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Disrupting Secured Transactions

Christopher G. Bradley
University of Kentucky Rosenberg College of Law, cgbradley@uky.edu

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ARTICLE

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ABSTRACT

Article 9 of the Uniform Commercial Code (UCC) governs secured transactions in personal property in all fifty states and has been lauded as "the most successful commercial statute ever." But while Article 9 has facilitated commerce and economic growth, it remains complicated and inefficient in numerous respects. Its weaknesses are well known but have been considered necessary evils, accepted because no better approaches were available. But just as the UCC was motivated initially by the idea of streamlining the law to accommodate modern commerce, now that goal should motivate revision of the UCC itself.

This Article proposes to remove and replace a primary structural component of Article 9 of the UCC—the filing system by which secured creditors put others on notice of their interest in items of collateral. The proposal would jettison this outdated and often ineffective method of providing notice of security interests, and instead, would look to modern technologies to stake clearer and more reliable claims on collateral. It would no longer be necessary to file financing statements indexed under the name

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and location of the owner of collateral. Instead, the proposed regime would allow creditors to stake their claims directly—by means of online "smart" maps or by electronic tags identifying interests in particular items of collateral—and would eliminate numerous arcane, inefficient, and inequitable features of the current regime.

The proposal serves the broader goals of commercial law as well, by reducing needless legal complexity and more closely aligning legal requirements with business realities. The "disruptive" changes proposed in this Article would increase certainty in commerce and shape secured transactions law to emerging practices in business and finance.

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I. INTRODUCTION

> [The Uniform Commercial Code] is an honest effort to state basic rules of commercial law which reflect, more accurately and flexibly than do the present rules, going methods of operation.
>
> –Grant Gilmore, Principal Drafter of UCC Article 9, 1952[1]

> The picture for the business man then is that the [Uniform Commercial] Code will make his law come home and be friendly and be understood. It will eliminate something of which he isn't fully conscious—the unnecessary tax on his business that legal uncertainty now imposes.
>
> –Karl Llewellyn, Chief Reporter of Uniform Commercial Code, 1953[2]

> [T]he Internet will disappear . . . . There will be so many IP addresses…so many devices, sensors, things that you are wearing, things that you are interacting with that you won't even sense it . . . . It will be part of your presence all the time. Imagine you walk into a room, and the room is dynamic. And with your permission and all of that, you are interacting with the things going on in the room.
>
> –Eric Schmidt, Chair of Google, Inc., 2015[3]

Article 9 of the UCC governs secured transactions in personal property in all fifty states as well as Puerto Rico and the District of Columbia.[4] It has facilitated billions of dollars of commerce, served as a model for reforms around the world, and been widely

1. Grant Gilmore, *The Uniform Commercial Code: A Reply to Professor Beutel*, 61 YALE L.J. 364, 378 (1952).

2. Karl M. Llewellyn, *Why a Commercial Code?*, 22 TENN. L. REV. 779, 783 (1953).

3. Georg Szalai, *Google Chairman Eric Schmidt: "The Internet Will Disappear,"* HOLLYWOOD REP. (Jan. 22, 2015), https://www.hollywoodreporter.com/news/google-chairman-eric-schmidt-internet-765989 [https://perma.cc/Z25Y-NUCL].

4. Some states' versions of Article 9 are "nonuniform," but the deviations are relatively minor. *See, e.g.*, 4 JAMES J. WHITE ET AL., UNIFORM COMMERCIAL CODE §§ 31:41, 31:32 & n.8, 32:18 & n.3, 34:17 & n.3 (6th ed. 2015) (discussing nonuniform state amendments).

lauded as "the most successful commercial statute ever."[5]

Article 9 relies upon the central notion of a "security interest" that a creditor obtains in a debtor's collateral by agreement.[6] A security interest can be obtained in almost every sort of personal property. Once it is "perfected," the security interest gives the secured creditor rights in the collateral, not just against the debtor but also against most subsequent lenders or buyers of the property. Under Article 9, a secured creditor's rights against collateral are generally perfected by virtue of a filing, called a "financing statement," made in a public office in the state of the debtor's location. A financing statement is indexed under the debtor's name and location and theoretically puts other creditors on notice of the security interest encumbering one or more items or classes of collateral identified in the statement.[7]

Although it arises from a transaction between a creditor and a debtor, a security interest is a relationship between a creditor and an item of property. Conceptually, the key feature of perfection is that it announces the creditor's claim on that *item* to third parties. Yet Article 9's filing system focuses on the creditor's relationship with the *debtor*, out of perceived practical necessity. This Article argues this is no longer necessary, thanks to the availability of technologies that can permit direct identification of collateral itself.

As it stands, Article 9 remains complicated and inefficient in numerous respects,[8] due in no small part to the deep structural flaw of permitting financing statements announcing a security interest to be filed and discovered only when indexed under the debtor's name and in the debtor's state.[9] This structure immediately raises questions: Which forms of a debtor's name suffice for a filing to be valid? How can a party be certain of the actual location or identity of a business entity doing business in state *A*, which might be incorporated under an identical name in states *B* or *C*? What about when debtors change locations or

5. Steven L. Harris & Charles W. Mooney, Jr., *A Property-Based Theory of Security Interests: Taking Debtors' Choices Seriously*, 80 VA. L. REV. 2021, 2021 (1994); *see also* Edward J. Janger, *Predicting When the Uniform Law Process Will Fail: Article 9, Capture, and the Race to the Bottom*, 83 IOWA L. REV. 569, 571 (1998) ("Article 9 of the Uniform Commercial Code . . . is, by all accounts, the crowning achievement of the UCC project . . . .").

6. *See infra* notes 29–31 and accompanying text.

7. *See infra* notes 33–37 and accompanying text (discussing this and other means of "perfection").

8. *See* Section II.A.2.

9. *See infra* notes 46–55 and accompanying text.

names; or when the collateral leaves the possession of one debtor and becomes the possession of another? Article 9's rules attempt to deal with these contingencies and a multitude of others,[10] but in the end, the oblique structure of announcing an interest in a *thing* (the collateral) through a filing against a *person* or *business* (the debtor) brings inevitable complications.

The law has developed a number of cumbersome workarounds to make the system function. In addition to the complexities introduced by the requirement of filing under the debtor's name are those arising when collateral is sold. Current secured transactions law permits a security interest to stretch beyond the collateral actually described on a creditor's filings to include proceeds obtained upon the sale of the original collateral. Under many circumstances, the regime also permits a security interest to *remain* on the *original* collateral after such a sale. Thus, the system protects the initial secured creditor at the expense of other parties dealing with the debtor or purchasing a debtor's former property, who may have little feasible means of obtaining notice of a prior security interest.

These workarounds allocate the losses in instances in which the theoretical goals of the system are not met; they do not provide parties with notice, help protect their interests, or set sound commercial expectations. They prevent the efficient and reliable granting of security interests, which the system purports to promote. Unsurprisingly, in light of these complications, many participants in the commercial system fail to protect their interests or to engage in otherwise desirable transactions. Some deem the burdens and uncertainties of the filing system not to be worth the candle. Others are ignorant of the law's rather arcane approach to the many difficult questions that the design of the system provokes. Either way, Article 9 imposes costly inefficiencies on commerce and finance.[11] Some lenders are more reluctant to lend against collateral than they would be if the system provided them with better means of attaining and protecting their perfection; some are taken advantage of by the false certainty promoted by Article 9's apparent—but not actual—coherence and reliability, and thus suffer needless losses.

Article 9's weaknesses are well known, but they have been

10. *See infra* Sections II.A.1–2.

11. As noted in one of the epigraphs to this Article, in explaining the motivation for the UCC, Karl Llewellyn expressed a desire to end "the unnecessary tax on . . . business that legal uncertainty now imposes." Llewellyn, *supra* note 2.

considered necessary evils, accepted because no better approaches were available. This Article proposes a better approach—one that ends the filing system's detour through the debtor's name and location and trims away the tangle of inefficient workarounds, including those related to proceeds of sales of collateral. The Article describes two "disruptive"[12] technologies that can and should bring a radical shift in secured transactions: "Internet of Things" (IoT) technologies and geolocation technologies. Importantly, businesses have widely adopted these technologies already, but their potential to transform commercial law has not been recognized. This Article proposes to develop a new secured transactions filing regime based on these emerging uses of technology.

Under the proposed regime, readily available IoT and geolocation technologies would furnish the means for creditors to provide clearer notice of security interests in collateral and establish more reliable claims in that collateral. The proposed regime would require creditors to stake their claims in collateral directly—by means of public "smart" maps or by individual electronic tags that facilitate identification of security interests in items of collateral. This simplification would eliminate the need for numerous arcane, inefficient, or inequitable features of the current regime.

To be clear, the proposed changes would be almost entirely in the law and not in business practices. Secured transactions law would not be embarking on some quixotic quest to convince businesses to adopt unknown new technologies. To the contrary, it would be accommodating the ways in which businesses *already widely use* these technologies—including to identify, track, and monitor their property (including their collateral). Because these technologies are widely adopted and becoming ever more pervasive, the costs of transitioning to a new legal regime would not be a significant burden for most commercial actors, and likely would be outweighed by the benefits of such a change.[13]

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12. On "disruptive" technologies, see Joseph L. Bower & Clayton M. Christensen, *Disruptive Technologies: Catching the Wave*, HARV. BUS. REV., Jan.–Feb. 1995, at 43. Law scholars have invoked the idea when looking for ways to regulate innovation. *See, e.g.*, Chris Brummer, *Disruptive Technology and Securities Regulation*, 84 FORDHAM L. REV. 977 (2015) (discussing regulatory approaches to disruptive financial technologies); Wulf A. Kaal & Erik P.M. Vermeulen, *How to Regulate Disruptive Innovation—from Facts to Data*, 57 JURIMETRICS J. 169, 177 (2017) (proposing data-based regulatory model for disruptive innovation). What has drawn less attention in the legal scholarship, but is central to this Article, is how disruptive innovations may "disrupt" entire bodies of law, such as Article 9.

13. The challenge of adoption that might be faced by commercially or technologically

In general outline, the proposal is as follows: a creditor taking a security interest in a particular item[14] of collateral would perfect that interest by one of two mechanisms. To use the first mechanism, the creditor (or its agent) would mark the collateral with an electronic tag or other readable label or device, containing the name and contact information of the secured creditor and an ID number generated automatically from an online interface hosted at the UCC filing office of the state where the collateral is located. Once the number is assigned and the creditor's name and contact information registered, the interest would be perfected. If the IoT-tagged collateral is moved or sold, the perfected interest would survive, because perfection is not linked to the debtor. Anywhere that collateral is encountered, subsequent searchers (such as potential lenders) could scan it with readily available technology (such as that included on most smartphones) and check online UCC databases to discover security interests. The later creditor would be subordinate to the prior creditor—unless the unique tag had been damaged or removed from the object (tags could be designed to stop transmitting if tampered with). In such a case, after the passage of a short grace period, the prior creditor would lose to other creditors because it is best positioned to monitor its collateral and protect against such an eventuality.

Monitoring costs should be minimal, given the power of IoT technologies to provide automatic, real-time updates from afar concerning relevant characteristics of collateral. IoT technologies are regularly used, for example, to monitor remotely the location of a shipping container or the temperature or humidity of a warehouse.[15] The technology is expected to expand even more in coming years. The law would merely be looking to these existing business practices and giving force to them.[16]

The most familiar IoT technology is radio frequency identification (RFID), which uses electromagnetic fields (radio waves) to identify and track objects by virtue of "tags" that consist of a tiny circuit and embedded antenna and that are attached to

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unsophisticated individuals and small businesses is discussed *infra* Section V.G.

14. Intangibles are discussed *infra* notes 133–36 and accompanying text; the proposal is limited to tangible property and would leave the systems dealing with intangible property intact.

15. *See* JAMES MACAULAY ET AL., INTERNET OF THINGS IN LOGISTICS 16 (2015), https://delivering-tomorrow.com/wp-content/uploads/2015/08/DHLTrendReport_Internet_of_things.pdf [https://perma.cc/P5T3-M72H]; *see also infra* note 78.

16. *See infra* Section II.B (comparing need for monitoring under current Article 9 with the proposed system).

objects.[17] This technology is already ubiquitous. Retailers use RFID to identify goods received from suppliers and then purchased by consumers; pharmacists use RFID to weed out counterfeits and verify the authenticity of medications; and employers use RFID on security badges. RFID is inexpensive, and its costs are expected to diminish even further in the future.[18] And this is only one of a number of existing technologies, which are varied in capabilities and cost and can be customized to an astonishing variety of business uses.

This mechanism of perfection mimics, in some ways, the system already in place for items such as airplanes and cars, which are assigned unique identifiers by which security interests can be perfected.[19] Identification of items of collateral has long been known to make sense in theory, but until now, it was impracticable for most pieces of collateral, which were not expensive enough to merit the treatment that valuable items such as cars or airplanes received. This proposal is a response to the development of cheap and reliable technology allowing for the tagging of individual items—technology that did not exist at the time of the UCC's drafting.

The second method of perfection would involve geolocation technology (such as that underlying GPS navigation).[20] A creditor could log in to a publicly maintained interactive map, navigate and click to identify the location of its collateral, and then provide its name and a description of the collateral (broad or narrow as suited to the individual situation). The security interest would then be perfected as to any described collateral within that location. Subsequent searchers could easily check the map and ascertain whether a geolocated interest had been claimed and inquire further if necessary. Geolocation would work well with collateral that typically remains in one place (e.g., large equipment), as well as with locations where there are many items of collateral that turn over frequently (e.g., warehouses, factories, and stores)—and thus where a creditor might determine that tagging each item of collateral individually is not worthwhile. With this simple method, a creditor could gain perfection in, for instance, each new batch of

17. *See infra* notes 99–100.

18. *Id.*

19. *See infra* notes 94–97 and accompanying text (discussing technology used in motor vehicle and aircraft industries). In part due to imperfect technologies and nonuniform legal regimes, the system of car titling has been subject to critique and might be another area where a system such as that proposed here could be helpful. I hope to address that issue in future work.

20. For a discussion on geophysical technology, see *infra* notes 107–15 and accompanying text.

inventory that arrived in a warehouse or to a given retail location. The creditor would be tasked with monitoring collateral because if the collateral were to be moved outside of the protected area without authorization, the creditor would have only a short grace period to detect the move, locate the collateral, and assert a claim against it. Again, due to recent advances, monitoring could be accomplished remotely, with readily available, inexpensive, and largely automated technology.

By directly connecting creditors with their collateral, and by giving notice based on individual tagging or identification of the location of collateral, the proposed system would lower Article 9 compliance costs and diminish the number of defective filings. It would also permit the removal of numerous problematic laws such as those protecting "proceeds."[21] The revised system would provide lenders more certainty and at the same time permit debtors to carve out more precisely the property they wish to subject to security interests (all of which, in turn, would presumably improve financial markets and foster commerce). Undeniably, the proposed system would affect the existing Article 9 in profound ways, some of which might unsettle current participants. All of these effects deserve careful consideration before implementation. But it cannot be ignored that some current practices—such as the dominant, routine use of "all assets of the debtor" as collateral[22]—might, in fact, be consequences of the compromises of the existing Article 9. Experimenting with more finely tuned legal approaches might lead to new, better practices.

In addition to these practical benefits, the proposal would put secured transactions on a sounder theoretical basis and fulfill the UCC's broader normative goals in two important ways. First, the proposed system would more closely align secured transactions doctrine with actual commercial practices. The UCC was born out of the legal realist movement[23] as part of an effort to shape commercial law around business realities and the actual practice

21. For a discussion of how this proposed change, which, given the extremely broad protection currently given to proceeds, might be the most disruptive of all, in some ways, to the UCC, see *infra* Section II.A.2.b (describing current proceeds regime) and *infra* Section IV.A (describing proposed regime).

22. *See infra* Section V.B (discussing "all-asset" lending).

23. *See generally* WILLIAM TWINING, KARL LLEWELLYN AND THE REALIST MOVEMENT 270–340 (2d ed. 2012) (discussing the "Genesis of the Uniform Commercial Code" and the "Jurisprudence of the Uniform Commercial Code" in the context of legal realism); Allen R. Kamp, *Between-the-Wars Social Thought: Karl Llewellyn, Legal Realism, and the Uniform Commercial Code in Context*, 59 ALB. L. REV. 325, 339–45 (1995) (outlining the intellectual and societal underpinnings of Llewellyn's "Realist" approach).

of commerce.[24] This proposal moves the law away from the increasingly archaic step of filing against the debtor's name and in the debtor's location toward the realities of how modern commercial actors actually protect interests in property, i.e., by monitoring that property directly.[25] Second, when compared with the debtor-centered system, the proposed system makes more conceptual sense. The proposal comports with the underlying notion of a *security interest*—which is a relationship between a creditor and its collateral—as well as with the stated purpose of the requirement of *perfection*—to inform third parties that a given piece of property is encumbered with a security interest. The proposed system requires creditors to make claims on collateral directly, through identification on a tag or by its location. The system would no longer require the detour through the *debtor's* name and location, which has been the source of much mischief in the law, and which is needless and confusing in light of the underlying relationship between creditor and collateral that we call a security interest.

This Article's proposal is also a unique contribution to the growing body of scholarly work exploring the possibilities of IoT and related technologies for law and policy.[26] While technologically savvy commercial lawyers have floated useful

24. *See* Richard Danzig, *A Comment on the Jurisprudence of the Uniform Commercial Code*, 27 STAN. L. REV. 621, 631 (1975) (surveying its history and describing the purpose of the UCC as removing "statute and case law debris from the field so that commercial law could follow the natural flow of commerce"); Zipporah Batshaw Wiseman, *The Limits of Vision: Karl Llewellyn and the Merchant Rules*, 100 HARV. L. REV. 465, 492 (1987) (noting "[UCC chief architect Karl Llewellyn's] commitment to merchant reality" as one of the two "essential themes of Llewellyn's vision [for what became the UCC]"). Wiseman notes that, "[a]s a realist, Llewellyn viewed law as a means to social ends and recognized the need to reexamine the law constantly to ensure that it fit the society it claimed to serve." *Id.* at 493.

25. As Ronald Mann has noted, "it is too simplistic to treat the codification of commercial law as a codification of the norms reflected in everyday business practices," and yet, "policymakers who want to affect the tenor of commercial life must work to develop rules that account for the legitimate needs reflected in the reality of commercial transactions." Ronald J. Mann, *Verification Institutions in Financing Transactions*, 87 GEO. L.J. 2225, 2272 (1999). This Article is a call to commercial law policymakers to "develop rules that account for" new technologies and move the law away from those technologies that have rendered the law unnecessarily burdensome.

26. *See, e.g.*, ERIC POSNER & E. GLEN WEYL, RADICAL MARKETS: UPROOTING CAPITALISM AND DEMOCRACY FOR A JUST SOCIETY 30–79 (2018) [hereinafter RADICAL MARKETS]; Richard M. Hynes, *Posted: Notice and the Right to Exclude*, 45 ARIZ. ST. L.J. 949, 951–54 (2013) (proposing for virtual "no trespassing" signs to be "posted" and accessible remotely via GPS devices and smart maps to hunters or recreationists); Eric A. Posner & E. Glen Weyl, *Property Is Only Another Name for Monopoly*, 9 J. LEGAL ANALYSIS 51, 54 (2017) (proposing a new system of property ownership, taxation, and transfer based in part on a technologically enabled, universal registry of all property).

proposals for revising Article 9,[27] none so far has looked to IoT technologies as a way of taking on the debtor-indexed filing system—even though this lumbering system is one of the biggest elephants in the secured transactions room. Even those who seek to reform the system have not found a way to remove it altogether.[28] This Article provides such a proposal.

