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If a Machine Could Talk, We Would Not Understand It: Canadian Innovation and the Copyright Act's TPM Interoperability Framework

Anthony D. Rosborough

If a Machine Could Talk, We Would Not Understand It: Canadian Innovation and the *Copyright Act*'s TPM Interoperability Framework

Anthony D. Rosborough[*]

Abstract

This analysis examines the legal implications of technological protection measures ("TPMs") under Canada's Copyright Act. *Through embedded computing systems and proprietary interfaces, TPMs are being used by original equipment manufacturers ("OEMs") of agricultural equipment to preclude reverse engineering and follow-on innovation. This has anti-competitive effects on Canada's "shortline" agricultural equipment industry, which produces add-on or peripheral equipment used with OEM machinery. This requires interoperability between the interfaces, data formats, and physical connectors, which are often the subject of TPM control. Exceptions under the* Act *have provided little assistance to the shortline industry.*

The research question posed by this analysis is: how does the Canadian Copyright Act*'s protection for TPMs and its interoperability exception impact follow-on innovation in secondary markets?*

Canada's protection for TPMs and its interoperability exception is inadequate for protecting follow-on innovation in relation to computerized machinery and embedded systems. This is due to the Act*'s broad protection for TPMs, yet limited conceptualization of interoperability as a process that exists only between two "computer programs". In legally protecting TPMs which safeguard uncopyrightable processes, data formats and interfaces, the* Act*'s interoperability exception fails to address the need to access subjects of TPM protection that extend beyond computer programs. This results in an asymmetry of protection and renders the interoperability exception inadequate.*

This article proposes enacting regulations under the Act *to provide new exceptions and limitations to TPM protections which would enable shortline innovation. Both the Copyright Act and the Canada-United States-Mexico Agreement envision such additional TPM exceptions where the effect of protection has adverse effects on competition in a secondary market. In exploring a path forward for Canada's shortline industry, the article then examines approaches taken in the United States and France to illustrate potential avenues for TPM regulation in Canada.*

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[*] PhD Researcher, European University Institute, anthony.rosborough@eui.eu.

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1. INTRODUCTION

When linguistic philosopher Ludwig Wittgenstein proclaimed that "if a lion could talk, we would not understand him," he referenced the distinction between translation and understanding in the context of language.[1] For Wittgenstein, even if it were possible to translate 'Lionese' to English, the lion's lived experiences are too different from those of humans to allow for conveyance of meaning and one-to-one understanding. The same disparity in lived experiences among humans is avoided by unconsciously playing something Wittgenstein called "language games." These are an unconscious system of communication where the communicator and recipient each refer to a set of rules which intermediate and contextualize language. It is only through the 'rules' in these 'games,' Wittgenstein reasoned, that the words or sentences we use have any meaning. Language is therefore not a static system, but rather an *activity*.

This article addresses the language game played by computerized equipment: *interoperability*. It arises in the context of computerized systems exchanging and making use of information, typically across distinct platforms. Like Wittgensteinian language games, the capacity to achieve interoperability often requires the establishment of common rules and standards, such as interfaces, physical connectors, data formats, and software code. When computerized equipment talks, interoperability (often through standards) allows it to be understood.

This article examines interoperability as the subject of legal and market forces. The right and ability to achieve interoperability is increasingly determined through intellectual property protections over software, technological design, and market strategies by firms. Academic discussions about the nature of interoperability have been dispersed across myriad domains, from healthcare[2] to cultural heritage preservation.[3] This article places interoperability within the context of computer programs under Canada's *Copyright Act* ("*Act*").[4] The *Act* conceptualizes interoperability as an exception to the circumvention of "digital

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1 Ludwig Wittgenstein, *Philosophical Investigations* (Oxford: Blackwell Publishing, 2001) at 4.

2 Anastasios Tagarsis et al, "Exploiting Ontology Based Search and HER Interoperability to Facilitate Clinical Trial Design" in Dionysios-Dimitrios Koutsouris & Athina A Lazakidou, eds, *Concepts and Trends in Healthcare Information Systems* (Springer, 2014) at 21.

