, it may not be willing to undertake the responsibilities (and potential liability) involved in a control agreement.” (<https://apps.americanbar.org/buslaw/blt/2005-01-02/soukup.shtml>)

[42] I am simplifying a bit here. For example, most modern corporations contain an “exculpation provision” in their charter which eliminates liability of directors for breaches of fiduciary duties, other than the duty of loyalty.

[43] Of course, it is important to note that corporate law does afford some flexibility—albeit not unlimited flexibility—to depart from the default rights for corporate capital stock if so specified in the corporation’s certificate of incorporation or contracts entered into among the corporation and its stockholders. Therefore, on the margins, some corporate capital stock will be non-voting, or will have a resemblance to debt in paying out a cumulative dividend and not having a general equity claim, etc. But I will mostly ignore those variations here and focus on the core, default rights of corporate capital stock.

[44] Of course, there are rare exceptions—the so-called “unicorns” that have become renown in Silicon Valley. Companies like Uber, Lyft, Palantir Technologies and others certainly attract widespread public attention—and can even have somewhat active secondary markets for their equities—far in advance of becoming public companies.

[45] J. Travis Laster and Marcel T. Rosner, *Distributed Stock Ledgers and Delaware Law*, 73 *Bus. Law.* 319 (Spring 2018), p. 326

[46] *Ibid.*

[47] <http://www.uniformlaws.org/ActSummary.aspx?title=UCC%20Article%208,%20Investment%20Securities%20%281994%29>

[48] The current norm for clearing/settlement of stock trades is “T + 2,” meaning that market participants have two business days after the date of the trade to settle it; this delay either creates counterparty risk or requires additional intermediaries (the clearing houses) to, in effect, buy that counterparty risk for a fee.

[49] See generally Laster, “Blockchain Plunger,” p. 6

[50] See generally, Bruce Fenton, “[How Do You Know You Own Your Stocks? You Don’t \[sic.\] So who has the ledger?](#),” *Medium*, Fenton cites issues lawyers had in deciding the number of Dole shares in the plaintiffs’ class for a class action suit, summarized in a misleadingly titled *Bloomberg* article “[Dole Food Had Too Many Shares](#)”. If you read the article, it becomes clear that any problems there

were solvable with some work, and essentially boiled down to a repeat of Problem #2: Delays. In other words, the problem was an epistemological one for lawyers litigating in a post-transaction environment where not every “client”—member of the class—was communicating with them; not a problem for the actual owners/members of the class, who presumably would know (if you asked them) whether their last Dole stock transaction was a buy or a sell.

[51] See generally J. Travis Laster, “The Block Chain Plunger: Using Technology to Clean Up Proxy Plumbing and Take Back the Vote,” Keynote Speech, Council of Institutional Investors, Chicago, September 29, 2016 and J. Travis Laster and Marcel T. Rosner, “Distributed Stock Ledgers and Delaware Law.”

[52] The Block Chain Plunger: Using Technology to Clean Up Proxy Plumbing and Take Back the Vote,” Vice Chancellor J. Travis Laster, Keynote Speech, Council of Institutional Investors, Chicago, September 29, 2016, pp. 9-10

[53] Plunger, p. 20

[54] J. Travis Laster and Marcel T. Rosner, “Distributed Stock Ledgers and Delaware Law,” p. 331

[55] Peter Todd, [Ripple Protocol Consensus Algorithm Review](#), May 11th, 2015

[56] Author writing as “Satoshi,” “[Decentralization ≠ Disintermediation: A history of disintermediation and its cousin, decentralization](#)”.

[57] See Andreas M.. Antonopoulos, “Blockchain vs. Bullshit” in *The Internet of Money Volume Two*. Merkle Bloom LLC, Mark D’Agostino, “[No Country for Private Blockchains](#),” and Alex Miller, “[Scaling Blockchains with Apache Kafka](#)”. For more on the difference between permissioned and unpermissioned blockchain networks generally, see also Lukas Kolisko, “[Do we need mining in private and permissioned blockchains?](#),” “[What is the Difference Between Public and Permissioned Blockchains?](#),” Brent Xu, “Blockchain vs. Distributed Ledger Technology Platforms”.

[58] See e.g. the systems described by Jeff Bandman and Jonathan Cardenas at https://www.americanbar.org/content/dam/aba/administrative/business_law/newsletters/CL930000/full-issue-201804.authcheckdam.pdf and the system for tokenizing asset-backed securities described by Doneene Keemer Damon (by way of Andrea Tinianow) at <https://www.forbes.com/sites/andreatinianow/2018/07/04/tokenized-securities-are-not-secured-by-delaware-blockchain-amendments/#7545e5143e79>

[59] Andrea Tinianow, “[Tokenized Securities Are Not Secured By Delaware Blockchain Amendments](#),” Forbes, Jul 4, 2018.