The Article proceeds as follows. Part II outlines the problems with the existing Article 9 system. Part III provides an overview of potentially "disruptive" advancements in two areas, in IoT technologies and in geolocation technologies. Part IV considers the strengths and weaknesses of potential regimes based on each of these technologies and proposes a hybrid perfection regime that would combine the best features of each. Part V considers potential hindrances to the proposal's implementation and functioning. Although it acknowledges how disruptive the proposed changes are and notes some ways in which the proposal could be modified to accommodate some existing practices (such as "all-asset" lending), it argues that the time has come for this tectonic shift to collateral-based identification, a shift that will benefit all stakeholders in the secured transactions regime. Part VI concludes.

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27. *See, e.g.*, Lynn M. LoPucki, *Computerization of the Article 9 Filing System: Thoughts on Building the Electronic Highway*, 55 LAW & CONTEMP. PROBS. 5, 15–17 (Summer 1992); Carla L. Reyes, *Conceptualizing Cryptolaw*, 96 NEB. L. REV. 384, 402–03, 417–21 (2017) (proposing Article 9 revision to permit use of blockchain technology in maintaining financing statement filing system). Notably, outside of the Article 9 arena, scholars have been usefully exploring other ways in which technologies such as the IoT and "smart contracts" will affect commercial law. *See, e.g.*, Anthony J. Casey & Anthony Niblett, *Self-Driving Contracts*, 43 J. CORP. L. 1, 13 (2017) (noting that "[u]biquitous monitoring technologies allow parties to agree to instantaneous verification of compliance (or lack thereof) with a micro-directive [in automated or algorithmically driven "smart contracts"] and, thus, reduce the cost of *enforcing* contingent contracts"); Stacy-Ann Elvy, *Contracting in the Age of the Internet of Things: Article 2 of the UCC and Beyond*, 44 HOFSTRA L. REV. 839 (2016) (discussing inadequacy of contract law, including Article 2 of the Uniform Commercial Code, in light of the rise of the IoT); Stacy-Ann Elvy, *Hybrid Transactions and the INTERNET of Things: Goods, Services, or Software?*, 74 WASH. & LEE L. REV. 77 (2017) (discussing how Article 2 of the Uniform Commercial Code should treat "hybrid" transactions involving both software, services, and goods, particularly with respect to networked devices).

28. Jonathan C. Lipson, *Secrets and Liens: The End of Notice in Commercial Finance Law*, 21 EMORY BANKR. DEV. J. 421, 455–74 (2005) (identifying numerous defects with the filing system following a recent major round of amendments); LoPucki, *supra* note 27, at 6–15 (providing detailed critique); Gerald T. McLaughlin, *"Seek but You May Not Find": Non-UCC Recorded, Unrecorded and Hidden Security Interests Under Article 9 of the Uniform Commercial Code*, 53 FORDHAM L. REV. 953, 954 (1985) (critiquing the filing system); Reyes, *supra* note 27, at 402–03 (cataloguing problems with the filing system). The filing system would only be removed as to *tangible* property under my proposal, although much law governing intangibles would be simplified as well. *See infra* notes 133–38 and accompanying text.

II. THE EXISTING SYSTEM

A. The Current Secured Transactions Regime

1. How the System Is Supposed to Work and Why. While its details are complicated, the core features of the Article 9 system are simple, even elegant. A summary can be provided as follows. A security interest is a creditor's legally recognized claim on some item of property.[29] Once a security interest has been granted by a debtor and certain other requirements have been met, the security interest attaches, meaning it is valid and enforceable as between the debtor and creditor.[30] Even if the collateral remains in the debtor's possession and the debtor keeps using it, the property remains as collateral for the obligation owed to the creditor. The crucial, indispensable feature of an Article 9 security interest is that it allows the creditor to look to the collateral for collection, regardless of whether the debtor is uncooperative or has vanished. If the debtor fails to pay, the creditor can seize the collateral—often without judicial process—and sell it to cover the debt that is owed.[31]

Commonly, parties agree for a security interest to "float" over not just the *original* collateral—that is, what was collateral at the time of attachment—but also over *after-acquired* collateral.[32] This is convenient, for instance, for inventory, which frequently turns over. One agreement can provide for many shipments rather than forcing the parties to enter into repeated agreements for each new delivery of collateral.

Attachment is not enough, however, because it is usually only valid as between the creditor and debtor. A debtor may have other creditors who might also have security interests in the same collateral, or who might try to seize the collateral through a collections process such as garnishment or levy. For one creditor to supersede others—to take *priority* over them with respect to particular collateral—the creditor generally must take further steps, to *perfect* that interest.[33] Usually, perfection is accomplished with the step of making a short, electronic filing, called a *financing*

29. U.C.C. § 1-201(b)(35) (AM. LAW INST. & UNIF. LAW COMM'N 2017).

30. *Id.* § 9-203(a)–(b) (requirements of attachment).

31. *See id.* § 9-609 (creditor can seize collateral after default if done "without breach of the peace"); *id.* § 9-610 (creditor can sell collateral); *id.* § 9-615 (sale proceeds used to pay off debt, and excess returned to debtor).

32. *Id.* § 9-204 (after-acquired property); *id.* cmt. 2.

33. *Id.* § 9-308(a) (defining perfection).

statement, in an office designated by the Secretary of State of the debtor's state of residence or incorporation.[34] The financing statement provides the debtor's name and address, the secured creditor's name and address, and a description of the collateral, which can be as general as "all assets."[35] Once filed (usually electronically), the financing statement is indexed by the debtor's name, and after that point, in most states, a creditor or other inquirer can run an online search using the debtor's name to find any given financing statement.[36]

Usually, the first creditor to file a financing statement will have priority as to collateral covered by that statement—even if, at the time of filing, the security interest has not actually attached, or if a second creditor's interest attaches first.[37] The theory is that the financing statement proclaims the secured creditor's interest in the collateral, thus putting later creditors on notice that they may not be first in line.

Imagine that Creditor *A* has a perfected security interest with priority over an interest of Creditor *B*. If Debtor defaults on payments to Creditor *A*, Creditor *A* has the right to seize the collateral and auction it off to cover what it is owed by Debtor, notwithstanding Creditor *B*'s competing interest. For this reason, Creditor *A* is, in theory, able to deal with Debtor on more favorable terms, in light of its certainty regarding the collectability of its debt given its superior interest in the collateral. By contrast, Creditor *B* would be left only with leftover proceeds from the auction (if any), after Creditor *A* has been paid in full.[38] Accordingly, if Creditor *B* searches the records and discovers a financing statement of Creditor *A*, it may refuse to lend to Debtor, charge Debtor a higher interest rate, or demand more collateral to compensate for the increased risk that if Debtor defaults on the

34. *Id.* § 9-310(a); 4 WHITE ET AL., *supra* note 4, § 31:27 ("Perfection by filing is by far the most common method of perfecting a security interest under Article 9. . . . We suspect that for more than 90% of the universe, perfection occurs by some form of filing of a document, which the [UCC] calls a 'financing statement' . . . .").

35. U.C.C. § 9-108; *id.* cmt. 2 (explaining that a financing statement sufficiently indicates collateral with the phrase "covers all assets or all personal property," a phrase that would not be sufficient indication in a security agreement).

36. *See, e.g.*, *Revised Article 9 UCC Search*, KY. SECRETARY OF ST. ONLINE SERVS., https://app.sos.ky.gov/ftucc/(S(iof21xjbrgxalmjilhet0k34))/search.aspx [https://perma.cc/6G89-PNL9] (last visited Apr. 16, 2019).

37. Notably, it is the first creditor to *file* such a statement whose security interest will have priority, not the first creditor to have *perfected* the interest. The filing can be (and often is) made prior to attachment and in essence preserves the creditor's "place in line" if and when it perfects. U.C.C. § 9-322(a); 4 WHITE ET AL., *supra* note 4, § 33:3.

38. U.C.C. § 9-615(d).

debt, the collateral's value to Creditor *B* will be diminished (due to Creditor *A*'s continued, higher priority rights in it).

Thus, the awarding of priority to Creditor *A* is thought to be justified by Creditor *B*'s opportunity to adjust the terms of any credit it extends to Debtor in light of its notice of Creditor *A*'s prior interest.[39] Creditor *B* is deemed to have dealt with Debtor on terms that reflected Creditor *A*'s prior interest. The importance that Article 9 places on notice to creditors is connected to the notion, which has a centuries-long historical pedigree, that inequity and fraud may be perpetrated if "secret liens" are granted legal validity—in other words, if the *apparent* or *ostensible owner* of property has, without public notice, transferred property out of the grasp of unsuspecting creditors.[40] The principle dates back, at least, to the English *Twyne's Case* of 1601.[41] The notice aspect of the modern Article 9 system is structured to promote commerce by maximizing transferability of interests in property while assuring participants in the system that their expectations and interests will not be undermined by secret liens or other deceptive devices.

The above summarizes the basic structure and rationale of the existing secured transactions system as embodied in Article 9 of the UCC. The notion of a security interest and of perfection via a brief financing statement filed in a central location was revolutionary at the time of the UCC's development in the 1950s and '60s.[42] The system has been attacked—and defended—on normative bases,[43] but its rudiments have remained unchanged

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39. Some creditors have no opportunity to benefit from notice or adjust credit terms. Tort creditors, for instance. Lack of consideration of such creditors has been criticized. *See infra* note 154.

40. *See generally* Douglas G. Baird, *Notice Filing and the Problem of Ostensible Ownership*, 12 J. LEGAL STUD. 53, 53–54 (1983); Lipson, *supra* note 28, at 424–45.

41. 76 Eng. Rep. 809, 810 (Star Chamber 1601); *see also* Baird, *supra* note 40, at 53–54; Lipson, *supra* note 28, at 437–38.

42. These are the primary reasons that "Article 9 was the most innovative of the original Code articles . . . ." 4 WHITE ET AL., *supra* note 4, § 30:1 ("In pre-Code days, the lawyer had to work with a variety of security devices, each governed by its own body of law. . . . The grand innovation of Article 9 in 1962 was the introduction of a single 'unitary' security device."); *id.* § 31:27 ("Filing of a financing statement as to personal property was revolutionized by the initial adoption of the [UCC], and later by the widespread use of electronic data storage. Prior to the Code's filing system, filing was haphazard and nonuniform . . . .").

43. *See, e.g.*, Grant Gilmore, *The Secured Transactions Article of the Commercial Code*, 16 LAW & CONTEMP. PROBS. 27, 33 (Winter 1951) (providing an early account of Article 9 by its primary drafter); Robert K. Rasmussen, *The Uneasy Case Against the Uniform Commercial Code*, 62 LA. L. REV. 1097, 1105–07, 1110–12 (2002) (providing a critical and scholarly overview of the substance of the UCC, with a focus on Article 2 and Article 9, as well as the lawmaking process).

since the original passage of Article 9.[44]

2. How the System Actually Works and Why. The core concepts and basic structure of Article 9 are sensible and coherent. Faced with a welter of convoluted, contradictory, or uncertain state laws governing the diverse array of secured transactions and claims to collateral, the drafters of Article 9 fashioned a relatively brief and conceptually sound statute that despite several rounds of amendment remains fundamentally intact more than half a century later.[45] Their work product, Article 9, provides a logical method of organizing claims to and rights in collateral, based on the unifying notions of the "security interest" that is "attached" and then "perfected," and takes "priority" in the collateral.

But the system is riddled with loopholes, gaps, and exceptions. As a result, creditors remain unsure of how secure their interest in collateral really is. There are two general types of problems with the operation of the current Article 9 system. The first type arises from difficulties in obtaining or maintaining perfection. For instance, it might arise due to uncertainty about how to identify the debtor, about where to file the requisite forms, or about who actually has rights in the property at a given time. The second type of problem is more esoteric but highly pertinent in the actual functioning of the system. This difficulty arises from the fact that even after a debtor disposes of the collateral, the UCC permits creditors to maintain certain rights both in the original collateral and in any proceeds from the sale of that collateral. For these rights to be exercised, a creditor must "trace" the collateral and the proceeds to whomever now owns or has other rights in them—who may well be surprised by the creditor's assertion of rights.

The central theme of this section is that the promise of certainty is not fulfilled because Article 9's current system of debtor-based identification is cumbersome and ineffective. It includes various ornate provisions for maintaining existing

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44. Despite the changes to Article 9 over time, the core ideas (collateral, attachment, etc.) have remained consistent. *See generally* 4 WHITE ET AL., *supra* note 4, § 30:1 (summarizing the history of Article 9); *id.* § 30:2 (summarizing the basic "definitions and concepts").

45. This might be because the fundamental structure is sound, or that the committees tasked with amendment have been "congenitally conservative." James J. White, *Revising Article 9 to Reduce Wasteful Litigation*, 26 LOY. L.A. L. REV. 823, 823 (1993) (noting "members [of such committees] quickly become focused on revisions and amendments that any outsider would describe as modest"). White concludes that "[t]o the extent that the revision of any of the articles of the [UCC] is going to be more than modest, the push must come from academics or practicing commercial lawyers outside of these committees." *Id.* This Article attempts to "push" just such a "revision" of Article 9.

interests even where they aren't really identified and can't put another lender on notice. This section probes the nature and extent of those problems, and the rest of the Article explains how they can be minimized or eliminated by application of new technologies.

a. Rights in Original Collateral. The first type of problem arises when a creditor attempts to obtain and maintain rights in an item of collateral. Despite several rounds of amendment to try to make Article 9's process simpler and more certain, there remain numerous situations in which such a problem can arise.

The most important pieces of information in a financing statement, both for initial filing and for later searching, are the debtor's name and location.[46] The correct forms of debtors' names for financing statements are specified by a combination of uniform statute and state choice.[47] Location is defined as residence for a natural person, state of incorporation for a registered organization, and principal place of business for an unregistered organization.[48] With narrow exceptions, if a creditor enters an incorrect debtor's name in a financing statement, then the statement will not be valid.[49] On the other hand, if a searcher does not know the correct debtor's name, then it may fail to locate a valid financing statement. The same outcome would result if the searcher were to search the wrong set of records—for instance, searching the Delaware records for filings against "Acme, Inc.," rather than searching the Connecticut records, which, if this particular Acme is a Connecticut entity, would be the correct record to search.[50] Of course, in all of these situations, the "notice" function of the filing system has failed.

These errors might seem easy to prevent by a knowledgeable party (although easy to make by a commercially unsophisticated

46. U.C.C. § 9-503(a); *see also id.* § 9-503 cmt. 2 ("The requirement that a financing statement provides the debtor's name is particularly important. Financing statements are indexed under the name of the debtor, and those who wish to find financing statements search for them under the debtor's name.").

47. *Id.* § 9-503 (providing alternatives *A* and *B*).

48. *Id.* § 9-307(b), (e).

49. *Id.* § 9-506; *see* also *id.* cmt. 2 (noting that the intent of this section and section 9-503 is to "balance the interests of filers and searchers").

50. *Id.* § 9-503; *see also id.* cmt. 2 (noting that because "[f]inancing statements are indexed under the name of the debtor," the "requirement that a financing statement provide the debtor's name is particularly important"). Technically, the issue is whether you even have the right debtor in mind, whether you know which business entity actually owns the relevant assets. The practical import is the same regardless of how this uncertainty is phrased; and the proposal of this Article squarely addresses this uncertainty.

party). A creditor can obtain the debtor's correct name from an authoritative document (for instance, a company's "public organic record"[51] or an individual's current driver's license) at the time of a particular filing, and thus be relatively assured, at that moment, that the interest is perfected as to the particular collateral that is owned by that debtor. But, such certainty is more apparent than real. Even if an interest has been duly perfected, maintaining it can be problematic. A debtor may change its primary residence without informing the secured creditor, thus requiring the creditor to re-file in the new state to remain perfected.[52] Or a debtor may change names without notifying the creditor.[53] Or a debtor may transfer ownership of the collateral without notifying the creditor—perhaps to an identically named corporate entity in another state.[54] And all of these occurrences may be characterized differently under the UCC depending on whether the debtor and collateral are still in the same state or whether they have crossed state lines.[55] Making an accurate filing and maintaining it over time are not as simple as they appear.

In many ways, assuring *priority* is often as important as assuring *perfection*. Under the idealized version of the system, priority is assured by a creditor checking the public records to ascertain that its desired priority is available, and then filing a financing statement to "save its place in line." This is how the notice system is supposed to function.

In fact, assuring priority is difficult and uncertain under Article 9. For instance, Article 9 provides for perfection not only by filing but by *possession* of collateral.[56] The thought here is that

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51. *Id*. §§ 9-503, 9-102(a)(68).

52. *Id*. § 9-316(a)(2); *see also id*. § 9-316 cmt. 2 (noting that "a security interest perfected under the law of one jurisdiction remains perfected for a fixed period of time . . . depending on the circumstances[], even though the jurisdiction whose law governs perfection changes" and arguing the time periods provided "are long enough for a secured party to discover in most cases that the law of a different jurisdiction governs perfection and to reperfect").

53. Because there is no single authoritative form of an individual's name, and names can change, debtor names are hard to specify correctly and require numerous filings and regular monitoring. The same holds for unincorporated entities.

54. U.C.C. § 9-316(a)(2) ("A security interest perfected [in State A] remains perfected until . . . four months after [debtor moves]."); *id*. § 9-316(a)(3) ("A security interest perfected [where the debtor is located] remains perfected until . . . one year after a transfer of collateral to a person . . . located in another jurisdiction."). The commentary argues (without explanation) that the grace periods "are long enough for a secured party to discover [the change and] reperfect." *Id*. § 9-316 cmt. 2; *see also id*. exs. 1–4 (providing sample exemplary fact patterns); *see supra* note 52 and accompanying text.

55. U.C.C. § 9-507(c).

56. *Id*. § 9-313.

when a creditor has actually taken possession of the collateral, such possession effectively gives notice that the creditor has an interest in the property. In other words, because the debtor does not even possess the collateral, other creditors are on inquiry notice, at least, of a competing interest. But the standard for possession can be met without an inquirer actually getting any sort of notice. For instance, the person holding the collateral could be acting as agent or as holder on behalf of the debtor, and that status need not be ascertainable by any public observation (or even communicated in answer to a formal inquiry).[57] Thus, even if an agent of the secured creditor arrives at a warehouse and takes an accounting of the property on premises, the secured creditor cannot be certain of the legal possession of the collateral. The debtor could merely be the apparent owner of the property. If the warehouse employees have agreed to serve as a competing creditor's agents, or even as agents of *both* the debtor and the competing creditor, the investigating party may end up unknowingly "junior" (i.e., of lower priority).

Priority can also be threatened if the goods were "consumer goods" at the time they were originally purchased.[58] If this is the case, another creditor's interest might have been "perfected automatically" in them (meaning a filing would not be necessary), without notice of such interest being available to later inquirers.[59]

b. Rights After Disposition of Collateral. Article 9 currently provides that after disposition—including a sale for fair market value—of an item of collateral, an existing security interest generally remains on that collateral.[60] The statute provides a partial exception for a "buyer in ordinary course of business" of an

57. *See id.* § 9-313(c) (secured party can take "possession" by virtue of an "acknowledge[ment]" from the person actually in possession that they hold possession "for the secured party's benefit"); *id.* § 9-313 cmt. 3 (explaining that if possessor is agent of secured creditor, it is deemed actual possession under principles of agency law, and subsection (c) is not implicated). These provisions have been sharply criticized. *See, e.g.*, Lipson, *supra* note 28, at 432–35.

58. *See* U.C.C. § 9-102(a)(23) (defining consumer goods); *id.* § 9-309(1) (stating that a purchase-money security interest in consumer goods is perfected when attached); *id.* § 9-320 cmt. 5 (discussing purchase-money security interests with regards to filing).