3 Jonathan Le Lous et al, "Elements of a Technical Interoperability Framework for Canadian Heritage" (8 February 2016), online: *Government of Canada GCwiki.* <wiki.gccollab.ca/Elements_of_a_Technical_Interoperability_Framework_for_Canadian_Heritage> [perma.cc/BQ5N-JLVU].

4 *Copyright Act,* R.S.C. 1985, c. C-42 ["*Copyright Act*"].

locks" protecting computer programs, known formally as technological protection measures.[5] The primary concern of this analysis is the efficacy of this exception in relation to industrial machinery. This article reveals that the embedded system design of modern industrial equipment creates a need for an interoperability concept that goes beyond computer programs. The research question posed by this analysis is: how does the *Act*'s protection for TPMs and its interoperability exception impact follow-on innovation in secondary markets?

The chosen case study for this analysis is Canada's shortline agricultural equipment sector and its contemporary interoperability challenges. This sector is best understood as the manufacture of "add-on" equipment for industrial and agricultural machinery, including tractors and combines. Widespread computerization, embedded system design[6] and network connectivity of these machines has now made reverse engineering and interoperability essential to this industry. The shortline's contemporary interoperability challenges stem largely from the dominance of original equipment manufacturer's ("OEM") proprietary interfaces and data formats which are protected by TPMs. These features lock out shortline innovators from participation in the secondary market by making it difficult (and in some cases impossible) to achieve interoperability through reverse engineering. Further, existing exceptions in the *Act* fail to assist the shortline industry. As will be elaborated upon in this analysis, these design techniques and the legal protections which support them have raised the call for regulatory intervention to safeguard innovation and competition in a broader context.

Part 2 of this article begins by highlighting the relationship between interoperability and innovation. This part demonstrates that in certain cases intellectual property rights can be weaponized against follow-on innovation. In other instances, it can be used to foster innovation through standard setting and interoperability. The law should encourage the latter. Part 3 examines Canada's shortline agricultural equipment sector as an example of follow-on innovation with strong social and economic benefits. The shortline industry also serves as an example of contemporary interoperability challenges stemming from embedded system design. Part 4 then looks to the *Act*'s impact on innovation, with a particular focus on its protection for technological protection measures ("TPMs"). This part reveals how strong protections came to exist in Canadian law and their anti-competitive effects on the shortline industry. Part 5 addresses the inadequacies latent in the *Act*'s exception allowing TPM circumvention for the purposes of interoperability. It demonstrates that this framework's limited conceptualization of interoperability as a process that exists between two computer programs greatly limits its scope of application to a narrow class of technologies. Finally, part VI canvasses some potential solutions to ameliorate

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5 *Ibid.,* s. 40.12.

6 "The Perfect Processor for Embedded Systems" (2013), online (pdf): *Intel Intelligent Systems* <intel.com/content/dam/www/public/us/en/documents/white-papers/perfect-processor-for-embedded-systems-paper.pdf> [perma.cc/JC83-KVMK].

the anti-competitive effects of TPM protections which are used to preclude competition by the shortline industry. This part highlights an exception in the *Act* which would allow the creation of new exceptions and limitations to TPM protections that could assist the shortline industry and other secondary market participants. Regulatory and administrative approaches taken in the United States and France are canvassed to demonstrate potential ways forward for Canada's regulation of TPMs. Finally, this analysis concludes with a call for Canada's *Act* to foster innovation through a dynamic interoperability framework which allows Canadian firms to flourish in secondary markets.

2. THE RELATIONSHIP BETWEEN INTEROPERABILITY AND INNOVATION

In modern life, interoperable standards have become such an innate feature of technology that their ubiquity may obscure their vital role in enabling efficient use of disparate software platforms and hardware. We often take for granted the longstanding efforts of technologists and innovators to find solutions to make software and hardware interoperable for ease of daily use. The ability for various systems, products, and formats to work seamlessly has been the source of immense innovation, both in finding ways to achieve interoperability and building upon its capabilities. This section briefly addresses the latter with respect to the relationship between interoperability, innovation, and the role of intellectual property protections.