[60] One theoretical alternative—albeit I have never heard any PDLT proponents advocating for it—would be to have stockholders vote to permission the nodes in a kind of delegated proof-of-stake or similar system. While such on-chain governance would be superior from the standpoint of individual asset sovereignty values, it is not free from problems: on-chain governance by stakeholder voting is notoriously tricky and subject to cartel-formation and other bad behavior. Even assuming those problems generally can be solved with good governance, the bigger business issue is that such a system is *expensive*: one must pay, and pay handsomely, for nodes to be willing to serve as elected validators. Thus, the transaction fee problem could become much worse in such a system than in the current public stock markets.

[61] Uniform Law Commissioners, “[Summary – Uniform Commercial Code Revised Article 8 – Investment Securities](#)”.

[62] § 8-301(a)(1)

[63] § 8-104(a)(1)

[64] § 8-302(a)

[65] § 8-303

[66] § 8-303(a)(1)

[67] § 8-303(a)(2)

[68] § 8-303(a)(3)

[69] § 8-106(b)

[70] § 8-106(c)

[71] § 8-301(b)(1)

[72] § 8-104(a)(1)

[73] § 8-302(a)

[74] § 8-303

[75] § 8-303(a)(1)

[76] § 8-303(a)(2)

[77] § 8-303(a)(3)

[78] § 8-106(c)

[79] § 8-102(1)

[80] §8-105(a)(1)

[81] §8-105(a)(2). More technically and in the words of the statute, “is aware of facts sufficient to indicate there is a significant probability that the adverse claim exists and deliberately avoids information that would establish the existence of the adverse claim”

[82] §8-105(a)(3). The National Conference of Commissioners on Uniform State Laws has noted that “Such a statutory or regulatory duty in [the context of virtual currencies] seems unlikely.”

[83] One might fairly ask—how is Alice to know that the stock is certificated or not? Typically this is specified in a corporation’s certificate of incorporation, which is publicly available. Also, she should do at least a certain amount of due diligence into the corporation and into Bob, and should get representations and warranties from Bob regarding the nature of the stock and his right to transfer it. The UCC does not protect buyers against a shoddy due diligence process that fails to uncover the fact that stock is certificated.

[84] ERC621, developed by my former Grid+ colleague Alex Miller, was prescient and is a particularly important piece of the tokenization puzzle. As Miller himself notes in his explanation of the standard: “*If we wish to allow physical or deposit backed assets to be digitized on the Ethereum*

platform, it becomes necessary to allow central operators to control the supply of their assets[...] This proposal is a notable departure from many trustless models that the crypto community is used to seeing. It is important to note that this proposal is mostly relevant to digitized assets already controlled by central issuers and that these models already require trust in the operator. However, use cases may emerge whereby increase/decrease privileges may be extended on a one-time-use basis. It is also important to note that if centralized issuers desire this functionality, they will put it into their token contracts whether or not a standard exists.” In other words, because, unlike bearer-style assets like ETH or BTC, these types of digital “assets” are really just *representations of other assets* (e.g., stock or other securities, or interests in physical assets), there is no shame in allowing supply to the contract and expand. Indeed, supply *must be flexible*, because the representations must diminish if what they are representing diminished, and increase if they are representing increases.

[85] I plan on publishing a related article in which I articulate a “Qualified Code Deference” (QCD) approach that meaningfully implements smart contract code as a true *alternative* to legal agreements. A QCD approach could be (but is not required to be) used by a corporation with Token Certificates to produce extra synergies. For now, see a rather laconic and imprecise Twitter explainer of QCD [here](#) and [here](#).

[86] <https://github.com/ethereum/EIPs/blob/master/EIPS/eip-884.md>

[87] “Implementers should maintain an off-chain private database that records the owner’s name, residential address, and Ethereum address.” <https://github.com/ethereum/EIPs/blob/master/EIPS/eip-884.md>

[88] “This event is emitted when an address is cancelled and replaced with a new address. This happens in the case where a shareholder has lost access to their original address and needs to have their share reissued to a new address. This is the equivalent of issuing replacement share certificates.” <https://github.com/ethereum/EIPs/blob/master/EIPS/eip-884.md>

[89] *Ibid.*