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A Virtual Analog Rule for Software Patent Eligibility

By Joseph S. Bird III

O ne of the main functions of law should be to provide relatively predictable rules that allow people to order their affairs with as much certainty as possible.[1] The development of patent law in the field of software, however, has not provided the relative predictability that minimizes unnecessary patent prosecution and litigation costs. The courts have not given much guidance on what constitutes an "abstract idea"[2] but have made "abstract idea" one of the key criteria for subject matter eligibility under 35 U.S.C. § 101, and this situation has produced real-world detriments. Innovators waste money and time either seeking patents they should not seek or defending themselves from patents that should be invalid. This article proposes a new rule for software patent eligibility that could help bring more clarity to the field.

Existing Law

The difficulties faced by the U.S. Patent and Trademark Office (USPTO) and the courts with patent eligibility of software under 35 U.S.C. § 101[3] have been legion. The Federal Circuit Court of Appeals recently said that "the state of the law of § 101 was deeply uncertain . . . in 2012,"[4] and not much has changed since then. It is the intangibility of software that makes its classification so difficult. Although "any new and useful process, machine, manufacture, or composition of matter" is the subject matter eligible for a patent, there are settled judicial exclusions; for instance, patent eligibility does not extend to laws of nature, natural phenomena, and abstract ideas (i.e., mental steps). The policy behind these exclusions from § 101 subject matter is the avoidance of preemption—that a patent should not preclude transmission of ideas or use of naturally occurring things.

Until 1998, software was patent eligible if it was "applied in any manner to physical elements or process steps."[5] Then, the Federal Circuit opened eligibility broadly to any method producing "useful, concrete and tangible result[s]."[6] Ten years later, after thousands of software patents had been issued under the

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looser standard, in 2008 the Federal Circuit's *In re Bilski* opinion limited patentability to software that was tied to a particular article or that transformed a particular article into a different state or thing.[7] This is known as the machine-or-transformation test.

In 2010, the Supreme Court in *Bilski v. Kappos* held the machine-or-transformation test was a useful "clue" in patent eligibility inquiries, but was not exclusive or exhaustive.[8] The Supreme Court held that all software need not meet the machine-or-transformation test to be patent eligible[9] but left the lower courts to sort out the details.[10] In dictum, the Court also suggested another pathway to eligibility if the software participated in the basic operation of a computer. The Court stated that if the machine-or-transformation test were the sole criterion for patent eligibility, this would create uncertainty for "linear programming, data compression, and the manipulation of digital signals."[11] This language implies that software for these and other basic computer functions could be patent eligible. The USPTO has cited to basic computer operations as one of the ways to satisfy eligibility requirements, a concept which this author is calling the "computer operation test," although neither the judiciary nor the USPTO has used this name formally. The USPTO's July 2015 update to its "2014 Interim Guidance on Patent Subject Matter Eligibility" (2014 Interim Guidance) reaffirmed the computer operation test.[12]

Five years after *Bilski v. Kappos*, the Supreme Court has had at least two opportunities[13] to provide additional guidance to the USPTO and the Federal Circuit. The first Supreme Court software case after *Bilski v. Kappos* was *Alice Corp. Pty. Ltd. v. CLS Bank International*. In *Alice*, the Supreme Court applied its § 101 analysis from a biotechnology case[14] to hold that, if software was based on an abstract idea, there must be an additional "inventive concept" having "additional features" beyond the concept. *Alice* also commented favorably on the computer operation test.[15] In another situation,[16] the Supreme Court recently granted certiorari but then remanded a case in which the Federal Circuit had held patent ineligible a method of providing copyrighted content over the Internet. The Supreme Court instructed the Federal Circuit to apply the rule in *Alice* on remand.

Beyond the machine-or-transformation and the computer operation tests, neither the USPTO nor the Federal Circuit has fashioned an additional test for software patent eligibility

that provides significant guidance and predictability. Amplifying the holding in *Alice*, the USPTO issued its 2014 Interim Guidance[17] on these analytical inquiries: (1) whether the patent claim is directed to a law of nature, natural phenomenon, or abstract idea; and if so, (2) whether the patent claim recites *additional elements* that amount to *significantly more* than the judicial exception. In addition to the machine-or-transformation and computer operation tests, the USPTO also listed the following as sufficient: "a specific limitation," "adding unconventional steps that confine the claim to a particular useful application," "[o]ther meaningful limitations," or "[i]mprovements to another technology or technical field."[18] The 2014 Interim Guidance says "additional elements" cannot be established by (1) adding the words "apply it," (2) applying a "well-understood, routine and conventional" activity to a computer, (3) adding "insignificant extrasolution activity," or (4) "[g]enerally linking the use of the judicial exception to a particular technolog[y]."[19] Although the new 2014 Interim Guidance is a good effort, it mirrors the existing law's ambiguity and imprecision (e.g., "other meaningful limitations").