(a) Interoperability as a Platform

The creation of the Universal Serial Bus ("USB") is exemplary of using interoperability and standards as an innovation platform among diverse interests and market competitors. Though it is likely we have all experienced the frustration of plugging in a USB cable the wrong way on our first (or even second) attempt,[7] we have benefited immensely from the interoperability that USB has offered us.

It may be difficult to remember the world before USB and its successor type interfaces. During these early days of desktop PC computing, users had to sort through an array of cables (each with their own proprietary connectors) to make peripheral devices like printers work. This involved finding and manually installing firmware (i.e., "drivers") and often required entire system restarts before devices would function. And even if they did work, the diverging data formats and standards between devices meant that multiple peripherals attached to the same system often failed to work together. USB was created with a view to achieving a simple and universal solution, where a user can simply plug in a device using a standard connector, and it would work.[8]

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[7] Chris Hoffman, "The USB Paradox: Why do USB Connections Need Three Tries?" (15 February 2021), online: *How-To Geek* <howtogeek.com/713525/the-usb-paradox-why-do-usb-connections-need-three-tries/> [perma.cc/76M4-7Z7L].

What makes the creation of USB remarkable beyond the innate engineering and logistical challenges is the disparate market interests that came together to establish it. In 1994, seven large technology companies came together to create USB: Intel, IBM, Microsoft, NEC, Nortel, DEC and Compaq.[9] Despite their overlapping products, services, and market positions, the conglomerate of firms adopted a joint approach. They found the creation of an interoperable industry standard to be the best way to move forward.

The contributors to the USB development project largely succeeded. USB has since transcended desktop computing and has moved into the realm of smartphones and mobile computing, albeit with significant improvements in transfer speeds and connector interfaces.[10] The widespread adoption of USB as a host platform has led to an explosion of new peripheral devices, the redesign of existing technology, follow-on innovation, and technological development. The USB port is now found everywhere, including the backs of airplane seats,[11] car dashboards, suitcases,[12] desk lamps, heated dog vests,[13] and wall outlets. Much of today's technology is reliant on the USB interface in some shape or form, and the forces that led to this standard were rooted in collaboration, compromise, and finding common objectives.

The case of USB's development may suggest that the establishment of common interoperable standards necessarily requires competing firms to abandon their proprietary and exclusionary interests. It may also suggest that exclusive rights granted to innovators creates a disincentive for this type of collaboration. Yet the development of USB, with all its efforts to bring stakeholders together, still adhered (formally) to the traditional model of intellectual property exclusivity. The interface was patented and licensed. Its creator is in fact an individual: Joseph Decruir, a fellow with the institute of Electrical and Electronics Engineers ("IEEE"), and he remains listed as the creator on the original USB interface patent.[14]

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8 Joel Johnson, "The Unlikely Origins of USB, the Port that Changed Everything" (29 May 2019), online: *Fast Company* <fastcompany.com/3060705/an-oral-history-of-the-usb> [perma.cc/KJ96-BZ66].

9 Technology Dictionary, "What does Universal Serial Bus (USB) Mean?" (last visited 19 March 2021), online: *Techopedia* <techopedia.com/definition/2320/universal-serial-bus-usb> [perma.cc/Y95M-6VBN].

10 Andrew Rogers, "Introduction to USB Type-C" (2015), online: *Microchip Technology* <ww1.microchip.com/downloads/en/AppNotes/00001953A.pdf>.

11 Bernie Baldwin, "The Future of Onboard Power Outlet Systems" (15 December 2019), online: *Aviation Business News* <aviationbusinessnews.com/cabin/onboard-power-outlet-systems/>.

12 Jacob Osborn, "8 Best USB Charging Luggage and Suitcases" (5 March 2020), online: *ManOfMany* <manofmany.com/lifestyle/travel/best-usb-charging-luggage-and-suitcases> [perma.cc/HP7S-3D34].