59. *See id.* § 9-320 cmt. 5. As the text suggests, this status is triggered by the purchasing party's intent at the time of purchase, and thus not objectively verifiable nor stable over time. And even quite expensive or large items have been deemed eligible for this status, contrary to the apparent purpose of the law, which is to insulate commercially unsophisticated buyers of small household items from hidden UCC issues. *See* LYNN M. LOPUCKI ET AL., SECURED TRANSACTIONS: A SYSTEMS APPROACH 333–36 (8th ed. 2016) (discussing large and expensive "consumer goods").

60. U.C.C. § 9-315(a)(1).

item, but even this exception only provides that such a buyer takes the item free of security interests created by the party selling the item to that buyer—not any interests created by prior owners of the collateral.[61]

In theory, then, a would-be buyer seeking to ensure a purchase free and clear of prior encumbrances, or a would-be creditor seeking a security interest in that item, must investigate the full, prior ownership history of any personal property to ensure that it is free of an existing security interest.[62] In practice, obviously, the burdensome nature of such a search—assuming it is even possible—is more than what a rational lender or buyer would be willing to undertake, except perhaps with respect to exceptionally valuable items of collateral.

An existing security interest also attaches to the money (or anything else) received in exchange for the original collateral. Article 9 provides detailed rules concerning proceeds of collateral, which permit security interests to proliferate far beyond an original item of collateral. The rule generally provides that if a creditor has a security interest in one piece of collateral, the security interest will attach to any proceeds of that collateral.[63] Often, the interest not only attaches to, but remains perfected in, the proceeds, whether permanently or for a limited time, and thus can bind unsuspecting third parties.[64]

Proceeds are defined broadly to include any piece of property (tangible or intangible) obtained by the sale or disposition of that collateral, and even any "rights arising out of collateral" (whatever that may mean).[65] The protection extends beyond any initial sale or exchange because proceeds-of-proceeds are subject to the same protection as the original proceeds.[66] The process continues on and on, as long as the chain of proceeds can be traced back to the original collateral.

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61. *See id.* § 1-201(b)(9) (defining buyer in ordinary course of business); *id.* § 9-320(a) (sale to buyer in ordinary course strips off only those security interests "created by the buyer's seller"); *id.* § 9-320 cmts. 3, 6 (providing examples of buyer in ordinary course exception, the exceptions to this exception, and the exceptions to the exceptions to this exception).

62. *See id.* § 9-507(a); *id.* § 9-507 cmt. 3 (noting that any person searching the condition of the ownership of a debtor must make inquiry as to the debtor's source of title and must search in the name of a former owner if circumstances seem to require it).

63. *Id.* § 9-315(a)(2).

64. *Id.* § 9-315(c).

65. *Id.* § 9-102(a)(64).

66. *Id.* § 9-102(a)(12) (defining "collateral" as including proceeds of original collateral); *id.* § 9-102(a)(64) cmt. 13(c) (clarifying that subsection (a)(12) means that proceeds-of-proceeds are protected as proceeds).

Under these rules, a financing statement perfecting an interest in *inventory* may have the effect of perfecting an interest in money, accounts receivable, or even equipment, if rights in such collateral were acquired upon the disposition of the original collateral (or any of its proceeds).[67] Disturbingly, these additional categories of items that would be subject to a security interest need not be disclosed anywhere on a financing statement.[68]

There are some limitations. Under some circumstances, perfection in proceeds is limited in time, such that if a secured creditor does not act quickly to remain perfected in the proceeds by some other means (e.g., a financing statement), the perfection lapses.[69] Some types of proceeds—for instance, those purchased by cash that is itself proceeds—do not receive the protection of automatic perfection.[70] But these limitations merely underscore the arbitrariness of the existing system. Why should one buyer be protected because the seller purchased an item with cash proceeds and another buyer be unprotected because the seller obtained an item by an in-kind trade involving goods that were proceeds?

B. The Problem with Article 9's Problems—and the Way to a Solution

Article 9 is rife with opportunities for well-founded commercial interests to be undermined by events or circumstances that are unknown to a creditor or that transpire after the creditor believes it has secured its rights in the collateral. These opportunities may be exploited in bad faith, as when a debtor deceives a creditor as to its rights in particular collateral. More often, problems arise innocently, as when a creditor's collateral is disposed of without that creditor's knowledge or consent, leaving the creditor to seek protection in the rules concerning proceeds,

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67. *See id.* § 9-102(a)(64) (definition of proceeds); *id.* § 9-203(f) (providing that a security interest in collateral extends to proceeds of that collateral); *id.* § 9-315(c)–(e) (establishing rules regarding preservation of perfection of security interests). The definition of proceeds expanded under the 2001 revisions. *See* LOPUCKI ET AL., *supra* note 59, at 163–64.

68. This is what Professor Lipson has aptly termed "remote control": "the unique power created by Article 9 to assert rights in assets in the hands of parties far removed from the original debtor, in a transaction that is likely undiscoverable by that remote party." Jonathan C. Lipson, *Remote Control: Revised Article 9 and the Negotiability of Information*, 63 OHIO ST. L.J. 1327, 1333 (2002).

69. U.C.C. § 9-315(c)–(e) (providing for continuation, and lapse, of perfection of security interests in proceeds, under various circumstances); *id.* § 9-515(c)–(e) (providing for lapse of effectiveness of financing statements). On the treatment of proceeds and after-acquired property in bankruptcy, see 11 U.S.C. § 552 (2012).

70. U.C.C. § 9-315 cmt. 5.

which in turn impact unsuspecting third parties.

The steps required to obtain extra certainty under Article 9 are burdensome, and for all but the most valuable items, the costs of certainty are not worth the marginal benefits to most individual creditors. As a result, numerous UCC rules act more as loss-allocation mechanisms rather than guides to actual or potential practice of creditors.[71] These mechanisms are often arbitrary in effect and impose a societal cost by significantly undermining commercial certainty of actors engaged in borrowing or lending.

Article 9's function as an erratic loss-allocation regime rather than a practical guide for compliance negatively impacts the entire commercial law framework. First, it subjects the Article 9 system to criticism on substantive grounds: the law provides less predictability ex ante than expected, its results ex post are often questionable (and subject to uncertainty and splits in legal authority), and commerce suffers as a result.

Second, it subjects Article 9 to attack on grounds that, procedurally, the uniform law process by which it has been developed is inequitable, or simply biased and captured.[72] The process by which Article 9 is annotated and amended has been viewed as political rather than technical, dominated by powerful interests, undermining Article 9's legitimacy as law.[73] Technocrats and legal scholars may be entrusted with the power to develop efficient and equitable rules, but the purportedly neutral, expertise-driven process lacks legitimacy when it wields power over the distributive question—not particularly susceptible to technical analysis—of how losses should be allocated across a wide swathe of commercial activities including those involving consumers. Criticisms of the uniform law process, by which

71. *See* LOPUCKI ET AL., *supra* note 59, at 339, 394 ("In circumstances where potential losses are not worth the effort necessary to avoid them, the [UCC Art. 9] rules simply allocate those losses to the filers or searchers."); *see also* LoPucki, *supra* note 27, at 14–15.

72. Scholarship on the uniform law process, including Article 9's drafting and amendment, is extensive. *See, e.g.*, David Frisch & Peter A. Alces, *On the U.C.C. Revision Process: A Reply to Dean Scott*, 37 WM. & MARY L. REV. 1217, 1219–20 (1996); Steven L. Harris & Charles W. Mooney, Jr., *How Successful Was the Revision of UCC Article 9?: Reflections of the Reporters*, 74 CHI.-KENT L. REV. 1357, 1367 (1999) (describing process from inside perspective); Janger, *supra* note 5, at 618 (identifying problematic aspects of revision process); Robert E. Scott, *The Politics of Article 9*, 80 VA. L. REV. 1783, 1816–22 (1994) (providing public choice analysis). For this Article, the key point is that if rather than providing loss-allocation rules in a zero-sum game, Article 9 were to provide feasible and reliable means of fulfilling commercial expectations, the stakes of the amendment process may be lower.

73. This erosion of Article 9's legitimacy could lead to more states passing nonuniform amendments to the law or to more judges or lawmakers putting their "thumbs on the scale" in favor of consumer, bankruptcy, or real estate law when they conflict with the UCC.

amendments to Article 9 are proposed and by which its text is formally annotated, have bite because the distributive impact of Article 9 is so pronounced, more than might be supposed from its posture as a neutral source of the rules of the game.

All of this would be merely academic, however, without changes in technology providing the hope of another way to do things. Hitherto, there was little that could be done, even by those who saw this situation clearly. Now, technologies have changed the means by which commercial actors transfer and monitor interests in collateral, allowing them to directly and remotely track the location and status of the property to which they have claims.[74] As a result, the step of filing a financing statement against the debtor's name and in the debtor's location seems a bureaucratic hassle using an archaic tool of limited effectiveness. The UCC emerged from legal realism, with a commitment to shape commercial law around the actual practice of commerce.[75] Particularly in light of that underlying commitment, Article 9's legal rules are ripe for the same technological disruption that has been working its way through the world of business and finance.

In other words, Article 9's rules were defensible based on the limitations of the world in which it was drafted. The Article 9 regime is a historical artifact of an era when both collateral-specific identification and cheap, automated, ongoing monitoring of collateral were not feasible. In light of technological change, which has largely removed those limitations, the rules are needlessly cumbersome and ripe for substantial revision. Part III explores the new technologies that can and should support this change. The changes ultimately proposed would benefit commercial law in two major ways: they would align Article 9 more closely with modern commercial practices, and they would rebuild its legitimacy by making it less of a tangle of distributively consequential but difficult-to-defend loss-allocation rules and more of a feasible and functional guide to facilitating reliable financing and obtaining commercial certainty.

III. TECHNOLOGICAL ALTERNATIVES

There are at least two areas of technology that could revamp the secured transactions system: (1) technologies using tags that can communicate remotely and (2) technologies related to

74. *See generally* Luigi Atzori et al., *The Internet of Things: A Survey*, 54 COMPUTER NETWORKS 2787, 2787 (2010) (illustrating new technologies that will permit commercial actors to monitor collateral).

75. *See supra* notes 23–25 and accompanying text.

geolocation. This section considers the potential of each area of technology to transform the secured transactions system.

Each technology faces limits that would likely prevent it—at least on its own—from serving as the basis of a new system. However, a hybrid regime is possible, one that combines the strengths of both technologies and eliminates most of their weak points.

A. "Internet of Things" Technology

A security interest is a relationship between a creditor and an item of collateral.[76] Yet security interests are indexed by reference to the debtor's name, rather than the collateral. This indirect system of reference is a fundamental problem with the secured transactions system. As shown in the previous section, Article 9 has been unable to work around this indirectness problem.

Technology now permits a relationship to be established directly with items of collateral. Even on a mass scale, items can be inexpensively identified and remotely monitored from afar. The relevant technologies are generally discussed under the rubric of the Internet of Things.[77] The IoT is the incorporation of items from vacuum cleaners to shipping crates into computer networks via technologically enabled sensors, tags, and devices.[78] One trillion

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76. *See supra* Section II.A.1.

77. *See, e.g.*, Luigi Atzori et al., *supra* note 68, at 2787 ("The basic idea of this concept is the pervasive presence around us of a variety of *things* or *objects* – such as Radio-Frequency IDentification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals."); Eleanora Borgia, *The Internet of Things Vision: Key Features, Applications and Open Issues,* 54 COMPUTER COMM. 1, 1 (2014) ("IoT refers to an emerging paradigm consisting of a continuum of uniquely addressable *things* communicating one another to form a worldwide dynamic network."); In Lee & Kyoochun Lee, *The Internet of Things (IoT): Applications, Investments, and Challenges for Enterprises*, 58 BUS. HORIZONS 431, 431 (2015) ("The IoT is recognized as one of the most important areas of future technology . . . ."); Felix Wortmann & Kristina Flüchter, *Internet of Things: Technology & Value Added*, 57 BUS. INFO. SYS. ENGINEERING 221, 221 (2015) ("[E]stimates currently suggest that the IoT could grow into a market worth $7.1 trillion by 2020.").

78. *See, e.g.*, Matthew Lacey et al., *Shipping Smarter: IoT Opportunities in Transport and Logistics* 2 (Deloitte Univ. Press, 2015), https://www2.deloitte.com/content/dam/insights/us/articles/iot-in-shipping-industry/DUP1271_IoT_Transportation-and-Logistics_MASTER.pdf [https://perma.cc/QG6Q-HYRE] ("[C]ompanies in this sector have embraced the suite of data-driven technologies dubbed the Internet of Things (IoT) in diverse settings, from maritime and aviation freight to warehousing to package delivery."). Powerful devices are readily available on an off-the-rack basis. *See, e.g.*, *Shipping Container Management Solutions*, AT&T BUS., https://www.business.att.com/solutions/service/internet-of-things/assetmanagement/shipping-container-trailers.html [https://perma.cc/PEN7-Y6JC] (last visited Apr. 16, 2019) (offering "[m]onitoring devices attached to your containers or trailers [that] gather data from an array of sensors that track the condition of the container and contents over the duration of its trip," and noting that "[t]he collected data is sent to the

devices are estimated to be networked by 2025.[79] This huge networking effort is perhaps more aptly called the "Internet of Everything."[80] Innovations have made technologies for detecting and monitoring goods, payments, and places much cheaper and more accurate, and these innovations have transformed commerce—even if that change is not yet reflected in the law.

High-profile examples of the IoT are in-home devices such as Amazon's Echo and Google's Home, which require a user only to speak appropriate commands to monitor and control IoT-enabled devices throughout the home to: adjust the thermostat, lock the doors, print an e-mail, order more dish soap, play music, or converse with someone at the door.[81]

Although they garner less media attention, business applications of the IoT are more ubiquitous and more economically important than consumer applications.[82] Merchants have adopted

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cloud for viewing from an application that provides alerts and notifications, customizable to support the needs of your business"); *The Internet of Things: The Future of Consumer Adoption*, ACCENTURE INTERACTIVE: POINT OF VIEW SERIES (2014), https://www.accenture.com/t20150624T211456__w__/us-en/_acnmedia/ Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Technology_9/Accenture-Internet-Things.pdf [https://perma.cc/52NG-89HF] (predicting eventual smart vacuum cleaner market share of 40%).

79. Scott R. Peppet, *Regulating the Internet of Things: First Steps Toward Managing Discrimination, Privacy, Security, and Consent*, 93 TEX. L. REV. 85, 98 (2014) (citing this estimate).

80. *Id.* at 89 n.14 (discussing the origin and aptness of this phrase).

81. *See* Grant Clauser, *Amazon Echo vs. Google Home: Which Voice Controlled Speaker Is Best for You?*, WIRECUTTER, https://thewirecutter.com/reviews/amazon-echo-vs-google-home/ [https://perma.cc/X4NL-25LW] (last updated Jan. 22, 2019) (describing capabilities of the devices as "digital assistants" by which they control "smart home" devices such as thermostats, speakers, doorbells, and lights). On various other consumer functionalities of IoT devices, see, for example, Richard Baguley & Colin McDonald, *Appliance Science: The Internet of Toasters (and Other Things)*, CNET NEWS (Mar. 2, 2015), https://www.cnet.com/news/appliance-science-the-internet-of-toasters-and-other-things/ [https://perma.cc/3U9P-SRBC?type=image] (noting that existing technologies already include "washing machines and dryers from Whirlpool and others that ping your cell phone when they are done and also know when electricity is cheapest (to keep down the cost of the wash)"); Nick Wingfield, *With Meld, Another Step Toward the Internet of Tasty Things*, N.Y. TIMES BITS (Apr. 7, 2015, 9:00 AM), https://bits.blogs.nytimes.com/2015/04/07/with-meld-another-step-toward-the-internet-of-tasty-things/ (describing device and application that aids food preparation by giving real-time sensor-based monitoring of dishes, and automated control of stove); Parija Kavilanz, *'Connected' Babies = More Sleep for You*, CNN MONEY (Apr. 17, 2015), http://money.cnn.com/2015/04/16/smallbusiness/mimo-wearable-baby-monitor/index.html [https://perma.cc/6KW3-SZX3] (describing baby monitoring technologies such as sensor-embedded onesies that transmit information to a smartphone application).

82. James Manyika et al., *Unlocking the Potential of the Internet of Things*, MCKINSEY GLOBAL INST. (June 2015), https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world [https://perma.cc/4P6U-FCS9] ("Business-to-business applications [of the IoT] will probably capture more value—nearly 70 percent of it—than consumer uses, although consumer applications, such as fitness monitors and self-driving cars, attract the most

technologies such as RFID to track millions of objects shipped great distances (and moved around stores and warehouses) remotely[83]; the IoT generates vast amounts of everyday data allowing firms to tailor goods and services (and advertising) to newly revealed consumer behaviors; and businesses are integrating blockchain and "smart contract" technologies with the IoT to ease the administrative risks and costs of large-volume, long-distance shipping. Farm equipment is now embedded with IoT technology to aid automation, generate data for the manufacturer and for users, and permit more efficiently tailored processes for tasks like planting seeds or spreading fertilizer by analyzing soil conditions in real time.[84] The movement of freight across borders, over land and seas, and through ports is monitored remotely by both government authorities and private companies to diminish paperwork burdens and increase security.[85] Airlines and plane manufacturers use sensors to speedily and reliably log airplane parts, tools, and safety devices at airport construction and maintenance facilities and on airplanes themselves.[86] Fleets of work vehicles are remotely tracked through onboard telematics, and the data analyzed, to encourage cautious and lawful driving, keep workers on task, and prevent theft.[87] Supply chain

attention . . . .").

83. *See infra* notes 90–92 and accompanying text (describing RFID technology and applications).

84. *See, e.g.*, Alex Fitzpatrick, *Hand Me That Wrench: Farmers and Apple Fight Over the Toolbox*, TIME, July 3, 2017, at 20–21 (mentioning self-driving tractors equipped with software and GPS). This has led to a battle over farmers' right to repair or modify their equipment. *See, e.g.*, Grant Gerlock, *Farmers Look for Ways to Circumvent Tractor Software Locks*, NPR: ALL TECH CONSIDERED (Apr. 9, 2017), http://www.npr.org/sections/alltechconsidered/2017/04/09/523024776/farmers-look-for-ways-to-circumvent-tractor-software-locks [https://perma.cc/FG6W-5TXJ]. I am grateful to my former student Nicholas Oleson for bringing this to my attention.

85. *See supra* note 78 (detailing the wide adoption of IoT technologies for tracking and monitoring in the shipping industry).

86. *See, e.g.*, VIKTOR MAYER-SCHÖENBERGER & KENNETH CUKIER, BIG DATA: A REVOLUTION THAT WILL TRANSFORM HOW WE LIVE, WORK, AND THINK 146 (2013) (noting that "aircraft engine-maker Rolls-Royce . . . transformed its business over the past decade by analyzing the data from its products, not just building them," that it "continuously monitors the performance of more than 3,700 jet engines worldwide to spot problems before breakdowns occur," and that it has "used data to help turn a manufacturing business into" a service-focused one); INT'L AIR TRANSP. ASS'N, GUIDANCE ON INTRODUCING RADIO FREQUENCY IDENTIFICATION (RFID) INTO AIRLINE MAINTENANCE OPERATIONS 4–12 (May 2013), https://skybrary.aero/bookshelf/books/2476.pdf [https://perma.cc/BNS4-B9LQ] (describing technology and uses in airline industry); *cf.* Martha C. White, *Investing in Tech to Tackle an Awful Annoyance: Lost Luggage*, N.Y. TIMES, May 16, 2017, at B4 ("[N]ew bag tags are embedded with RFID chips . . . which means the location of bags is tracked and electronically crosschecked against a database to make sure that they are in the right place at the right time.").