Software has been seen as falling within the literal wording of "process" in § 101 because it is a series of processes based on formalized rules or on objects. Judges and patent examiners have had understandable difficulty determining how "process" in § 101 meshes with the patent law rule excluding laws of nature, natural phenomena, and abstract ideas. The courts have given some guidance on what *is* or *is not* patent eligible on either end of the spectrum, but they have not defined the border between the two adequately. The patent-eligible end of the spectrum is software tied to a particular machine (e.g., MRI), and the noneligible end is financial transaction processing software, which is labeled merely as an "abstract idea." The abstract idea exclusion, however, is a slippery slope, as the Supreme Court has said: "[W]e tread carefully in construing this exclusionary principle lest it swallow all of patent law. At some level, 'all inventions . . . embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas.'"[20] Justice Stevens's concurrence in *Bilski v. Kappos* even pointed out that the Supreme Court has "never provide[d] a satisfying account of what constitutes an unpatentable abstract idea."[21] The July 2015 update acknowledged that, even now, "the courts have declined to define abstract ideas."[22]

Even the most tangible machine is based on one or more abstract ideas about how to perform a task. If all inventions at some level are based on abstract ideas, then the answer to the first question in the *Alice* analysis could always be in the affirmative. In these areas of intangibility, the lines have been difficult to draw, and uncertainty abounds.[23] A suggestion for a definition of "abstract idea" is that the invention cannot be conceived as a physical process, machine, manufacture, or composition of matter. A physical process is one that cannot be performed strictly in the mind or between people.

The Virtual Analog Rule

The earliest computers were patented as mechanical devices that tabulated paper cards with slots punched out to represent information,[24] but then these devices gradually evolved into the computers of today with integrated circuits.[25] Anything that enables or runs a computer, or improves its performance as a machine, is in fact a virtual component of a machine. The meaning of the computer operation test, then, is that a nonphysical "part" or "component" should satisfy § 101 as a virtual analog of a physical reality.[26] This logic should be extended beyond the computer to other virtual analogs of physical things.

A virtual analog rule therefore is proposed under which software would be patent eligible to the extent it performs a machine's task or serves a purpose analogous to that of a physical machine, manufacture, or composition of matter. If one can cite to—or reasonably imagine—a physical process, machine, manufacture, or composition of matter that would perform a similar function, then the software standing in its place would also be patent eligible. There need never have been an actual physical machine that performed the tasks performed by the software, as long as a physical machine can be visualized and articulated. Or, software may be eligible if it transforms purely digital information in a way analogous to a physical process or simulates a physical manufacture or composition of matter. The virtual analog rule would extend eligibility to software inventions that substitute for a physical process, machine, manufacture, or composition of matter, whether or not the invention satisfies the machine-or-transformation or computer operation tests. Requiring a corresponding physical reality (actual or imagined) is a shorthand way of saying there is a limitation to the scope of the claimed invention. Patent examiners and courts applying the new rule must be rigorous in their demands that patent owners provide proof of an actual or possible analogous physical reality.

The proposed rule fits within the language of § 101 because it specifies the four statutory categories—albeit in a virtual way. Support for the new rule is found by looking to the meaning of the term "machine," which, since the 1950s, has carried the meaning of "virtual machine." The *Oxford English Dictionary*[27] cites usages beginning in the 1950s in which authors say computer programs are virtual machines, including: "Our system runs in a virtual machine, which is implemented by an interpreter. We can therefore easily add new instructions to our virtual hardware, merely by extending the interpreter."[28] In 1957, *Webster's Dictionary* defined a machine as "a contrivance, device, or structure by means of which a force or forces may be advantageously applied," and defined virtual as "having the power of acting or of invisible efficacy without the material or sensible part."[29] A machine as defined in the 1950s—near the time of the 1952 Patent Act— would then have included software.