13 "Keep Your Dog Toasty and Warm During Walks with this Heated Vest" (24 February 2021), online: *Boing Boing* <boingboing.net/2021/02/24/keep-your-dog-toasty-and-warm-during-walks-with-this-heated-vest.html> [perma.cc/9TA4-A2L8].

At first blush, there may appear to be a paradox here. The collaborative interests of the conglomerate of firms which pushed for the creation of USB seems to be at odds with the high degree of exclusivity and control envisioned by patent protection and the rights initially granted to Decruir. Yet, this is how much of today's *open innovation* occurs.[15] The history of USB demonstrates that subjects of exclusive intellectual property protection can nevertheless serve as open standards and platforms for follow-on innovation with immense social and economic benefits. They act as building blocks for common design languages and interfaces which enable subsequent competition and innovation. As the contributors to the USB project knew and internalized, subsequent competition and innovation strengthens (not weakens) the interests of those who create and develop such standards.

(b) The Role of Intellectual Property Rights

Intellectual property rights have long been regarded as an essential catalyst for innovation, economic growth, scientific discovery, and cultural enrichment. Nevertheless, the intellectual property system's role goes beyond a mere enabler of exclusivity and competitive advantage between firms. In the context of open innovation, intellectual property rights are increasingly the facilitator of innovation, sharing, and collaboration between firms to create products and services which build upon prior successes.[16] Though there are counterexamples to this notion,[17] the history and development of USB demonstrates that exclusive rights play a key role as an innovation facilitator, particularly within the information and communications technology ("ICT") sector.

In some ways, exclusive intellectual property rights are a necessary starting point for follow-on innovation. Where such rights are not sufficiently delineated through the grant of exclusive rights (particularly in the case of patents), their likelihood to becoming adopted as industry standards is reduced.[18] The exclusive grant of intellectual property rights, therefore, is often what facilitates the creation of a standard by creating a frame of reference for third parties to adopt. In exercising market power through becoming *de facto* standards, many longstanding intellectual property rights holders now serve as platform enablers for vast and profitable new sectors in the digital environment.[19]

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[14] "System and Method for a Switched Data Bus Termination", US Patent No 5781028A (21 June 1996).

[15] Henry Chesbrough, "The Logic of Open Innovation: Managing Intellectual Property" (2003) 45:3 Cal. Management Rev. 33 [Chesbrough, "The Logic of Open Innovation"].

[16] Nicos L. Tsilas, "Open Innovation and Interoperability" in Laura DeNaris, ed, *Opening Standards: The Global Politics of Interoperability* (Cambridge, Massachusetts: MIT Press, 2011) 97 at 98.

[17] Joanne Elizabeth Gray, *Google Rules: The History and Future of Copyright Under the Influence of Google,* (New York, NY: OUP, 2020) at 89.

[18] Tsilas, *supra* note 16 at 104-06.

[19] Nicos L. Tsilas, "Enabling Open Innovation and Interoperability: Recommendations

The openness or closedness of a standard will depend less on the mere grant of exclusive rights than the business model and competition strategy adopted by its owner(s). This comes down to a question of strategic priorities of individual firms.[20] USB was able to become an open and interoperable standard precisely because of the willingness of industry to collaborate not only in its creation, but also in its use and implementation. On this basis, we can distinguish between: (1) purely exclusive proprietary formats[21]; (2) quasi-standards which have through market forces become *the de facto standard* by sheer volume of users[22]; and (3) open standards which are intended to be used widely. Respective to these three scenarios, the degree of exclusivity correspondingly lessens, and the degree of openness increases. Yet, the core intellectual property protections at issue may nevertheless be the same (or very similar) in all three cases.