87. The technology is generally termed "telematics." *See* CATHY O'NEIL, WEAPONS OF

management has been transformed by IoT technologies, with more change on the horizon;[88] for example, Amazon's vast warehouses are reliant upon algorithms to maximize efficient and accurate movement of both people and items.[89] In fact, decades before, Walmart attained dominance by superior efficiency in supply chain and inventory management, in part due to its extensive adoption of what can be thought of as proto-IoT technologies, such as barcodes and RFID tags.[90] Bar codes are familiar to all

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MATH DESTRUCTION: HOW BIG DATA INCREASES INEQUALITY AND THREATENS DEMOCRACY 167–71 (2016); MAYER-SCHÖENBERGER & CUKIER, *supra* note 86, at 89 (describing how UPS uses telematics to monitor employees, predict repair needs, and optimize delivery routes for length, speed, and safety; noting that UPS cut thirty million miles off of drivers' routes using these systems in 2011); *id.* at 135 (noting that the company Inrix "compiles real-time geo-location data from 100 million vehicles in North America and Europe"); SEBASTIAN PFEIFLE ET AL., FLEET LEASING & MANAGEMENT IN NORTH AMERICA: KEY ENABLER FOR THE FUTURE OF MOBILITY 36–37 (2018), https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consumer-industrial-products/Deloitte_Fleet-leasing-and-management-in-North-America.pdf [https://perma.cc/W8F2-TWP2] ("Today about 40-45 percent of all US fleet vehicles are already equipped with a telematics device."); INTEL CORP., INTELLIGENT FLEET MANAGEMENT 3–4 (2015), https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/atom-e3800-intelligent-fleet-management-paper.pdf [https://perma.cc/TUE2-LGS9] (explaining fleet management system structure and providing results of case studies showing significantly safer and more fuel-efficient driving after system implementation); Andy Lundin, *Telematics Evolution Pushes Forward for Fleets*, AUTOMOTIVE FLEET (Feb. 1, 2018), http://www.automotive-fleet.com/279628/telematics-evolution-pushes-forward-for-fleets [https://perma.cc/BB6V-8GLN] (predicting continued steep growth in adoption of monitoring technologies for commercial automobile fleets). Federal rules have begun to require telematics in commercial trucking to ensure compliance with, for instance, driver's hours-of-service rules. *See, e.g.*, 49 C.F.R. pt. 395, Subpart B (2018) (detailing Electronic Logging Device requirements).

88. Joe Mariani et al., *Forging Links Into Loops: the Internet of Things' Potential to Recast Supply Chain Management*, 17 DELOITTE REV. 119, 119, 128 (2015), https://www2.deloitte.com/content/dam/insights/us/articles/internet-of-things-supply-chain-management/DUP1159_DR17_ForgingLinksIntoLoops.pdf [https://perma.cc/5RCH-FTJ6] (noting ways IoT is transforming principles of supply chain management).

89. *See, e.g.*, Chris Baraniuk, *How Algorithms Run Amazon's Warehouses*, BBC FUTURE (Aug. 18, 2015), http://www.bbc.com/future/story/20150818-how-algorithms-run-amazons-warehouses [https://perma.cc/B9R3-Z2NX] (describing use of both workers and computer algorithms to locate, track, and package inventory in warehouses); Will Knight, *Inside Amazon's Warehouse, Human-Robot Symbiosis*, MIT TECH. REV. (July 7, 2015), https://www.technologyreview.com/s/538601/inside-amazons-warehouse-human-robot-symbiosis/ [https://perma.cc/2PKY-NQEG] (describing "robotic shelves" and other innovations for making Amazon's order fulfillment more efficient); Marcus Wohlsen, *A Rare Peek Inside Amazon's Massive Wish-Fulfilling Machine*, WIRED (June 16, 2014), https://www.wired.com/2014/06/inside-amazon-warehouse/ [https://perma.cc/ZGT8-YTSE] (describing Amazon fulfillment center (i.e., inventory warehouse) as "a uniquely 21st-century creation-a vast, networked, intelligent engine for sating consumer desire," and noting that "[e]ach shelf [in the warehouse] is divided into small cubbies, and each cubby gets a barcode and an alphanumeric ID, much like the Dewey Decimal System").

90. *See, e.g.*, MICHAEL H. HUGOS, ESSENTIALS OF SUPPLY CHAIN MANAGEMENT 18–20 (3d ed. 2011) ("Wal-Mart is a company shaped by its supply chain . . . ."); *id.* at 125 ("Large companies . . . such as Wal-Mart, are mandating that their suppliers start using passive RFID tags on the products that they ship."); MAYER-SCHÖENBERGER & CUKIER, *supra* note 86, at 53–54 (2013) (discussing its use of a system called "Retail Link" to connect its

shoppers, but RFID tags are just as important, even if less understood. RFID tags consist of microchips attached to antennas, which can receive "queries" and transmit a "response" to them:

> Tags are characterized by a unique identifier and are applied to objects (even persons or animals). Readers trigger the tag transmission by generating an appropriate signal, which represents a query for the possible presence of tags in the surrounding area and for the reception of their IDs. Accordingly, RFID systems can be used to monitor objects in real-time, without the need of being in line-of-sight; this allows for mapping the real world into the virtual world.[91]

To put it plainly, RFID tags allow objects to "speak" for themselves (and among themselves), and to be communicated with remotely.

As might be expected, RFID tags range widely in terms of functionality (e.g., range of transmission, amount of data stored, etc.), size (as small as half a millimeter along each dimension), and price (as little as 7¢ per tag, currently).[92] As with other forms of microtechnology, the pace of improvement along all of these dimensions is likely to continue, making new uses feasible.

Because it permits a direct relationship to be established between any user and an IoT-enabled object, the IoT could serve as the basis of a secured transactions system. The basic idea would be that when a secured creditor evaluates collateral in anticipation of lending, rather than having to investigate a chain of title, interrogate control of a warehouse, or accept the risk of having an interest later overturned, the potential creditor would merely use a smartphone to search for security-interest tags on any items intended to serve as collateral. Each tag would be set to transmit a UCC registration number unique to that object, which could allow the potential creditor to instantaneously pull up the record (including the existing creditor's contact information) on the

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suppliers with real-time information about its sales and inventory levels); Nicholas Varchaver, *Scanning the Globe: The Humble Bar Code*, FORTUNE (May 31, 2004), http://archive.fortune.com/magazines/fortune/fortune_archive/2004/05/31/370719/index.htm [https://perma.cc/2JGM-MESX] ("A key element of Wal-Mart's rise has been its hyperefficient supply chain and inventory management, which have allowed it to keep costs—and prices—down.").

91. Atzori et al., *supra* note 74, at 2790 (emphases omitted); *see also* Claudia Loebbecke, *RFID in the Supply Chain*, *in* ENCYCLOPEDIA OF E-COMMERCE, E-GOVERNMENT, AND MOBILE COMMERCE 948–53 (2006) (describing technological features and business uses of RFID).

92. *See RFID Frequently Asked Question*, RFID J., https://www.rfidjournal.com/faq/show?85 [https://perma.cc/5YLE-H4S4] (noting prices can range from as low as seven cents to as high as $25 or more depending on technology and other features desired); Atzori et al., *supra* note 74, at 2790.

state's UCC app. Thus alerted, the potential creditor could contact that earlier creditor (or have the debtor do so) to establish the nature of its claim, which would then affect whether the new creditor would proceed with the transaction or not. If no tags were detected on the app, the creditor could rely on that fact, tag the objects, and extend credit on a secured basis. Each creditor would bear a burden to monitor its collateral, for instance against manipulation or malfunction of the tags, but this could be automated, for instance via a central node that maintained wireless internet connections with any tagged objects, and even, if warranted, via a video-feed (or any other type of sensor) as further insurance.[93] Such automated monitoring would serve as proof in any potential dispute over the collateral. This roughly sketched system could bring a dramatic shift, and radical simplification, to Article 9, by allowing creditors to establish, and to put others on notice of, a direct relationship with the relevant collateral.

Article 9's debtor- (as opposed to collateral-) centered filing structure is far from the only possible arrangement. Various systems already use direct identification of collateral as the basis for providing notice of a claim in collateral and for protecting rights vis-à-vis third parties (in other words, for the non-UCC analogies to the UCC concept of perfection). Claims on cars, once they have been sold, are made on title documents, which are easily linked directly to the relevant automobiles by virtue of standardized and mandatory vehicle identification numbers (VINs).[94] A similar system exists for certain airplanes and airplane parts, which in the United States, pursuant to federal law and to international treaty, must be registered by standardized identification number with federal authorities and with an

93. *Cf.* ANDREW SLAUGHTER ET AL., DELOITTE CTR. ENERGY SOLS., CONNECTED BARRELS: TRANSFORMING OIL AND GAS STRATEGIES WITH THE INTERNET OF THINGS 10–11 (2015), https://www2.deloitte.com/content/dam/insights/us/articles/iot-in-oil-and-gas-industry/DUP-1169_IoT_OilGas.pdf [https://perma.cc/M6EX-SSH8] (noting that "companies are joining forces in developing a data-enabled monitoring infrastructure" to protect against oil spills and pump breakdowns).

94. U.C.C. § 9-316(d)–(e); *id.* cmt. 5. The car titling system itself has been imperfect due to lack of uniform state laws and poor integration of state systems—in other words it too could benefit from a technological facelift. Nonetheless it is a useful illustration of the fact that collateral-based identification is not wholly unheard-of. *Cf.* Larry N. Miller, *A Proposal for Modernization of the Vehicle Certificate of Title System*, 49 CONSUMER FIN. L.Q. REP. 400, 402 (1995); Memorandum from Professor Stephen L. Sepinuck to Ed Smith, Chair of Joint Review Comm. for Article 9 (Feb. 13, 2009), http://www.uniformlaws.org/shared/docs/ucc9/ucc9_sepinuckmemo_021309.pdf [https://web.archive.org/web/20150415152115/http:/www.uniformlaws.org/shared/docs/ucc9/ucc9_sepinuckmemo_021309.pdf] (surveying state motor vehicle certificate of title laws).

international registry.[95] Both systems obviously bear strong parallels to the proposed IoT-based method of perfecting security interests.

It is easy to see why, for practical reasons, the personal property system developed as it did: it was feasible, given 20th century technology, to provide a unique, standardized mark on airplane engines and cars but not to do the same for many thousands of items of personal property.[96] Thus the debtor-centered personal property structure seemed inevitable. Now, technology permits a different alternative.

Notably, the car titling and airplane part registration systems were *not* developed primarily to protect security interests. Rather, the car system developed to prevent theft and protect the integrity of car manufacturing, and the airplane parts system is in large part an initiative to build safety and reliability in the airplane manufacturing and repair business as well as to address theft.[97] In this way, too, then, these systems are similar to the system proposed here, because it would piggyback on technology and practices already developed for *other* reasons, and then used to develop the legal regime. In this case, secured transactions law can take advantage of technologies developed in large part for business reasons such as supply chain management, inventory monitoring, factory automation, and so on.

The proposed IoT-based system would also resemble the real

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95. The contours of this legal regime, which appears to be dominated by a relatively small group of highly specialized merchants of expensive precision parts, remain somewhat unclear. So far as the federal law (now supplemented with an international treaty) stretches, it preempts the UCC. *See* Steven L. Harris, *Cape Town Convention*, *in* 10B UNIFORM COMMERCIAL CODE SERIES § 9.55 (2018) (summarizing Cape Town Convention's International Registry for aircraft objects); Nettie Downs, Comment, *Taking Flight from Cape Town: Increasing Access to Aircraft Financing*, 35 U. PA. J. INT'L L. 863, 865–74 (2014) (summarizing law); Kaitlyn Schrick, Comment, *Does Anyone Have "Actual Knowledge" of What Effects the Cape Town Treaty Has Had on the Application of* Philko Aviation, Inc. v. Shacket*?*, 67 OKLA. L. REV. 867, 877–81, 896 (2015) (summarizing law and identifying potential conflict of treaty regime with Supreme Court jurisprudence).

96. Interactive "smart" maps, as required by the proposed geolocation method of perfection, were of course also not readily available in the 20th century either. Notably, simple, nonnetworked tags (e.g., bar code stickers) could not provide the basis for a system in the way that IoT devices can because of the difficulty of verifying and monitoring the presence and location of such tags (and, in addition, the difficulty of altering the information on them).

97. *See supra* note 94 (motor vehicle law); *supra* note 95 (aircraft and parts law). Registries have all sorts of purposes, some relating to forms of property rights and some related to other purposes, such as the reinforcing of social norms or maintenance of group identity. *See* David Fagundes & Aaron Perzanowski, *Clown Eggs*, 94 NOTRE DAME L. REV. 1313 (2019) (discussing the registry of eggs painted to resemble clowns' makeup kept in Wookey Hole, England).

estate title recording system, which is ultimately based on information tied directly to the particular property at issue. For centuries, public authorities have developed and maintained records of ownership, mortgages, and other claims upon real property, often for reasons relating to taxation, estate preservation, and the facilitation of reliable transactions.[98] Of course, the proposed Article 9 system would be reliant on much more advanced technology than the antiquated[99] and highly fragmented[100] real estate recording systems of the United States. In fact, real estate records are much criticized by legal scholars, including because many of them index land records primarily by owner names rather than by locations (tract numbers), and thus suffer from similar problems to those characterizing the current Article 9 system as discussed above.[101] Proposals for technologically driven reforms in real estate recording have been offered but have not yet gained much traction.[102] For this reason,

98. On real estate recording, see GRANT S. NELSON ET AL., REAL ESTATE TRANSFER, FINANCE, AND DEVELOPMENT: CASES AND MATERIALS 201–38 (8th ed. 2009); Lipson, *supra* note 28, at 435–39 (describing early recordation systems and collecting sources).

99. Dale A. Whitman, *Digital Recording of Real Estate Conveyances*, 32 J. MARSHALL L. REV. 227, 227 (1999) ("During the past 350 years, little has changed in the way real estate conveyances are recorded in America.").

100. Sam Stonefield, *Electronic Real Estate Documents: Context, Unresolved Cost-Benefit Issues and a Recommended Decisional Process*, 24 W. NEW ENG. L. REV. 205, 222 (2002) ("There are 3524 recording jurisdictions nationwide.").

101. NELSON ET AL., *supra* note 98, at 232 ("[C]hain-of-title problems illustrate vividly the deficiencies of name-index recording systems."). Nonspecialists sometimes seem to assume the existing real estate recording system is more manageable and coherent than it is. *Compare* Rasmussen, *supra* note 43, at 1143 ("With real estate, the answer of where to look is relatively easy. The location of the land is fixed, and the searcher merely has to learn at which level, state or local, the records are kept."), *with* NELSON ET AL., *supra* note 98, at 212 ("In addition to interests which need not be recorded at all (like adverse possession) and those which need be recorded only after the fact (like mechanics' liens), problems are raised by those which are allowed to be . . . recorded in places other than the county recorder's office. . . . One compilation for Cleveland, Ohio listed 76 types of records in 16 different public offices which might contain land title data.").

102. *See, e.g.*, Emily Bayer-Pacht, *The Computerization of Land Records: How Advances in Recording Systems Affect the Rationale Behind Some Existing Chain of Title Doctrine*, 32 CARDOZO L. REV. 337, 369–70 (2010) (suggesting areas where doctrine should be revisited as technological changes take hold in some real estate recording systems); Donald J. Kochan, *Dealing with Dirty Deeds: Matching* Nemo Dat *Preferences with Property Law Pragmatism*, 64 U. KAN. L. REV. 1, 54 (2015) (proposing technologically driven amendments to recording); Tanya Marsh, *Foreclosures and the Failure of the American Land Title Recording System*, 111 COLUM. L. REV. SIDEBAR 19, 21, 24 (2011) (lamenting failure of real estate recording system to respond to prior calls for modernization and urging solutions based on updated technologies); Stonefield, *supra* note 100, 227–28, 232 (evaluating costs and benefits of transition); Whitman, *supra* note 99, at 228 ("We can make recording much easier, faster and less costly. . . . All of this can be done with the use of digital computing technology that is virtually 'on the shelf' today."). The proposed simplification of the real estate recording system is all the more feasible given advancements in technology. Controllers of private, for-profit "title plants" that have come

if the proposed system takes hold in the UCC context, something like it may also be appealing in the real estate context. Integration of the real estate and personal property systems, which might help address confusing conflicts between the two, might even be possible. In any case, the examples of cars, airplane parts, and real estate recording show that perfection by direct reference to collateral without indexing through the debtor's name has been done elsewhere, and under analogous circumstances.

Several concerns about the IoT-based system sketched above can be easily addressed.

First, there might be a concern over expense. The idea might work for large pieces of equipment, but what about, say, an inventory of cases of wine? The expense should not be overestimated. As mentioned, currently RFID cost as little as 7¢ per tag, depending on the technology included in the tag itself—such factors as how much data is stored, how far away the information is transmitted, and what security features are included. Active, wireless-enabled sensors—that is, those that can directly connect with a wireless router without even the requirement of another central node—are a few dollars each, at most, and the most expensive technology is often reusable. As electronics become ever smaller, more reliable, more capable of storing data and of performing analytical and communicative tasks, the expense could become negligible. Also, many items are already tagged, for shipment and supply chain purchases. For such items, meeting the Article 9 requirements would add little expense and would merely require one extra, automated step. It would simply reflect the already existing reality that the IoT is deeply integrated into the practices of commerce.

Second, there might be a concern over the tags being stripped off or losing power over time. The burden of proving that tags were operational at a given time (for instance in a dispute with a future creditor or buyer) would fall on the creditor claiming an interest: the system is not "tag and forget about it," but rather "tag and monitor." Monitoring could be done by regularly "pinging" each tag, and by using cameras or other sensors as appropriate to ensure collateral has not been tampered with: records of these

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to dominate real estate title searching might complicate such efforts. *See* NELSON, *supra* note 98, at 204 (noting that entrenched interests may be a reason real estate recording has not been reformed); Whitman, *supra* note 99, at 230–31 (explaining title plants); Dale A. Whitman, *Are We There Yet? The Case for a Uniform Electronic Recording Act*, 24 W. NEW ENG. L. REV. 245, 246–47 (2002) (outlining practical and political difficulties with shifts to higher technology recording).

processes would serve as sufficient proof of the maintenance of the interest in collateral. Monitoring could be automated, with technology that is already widely available "off the rack" at minimal cost.[103] Thus, tag degradation, in addition to being rare, could be easily monitored and corrected when it does occur.

Third, there might be a concern over transportation of collateral. When collateral leaves a monitored space (say, a warehouse) and is transported somewhere else (say, a delivery truck), the connection of the item to the IoT network might well be severed, thus preventing monitoring. But it is not at all clear that such a severance is required. Many vehicles are or can be equipped with wireless internet connections. For more valuable devices, a transmitter capable of maintaining a connection to cellular networks is also possible where wireless internet is lacking. In any case, even where a temporary severance of connection is anticipated by a creditor, the creditor could take appropriate steps to maintain the connection, employ an agent to protect the collateral in transit, or to release the security interest (for instance, in favor of a new shipment arriving into the warehouse) as appropriate. The risk of forfeiting an interest due to failure to monitor in transit would not seem to be much of a problem. In fact, the IoT approach's advantage is that it permits increased certainty and relatively easy maintenance of a claim for mobile collateral.