Under this proposal, there would be at least three rules for software patent eligibility. The virtual analog rule would coexist with the machine-or-transformation and computer operation tests, and satisfying any of the three would produce an affirmative answer to the second inquiry in *Alice* and the 2014 Interim Guidance (step 2A). A practical advantage of the rule would be that applying it makes it easier to visualize what the software invention is doing. Having a better model helps keep track of the intangible.[30] Application of the rule could increase predictability in patent examination and in infringement litigation, and therefore reduce costs in both.

One way to conceive of how these three rules relate to one another is to think of concentric circles in which the computer's core software processes represent the center (see fig. 1). The middle circle represents applications that run on the computer as the virtual analog of a physical process, machine, manufacture, or composition of matter. In the outer circle are applications that are limited to use with a particular physical machine (outside the computer itself) or a transformation. The inner circles are for virtual things only, although they are analogous to physical things, but the outer circle requires the participation of a physical element.
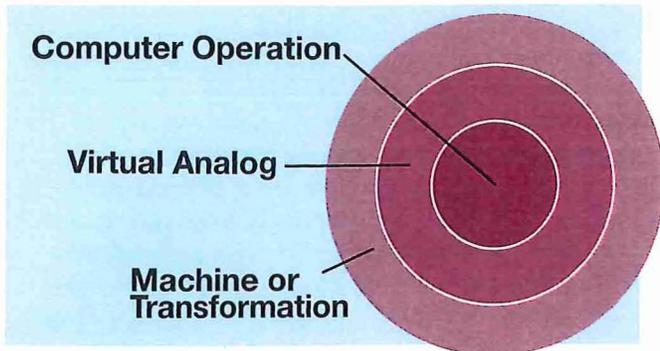

Figure 1

Comparison of Existing Law to the New Rule

Results under existing law and the proposed rule overlap partially because existing law has been applied in a fairly haphazard way. The virtual analog rule provides additional clarity as to which inventions are patent eligible, and therefore adds to predictability. The new rule would solve some problems in § 101 analysis, as shown below regarding inventions from patents or published applications. Examples of inconsistent results on patent eligibility in e-commerce and image processing software under existing law are discussed below, suggesting a need for new rules. Careful application of the three eligibility rules in the future would result in selection of one of the rules as a basis for patent eligibility, because the three rules define different conceptual areas.

Ineligible under Existing Law and the Virtual Analog Rule

Financial Hedging
The invention in *Bilski* was a method of balancing risk in energy transactions that was implemented through software.[31] At bottom, the invention was a series of human judgments (abstract ideas) about how to balance financial risk. This method is clearly not analogous to a physical process, method, manufacture, or composition of matter, so it is patent eligible under neither existing law nor the virtual analog rule.

Financial Intermediary
The invention in *Alice* was software for decreasing settlement risk that only one party to a financial transaction would satisfy its obligation.[32] A third-party intermediary was specified for creating "shadow" credit and debit records that replicated the balances in the parties' real-world accounts at financial institutions. The intermediary updated the shadow records in real time as transactions were entered, allowing only those transactions for which the parties' updated shadow records showed sufficient resources to satisfy their mutual obligations. The intermediary instructed the financial institutions to carry out the permitted transactions in conformity to the updated shadow records, reducing the risk that only one party would perform the agreed-upon exchange. The software did what a human escrow agent in fact does to close a financial transaction—he or she checks to confirm both parties have satisfied their obligations before allowing consideration to flow from one side to the other. Replicating in software the work of a human escrow agent—even working very quickly—would satisfy neither existing law nor the virtual analog rule.

Disposition of Property
Consider a system and method "for the controlled disposition of selected capital assets" that were contemplated to be mostly surplus or obsolete computers.[33] The software had an interactive multimedia system combining images of the equipment with data, audio records, and disposition instructions, and contained processes for tracking or accomplishing transportation, receipt, sorting, disposition, and certification or verification. Some of the steps claimed were performed in the virtual world of the software, but other steps were performed in the physical world, such as transportation and sorting of equipment. This invention was recently held to be patent ineligible by the Patent Trial and Appeal Board (PTAB) as a covered business method;[34] neither would it satisfy the virtual analog rule because it includes several mental steps.