From a policy perspective, the easiest scenarios above to address are purely exclusive standards and purely open standards. They represent outcomes that are consistent with the degree of exclusive protection and the strategic priorities of the firms who hold those rights. The issue becomes more complicated, however, in relation to quasi-standards which involve an exclusive proprietary standard becoming a *de facto* platform as the result of ubiquity. In these cases, the mutually beneficial relationship between innovation and intellectual property protection erodes. We risk losing the benefits of innovation, delayed development of technologies, and lost market opportunities.[23] By extension, the gap between private and public interests is both unsatisfactory and inefficient. This is precisely the scenario exemplified by Canada's shortline industry. It is also becoming more prominent as the result of the COVID-19 pandemic due to the need to increase the speed of innovation and knowledge sharing.[24]

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for Policy-Makers" (Paper delivered at the International Conference on Theory and Practice of Electronic Governance, China, Macao, December 2007) Proceedings of the 1st ICEGOV '07 53 at 54.

[20] Urs Gasser & John Palfrey, "Breaking Down Digital Barriers: When and How ICT Interoperability Drives Innovation" (Berkman Center for Internet & Society: November 2007), online: *Harvard University* < dash.harvard.edu/bitstream/handle/1/2710237/Breaking%20Down%20Digital%20Barriers.pdf?sequence = 2&isAllowed = y > [perma.cc/7AX8-JAWK].

[21] Nicola Sharpe & Olufunmilayo Arewa, "Is Apple Playing Fair? Navigating the iPod FairPlay DRM Controversy" (2007) 5:2 Northwestern J. of Technology & Intellectual Property 332.

[22] Enrico Bonadio, "Standardization Agreements, Intellectual Property Rights and AnticompetitiveConcerns" (2013) 3:1 Queen Mary J. of Intellectual Property 22 at 24.

[23] Michael A. Carrier, "Copyright and Innovation: The Untold Story" (2012) 4 Wis. L. Rev. 891-960 at 950.

[24] Henry Chesbrough, "To Recover Faster From COVID-19, Open Up: Managerial Implications from an Open Innovation Perspective" (2020) 88 Industrial Marketing Management 410 at 410—413.

In certain instances, intellectual property rights can act as a tool to either curb or foster secondary innovation. The following case study of Canada's shortline industry evidences the former. It involves a *de facto* standard being closed off to the detriment of market competition. It will be shown that the woes of Canada's shortline industry call for a more dynamic interoperability concept under the *Act*.

3. CASE STUDY: CANADA'S SHORTLINE AGRICULTURAL EQUIPMENT SECTOR

Canada's shortline agricultural equipment manufacturing sector is a prime example of the social, economic, and community benefits of open innovation. It also demonstrates the clash between distinct innovation paradigms. The sector is best understood as creating add-on equipment for agricultural and industrial machinery, such as combines and tractors.[25] These are attachments for seeding and harvesting crops that provide customized solutions to farmers that address seed, crop, or soil types.[26] Harvesting implements, known as "headers," attach to original equipment manufactured ("OEM") machinery produced by the likes of John Deere, New Holland and Lexion. OEM machines are not unlike a KitchenAid stand mixer, which can accept a variety of attachments to perform different functions.[27] In this way, many pieces of OEM agricultural equipment act as host platforms. By using standard interfaces, they enable a range of options to be plugged into them, and Canada's shortline has built much of its innovative successes off its ability to work on top of these host platforms.[28]

Today's agricultural equipment is heavily computerized and reliant on a litany of sensors, central computer systems, network connectivity, proprietary cables, connectors, and software.[29] Undoubtedly, computerization and advances

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[25] Anthony Rosborough & Carlo Dade, "The Serious Hidden Problem Facing Canada's Agricultural Innovators" (25 February 2021), online: *Policy Options* < policyoptions.irpp.org/magazines/february-2021/the-serious-hidden-problem-facing-canadas-agricultural-innovators/ > [perma.cc/PM8Z-6QBN].