By contrast, consider what a creditor must do under the current system to maintain a claim over a piece of collateral that is mobile: file an accurate financing statement, and then either (a) trust the debtor and hope for the best, or (b) monitor the collateral and be able to trace it back to the debtor's ownership at the relevant time frame. The addition of the requirement of tagging is likely to be a substantial additional burden only on a creditor relying on (a) alone. The creditor who has chosen course (b) will likely find that tagging adds little burden, if any, because the monitoring it is already doing will likely match that required under the new system. Also, the IoT approach would remove the initial burden of filing a financing statement as well as all the uncertainties of the current system in instances of change of

103. Releasing or transferring interests could also be easily automated. For instance, RFID technology routinely allows for information to be securely re-written by a possessor of the password for a given tag. *Frequently Asked Questions*, RFID J., http://www.rfidjournal.com/site/faqs [https://perma.cc/QWR4-RDR8] (last visited Apr. 16, 2018) ("With read-write [RFID] chips, you can add information to the tag or write over existing information when the tag is within range of a reader . . . .").

ownership and location.[104]

Thus, potential concerns can be assuaged, in large part.[105]

Despite its many advantages, there are two major limitations to any system based solely on the IoT, at least with current technology. The two problems are difficult-to-tag items and items with a high turnover rate.

First, certain collateral may simply be difficult to tag. Consider corn in a silo or oil in a tank. While tech-enabled monitoring such collateral is certainly possible, tagging seems much less so. It is possible to conceive of a sensor-equipped tag that would keep track of each new addition to the tank or silo and proclaim the interest to any inquirers, but such a system seems to shift too much of the burden to a searcher for such interest. In other words, the tag in such a case seems like it would be insufficiently clear to those investigating the status of goods for existing encumbrances. There is no obvious way to solve this at present.

A second problem involves high-turnover items such as goods held as inventory in an urban retail environment. Tagging and registering the security in each item as it enters and exists inventory might be overly burdensome in some contexts. Many items are *already* RFID-tagged—such as clothing in the inventory of some retailers[106]—thus showing that the task is not impossible. Nonetheless, because of the vast number of objects involved, and given the current state of technology, it must be conceded that the IoT system may not yet be up to the task.

It is far from a stretch to imagine that technological advancement would render these problems manageable in the future. Yet for now, they suggest that the IoT approach on its own might not be feasible at the present time.

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104. Concerning the laws for collateral or debtors crossing state lines, see *supra* Section II.A.2.

105. There are other detailed questions and concerns that would arise from any full-scale modification of the Article 9 system. For instance, concerns over implementation difficulties, weighing of costs and benefits, overlap with other bodies of law, and numerous others. But because this Article's actual proposal is a hybrid one, based not just on IoT but also on geolocation technologies, consideration of these is deferred to Part IV, which lays out this Article's proposed system in more detail, and Part V, which answers several other objections.

106. *See, e.g.*, Lauren Indvik, *Why Luxury Brands Are Putting Microchips in Your Clothes and Accessories*, FASHIONISTA (Apr. 14, 2016), https://fashionista.com/2016/04/moncler-ferragamo-rfid-counterfeiting [https://perma.cc/6D5Y-D6LM] (noting security and prestige benefits of tagging to ascertain authenticity of luxury products).

B. Geolocation Technology

A second area of promising technology is geolocation. Geolocation technologies permit the pinpointing of precise locations anywhere in the United States (and most of the world), as well as the overlaying of other information on top of location data.[107] A point or area, plotted with longitude and latitude data (e.g., as identified by clicks on an interactive map),[108] can be overlaid with street names, tract numbers, elevations, crime records, and so on. All that is required is a database document linking (1) a list of the location information to map an area with (2) whatever additional information is to be associated with that area. There are widely available, high quality, and often free tools to convert such a list into a viewable "smart map," which displays all the information visually.[109] These technologies are used regularly by individuals, businesses, and governments.[110] State and local authorities maintain various databases linking area maps to information about individual properties for uses such as

107. *See generally* Ann M. Burkhart, *Real Estate Practice in the Twenty-First Century*, 72 MO. L. REV. 1031, 1070–71 (2007) (outlining innovations to real estate law and practice permitted by accuracy and low expense of global position system technologies); Harlan J. Onsrud & Robert I. Reis, *Law and Information Policy for Spatial Databases: A Research Agenda*, 35 JURIMETRICS J. 377 (1995) (providing overview of basic concepts and areas of legal concern); Jeremy Speich, Comment, *The Legal Implications Of Geographical Information Systems (GIS)*, 11 ALB. L.J. SCI. & TECH. 359, 360–62 (2001) (summarizing features of global information system).

108. Google Maps, for instance, requires a user only to right-click and select "What's Here?" to provide the longitude and latitude of any mapped item. It plots the University of Kentucky's Law Building at latitude 38.036829, longitude -84.507237. Searching from those coordinates will also point a user to that location. *See Google Maps*, GOOGLE, https://www.google.com/maps/ [https://perma.cc/6P82-7J7Y] (last visited Apr. 16, 2019).

109. Margaret Rhodes, *A Dead-Simple Tool that Lets Anyone Create Interactive Maps*, WIRED, (July 15, 2014), https://www.wired.com/2014/07/a-drag-and-drop-toolkit-that-lets-anyone-create-interactive-maps/ [https://perma.cc/VPK9-HTA8] (describing several tools). The software company Tableau, for instance, makes several powerful, easy-to-use, free tools. *See Resources*, TABLEAU, https://public.tableau.com/en-us/s/resources [https://perma.cc/N76F-X3RS] (last visited Apr. 16, 2018). Google provides tools for use with its Google Maps platform. *See Visualize Your Data on a Custom Map Using Google My Maps*, GOOGLE EARTH, https://www.google.com/earth/outreach/learn/visualize-your-data-on-a-custom-map-using-google-my-maps/ [https://perma.cc/A8RC-UDL2] (providing sample database file and step-by-step instructions for producing a custom map). Creative uses of such tools abound. *See, e.g.*, Nell Casey, *Interactive Map Shows What NYC Neighborhoods Have the Most Rat-Infested Restaurants*, GOTHAMIST (June 10, 2015), http://gothamist.com/2015/06/10/rat_map_2015.php [https://perma.cc/6SVS-R639].

110. *See generally* Speich, *supra* note 107, at 361–62 (outlining existing and potential uses such as land use, real estate and taxation, voting and census, and evidence collection).

assessing taxes[111] or inspecting restaurants.[112] Journalists have constructed their own smart maps.[113] An academic recently proposed to ease the burden on landowners by permitting them to "post" a "no trespassing" sign virtually on such maps, which would be available remotely on smart devices and GPS locaters to hikers and hunters.[114] Smart maps can also be made to be interactive, such that anyone with rights to add to a map can simply click on one or more points to designate a new location, and then enter additional information to be overlaid on that point.[115] Geolocation technologies, when combined with other related developments—the extensive availability of mobile devices, reliable mobile payment capabilities, and speedy background and license checks—have permitted the rise of ride-sharing services such as Uber.[116]

It is possible to imagine a filing system based on geolocation technology. The filing system could work like this: each state filing office would maintain a smart map available for free on an internet site. The map would show all existing claims of security interests within any particular geographic area in the state. A creditor desiring to add a claim of its own could obtain a username and password. Then, by clicking an area on a map and filling in basic information about the claimed interest, the creditor would be able to stake its claim to collateral within a given area. The creditor would have to provide its contact information, and describe the collateral claimed ("all assets," "inventory," "backhoe with serial number #xxx"). Nothing more would be required. The secured party would have thereby perfected its security interests on any

111. Travis County, Texas, where the city of Austin is located, maintains such a map and database. *See Map Search*, TRAVIS CAD, http://propaccess.traviscad.org/mapSearch/ [https://perma.cc/N65D-BADY] (last visited Apr. 16, 2019).

112. *See Restaurant Inspection Information*, N.Y.C. DEP'T OF HEALTH AND MENTAL HYGIENE, http://a816-restaurantinspection.nyc.gov/RestaurantInspection/SearchBrowse.do [https://perma.cc/3Y46-ZX9X] (last visited Apr. 16, 2019) (providing an interactive map but requiring specification of numerous search criteria before returning results). Private parties can then create their own interfaces for the same data. *See* Jeremy White, *New York Health Department Restaurant Ratings Map*, N.Y. TIMES, http://www.nytimes.com/interactive/dining/new-york-health-department-restaurant-ratings-map.html [https://perma.cc/B237-5YG7] (last visited Apr. 16, 2019).

113. *See, e.g.*, White, *supra* note 112 (New York City restaurants); Casey, *supra* note 109 (rats in New York City restaurants).

114. *See* Hynes, *supra* note 26, at 963–64. Hynes imagines that the system would be organized through the property tax system, but an interactive map would be possible. *Id.* at 974.

115. *See, e.g.*, *Smart Mapping*, ESRI, http://www.esri.com/software/arcgis/smart-mapping [https://perma.cc/UQX6-6D6X] (last visited Apr. 16, 2019).

116. *See, e.g.*, John Patrick Pullen, *Everything You Need to Know About Uber*, TIME (Nov. 4, 2014), http://time.com/3556741/uber/ [https://perma.cc/R4YW-9AQ6] (describing the basic aspects of Uber's operations).

collateral matching the provided description within the denoted area.[117] If a debtor had multiple locations, a secured party could go through this process for each of the debtor's locations, which would require little extra work.

Under this imagined system, any party interested in claiming collateral located within an area would be able to easily pull up the map and check to see if there was a competitor. Obviously, if a party had staked a valid claim in a particular area, the new creditor would have to negotiate with the prior creditor to narrow that interest, proceed with staking the claim while accepting a lower-priority spot in line, or simply decline to lend. On the other hand, if the claim on a particular area was not valid—for instance because the prior creditor had selected too large an area or had left the claim in place even though the debt had been paid—the system would be similar to the current system, in that the prior creditor would be obligated to narrow the claimed area or delete the claim, as appropriate (or risk liability).[118]

One objection to the imagined system might be that it would not deal well with a situation in which multiple debtors granted security interests in items within a given area. For instance, imagine there were two debtors sharing a warehouse. The system as described would not require a creditor to specify the debtor's name. Even if Creditor A's dealings are only with Debtor *A* and not Debtor *B*, a new creditor might be reluctant to lend against Debtor *B*'s property in that warehouse. Under Article 9 rules, even though Creditor *A*'s security interest would attach (and be perfected) only against Debtor *A*'s property, the notice could theoretically permit Creditor *A* to lend to Debtor *B* at a later point and have higher priority than any later claims.[119]

This challenge seems surmountable. One obvious solution might be for the law to require Creditor *A* to amend its claim to attach an addendum upon request of Debtor *B* (as an owner of

117. As with the current system, the secured party would only have perfected its interest to the extent its interest had attached—it would not have thereby encumbered property, for instance of parties other than the debtor.

118. U.C.C. § 9-513 (creditor must file statement indicating termination of security interest when appropriate); *id.* § 9-625(e) (creditor will owe damages if it files an unauthorized financing statement or refuses to file termination statement when appropriate). Arguably, any amended system should strengthen, or at least clarify, these provisions to make clear the creditor's obligations.

119. This would be similar to the effect now of lending to a debtor when there is an existing financing statement, even if the security interest to which that statement relates has not yet become enforceable. *See* 4 WHITE ET AL., *supra* note 4, § 33:3 (discussing this "first in time, first in right" rule of U.C.C. § 9-322(a)). Essentially, these rules oblige the debtor and new creditor to reach an agreement with the old creditor if the new creditor wishes to be ensured of priority. U.C.C. § 9-339; *id.* cmt. 2.

other property within the claimed area). The addendum would be a binding declaration as to which debtor the security interest attached; in other words, it would limit the creditor's claim to the property of Debtor *A*, thus providing the new creditor with some assurance that its interest would not be threatened. Even so, given the potential for confusion, the old and new creditors might well feel the need to reach a broader agreement among themselves concerning their respective claims and articles of collateral. This solution might seem burdensome but consider this same situation under the current system. It is difficult to conceive that many creditors would lend against the second debtor's supposedly unencumbered assets stored in the same warehouse as another debtor's encumbered assets, at least without having a subordination agreement or some other form of inter-creditor contractual assurance in place with respect to the prior creditor.

The more substantial objection to the geolocation system is the more obvious one—that interests are only perfected within the specified area. Under this imagined system, there is no clear way of maintaining an interest when items are *removed* from the designated area. Of course, one location might often be sufficient. An inventory lender might be content to know that the current contents of the warehouse will remain its collateral and might be comfortable with its interest being released when the items are removed. But other lenders might wish to maintain their interests beyond a specific location.

Solutions to this problem are conceivable. For instance, a security interest perfected by geolocation could remain perfected for a short grace period while the creditor has the opportunity to investigate the situation and stake a claim in the new location of the asset.[120] Just as "tag and monitor" was the requirement of the imagined IoT system, so "claim and monitor" would be required by a geolocation-based system. Again, such monitoring might be inexpensive thanks to modern technology—in fact, again, due to IoT technologies that permit for inexpensive, remote, automated sensing and tracking. In addition, it is far from clear that the monitoring requirements of the system as described would be substantially more burdensome than the current system. Under the current system, it is true that a valid claim could be asserted further in the future than in the imagined system—creditors are

120. *See infra* Section IV.A (discussing this as a solution to problems that might arise from a filing system based on geolocation technology).

not limited by some legally imposed grace period.[121] But realistically, once property of a debtor is moved to another location upon purchase, theft, or otherwise, it is hard to imagine that many creditors can later locate and successfully assert claims against that property. A creditor who cares about collateral must monitor that collateral—no matter what the law technically permits or requires.

A geolocation-based secured transactions system would have the appeal of simplicity and of increased certainty. The interface could be easily and intuitively navigated and could provide parties with considerable certainty under most of the real-world circumstances in which security interests are claimed, including the storage of inventory in warehouses. The capacity of parties to specify the scope of their interests in an objective, easily searchable visible format on a map holds great appeal. But geolocation's inability to deal with mobile objects represents a weakness. Accordingly, this Article proposes that the new secured transactions perfection system be a hybrid one, drawing on the strengths of both geolocation and IoT technologies and avoiding the weaknesses of each.

IV. THE PROPOSED SYSTEM

As explained in the previous Part, both geolocation and IoT technologies hold great promise as potential substitutes for the current secured transactions regime. However, under the current state of technology, there would be significant weaknesses in a system based exclusively on one or the other. While IoT technology is inexpensive and provides the most direct way of establishing and providing notice of the security-interest connection between creditor and collateral, IoT technology is not yet so easy to automate and so cheap to deploy that it can be imagined as a way of dealing with all collateral in all situations. For instance, it might be cumbersome to use it for large warehouses or large stores containing many small, individually packaged items. By contrast, geolocation technologies excel in the common scenario of property being held in one place for most or all of its useful life as collateral, thus filling the gap left by IoT technology. Geolocated claims can be made cheaply and easily, and the claims would be highly transparent to any searchers after records. The weakness of this approach, however, is that if a creditor desires to maintain a

121. *See supra* text accompanying notes 63–64 (discussing complications of maintaining perfection under the current system); *see also* U.C.C. § 9-315(a).

security interest over collateral as it moves from place to place, geolocation provides no obvious means to do so. An IoT approach, of course, does. As is readily apparent, then, the two technologies have complementary strengths.

This Part proposes a reformed secured transactions system, a hybrid involving the use of both IoT and geolocation technologies. In rough outline, the proposed system would permit notice of claims of security interests in tangible collateral to be claimed either through an IoT tagging approach or through geolocation.[122] Once claimed, and provided that certain monitoring requirements are complied with, the proposed system would provide significantly improved commercial certainty. Numerous existing provisions, most notably those regarding proceeds, would be jettisoned or greatly simplified, and numerous exceptions would be eliminated.

Section A outlines how the hybrid system would work. Section B works through several examples of its proposed operation. These sections explain how the proposed law would assign rights and responsibilities to participants in secured transactions, and what would change or be eliminated from the current law. The next Part provides a discussion of several specific concerns that the proposal might provoke.

A. The Proposed System in Outline

The proposed system is easily described and is, from a legal perspective and compared with the current regime, very simple.

Tagging. First, collateral could be tagged with an RFID or other transmitting beacon containing basic information about the claimed security interest and contact information for the party claiming the interest, along with a unique alphanumeric code identifying that object.[123] Once the tag is affixed and registered with a given Secretary of State, the security interest would be perfected within that state's boundaries. If creditors were concerned about collateral "walking" across state lines without consent, there is no reason that they could not register the same

122. Interests in intangible collateral would be left as-is. *See infra* notes 133–35 and accompanying text.

123. It is unlikely that there would be a limit to the unique collateral codes available. The underlying architecture of the internet has been adjusted to permit much larger numbers of uniquely identified participants: Internet Protocol v6, the transition to which began in 2012, permits up to 3.4×10^{38} unique addresses. *See generally Overview*, GOOGLE IPV6, https://www.google.com/intl/en/ipv6/index.html [https://perma.cc/3M7W-XEEM]. More simply, consider that there are over 2.176 billion (i.e., 36^6) unique combinations of alphanumeric characters if each combination uses only six characters.

collateral in all fifty states, the District of Columbia, and Puerto Rico. Collateral in a box or other container could be tagged on an entire-container basis, although once the individual items were separated from the container, perfection would cease.

Geolocation. Alternatively (or additionally, at the creditor's election), a security interest could be perfected by designating an area using coordinates registered on a map maintained by the Secretary of State of each state, providing contact information and a legal description of the collateral claimed within that area.[124] The process of claiming a geolocated interest would be simple. A creditor would obtain a username and password to log in to the system and provide a credit or bank card number. Thus, only "known" parties would be able to add entries to the interactive map, which would serve as protection against fraudulent or frivolous claims.[125] Next, the creditor would navigate on the map to the desired spot, identify the relevant area by clicking on its four corners (or if the map was linked to an existing tract map, simply click on the desired tract(s)). The creditor would identify the collateral that it claimed an interest in within that area ("all collateral," "crane with serial # ___") and fill in its name and contact information. With no further steps needed, the claim would be made at that point. Any searcher could easily pull up the map, navigate to an area of interest, receive notice of the claim, and take appropriate steps.

As with the current system, there is of course some possibility of abuse because a creditor could easily encumber more than intended by simply submitting a filing covering more than strictly necessary and claiming "all assets" as collateral. Thus, there would need to be a clearing mechanism available for parties covered by a too-broad filing (perhaps together with penalties for

124. *See supra* notes 107–15 and accompanying text (discussing geolocation technologies).

125. There is no reason to think the proposed system would be any more plagued by false filings than the current system, which is not particularly effective at dealing with this problem. *See* NAT'L ASS'N OF SEC'YS OF STATE, STATE STRATEGIES TO SUBVERT FRAUDULENT UNIFORM COMMERCIAL CODE (UCC) FILINGS (2014), http://www.nass.org/sites/default/files/surveys/2017-08/final-nass-report-bogus-filings-040914.pdf [https://perma.cc/YGU2-J9E6] (describing fraudulent filings problem, state and federal law-based remedies, and potential solutions). A technologically streamlined system could provide for more effective policing of abusive filings. A similar system has been implemented elsewhere. *See* Todd J. Janzen, Note, *Nationalize the Revised Article 9 Filing System: A Comparison of the Old Article 9 and Canadian Personal Property Filing Systems*, 11 IND. INT'L & COMP. L. REV. 389, 401 (2001) ("Ontario protects debtors by limiting who can file a financing statement electronically. . . . [A] filing party must register with . . . the central filing office, in order to obtain an account. This account allows the filing party . . . to submit financing statements electronically.").

carelessly or intentionally overbroad filings). In addition, the law might need to limit the size of each area covered, to prevent creditors from seeking to encumber assets from a broader area than intended.[126]

For the foreseeable future, the geolocation route to perfection remains important, as it may be the only feasible way of perfecting in certain collateral, the tagging of which would be too difficult or too expensive with current technology. However, if IoT-enabled tags move from being common (as they are now), to being ubiquitous, then the perfection process could, for instance, simply become part of the inventory intake process, with registration of the creditor's interest accomplished automatically as each shipment is scanned into a warehouse or store and monitored thereafter by IoT security mechanisms that are themselves already common. In such an instance, geolocation might or might not remain necessary as a parallel system.