Ineligible under Existing Law but Eligible under the Virtual Analog Rule

Image Processing
Well-developed case law has held image processing software ineligible. A patent[35] for software claiming a "device profile for describing properties of a device in a digital image reproduction system to capture, transform or render an image" was held recently to be patent ineligible.[36] The Federal Circuit labeled the device profile merely "[d]ata in its ethereal, non-physical form [which] is simply information that does not fall under any of the categories of eligible subject matter under section 101."[37] The court even resorted to resting its opinion on the reasoning in *In re Nuijten*[38] which, if applied consistently to all software patents, would render them all invalid. The image processing software here would be patent eligible under the virtual analog rule by analogy to a non-digital camera and to the physical techniques for developing nondigital photographs. At least two other image processing software inventions were held ineligible by the Board of Patent Appeals and Interferences (BPAI, now the PTAB). One allowed dimensions on a digital image to be marked, measured, and calculated,[39] and the other allowed rasterizing images.[40] Yet another image processing case,[41] however, is inconsistent with these results, and is discussed below.

Random Number Generation
Consider a software method for generating pseudo-random bits which were sufficiently random that they could be considered

random for many applications.[42] This software performs a task similar to that performed by mechanical devices such as dice, flipped coins, spinning wheels, Zener diodes, and ping pong ball blowers. Although the BPAI held the software patent ineligible, it would have been patent eligible under the virtual analog rule.

Eligible under Existing Law but Ineligible under the Virtual Analog Rule

In *DDR Holdings, LLC v. Hotels.com, L.P.*, there was a surprising outcome of patent eligibility[43] for an Internet-based e-commerce system generating a composite web page combining visual elements of a host website with content of a third-party merchant. The generated composite web page could combine the logo, background color, and fonts of the host website with product information from the merchant.[44] The Federal Circuit said these claims do not merely recite a pre-Internet business practice with the requirement to perform it on the Internet. Instead, the solution was "necessarily rooted in computer technology in order to overcome a problem specifically arising in the realm of computer networks."[45] It is difficult to reconcile e-commerce cases such as *DDR Holdings* with *Ultramercial* and *CyberSource Corp. v. Retail Decisions, Inc.*,[46] the latter case also solving an "Internet problem" of using Internet addresses to perpetrate fraud. The "Internet problem" of retaining website visitors and preventing diversion from a host website to an advertiser's website is nothing more than the abstract business idea of attracting and retaining customers. The patent in *DDR Holdings* would not be patent eligible under the virtual analog rule.

Eligible under Existing Law and the Virtual Analog Rule

Image Processing

In *Research Corp. Technologies, Inc. v. Microsoft Corp.*, patent eligibility was allowed[47] for software for halftoning gray scale images allowing a computer to present many shades and color tones with a limited number of pixels.[48] The software "used a blue noise mask, which was stored in a computer's memory, to carry out a pixel-by-pixel comparison of the mask to the digital image. [It] compares the gray level of each pixel in a digital image to the corresponding threshold number in the blue noise mask to produce a halftone image."[49] This opinion even highlights the algorithms used in the software, and the use of algorithms (which are abstract ideas) without satisfying the machine-or-transformation test has been held to be patent ineligible many times. This case is also difficult to reconcile with other image processing cases such as *Digitech* discussed above, and the disparity among the cases in this field suggests the need for more predictability. The patent in this case would have been eligible under the virtual analog rule, as being involved in physical processes of photography and other graphic arts and printing.

GPS

A method for calculating an absolute position of a GPS receiver and an absolute time of reception of satellite signals[50] was held to be patent eligible by the Federal Circuit.[51]

Although the calculation of position and time relative to global positioning satellites is a mathematical concept, and therefore an abstract idea, the mathematical operations were limited to use with a GPS receiver, which satisfied the machine-or-transformation test. The eligibility in *SiRF* was explained because "the calculations [could not] be performed entirely in the human mind."[52] This basis of this decision under the machine-or-transformation test is debatable, as "GPS receiver" was not defined, and it is not clear that a GPS receiver is anything more than a computer running specific software. The software invention would have been patent eligible under the virtual analog rule because other devices such as radar provide an analogous function of position location.

Conclusion

The virtual analog rule fits within the framework of existing law to provide more clarity for software applications whose patent eligibility has been uncertain. The relative simplicity of the rule is one of its advantages.[53] If the rule were adopted, there would be at least three pathways to software patent eligibility: the machine-or-transformation test, the computer operation test, and the virtual analog rule. If one of these conditions is met, the USPTO (and the courts) would then proceed to assess enablement under § 112 in the context of claim scope. Given the recurring problems in dealing with intangibility, the USPTO and the courts should also continue to focus on developing special rules for software patents beyond § 101 eligibility.[54] ∎

Endnotes

1. Friedrich A. Hayek, The Constitution of Liberty 208–09 (1960).

2. Mark A. Lemley et al., *Life after* Bilski, 63 Stan. L. Rev. 1315, 1316 (2011).

3. Section 101 provides: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."

4. Content Extraction & Transmission LLC v. Wells Fargo Bank, N.A., 776 F.3d 1343, 1350 (Fed. Cir. 2014).

5. *In re* Abele, 684 F.2d 902, 906–07 (C.C.P.A. 1982); *see also In re* Walter, 618 F.2d 758 (C.C.P.A. 1980); *In re* Freeman, 573 F.2d 1237 (C.C.P.A. 1978).