[26] *Ibid.*

[27] An analogy I have borrowed from Kyle Wiens of i*Fixit*. He drew this comparison while explaining the agricultural equipment industry during the Electronic Frontier Foundation's "Worst in Show Awards" ["The Repair Association Presents the First Annual Worst in Show Awards!" (15 January 2021), online (video): *YouTube* < https://www.youtube.com/watch?v = XeUhrRRsyZs&ab_channel = iFixit >]; "All Stand Mixer Attachments" (last visited 19 March 2021), online: *KitchenAid* < kitchenaid.ca/en_ca/countertop-appliances/stand-mixers/attachments/see-all.html?plp = %253Arelevance%253Acategory%253ACountertopAppliancesStandMixersAttachments&plpView = grid > [perma.cc/KA7X-U3K5].

[28] Jennifer Blair, "Canada's Short Line Equipment Makers on the Cutting Edge" (17 September 2018), online: *Alberta Farmer Express* < https://www.albertafarmexpress.ca/news/canadas-short-line-equipment-makers-on-the-cutting-edge/ > [perma.cc/677Q-ZJGU].

[29] Anthony Rosborough, "Unscrewing the Future: The Right to Repair and the

in precision agriculture[30] have had positive effects in terms of emissions, efficiency, and larger crop yields.[31] Nevertheless, the increasing sophistication of these machines has made follow-on innovation increasingly difficult, particularly for the shortline industry.

Given the pace of technological advance, Canada's shortline innovators have gradually become highly digital and tech-focused businesses. The industry is (as of 2021) comprised of over 500 companies across Canada, with some holding nearly 100 patents each.[32] It is a dynamic, globally integrated sector that accounts for revenues of over $4-billion in Canada.[33] And in Western Canada alone, Canada's agricultural equipment manufacturing sector accounted for $2.6-billion in revenue in 2018, with salaries and wages comprising $488-million.[34] These companies act as the tech employment engine of many rural communities throughout Canada and show promise in terms of homegrown innovation and exports, which grew more than 30 percent annually between 2015 and 2018.[35]

Despite the shortline industry's successes, it has been under considerable strain in recent years. It has faced increasing challenges in devising solutions that are interoperable with the latest lines of OEM products, and particularly John Deere's newest tractors and combines. John Deere accounted for over half of global revenues in the agricultural machinery sector in 2020 and remains the dominant player in the North American market.[36] Its equipment has become the default standard through volume of sales and widespread adoption. At the same time, its products are among the most heavily computerized and feature the most impenetrable proprietary interfaces and connectors, which make reverse

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Circumvention of Software TPMs in the EU" (2020) 11:3 J. Intellectual Property, Information Technology and E-Commerce L. 26 at para 24.

30 Aaron Pressman, "A.I. Gets Down in the Dirt as Precision Agriculture Takes Off" (5 October 2020), online: *Fortune* <fortune.com/2020/10/05/a-i-precision-agriculture-deere/> [perma.cc/9PYF-MNL2].

31 Mark Young, "The Age of Digital Agriculture" (2018), online (pdf): *Climate Fieldview* <s3-us-west-2.amazonaws.com/climate-com/images/the-age-of-digital-agriculture.pdf> [perma.cc/NFC5-8F9Q].

32 Rosborough & Dade, *supra* note 25.

33 Western Economic Diversification Canada, "Interoperability: An Overview with a Western Perspective" (5 February 2021) at 4, online: *Government of Canada* <opencanada.blob.core.windows.net/opengovprod/resources/36976fc5-a393-409b-9416-47707fb6a34b/interoperability-an-overview-with-a-western-perspective-final.pdf?sr=b&sp=r&sig=dcOkNv7fX0cmEs1u7JDpVBOhaAnEbEyDNkw3YXFooD4%3D&sv=2015-07-08&se=2021-03-20T00%3A09%3A05Z> [perma.cc/LK3A-JFGG].

34 *Ibid.*

35 Rosborough & Dade, *supra* note 25.

36 I Wagner, "Revenue of the World's Largest Farm Machinery Manufacturers 2020" (11 March 2021) online: *Statista* <https://www.statista.com/statistics/461428/revenue-of-major-farm-machinery-manufacturers-worldwide/> [perma.cc/48RN-VTL4].

engineering extraordinarily difficult. In controlling access to the machine's software code, which manages its entire functioning, the OEM can preclude shortline equipment from working altogether by requiring OEM authorization to "activate" (or not) the shortline-made components[37] and by preventing its proprietary interfaces and connectors from sending or receiving data to third-party peripherals.