Priority. If an item were both tagged and located within a geolocated claim, the *first* interest to be claimed *over that item* would generally prevail. The *over that item* proviso is important: if an already tagged item were later brought within a geolocated area, the tagged interest would prevail, even if the geolocated claim over the area was made before the item was tagged. As long as the tagging was done prior to the item entering the area, it would prevail. On the other hand, if an item within a geolocationally claimed area were then tagged, the geolocated interest would prevail—of course, only so long as the item remains within that area.

As under current law,[127] a party could remain perfected (i.e., have perfection "credited back" to the original date of a claim) over an item by overlapping one method of perfection with the other. In other words, it could remain continuously perfected in an item even after it was removed from a perfected-by-geolocation area by perfecting-by-tagging the item before it left that area. Insofar as proving the time of a claim might be difficult for a particular geolocated item, increased monitoring systems could help—most obviously, a video display of the object upon arrival or construction in a space would be a useful form of proof. Such proof would usually be no more complicated, and might often be simpler, than

126. Upper limits of areas to be claimed could even be adjusted to the average density in an area. In urban areas, perhaps only a block or fraction of a block could be covered per claim, whereas in vast open places such as West Texas, upper limits of filings could be much larger to permit coverage of cattle, for instance.

127. *See* U.C.C. § 9-308(c).

proving possession or ownership at a given time by a given debtor under the existing legal regime.[128] Proving a time of tagging should usually be easy, although similar proof could easily be produced.

Although predicting technological development is a perilous task, the IoT is likely to continue to develop by allowing smoother and fuller integration of numerous types of technology. Already, the IoT involves inputs not just from RFID-type tags but also from visual contacts, temperature and other sensors, and even monitoring by drone. Geolocation technologies are a part of the panoply of interrelated technologies that augment the IoT. It is not hard to imagine that the two aspects of the proposed system could be linked, such that IoT interests could be continuously plotted on maps as well, providing two forms of notice (one remote, one short-range) of a security interest, and allowing ever easier and more automated monitoring.

Proceeds. Under current law, a perfected security interest is often maintained even after the sale or exchange of an item, both in the original item (now sold) and in whatever has been obtained through the sale (money, an account receivable, etc.).[129] While there are important exceptions to this principle, most importantly for "[b]uyer[s] in [the] ordinary course of business," there are exceptions-to-the-exceptions as well.[130] The law is full of traps for the unwary and is at best imperfect.

In the proposed system, the entire proceeds regime would be eliminated. This is its most significant advantage, as well as perhaps its most disruptive aspect. Perfected security interests in the original collateral would generally be unaffected by sale or disposition of the collateral. With the exception of the rules concerning buyers in ordinary course and sales to which a creditor has consented, the sale or disposition would simply not affect the perfection of a security interest. As long as collateral remained within the geolocated area, it would remain encumbered. If it were removed, however, an assertion of the security interest would be required within seven days. As for tagged collateral, the security interest would remain as long as the tag remained operative, and

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128. Imagine a creditor with a second-filed financing statement claims to have been earlier perfected by virtue of having possession nine years before, prior to the first financing statement having been filed. This illustrates the difficulty under current law of *dis*proving such matters as possession, when possession can be established by anyone who has agreed to act on the secured creditor's behalf. *See* LOPUCKI ET AL., *supra* note 67, at 390 (using Problem 22.3 to illustrate this point); *see also supra* note 57 and accompanying text.

129. *See supra* note 67 and accompanying text.

130. *See supra* note 61 and accompanying text.

again, there would be a short challenge window once it was no longer operative. In other words, absent the narrow but important exceptions already mentioned, the rule would be that once attached and perfected, a security interest persists so long as the tagging or geolocation covers the property. As soon as one of those means of perfection has lapsed, the creditor would have a very short grace period to re-establish or assert the interest.

To assert a security interest in what was acquired by the sale or disposition (what is currently known as proceeds), the secured creditor would have to perfect some other way. If the new property of the debtor fell within the description of collateral claims in an already demarcated geolocated area, then it would be included as soon as it arrived on premises. The same principle would apply to tagged items. Upon the arrival of new inventory, for instance, tags on cases of wine or other collateral could be immediately electronically activated when scanned, on an automated basis. Technically speaking, then, the security interest could (by agreement) extend to proceeds but would not do so as a matter of course, and in any case, perfection in the original collateral would not automatically follow in the proceeds.[131]

Numerous other details concerning the proposed system would have to be considered before implementation,[132] but this description suffices as to the basic features of the system and the ways in which it can be distinguished from the existing system.

Intangibles. Article 9 provides for security interests to be perfected in a range of intangible types of property, such as trade secrets, copyrights, accounts receivable, and so on.[133] Because intangibles are not "things" that can be tagged and tracked, nor are they geolocatable, the proposed system would not apply to them. The proposed system would largely leave the current system in place with respect to intangibles. This makes sense: for instance, accounts receivable are probably best identified by means of the party to whom payment is initially owing—i.e., the

131. For an analysis concerning the problems with the current proceeds regime, see *supra* Section II.A.2.b.

132. For instance, the maximum length of effectiveness of a registered claim, currently provided for by U.C.C. § 9-515; and the treatment of proceeds in bankruptcy, currently provided for by 11 U.S.C. § 552. I intend to consider some details of potential implementation in future work.

133. U.C.C. § 9-102(a)(2), (42); *see id.* § 9-102 cmt. 5(d). Depending on the precise form they take, what are colloquially referred to as accounts receivable can fall, sometimes, within the scope of other UCC terms, such as payment intangible, *id.* § 9-102(a)(61), or even instrument, see *id.* § 9-102(a)(47), but the analysis here would not be changed substantially in either case.

owner of the account. A similar principle is true of the party who owns a trade secret, an unregistered copyright, and so on.

It might seem burdensome to have three parallel systems—the geolocation system, the tagging system, and the legacy system that would be left in place for intangibles. However, the burden is actually light because there would be little overlap among the different systems. Intangibles under the current system are frequently generated from the sale of tangible assets—for instance, accounts receivable—with the new intangible being treated as "proceeds" of the tangible collateral.[134] That would no longer be the case under the proposed system. Hidden liens on accounts in favor of one creditor arising from the sale of that creditor's tangible collateral would no longer have any power. In other words, perfection in the tangible systems would not significantly affect the intangible system, and vice-versa. Thus, ascertaining who had a claim to the intangibles would be easier under the proposed system.

The secured transactions regime governing intangibles is already complicated by a confusing overlap of federal and state law, particularly with respect to intellectual property, and is in grave need of reform.[135] While the regime for perfecting interests in intangibles will remain confusing until broader reform is initiated, the proposed system would simplify the current system

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134. *See id.* § 9-102(a)(64) (defining proceeds); *supra* notes 63–70 and accompanying text.

135. *See, e.g.*, Jonathan C. Lipson, *Financing Information Technologies: Fairness and Function*, 2001 WIS. L. REV. 1067, 1105–07, 1123–25, 1153 (critiquing the Article 9 regime on intangibles); Juliet M. Moringiello, *False Categories in Commercial Law: The (Ir)relevance of (In)tangibility*, 35 FLA. ST. U. L. REV. 119, 141, 150, 156–57, 164–65 (2007) (arguing that the distinction of tangible/intangible property presents problems and proposing better functional distinctions).

With respect to copyrights, for instance, legal authorities are divided on when security interests must be filed in the federal Copyright Office and when in the UCC filing offices. 4 WHITE ET AL., *supra* note 4, § 30:30, at 116–17 (noting divisions in law concerning copyrights). This has initiated considerable uncertainty, misleading creditors, splitting courts, and inciting criticism from academics. *Id.* § 30:30, at 114, 116–18; *see also* Molly Shaffer Van Houweling, *Land Recording and Copyright Reform*, 28 BERKELEY TECH. L.J. 1497, 1499–1508 (2013) (analogizing defects in the copyright system to those of the land recording system).

By contrast, patents, another important category of intangibles, are currently perfected in the UCC filing system, while ownership interests in them are made by reference to their federal patent office identifiers. This bifurcation is confusing and seems inefficient. Where there is a centralized system for granting or protecting property interests in such assets, it makes the most sense to permit claims perfecting security interests to be made in the same place as ownership claims. Such an alternative system is not always practicable, but where it is, it provides a direct link between creditor and collateral comparable to that proposed in this Article for other forms of property, and it should be implemented.

by removing some of the complicated linkages between methods of ascertaining interests in tangible and intangible forms of property.

Possession. Another alternative that lawmakers could consider is to provide yet another route to perfection, which could be termed "notorious possession," that is, possession that is marked and clear to any observer.[136] Notorious possession would be unlike the type that is permitted under Article 9, where possession is easily obtained or falsified without true notice to any other party having been provided.[137] A creditor could claim this form of possession simply by clearly and unmistakably possessing an item.

In most cases, geolocation could accomplish much the same end because a creditor could simply claim the location where the creditor was holding the collateral on the UCC map. But under some circumstances—for instance if a debtor is transporting collateral from place to place and has not yet been able to tag it—notorious possession could be another sensible supplement to the proposed system. As with the other proposed means of protection, the creditor would bear the burden of monitoring the collateral and maintaining sufficient records to demonstrate its possession at the relevant times.

Implementation. The proposed regime is radically different from the present one. Its implementation, however, need not be radically disruptive.[138] The old debtor name-based register could be maintained, and the validity of perfection obtained under it left in place long enough to provide parties a chance to adjust and re-perfect as necessary. Consent granted for the initial financing statement (which can be implied from the consent granted in a security agreement) could cover an amendment to perfection practices within the scope of the original agreement.[139] If a creditor re-perfected under the new system during the transition period, perfection could be deemed to have been continuous from the time of the original filing under the prior regime. At some point, perfection obtained by the new system would begin to be given priority over perfection obtained the prior way. Either at that

136. The possession rules could also require the name and contact information of the possession creditor (or its agent) to be clearly observable as well, to facilitate inquiry.

137. *See supra* notes 56–57 and accompanying text.

138. For an analysis concerning the transition from the major 2001 revision, see Caroline N. Brown, *U.C.C. Revised Article 9: The Transition Rules*, 79 N.C. L. REV. 993 (2001).

139. *See* U.C.C. § 9-509(b) (consent to security agreement implicitly includes consent to all necessary financing statements and other filings).

same time or at a later point, perfection under the old system would be deemed to have lapsed as to lien creditors and other potential claimants on the collateral.

It is conceivable that automation could help with the transition to the new system, particularly if state authorities were to take the initiative. The name and address of both creditor and debtor are supposed to be included on the UCC1 forms currently on file.[140] A state filing office could notify the creditor at the address given on the current form and could provide the creditor with the opportunity, for a fee, to instruct the office to re-perfect the interest by identifying it on the map using the debtor's address.[141]

Fees and funding. The current Article 9 regime generates funds for the filing offices,[142] usually the Secretaries of State of each state.[143] The proposed system would as well, particularly after implementation and transition costs have been paid. The transition to the new system would require some amount of initial investment, but much of the required costs could be covered by a fee structure designed generally to approximate the current structure. Much or all of the proposed software could be partially obtained on an off-the-rack basis, and the experience of the first states to transition to the new regime could benefit the later states to transition.

The fee structure for filings would require some adjustment. One solution would be to permit users of the IoT-based service to pay a regular (biannual, annual, monthly, etc.) fixed fee covering as many filings as they wish. In any case, the per-filing fee for IoT registrations will have to be low, to allow for the many thousands of filings that the system contemplates. As for claims based on geolocation, one option would be to require users to pay a small fee for each claim made, perhaps with fees linked to the size of the claimed area, to discourage overbreadth. Another alternative would again be to charge a user fee that includes the right to make a number of claims.

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140. *See id.* § 9-502(a) (noting requirements of financing statements); *id.* § 9-516(b) (stating record filing requirements); *id.* § 9-521(a) (displaying sections one and three of the UCC1 model form).

141. Because filings would be at the location of collateral and not state of incorporation, this solution would require coordination between states.

142. *See* U.C.C. § 9-516(a) (discussing the need to pay the appropriate fee with the filing office for filing to be effective).

143. *See, e.g.*, *Uniform Commercial Code*, KY. SEC'Y OF STATE, https://www.sos.ky.gov/bus/UCC/Pages/default.aspx [https://perma.cc/JY6A-KNSP] (last visited Apr. 16, 2019) (demonstrating that in Kentucky, the Secretary of State runs the UCC filing office).

In terms of how long filings would remain valid, one alternative is to adopt a system akin to that of some Canadian provinces, where users can choose the length of time of effectiveness, with fees rising on a sliding scale based on the length of time claimed.[144] With tagged claims, because IoT hardware generally has a lifetime of years not decades, there may be a natural limit to how long parties will pay to register the interests. By contrast, under the IoT system, parties need not sift through multiple search results to find the relevant information about a given piece of collateral, because each registration would have its own specific alphanumeric identifier.[145] Geolocated claims could be cleared out by the process described above when they are no longer valid over the identified area.

There is of course a tension between allowing sufficient fees to be charged so that filing offices can maintain a well-functioning, secure infrastructure and qualified staff and imposing fees so high that they deter parties from using the system. As under the current system, the proposed system would defer to states to strike this balance, on the reasonable assumption that users of the system will have sufficient incentive to advocate against filing offices seeking to charge exorbitant fees. There have been proposals to induce competition among state filing offices, or even to eliminate them in favor of national filing.[146] If these proposals gain steam, they might help lessen concerns over inconsistencies or inequities in state fee structures. The uniform law commissioners could also have a role if states are perceived to abuse their rights to set their own fees.[147]

B. Examples of the Proposed System's Operation

The previous section provided an overview of the proposed legal regime for secured transactions. To illustrate how the proposed regime would work, this section provides examples of the new law's effect on several common types of secured financing arrangements.

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144. This appears to be the Canadian approach. *See* Ronald C.C. Cuming, *Article 9 North of 49°: The Canadian PPS Acts and the Quebec Civil Code*, 29 LOY. L.A. L. REV. 971, 981 (1996) ("When registering a financing statement, the registering party can choose the period of registration between one and twenty-five years or the party can choose infinity registration. The registration fees in Saskatchewan are five dollars per year or $400 for infinity registration.").

145. *See supra* note 123 and accompanying text (noting the availability of identifiers).

146. *See* LoPucki, *supra* note 27, at 15–16.

147. *See* U.C.C. § 9-526(a) cmt. 3 (permitting states to set fee structure); *id.* §§ 9-519 to -520 (providing the responsibilities of filing offices).

Consider the example of a restaurant, with revolving inventory and existing equipment in place, all of its collateral for a loan from Acme Bank. The equipment could include ovens as well as plates, glasses, and flatware for service. The restaurant's inventory could include food and drink that fill those plates and glasses.

Equipment such as an oven would be easy to tag—an RFID tag or WiFi-transmitting device would operate like a "beacon" to any nearby readers, including a wireless router. The tag would include an identifying number and a statement to the effect of "Oven is Collateral of Acme Bank," with contact information for the secured party, and registered in the relevant filing office (i.e., the state Secretary of State). The tag could be read by any party with a device capable of reading such tags (including most smartphones). If the security interest is lifted (for instance, the obligation is satisfied), then the tag could be removed or remotely reprogrammed to be blank or to specify a new secured creditor. If the oven is moved, the secured creditor could ascertain that fact very quickly—either by cheap, regular monitoring by hand-held devices (which could be wielded by the debtor's employees, with updates uploaded and transmitted to the secured creditor's collateral management program[148]), or by virtue of a direct connection of the oven to a wireless network in the restaurant. The tag would be difficult or impossible to remove from the oven without breaking the tag, which would thus no longer transmit as designed and set off remote alarms for the creditor.

Legally speaking, the burden would be on the secured creditor to monitor its collateral and pursue remedies—locating the oven, calling the debt, taking whatever other steps are permitted by the contract. With an automated system established, the creditor could prove the location of the collateral and the existence of its tag at any given time. Thus, if any competing creditor tried to tag the oven and claim priority, the original creditor would be able to refute such a claim easily. In fact, the same monitoring system that allows it to maintain contact with its own tag would also detect such a competing interest as soon as its establishment was attempted, since the competing tag would be readable. If a creditor sought to maintain the tag longer than was permissible, then a debtor could bring a legal challenge to have the creditor's claim (and its corresponding tag) lawfully removed; if a creditor's tag

148. The debtor would of course have an incentive to cooperate with this arrangement, or risk being in default of their agreement as well as not receiving any further financing from the creditor.

was wrongfully removed, the law would permit a short window or grace period in which it could vindicate its interest in the oven, otherwise its interest would be forfeited as to a good-faith buyer or to another creditor who loaned money on the collateral in good faith and otherwise took steps to perfect its interest. Challenges to the subsequent buyer or lender (after a short initial period in which the original claim could be vindicated) would be limited to lack of good faith.

More to the point, there would be no need for the elaborate panoply of UCC rules concerning proceeds and after-acquired property; if the lender wished to obtain more collateral as it came in, it could simply have the debtor's employees tag and scan such collateral, and thus smoothly add it to the monitoring system. Otherwise, a perfected security interest would *not* extend beyond the particular tagged item, thus vastly reducing the risk to competing creditors of being ambushed by a "secret lien" obtained by virtue of the proceeds rules.

As for the inventory, we can picture boxes of frozen or refrigerated meat, pallets of vegetables, bottles of alcohol, and so on. The proposal would permit security interests in these goods to be perfected by two different means. One is now familiar: individually tagging the items as they arrive. This might not be as cumbersome as it sounds. Consider a box of frozen salmon fillets or a bottle of bourbon. The box or bottle could be tagged cheaply, and as long as it was intact would retain significant value as collateral. To be sure, neither one empty bottle nor box would be worth much, and a creditor might have a hard time detecting from afar whether bottles were full or not. On the other hand, as discussed above, WiFi-enabled camera technology is readily available, and it is easy to imagine that a creditor could ascertain whether the hundred bottles of bourbon or boxes of frozen salmon in a supply pantry or refrigerator were empty, or whether they were unopened and full of their valuable contents. As bottles or boxes were taken out of storage and used, the creditor could monitor the replenishment of its collateral or the payments made with respect to the consumption of such inventory.

If the creditor deemed tagging to be infeasible, a second option would be available: a geolocated claim for a specified type of collateral on premises. To obtain such an interest, all that would be required would be the registration of latitude and longitude coordinates with the Secretary of State, along with a statement of the type of collateral claimed ("all assets," as under the current regime, could be an option). Again, any debtor would have the right to challenge such a claim at any time. Aside from the

indexing by location rather than debtor name, this option largely resembles the existing system. There are several significant ramifications of this distinction. Because claims are limited to that location, they are thus more transparent to third parties, more certain for the claimant (who does not have to worry about "hidden liens" encumbering property in that location), as well as more fragile, since the security interest will be lost as to property taken off those premises. The limitation encourages monitoring/diligence on behalf of secured parties, although again, in light of the availability of remote, automated monitoring technology such as WiFi-enabled cameras and sensors, the burden would be relatively light. What is gained is certainty concerning legal rights.

To take another example, consider a factory producing goods for sale out of raw materials. Tagging goods that are being warehoused would certainly seem possible in many cases, for instance, large pieces of timber or commodities being stored for later shipment. In other cases, tagging raw materials might not be feasible, particularly if they are being transformed into manufactured or processed goods. As with the salmon and bourbon examples above, WiFi-enabled sensors could readily and automatically transmit real-time information concerning the collateral present in a given warehouse, silo, tank, or other space (moisture levels, weight/volume/density, would all be possible). But once the raw materials change form, they would have to be tagged again (presumably the original tag(s) would have been compromised or destroyed in the manufacturing process). Alternatively, they could be otherwise included, for instance, as part of an all-assets claim in the geolocation-based filing. Presumably, the geolocated claim would be preferred in most such cases.