6. State St. Bank & Trust Co. v. Signature Fin. Grp., Inc., 149 F.3d 1368, 1373 (Fed. Cir. 1998).

7. 545 F.3d 943, 954 (Fed. Cir. 2008).

8. 561 U.S. 593, 604 (2010).

9. The Supreme Court stated, "It may not make sense to require courts to confine themselves to asking the questions posed by the machine-or-transformation test. Section 101's terms suggest that new technologies may call for new inquiries." *Id.* at 606.

10. The Supreme Court remanded to the Federal Circuit for the express purpose of determining patent eligibility in that case—and for the implied purpose of fashioning more flexible rules for providing guidance to the public, but the Court did not "take a position on where that balance ought to be struck." *Id.*

11. *Id.* at 605.

12. USPTO, July 2015 Update Appendix 2: Index of Eligibility Examples, 3 ex. 23 (2015), http://www.uspto.gov/sites/default/files/

documents/ieg-july-2015-app2.pdf [hereinafter July 2015 Update].

13. WildTangent, Inc. v. Ultramercial, LLC, 134 S. Ct. 2870 (2014), *on remand*, Ultramercial, Inc. v. Hulu, LLC, 772 F.2d 709 (Fed. Cir. 2014); Alice Corp. Pty. Ltd. v. CLS Bank Int'l, 134 S. Ct. 2347 (2014).

14. *Alice* cited the rule previously adopted in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, 132 S. Ct. 1289 (2012), in the field of biotechnology.

15. The *Alice* Court stated the following about the software it had ruled ineligible: "The method claims do not, for example, purport to improve the functioning of the computer itself." 134 S. Ct. at 2359. This dictum from *Alice* is an important suggestion that improving computer technology with software *is* patent eligible, and the USPTO has adopted this view.

16. *Ultramercial*, 134 S. Ct. 2870.

17. 2014 Interim Guidance on Patent Subject Matter Eligibility, 79 Fed. Reg. 74,618, 74,621 (Dec. 16, 2014) [hereinafter 2014 Interim Guidance].

18. *Id.* at 74,624, § I.B.1. "Specific limitation" is suggestive of a "scope based" inquiry as to "whether the claim is so abstract and sweeping as to preclude all uses of the inventive idea, or whether it is sufficiently applied." Lemley et al., *supra* note 2, at 1345. The 2014 Interim Guidance adds the requirement of "unconventional steps" in § 101, which confuses eligibility with novelty and nonobviousness. Citation to a physical analog to establish eligibility should not be used as evidence per se of obviousness under § 103. It is one thing to say an invention is eligible to be considered for a patent because it represents a virtual machine with a physical analog, but quite another to say the existence of an analog means the invention must therefore be obvious. The 2014 Interim Guidance's provision for "[i]mprovements to another technology or technical field" cites to *Diamond v. Diehr*, 450 U.S. 175, 177–78 (1981), which seems to have approved eligibility because the invention would have fit within the machine-or-transformation test, had the test been articulated at the time.

19. 2014 Interim Guidance, *supra* note 18, at 74,624, § I.B.1.

20. *Alice*, 134 S. Ct. at 2354 (citing Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1293–94 (2012)).

21. 561 U.S. 593, 621 (2010) (Stevens, J., concurring).

22. July 2015 Update, *supra* note 13, at 3.

23. Richard M. Lee, *Beta-Testing the "Particular Machine": The Machine-or-Transformation Test in Peril and Its Impact on Cloud Computing*, 11 Duke L. & Tech. Rev. 175, 181 (2012).

24. U.S. Patent No. 395,782 (filed Sept. 23, 1884) (issued Jan. 8, 1889).

25. Gregory A. Stobbs, Software Patents § 1.03 (2000) (citing Charles J. Bashe et al., IBM's Early Computers (1986)).

26. The Federal Circuit's suggestion that transforming data into a graphic display can create patent eligibility is not particularly helpful here, because most software could do so. *See In re* Bilski, 545 F.3d 943, 962–63 (Fed. Cir. 2008).