Devising solutions to technical problems is the raison d'être of Canada's shortline. In response to OEM efforts to close off their products and prevent downstream innovation, the shortline has relied on achieving interoperability through reverse engineering. Though these efforts have been met with some success, a culmination of legal protections and technological design are now increasingly raising the stakes (and costs) of innovation.[38]

John Deere's latest X9 machine is a prime example of technological design and legal protections acting to curb innovation. The X9 is a $1-million USD combine which is designed principally for harvesting wheat, corn, and similar crops.[39] Like many of John Deere's prior machinery, it is heavily reliant on computerization, proprietary interfaces, and data formats. What is new, however, is the X9's use of a bespoke proprietary interface which prevents any shortline or third-party equipment from working with it. The proprietary interface also makes it nearly impossible to repair without authorization from John Deere.[40]

The X9 marks a shift in agricultural machinery because every prior piece of equipment had allowed for interoperability to some degree. It is the first time in the history of agricultural equipment that a manufacturer has unequivocally blocked the ability to use third-party equipment to suit farmer-specific needs or market demands.[41] Prior to the X9, ostensibly all widely distributed, modern precision agricultural equipment had settled on a few common standards. One such standard is ISOBUS, an international communication protocol that operates as the standard for agriculture electronics.[42] ISOBUS was created through the Agricultural Industry Electronics Foundation ("AEF") for the

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37 Rosborough, *supra* note 29 at para 27.

38 Kelvin Heppner, "Ag Manufacturers say Uneven Intellectual Property Rules Could Freeze them out of U.S.-made Machinery Market" (9 March 2020), online: *realagriculture* <realagriculture.com/2020/03/ag-manufacturers-say-uneven-intellectual-property-rules-could-freeze-them-out-of-u-s-market/> [perma.cc/MDK4-LMAU].

39 "X91000 Combine" (last visited 19 March 2021), online: *John Deere* <deere.ca/en/harvesting/x-series-combines/x91000-combine/?cid=SEM_Ag_en_CA_P&PA&gclid=Cj0KCQiAv6yCBhCLARIsABqJTjbYTF6f-3NR4KePr_3-amejL-ChAp9Nx8hqdVPMEdxfMvvUdMx2Bp2AaAuCuEALw_wcB&gclsrc=aw.ds> [perma.cc/5FQ4-LJV4].

40 Rosborough, *supra* note 29 at para 27.

41 "Worst in Show" (last visited 19 March 2021), online: *Repair.org* <repair.org/worstinshow> [perma.cc/RDX9-X5HU].

42 Sam Worley, "What is ISOBUS?" (16 July 2015), online: *Ag Leader* <agleader.com/blog/what-is-isobus-2/?locale=en> [perma.cc/QM68-SNPT].

purposes of achieving cross-manufacturer interoperability through an international standard.[43] As the computerization and sophistication of agricultural equipment continues to advance, the AEF has set its sights on a successor, the Tractor Implement Management (''TIM'') standard, which will allow for closer integration between the tractor's central computer system and the add-on component, regardless of manufacturer.[44]

Despite these movements toward common industry standards, John Deere's X9 deliberately adopts an approach in the other direction. Even though John Deere has been a significant contributor to the AEF and creation of ISOBUS, the connection between the X9 and its header or add-on implements does not interoperate with any of the existing industry standards. Further, despite the shortline's request for particulars, John Deere has refused to share the interface's particulars to allow for reverse engineering.[45]