This Part has explained the substance and function of the proposed new system and clarified how the new law could plausibly provide for increased certainty in several typical secured financing arrangements without adding significant expense. In fact, the new law would simply give legal force to commercial practices that are already increasingly being adopted. The next Part provides more in-depth discussion of several potential objections to the proposed law, which allows the weighing of its costs and benefits more clearly.

V. POTENTIAL OBJECTIONS

This Part considers several objections that might be made to the proposed system, ranging from the practical to the more

philosophical. Section A considers whether the benefits of the proposed system outweigh the costs of it (including the costs of transitioning). Section B examines the relationship of the proposed system to the currently common practice of all-asset lending. Section C discusses whether particular political constituencies would oppose the amendments. Section D explains how the proposed system would deal with certain hard-to-categorize classes of assets, such as deposit accounts. Section E answers objections about the overlap of the proposed regime with other bodies of law, such as real estate law. Section F discusses privacy concerns that the proposed system might present. Section G outlines potential problems of access to, and participation in, the proposed system that might be faced by small businesses, consumers, and other commercially unsophisticated parties, and suggests some ways of easing those difficulties. Finally, Section H explores the discomfort that the proposed system might provoke as an apparent step toward a world of total technological control that could reach down to the level of each individual object and area on the entire earth.

This Part concludes that even in light of its costs and some potential concerns, the proposal presents a considerable improvement over the existing system.

A. The Costs and Benefits of Disrupting the Status Quo

One obvious challenge to the proposal is purely practical. There are costs: costs to changes in the legal system and costs to creditors for updated technological and monitoring requirements. Do the proposal's promised benefits exceed its likely costs?

In terms of legal change, the costs may be limited. The language of the amendments would have to be drafted and passed through the appropriate political channels, with uniform law bodies, and in the various states. Lawyers and their clients would have to transition to the new system. Disputes would arise as to the interpretation of numerous sections, and courts and law drafters would be busy filling gaps and clarifying ambiguities for some period of time after passage.

On the other hand, the body of UCC law would be dramatically simplified by the proposals. Numerous complicated provisions of the current law that strive to balance the interests of present and potential creditors would be cut in favor of more certainty and simplicity. In sum, the costs of legal change would be concentrated in the transition period and would likely be balanced by the benefits after that period.

In terms of practical changes, the proposal might seem to require more vigilance from creditors to maintain their interests in collateral. To be sure, the new proposal explicitly contemplates that if a creditor fails to detect the movement of collateral outside of a geolocated zone, after a grace period passes, perfection over that property lapses. If an IoT monitor or tag is removed such that another interest holder cannot perceive the interest, after a similar grace period, the interest again lapses. These rules require continuous monitoring to maintain full protection; whereas under the current system, interests usually remain perfected, even if property is moved around or altered—or disposed of in exchange for other property.

In practical terms, however, the differences may be more illusory than real. Although the current system does not require the same level of vigilance, a creditor that is not monitoring its collateral can hardly expect to maintain its interest in that collateral. Under the current regime, without a secured creditor carefully monitoring collateral, it seems impossible to believe that its legal rights, while technically protected, are in fact worth much. The original drafter of Article 9, Grant Gilmore, put it like this:

> Article 9 does make it possible for a lender to take a security interest in all of a debtor's present and future property, advance his money, sit back and take no further interest in what goes on. He will not be well advised to do this. This hypothetical course of action makes little or no sense from a business or banking point of view.[149]

This insight would remain true under the new regime as under the old. Whatever its legal rights may be, an inattentive creditor risks significant loss of personal property collateral, which is relatively moveable, not difficult to spirit away. If a creditor has not found the collateral worth monitoring in any meaningful way under the current system, it is unlikely to do so under the new system, and apparently it does not anticipate any resultant losses being particularly severe. Of course, insofar as the creditor *is* monitoring collateral, the proposed system would represent little additional imposition. In other words, there is a general principle, which holds true under both the current and the proposed regimes: if collateral is worth having, it is worth monitoring.

Indeed, the *practical* need for monitoring, even under the current system, is one reason that monitoring technologies have come into widespread use. As discussed above, the technology is

149. Grant Gilmore, *Article 9: What It Does for the Past*, 26 LA. L. REV. 285, 299 (1966).

continuing to improve and is neither particularly expensive nor complicated to use, so there are few barriers to wider adoption.

Without better data concerning the pervasiveness of such technologies in commercial practice, it is difficult to assess what the *actual* costs of transition would be. It seems entirely possible that over the five to ten years required to bring the proposed system fully into force, most or all secured creditors would have already availed themselves of the requisite technologies—whether for monitoring of collateral or for the numerous other purposes such technology serves, such as supply chain management, regulatory compliance, security, and so on.

If that turns out to be the case, then the actual additional costs to creditors would approach zero. The corresponding benefit would be, of course, the curtailment of the existing Article 9 requirements and their attendant uncertainties.

B. "All-Asset" Lending

A related concern arises from the current practice of "all-asset" or "blanket" lending. The current practice of secured lending is a grant of security interests in all assets of the debtor, as a default. Many, perhaps most, secured transactions grant security on this basis, and this has been the case for at least several decades.[150] The result of this practice is that the most common type of security interest is what is known colloquially as a blanket lien—a lien on all of the debtor's property.[151] Although this is an issue that merits exploration in future work, the proposed system may be able to accommodate the current practices of all-asset lenders with fairly little disruption.[152]

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150. *See, e.g.*, Morris G. Shanker, *A Proposal for a Simplified All-Embracing Security Interest*, 14 UCC L.J. 23, 26–27 (1981) (noting that "an all-embracing lien, that is, a security interest on all of the debtor's property. . . . is what most secured parties want, and that is what most of them are now getting").

151. *See, e.g.*, Edward J. Janger, *The Logic and Limits of Liens*, 2015 U. ILL. L. REV. 589, 595–96.

152. There are fierce debates about such liens from efficiency and equity standpoints. While Shanker takes no view on the desirability of the "all-embracing lien," he suggests that if the law is to permit such liens, it should not complicate the process of claiming them without reason:

> If the law intends that security over all of the debtor's assets can be obtained . . . by simply copying from a boiler-plate list of words found in Article 9, then why even require it? At best, continuing to require this boiler-plate list can serve only as a trap for those who, by reason of inadvertence or lack of proper advice, fail to copy it precisely. And that seems a poor reason to penalize these unfortunate souls.

See Shanker, *supra* note 150, at 26. This proposal was almost entirely implemented in later versions of the UCC, although "unfortunate souls" are still occasionally caught in the few

Under the proposal, all assets could be claimed with only slightly more work than the current system. A claim on intangible assets would be made largely as under the current system (although neither these nor other claims would benefit from the current system's expansive proceeds protection). A claim on tangible assets in a given location could be made easily by a geolocation claim. The security interests thus perfected could "float" over future intangibles and over tangible assets brought on premises. With a few clicks and keystrokes, a security interest over much of a debtor's property could be perfected remotely and quickly. The new system would be inconvenient only when debtors have a very large number of locations or many items of collateral constantly on the move. Even then, the proposed IoT and geolocation technologies are unlikely to require significant adjustments.

Similarly, the additional monitoring requirements of the new system on such a creditor would likely be manageable. As mentioned above, and as recognized decades ago by Article 9's lead drafter Grant Gilmore, if the creditor actually cares about the collateral, it must monitor those materials anyway. For creditors who lack the energy to monitor, their "all-assets" claim may cover far fewer assets than intended.

Finally, because the proposed system reduces "secret lien" possibilities, the proposed system would often help protect the hypothetical, "lazy" all-assets creditor, who might not bother to investigate much prior to claiming the lien. Also, the proposed system would facilitate easy and certain means of carving out *exceptions* to an "all-assets" lien. This would provide a sort of natural experiment to shed light on when and why the all-asset approach remains appealing, by providing other easy and reliable options for "slicing" a debtor's property more finely among different security interests.

If, despite the above argument, proponents of the all-asset practice were to stand implacably opposed to the proposed system, it might be possible to modify the proposed system to appease them. The existing filing system could be left in place and permit

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traps that remain. *See, e.g.*, *In re* Lexington Hosp. Grp., LLC, No. 17-51568, 94 UCC Rep. Serv. (West) 42, 2017 WL 5035081, at *11 (Bankr. E.D. Ky. Nov. 1, 2017) (denying creditor relief because financing statement failed to list the necessary collateral and therefore holding the security interest unperfected). Even under existing law, there may be personal property interests that even an "all-asset" lien does not encompass—and that some argue it should not encompass. *See, e.g.*, Janger, *supra* note 151, at 595 ("[I]nvestors often speak of 'blanket liens' as if there is such a thing."). Janger notes that there are "gaps" in the "blanket" such that parts of a debtor's property are not covered by it. *Id.* at 596–97 & n.41 (citing examples).

for all-asset filings on the basis of the debtor's identity only to perfect as to all of the debtor's assets. Such perfection would be limited to original and after-acquired collateral and would not extend to proceeds. The all-assets filing would lose priority to valid geolocated or IoT-based claims; in other words, it would *not* defeat parties who had perfected through one of these other means, even after the "all-assets" filing was made. Essentially, it would only trump unsecured creditors and creditors who have attempted to levy on collateral of the debtor pursuant to a judicial lien.[153] This proposed modification would protect the current all-assets practice while allowing for the implementation of the proposed system, although it might have troubling distributive consequences, which are worth exploring but beyond the scope of this Article.[154]

In sum, the proposed system would not necessarily represent a major burden or disruption to current all-asset practice. That practice might ultimately diminish, however, if creditors find that the proposed system provides a sufficient increase in certainty that more limited security interests will allow them to meet their financing needs without resorting to the broad brush of "all assets." Thus, the proposed system might unlock new and more efficient lending practices, carving up collateral more precisely.

C. Political Resistance

Proposed amendments to law commonly run into difficulties because of opposition by entrenched interests. For instance, there have been credible proposals to use technology to consolidate and simplify existing real estate recording systems, but they have encountered resistance and made only sporadic progress.[155] Proposals concerning the UCC, such as proposals to nationalize the UCC filing system, have failed to take hold.[156] The uniform law process, by which Article 9 is amended, has been subject to

153. This would include the trustee in bankruptcy standing in the shoes of a lien creditor. 11 U.S.C. § 544(a)(1) (2012).

154. It might be seen to further disadvantage "involuntary" or "nonadjusting" creditors, who are already disfavored, without clear normative justification. *See, e.g.*, Lucian A. Bebchuk & Jesse M. Fried, *The Uneasy Case for the Priority of Secured Claims in Bankruptcy*, 105 YALE L.J. 857, 869–70 (1996); Elizabeth Warren, *Making Policy with Imperfect Information: The Article 9 Full Priority Debates*, 82 CORNELL L. REV. 1373, 1389 (1997); *see also* Alan Schwartz, *Security Interests and Bankruptcy Priorities: A Review of Current Theories*, 10 J. LEGAL STUD. 1, 31–33 (1981) (noting the flaws in "offensive" and "defensive" distributional explanations).

155. *See supra* notes 98–102 and accompanying text.

156. *See* Janzen, *supra* note 125, at 394, 402 (noting failures in the new filing system proposals in the United States); LoPucki, *supra* note 27, at 6, 15–16 (noting a number of failed proposals to reform the filing system).

extensive analysis and critique.[157] Would a similar fate await this Article's proposal?

State filing officers might have an interest in maintaining a status quo that generates fees and employment. But they might see their role, if anything, enhanced by a system that would require creditors to have frequent recourse to IoT and geolocation systems maintained by filing offices. Some officers might resist the transition, which would entail significant start-up investments in infrastructure and training. However, it is also possible that these costs could be rapidly recovered in filing fees. There would be a likely spike in such fees upon implementation of the proposed system.

By shifting filings away from debtors' states of incorporation and to the location of collateral, the proposal would divert business from filing offices of common states of incorporation like Delaware. These common states of incorporation may therefore be opposed to the proposal. On the other hand, the move to state of incorporation is itself a relatively recent phenomenon, and thus undoing it might not prove very jarring. In addition, business would be diverted to a larger number of states, and their interests may outweigh concentrated resistance of major incorporation states.

Other potential opponents might be firms that gather credit-related information and sell access to the public. Conceivably, such firms (which can be termed "information intermediaries"[158]) might resist change because they are reluctant to adjust to a new regime, or they fear that making information too easily available will "democratize away" the very need for their businesses. But the former concern would arise only if companies thought the transition costs or barriers to entry to the new system would disadvantage them versus their competition. In fact, specialty firms likely could transition quickly due to their expertise, and thus maintain their advantages. A similar dynamic would likely answer the second concern. When the information-dissemination possibilities of the internet were newly discovered, some companies in the information business had concerns that the value of their expertise would diminish. But the opposite has proven true: with such a vast quantity and wide range of data available, data-gathering and data-analysis have become more difficult and

157. *See supra* note 72 and accompanying text.

158. *See* Mann, *supra* note 25, at 2269 (noting the role of credit reporters as "information intermediaries"); Lipson, *supra* note 28, at 452; *see also* Lynn M. LoPucki, *The Unsecured Creditor's Bargain*, 80 VA. L. REV. 1887, 1941 (1994).

more necessary, which has made them even bigger business than before.[159] In addition, such companies' interests are aligned with the broader purpose of this Article's proposal, namely the facilitation of commerce through increased certainty and decreased costs. Their business grows along with growth of commercial and financial activities and benefits from changes that bring growth.

For these reasons, it is unclear whether the proposal would run into insurmountable political obstacles. As with other matters regarding the process of implementation of any major reforms to Article 9, this is a question that deserves further study.

D. Borderline-Tangible and Other Complicated Assets

The regime governing intangible assets would be left largely in place, under my proposal.[160] Other assets present problems, however: negotiable instruments, cash, and investment properties such as certificated securities, all of which are "tangible" but present unusual features. Some of these assets most resemble intangible assets, and they should probably be perfected by debtor name as under the present system. Securities, for instance, are typically held by repositories such as the Depository Trust Company and indexed under the name of the owner of the security. For these, the use of debtor's name as a means of perfection is unlikely to mislead.

By contrast, assets susceptible to geolocating—cash in a register, for instance—could be perfected as under the proposed new regime. Similarly, negotiable instruments may be sufficiently tangible to apply the proposed system, requiring a creditor either to stake a geolocated claim or to tag the individual instruments (which could be done without damaging them).

In sum, additional consideration and line-drawing will be required for these complicated asset classes, but they do not present any serious threat to the proposal.

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159. One firm incorporates 1.3 billion updates to skip-tracing records per month. *What Makes Experian's Skip Tracing Tools Better?*, EXPERIAN, http://www.experian.com/small-business/skip-tracing-tools-software.jsp [https://perma.cc/JT3J-C9BA] (last visited Apr. 16, 2019). Dun & Bradstreet offers its own data for business credit monitoring and the data of a dozen partners across a range of industries. *Data Exchange Partners*, DUN & BRADSTREET, https://developer.dnb.com/marketplace/dataexchange/partners [https://perma.cc/MG7T-V46A] (last visited Apr. 16, 2019).

160. *See supra* notes 133–36 and accompanying text.

E. Article 9's Overlap with Related Areas of Law

Others might object that the proposed regime would complicate the interface between Article 9 and other bodies of law, most notably real estate laws. This interface comes into play, for instance, when personal property is transformed into part of real property. Imagine a heater being installed into a house, or a sound system into a music venue. There are inevitable tensions and gray areas between real and personal property laws in such cases, as would be expected.

The proposal does not change the balance between the real estate and UCC systems. The proposal affects perfection (and lapse of perfection) in interests in personal property. Where the current system awards priority to interests in real property over those in personal property, or to those in personal property over real property, there is no need for change.

That said, the real estate system could perhaps be improved by similar disruptions—specifically the use of geolocation technologies for the recording of land lending and purchase documents. If such improvements were made to the real estate system, then it seems plausible that greater integration of the real estate and personal property systems would be possible, benefitting both bodies of law by decreasing uncertainties, requiring fewer steps to claim or to search out security interests in personal property, in real property, or in the contested, in-between categories.

F. Privacy

Another objection that the proposed system might provoke is that information concerning exact scopes of property holdings would be more readily available and might intrude on legitimate trade secrecy interests or simple privacy interests. IoT technologies have raised these concerns in numerous areas of law.[161]

As noted, however, what would be disclosed would be minimal. As under the current system, the goal would be for the filing to provide inquiry notice only—enough of a trail for reliable inquiry to be made. For an IoT-based claim, a registration number and the secured creditor name and contact information are all that would be publicly available. For a geolocated claim, all that is needed aside from the location would be the name and contact

161. *See, e.g.*, Peppet, *supra* note 79, at 130–33.

information for the secured party or its agent. In the rare case that even the location information would reveal some information that is personally or commercially sensitive, then a move to the tagging system should usually be possible.

Arguments could potentially be made for the current UCC filing system to include more encompassing information about transactions, whether based on public-good rationales or contract rationales. The Article 9 filing system could serve as a location for all relevant transaction information, as the real estate records at least theoretically are.[162] The system proposed here could accommodate such a change, but an analysis of whether such a change is worthwhile is beyond the scope of this Article.

Because all that would be required under the proposal is enough for searchers to be put on inquiry notice and given sufficient information to enquire as to the source of a potentially conflicting claim (and debtors would be given sufficient chance to challenge claims clouding the title of their collateral), the intrusion on privacy should be minimal.

G. Access and Participation by Small Businesses, Consumers, and Other Commercially Unsophisticated Parties

Another concern might be that use of new, more technologically sophisticated requirements for filing and monitoring collateral puts too much of an onus on parties with little commercial sophistication. The proposed regime might impose new barriers on parties' access to markets and access to justice—on their access to the legal protections of the secured transaction system.

It is not clear that access would be any more difficult under the proposed system. Perfecting and maintaining a security interest in the current system requires accuracy and diligence beyond the means of many small-time players and leaves uncertainty even for those who take reasonable precautions.[163] The proposed system strips away various complicated legal provisions that represent traps for the unwary.

There is no reason to think that cost would be prohibitive. While technologically sophisticated, the tools required to claim

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162. One rationale for requiring more transaction information to be disclosed, for instance, could be that the availability of the records of underlying transactions could allow subsequent creditors to gain, more easily than now, a more thoroughgoing view of a debtor's finances. There are of course many counterarguments, such as the administrative costs, the potential disclosure of trade secrets, and so on. The question of the optimal amount of disclosure for a filing system to require is not a simple one.

163. *See supra* Section II.A.2.

and maintain an interest in the new system are widely available off-the-rack. As technology develops, the costs of claiming an interest and monitoring collateral should drop even more. Finally, by adding certainty, the proposal should make financing cheaper and more available under standard economic assumptions, benefitting marginal borrowers whose access to credit might otherwise be limited.

Consumers are accorded special treatment in some parts of Article 9, and they might be entitled to continued special treatment under the proposed system.[164] Historically, consumers, the goods they buy, and the transactions they enter were thought to require exemptions because of consumers' presumed lack of sophistication in secured transactions law and because it is more desirable to foster easy commerce in consumer goods than to subject such commerce to the usual rules of secured transactions. A fuller explanation of the rationales for such treatment is elusive in part because the exceptions granted to consumers, consumer transactions, and consumer goods are spotty and inconsistent at best, and probably not coherent under any single rationale. A full treatment of potential new approaches to security interests in consumer goods would require more consideration than is possible here. If desired, the status quo could be maintained: it would be possible to except consumers, consumer goods, and consumer transactions from the proposed system by granting them priority despite an otherwise perfected interest, or by leaving other special provisions in place, such as the automatic perfection of certain security interests in consumer goods.[165] Such exceptions would be no more disruptive than they are now.