27. A Supplement to the Oxford English Dictionary: Vol. 4, Se-Z 1174 (L.S. Burnett et al. eds., Oxford Univ. Press, 1986).

28. *Id.* (quoting J.E. Stoy & C. Strachey, *OS6—An Experimental Operating System for a Small Computer. Part 2: Input/Output and Filing System*, 14 Computer J. 195, 199 (1972)).

29. Webster's New Twentieth Century Dictionary of the English Language, Unabridged 1017, 1920 (H. Whitehall ed., 1957).

30. *See* Joseph S. Bird, *Cognitive Neuroscience as a Model for Neural Software Patent Examination*, 31 AIPLA Q.J. 273, 275–77

(2003); Allen Newell, *The Models Are Broken, the Models Are Broken*, 47 U. Pitt. L. Rev. 1023 (1986).

31. U.S. Patent Application Serial Number 08/833,892.

32. U.S. Patent No. 5,970,479 (filed May 28, 1993); U.S. Patent No. 7,725,375 (filed June 27, 2005).

33. U.S. Patent No. 5,424,944 (filed Feb. 2, 1994).

34. Dell Inc. v. Disposition Servs. LLC, No. CBM2013-00040, Paper No. 15 (P.T.A.B. Jan. 9, 2015).

35. U.S. Patent No. 6,128,415 (filed Sept. 6, 1996).

36. Digitech Image Techs., LLC v. Elecs. for Imaging, Inc., 758 F.3d 1344 (Fed. Cir. 2014).

37. *Id.* at 1350.

38. 500 F.3d 1346 (Fed. Cir. 2007). All software is essentially just electrical pulses or "signals" providing instructions to a computer. *Digitech* is an example of the tendency to apply the *Nuijten* reasoning in seemingly random fashion and produces inconsistency.

39. *Ex parte* Van Liere, No. 2008-5718 (B.P.A.I. Dec. 23, 2008). In addition to the image processing analogy, another basis for eligibility is that physical instruments for measuring anatomy such as calipers, measuring tapes, stadiometers, and anthropometers have been used for a long time.

40. *Ex parte* Morris, No. 2008-5581 (B.P.A.I. Feb. 13, 2009).

41. DDR Holdings, LLC v. Hotels.com, L.P., 773 F.3d 1245 (Fed. Cir. 2014).

42. *Ex parte* Gennaro, No. 2008-2944 (B.P.A.I. May 7, 2009).

43. 773 F.3d 1245.

44. U.S. Patent No. 6,993,572 (filed June 11, 2003); U.S. Patent No. 7,818,399 (filed Jan. 30, 2006).

45. 773 F.3d at 1257.

46. 654 F.3d 1366 (Fed. Cir. 2011). Consider this method "for verifying the validity of a credit card transaction over the Internet," including gathering information about other transactions using an Internet address associated with fraudulent transactions and then blocking any card used from that address. The Federal Circuit held this software to be patent ineligible because all of its steps "can be performed in the human mind, or by a human using a pen and paper." *Id.* at 1372. Although the opinion suggested that storage of fraudulent addresses could be as simple as "a list of a few credit card transactions," real-world conditions suggest thousands or hundreds of thousands of Internet addresses consisting of multiple numbers and characters would need to be scanned quickly during the pendency of the transaction. *See id.* at 1372–73.

47. 627 F.3d 859 (Fed. Cir. 2010).

48. U.S. Patent No. 5,111,310 (filed Dec. 4, 1990).

49. 627 F.3d at 864.

50. U.S. Patent No. 6,417,801 (filed Nov. 17, 2000).

51. SiRF Tech., Inc. v. Int'l Trade Comm'n, 601 F.3d 1319, 1332–33 (Fed. Cir. 2010).

52. *Id.* at 1333.

53. The scope-based test recommended in Lemley et al., *supra* note 2, could be helpful in areas such as biotechnology that fall outside the scope of the machine-or-transformation, computer operation, and virtual analog rules.

54. Julie E. Cohen & Mark A. Lemley, *Patent Scope and Innovation in the Software Industry*, 89 Cal. L. Rev. 1 (2001), proposes special rules for software patents, including that of narrowing the doctrine of equivalents. Given the lingering problems in dealing with intangibility, the USPTO and the courts should focus on these kinds of special rules for software.