More to the point, under the proposed system, consumers would have less to worry about. The geolocation approach would likely be preferred for small-time, everyday consumer goods, and once those goods left the designated area upon purchase (and the grace period passed), the interest would lapse, and the consumer would have nothing to worry about. If the IoT approach has been taken with respect to a particular item, then there is potentially more concern, and the consumer might have to look to the protections for "buyers in the ordinary course," which should in most cases be sufficient.[166]

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164. *See* Marion W. Benfield, Jr., *Consumer Provisions in Revised Article 9*, 74 CHI.-KENT L. REV. 1255, 1258 (1999).

165. *See supra* notes 58–59 and accompanying text (mentioning special provisions for consumer goods).

166. *See supra* note 61 and accompanying text.

If consumers desire to hold an item free of any security interest, at most, they could be required to scan an item to make sure it was not tagged with a continuing security interest before their purchase. This could be done by an application on a smartphone; or it could be done by virtue of a tool provided by the seller at time of sale, as a demonstration that no IoT-perfected interest is being claimed. A scan for IoT tags could even be integrated into the checkout scanning process, and then integrated with existing credit card payment processing systems or new payment platforms such as Apple Pay. Thus, a consumer could make a one-time selection only to approve payments for items that have scanned as "free-and-clear" at time of purchase, and never think about it again. Alternatively, as a policy matter, it might not be thought feasible to require a consumer to make such an inquiry, and thus a policy decision could be made for consumers to automatically take free and clear. Such an exception could of course be included in the amended Article 9 text.

H. Universal Property Registers and Maps of Everything: A Prelude to Dystopia?

A final objection is the general sense of unease that the proposal might provoke. The world imagined in the proposal may seem futuristic—in some ways utopian and ideal, and in others dystopian and nightmarish. The proposal might seem inadequately to account for the societal implications of the technological changes it relies upon.

Technological change has always brought change to law. Technologies have a way of upending assumptions about what is feasible or reasonable, and disrupting bodies of law developed based on those assumptions. On-the-ground realities shift such that once-sensible legal rules rapidly become ineffective or counter-productive. Vast swathes of law, both public and private, may need to be remade. Examples from the rapid development of technology in recent decades are easy to come by. The rise of ad-hoc workers and independent contracting in the "gig economy" will remake employment law and other bodies of law.[167] The deployment of AI to make decisions and provide services will

167. *See, e.g.*, V.B. Dubal, *Winning the Battle, Losing the War?: Assessing the Impact of Misclassification Litigation on Workers in the Gig Economy*, 2017 WIS. L. REV. 739, 749–58 (explaining gig economy and assessing its relationship to existing law). Related is the rise of the "sharing economy," which also presents challenges across numerous bodies of regulation at every level of government. *See, e.g.*, Abbey Stemler, *Betwixt & Between: Regulating the Shared Economy*, 43 FORDHAM URB. L.J. 31, 63–69 (2016).

challenge notions of responsibility and agency.[168] Technologically-enabled and automated forms of exchange and corporate enterprise will require development of new commercial and corporate laws.[169] Data gathering and analytics will challenge notions of privacy and property in personal information.[170] Human body augmentations and prosthetics that may stretch notions of personhood and identity. The continued development of remote warfare capabilities, like remote-controlled drones and "smart" missiles, will continue to challenge the laws of war and humanitarianism.[171] There are even more exotic examples of bodies of law that will have to be developed—for instance, the law that will govern activities undertaken in "virtual worlds," that is, in online social spaces inhabited only by computer-generated "avatars."[172]

The IoT and geolocation technologies at the heart of the proposal in this Article are working broad but uncertain changes in both law and society. Making use of these technologies' capabilities, the proposal amounts to a plan for precisely identifying, mapping, tracking, monitoring potentially millions or billions of individual items throughout their entire useful life. It imagines interactive, publicly available maps, accurate to within a few feet at most, which parties can rely upon to structure their financial dealings and to adjudicate property disputes. It assumes the longstanding, continuous availability of a vast amount of computing power and storage capacity, as well as widespread, high-capacity communication networks. It is premised on users who will integrate all of these technological capabilities thoroughly into their everyday business activities.

No doubt, this interconnected and sensor-laden world still

168. *See, e.g.*, Matthew A. Bruckner, *The Promise and Perils of Algorithmic Lenders' Use of Big Data*, 93 CHI.-KENT L. REV. 3 (2017).

169. *See, e.g.*, Anthony J. Casey & Anthony Niblett, *The Death of Rules & Standards*, 92 IND. L.J. 1401, 1403 (2017) (analyzing some likely ramification of technologies for "gap-filling" contracts); Carla Reyes, *If Rockefeller Were a Coder*, 87 GEO. WASH. L. REV. 373 (2019) (discussing appropriate legal structures under business organizations law for "decentralized autonomous organizations" and similar new forms of technologically enabled ventures).

170. *See, e.g.*, Peppet, *supra* note 79; Harry Surden, *Structural Rights in Privacy*, 60 SMU L. REV. 1605, 1617–20 (2007) (discussing effects of emerging technologies on effective rights including right to privacy).

171. *See, e.g.*, Veronica Ma, *The Ethics and Implications of Modern Warfare: Robotic Systems and Human Optimization*, HARV. INT'L REV., Summer 2016, at 43 (providing overview of emerging legal and ethical issues of warfare technology).

172. *See, e.g.*, Joshua Fairfield, *Escape Into the Panopticon: Virtual Worlds and the Surveillance Society*, 118 YALE L.J. POCKET PART 131 (2009).

seems futuristic. As a result, it is no wonder that the proposed system seems a step toward a sort of electronic panopticon, a world of total technological tracking and control that could reach down the level of each individual object and space on the globe.[173] And, while it still seems futuristic, the proposal is not quixotic—this is not a situation in which law would far outstrip facts. To the contrary, the practice of commercial and even governmental actors already mirrors, in many ways, what is proposed here. The proposed system for perfecting security interests in personal property would integrate easily with other systems involving extensive geolocation and IoT that already pervade the business world and increasingly, link to technologically connected ("smart") homes.

Thus, the time is ripe for scholarship both to consider the ways in which this technology should affect law, as well as the broader concerns about policy and society that it may provoke. These two strands of work cannot be undertaken in isolation; they must inform one another.

This Article deals with a set of normative questions concerning how existing or anticipated technological developments can help to develop, supplant, or be integrated into existing bodies of law. Others have begun to explore similar questions in analogous areas of law. For instance, in fascinating recent work, Eric Posner and Glen Weyl have recently proposed a system to reallocate property rights based on a publicly available, continually updated registry of ownership of essentially all property. Essentially, the way the Posner-Weyl system would work is that owners would provide a self-assessed valuation of all of their property, pay regular taxes based upon that valuation, and be continually at risk of losing any asset they place too low a value on, because anyone could purchase their assets for the announced valuation (plus some small amount to cover transaction costs) at any time. Implementation of the Posner-Weyl universal property registry—which they term the *cadaster*—would require heavy

173. For canonical discussions of the notion of a panopticon, see JEREMY BENTHAM, THE PANOPTICON WRITINGS (Miran Bozovic ed., 1995); MICHEL FOUCAULT, DISCIPLINE & PUNISH: THE BIRTH OF THE PRISON 195–230 (Alan Sheridan trans., Vintage Books 2d ed. 1995) (1977); *see also* Jeffrey H. Reiman, *Driving to the Panopticon: A Philosophical Exploration of the Risks to Privacy Posed by the Highway Technology of the Future*, 11 SANTA CLARA COMPUTER & HIGH TECH. L.J. 27, 28 (1995) ("The Panopticon was Jeremy Bentham's plan for a prison in which large numbers of convicts could be kept under surveillance by very few guards. . . . The French philosopher Michel Foucault used Bentham's Panopticon as an ominous metaphor for the mechanisms of large-scale social control that characterize the modern world.").

reliance on IoT and geolocation technologies.[174] Obviously, the Posner-Weyl cadaster bears a strong resemblance to the proposed secured transactions system explored in this Article.

In terms of work on broader policy concerns, scholars have begun to explore the ramifications of technologies discussed here and proposed ways of addressing them.[175] It seems increasingly likely that human society is facing a major shift as a result of the advance of communications, processing, and network technologies. In the same way that the Domesday Book dramatically increased the legibility of real property in medieval England and exemplified a paradigm shift in record-keeping and in legal consciousness with respect to property rights,[176] the IoT seems likely to transform numerous of our society's fundamental notions (including that of property itself) in quite sweeping and profound ways.[177] There are

174. Eric Posner & E. Glen Weyl, *Property Is Another Name for Monopoly*, 19 J. LEGAL ANALYSIS 51, 54 (2017); RADICAL MARKETS, *supra* note 26, at 30–79.

175. Numerous law articles have considered the rise of IoT and related technologies as potential panopticons in various legal and societal realms. *See, e.g.*, Sean C. Helms, *Translating Privacy Values with Technology*, 7 B.U. J. SCI. & TECH. L. 288, 290 (2001) (exploring ways of preserving user anonymity online in light of pervasive surveillance technologies that are "moving us toward a 'Cyber-Panopticon'"); Jerry Kang & Dana Cuff, *Pervasive Computing: Embedding the Public Sphere*, 62 WASH. & LEE L. REV. 93, 94 (2005) ("[T]he Internet will soon invade real space as networked computing elements become embedded into physical objects and environments . . . . [T]he physical world will gain digital qualities, such as computer-addressability through unique identification codes . . . . If the line between cyberspace and real space has grown increasingly difficult to draw, it may soon become impossible."); Bert-Jaap Koops & Ronald Leenes, *"Code" and the Slow Erosion of Privacy*, 12 MICH. TELECOMM. & TECH. L. REV. 115, 116, 184 (2005) (concluding that in numerous areas of law, including "law enforcement, national security, E-government, and commerce," technology has generally eroded privacy); Marcy Peek, *The Observer and the Observed: Re-Imagining Privacy Dichotomies in Information Privacy Law*, 8 NW. J. TECH. & INTELL. PROP. 51 (2009) (exploring implications of technological and related social changes on areas of legal doctrine in the areas of privacy); Neil M. Richards, *The Dangers of Surveillance*, 126 HARV. L. REV. 1934, 1936, 1940 (2013) (explaining concerns that the rise of government and corporate surveillance "menaces our intellectual privacy and threatens the development of individual beliefs in ways that are inconsistent with the basic commitments of democratic societies," and citing "software, RFID chips, GPS trackers, cameras, and other cheap sensors" as "the technologies of surveillance"); Rebecca Rubin, Note, *Smart Dust: Just a Speck Goes a Long Way in the Erosion of Fundamental Privacy Rights*, 15 J. HIGH TECH. L. 329, 330–31 (2015) (describing the nanotechnology of "[s]mart dust, miniature sensors proposed to be smaller than what the naked eye can see," and noting its potential to erode privacy and surveillance norms); Kevin Werbach, *Sensors & Sensibilities*, 28 CARDOZO L. REV. 2321, 2322 (2007) ("The sensor revolution will challenge hidden assumptions in a bewildering array of doctrinal fields, including contracts, evidence, trade secrets, patents, criminal law, securities regulation, and many others. The initial legal impacts of pervasive sensors will be both diffuse and unsettling."); Timothy Zick, *Clouds, Cameras, and Computers: The First Amendment and Networked Public Places*, 59 FLA. L. REV. 1, 3 (2007) (assessing the First Amendment implications of the "networking of public places" including by IoT technologies).

176. *See generally* M.T. CLANCHY, FROM MEMORY TO WRITTEN RECORD: ENGLAND 1066-1307 (2d ed. 1993).

177. The beginning of this shift predates the IoT, because it goes back at least to the

elements of technological development, both from the perspective of law and of society more generally, that can be alternatively worrisome and promising. This work is valuable and necessary. But it would be unwise to leave aside the work of this Article, or that of Posner and Weyl, which probes ways in which the law can begin to be adapted to these emerging technologies, to accomplish policy goals.

Thus, the approach taken in this Article is a way of informing future work on broader policy implications, concerning the threats and possibilities opened by new technologies,[178] but it is also a necessary concession to reality, to the technological facts on the ground. An amended Article 9 may not take the form imagined in this Article, or even rely upon the technologies outlined here.[179] But there is no doubt that the current Article 9 filing system technology is outdated and will only become more so in coming years. Without being brought closer into accord with actual commercial practices, it will recede ever further toward irrelevance. If amendment does not occur, then that will represent

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innovation of the bar code, the importance and unlikely success of which remains remarkable. *See generally* STEPHEN A. BROWN, REVOLUTION AT THE CHECKOUT COUNTER: THE EXPLOSION OF THE BAR CODE (1997) (providing an institutional history of the bar code, written by an insider in the process); Margalit Fox, *Alan Haberman, Who Ushered in the Bar Code, Dies at 81*, N.Y. TIMES, June 15, 2011, at B19 (quoting Haberman as discussing the importance of the invention of the UPC (the universal product code, the central feature of bar codes) in the most grandiose terms imaginable: "'Go back to Genesis and read about the Creation' . . . 'God says, "I will call the night 'night'; I will call the heavens 'heaven.'" Naming was important. Then the Tower of Babel came along and messed everything up. In effect, the U.P.C. has put everything back into one language, a kind of Esperanto, that works for everyone.'"); Varchaver, *supra* note 90 (discussing the history of the bar code and the IoT as its successor).

178. *See, e.g.*, Werbach, *supra* note 175, at 2323 ("The best response to the coming sensor revolution, therefore, is not to panic. Anticipating and appreciating the impacts of pervasive sensors is the best way to shepherd the law through a challenging transition process.").

179. There have, for instance, been moves toward trying to use the blockchain or other distributed ledger technologies for simplifying and improving some aspects of the filing system. *See, e.g.*, Reyes, *supra* note 27, at 402–03, 417–21 (proposing use of distributed ledger technologies like blockchain for UCC-1 filings); Andrea Tinianow et al., *Delaware's 2017 Resolution: Making Blockchain a Reality*, COINDESK (Jan. 4, 2017), https://www.coindesk.com/what-expect-delaware-blockchain-initiative-2017/ [https://perma.cc/DR9P-WYGN] (article by then-director of Delaware Blockchain Initiative and others discussing Delaware's initiatives, including the initiatives to give UCC filers "the opportunity to use smart-contract versions of UCC documents on a distributed ledger"); Andrea Tinianow & Caitlin Long, *Delaware Blockchain Initiative: Transforming the Foundational Infrastructure of Corporate Finance*, HARV. L. SCH. F. ON CORP. GOVERNANCE & FIN. REG. (Mar. 16, 2017), https://corpgov.law.harvard.edu/2017/03/16/delaware-blockchain-initiative-transforming-the-foundational-infrastructure-of-corporate-finance/ [https://perma.cc/AE25-6Z8N] (explaining and predicting adoption of distributed ledger-based "'smart UCC' filings" to improve the filing system, "which is still surprisingly paper-based, slow and error-prone").

not a victory for our commercial law, but a defeat.

VI. CONCLUSION

> That doesn't mean that the Internet of Things will triumph, because, in some ways, it can't win. It's too broad and vague to win; it's a huge, looming infrastructural phenomenon, much like 'electrification' or 'automation' once were. People never voted to become electrical or automated.
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> –Bruce Sterling, Tech Author and Journalist, 2014[180]

> The global industrial sector is poised to undergo a fundamental structural change akin to the industrial revolution as we usher in the IoT.
>
> –Equity Research, Goldman Sachs, 2014[181]

> Perhaps, in law as in politics, what appears to be a revolution is merely the recognition *de jure* of what has long since taken place *de facto*.
>
> –Grant Gilmore, Principal Drafter of Article 9 of UCC, 1966[182]

There have been numerous sensible proposals for streamlining the secured transactions system in light of advances in technology.[183] This proposal goes much further than other proposals because under it, the underlying structure of the Article 9 filing system would change from debtor-based indexing to collateral-based identification. The proposal removes a detour through the debtor's name and location and allows collateral to "speak for itself," using newly feasible technological means.

The proposal has two main benefits. First, the proposal better accords with the notion of a security interest as a direct relationship between a creditor and an item of collateral, in addition to the theory of notice that underlies the concept of perfection. Numerous provisions of Article 9 could be simplified or eliminated thanks to the proposed shift.

As new realms of information technology become ever more pervasive, this type of rethinking of fundamental legal structures

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180. BRUCE STERLING, THE EPIC STRUGGLE OF THE INTERNET OF THINGS (2014).

181. SIMONA JANKOWSKI ET AL., GOLDMAN SACHS, THE INTERNET OF THINGS: MAKING SENSE OF THE NEXT MEGA-TREND 10 (2014), https://www.goldmansachs.com/insights/pages/internet-of-things/iot-report.pdf [https://perma.cc/DMZ7-6KMQ].

182. Gilmore, *supra* note 149, at 294.

183. *See supra* note 27 and accompanying text.

should be expected. Technological shifts challenge existing notions about property; about social rights, responsibilities, and duties; and about the role of law itself in a world increasingly governed not just by law but, as Larry Lessig has put it, by "code."[184] In many cases, technology will render existing laws unnecessary, as in the case of the Article 9 filing regime. In other cases, it will necessitate the formation of new legal frameworks and new bodies of law.

Second, the proposed shift helps Article 9 better reflect commercial reality, which is a historically grounded and still-important goal of the UCC. From manufacture through sale, businesses have changed and will continue to change their practices to reflect technological advancements, including those that permit simplified identification, tracking, and monitoring of property from place to place and owner to owner. Chief among the advancements that have already revolutionized business are the technologies underlying geolocation and the Internet of Things. The proposal would use technology that is already being widely adopted by businesses, and in doing so, would permit notice of security interests to be provided more confidently and cheaply. As the statute the emerged most closely and most triumphantly from the leaders of the "Legal Realist" movement, it is appropriate that the UCC remains a frontier where evolving business practices and technological capacity would lead to reassessment and legal change.

To lawyers, the disruption of UCC Article 9 proposed here might seem dramatic and unsettling. To clients, the changes might have the opposite effect. For them, the changes might be seen to

184. Lessig argued that computer code functions as a substitute for, or a parallel governance regime to, law. LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE 5 (1999). Joshua Fairfield has explored aspects of this idea in the realm of property and commercial law. Law has not taken proper account of the power of information technologies, in part because legal thinkers have failed to recognize that much of law is about the *facilitation of a flow of information*. For instance, Fairfield states that "[p]roperty is the law of lists and ledgers. County land records, stock certificate entries, mortgage registries, Uniform Commercial Code filings on personal property . . . are all merely entries in a list, determining who owns what." Joshua A.T. Fairfield, *BitProperty*, 88 S. CAL. L. REV. 805, 805, 807 (2015). He argues "[p]roperty has not benefitted from the scaling effect of drastically reduced information costs because property law has been traditionally understood as being concerned with tangible objects, rather than information." *Id.* at 811; *see also* JOSHUA A. T. FAIRFIELD, OWNED: PROPERTY, PRIVACY, AND THE NEW DIGITAL SERFDOM 135 (2017) ("Property is all about information. In fact, traditional property rights are nothing but information: information about *who* may do *what* with *which resource* over *which time period*."). His view aligns with this Article, which proposes to give legal force to new forms of object-based communication, and discard information (the debtor's identity) that has frustrated the flow of relevant information. In essence, this Article proposes to simplify the "code" of the UCC filing system.

cut away a layer of artificial paperwork and replace it with a simpler and more predictable system. The new law of security interests would be more reflective of commercial reality and more reliable in protecting the reasonable expectations of lenders, buyers, and debtors. This proposal's simplicity, its consistency with the underlying notions of secured transactions doctrine, its reliance on existing technologies, and its capacity to evolve alongside further developments in technology and in commercial practice, suggest that its time has arrived.