Even more troubling is that the X9 incorporates harvest data sharing to John Deere's cloud services and so-called ''over the air'' software updates directly from the manufacturer.[46] For the shortline, this means that even if some reverse engineering or technological solution to the proprietary interface could be legally devised, there is the perennial risk that John Deere may be able to preclude this remotely through its software controls.[47] This overall trend whereby OEMs have tethered their products to their exclusive line of peripherals and software is only set to continue,[48] with much research and development by agricultural equipment OEMs being channelled toward new software platforms, on-board sensors, autonomous equipment, and, more broadly, ''digital agriculture.''[49]

The shortline's difficulties show that where OEMs with a dominant market position have become the *de facto* standard, they may nevertheless adopt a strategy of exclusivity and closed innovation. The John Deere X9 combine's design also shows that the rejection of open standards may even be adopted by

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[43] ''Electronics Are the Key'' (last visited 19 March 2021), online: *AEF* <aef-online.org/about-us/isobus.html#/About> [perma.cc/3LEL-J46E].

[44] ''Tractor Implement Management (TIM): The Implement Controls the Tractor'' (last visited 19 March 2021), online: *AEF* <https://www.aef-online.org/about-us/activities/tractor-implement-management-tim.html> [perma.cc/FG37-Q6LB].

[45] Rosborough & Dade, *supra* note 25.

[46] Travis Warkentin, ''John Deere Announces New High-Capacity X Series Combines'' (25 August 2020), online: *Grainews* <https://www.grainews.ca/machinery-shop/john-deere-announces-new-high-capacity-x-series-combines/> [perma.cc/H8GZ-4V3N].

[47] John Deere, ''Distance is no Longer a Barrier with John Deere Connected Support'' (16 March 2020), online: *Farming Ahead* <https://www.farmingahead.com.au/partners/partner-content/1382616/distance-is-no-longer-barrier-with-john-deere-connected-support> [perma.cc/Z76S-VHZG].

[48] Chris Jay Hoodnagle, Aniket Kesari & Aaron Perzanowski, ''The Tethered Economy'' (2019) 87 George Washington L. Rev. 783 at 798.

[49] Mark Young, ''The Age of Digital Agriculture'' (2018), online (pdf): *Climate Fieldview* <s3-us-west-2.amazonaws.com/climate-com/images/the-age-of-digital-agriculture.pdf> [perma.cc/NFC5-8F9Q].

firms who play a large role in creating open standards. In this closed innovation paradigm, strict control over intellectual property is essential to preventing benefits accruing to competitors.[50] There could be many reasons for this, including reserving these segments of the aftermarket for themselves or ensuring so-called "brand purity."[51] The consequences for the shortline, however, are the same.

Canada's shortline and its difficulty with the OEM equipment also evidences the importance of interoperability as a legal and regulatory concept. It is both legal and technical. In the absence of legal support for interoperability, equipment design and intellectual property protections can be used to preclude innovative efforts. For this reason, the legal treatment of interoperability requires careful articulation in order to foster open innovation. The following section addresses the *Copyright Act*'s role in regulating interoperability as a legal concept.

4. THE COPYRIGHT ACT AND INNOVATION

From a legal perspective, the challenges faced by Canada's shortline suggest quite a few different avenues for analysis and scrutiny. On the one hand, the ability for a dominant player in the agricultural machinery market to effectively monopolize follow-on innovation in the aftermarket presents itself as principally an issue for competition law.[52] The tethering of OEM products to their related peripherals, services, and software only adds to this interpretation. On the other hand, the restriction on farmers' choice of header or add-on suggests that the issue also shares some overlap with consumer protection laws. Though there is undoubtedly more than one way the issue could be approached from a legal perspective,[53] the role of copyright vis-à-vis technological protection measures is central to these challenges. Ultimately, OEMs can preclude innovation through design techniques and legal protection. Proprietary interfaces, connectors, cables, data formats, encryption, and other measures all act to lock out follow-on innovation. While this design approach presents very practical obstacles, the legal protections over these techniques create an added layer of liability and concern.

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50 Chesbrough, "The Logic of Open Innovation," *supra* note 15 at 38.

51 WIPO Doc, "Chapter 3: Branding, Innovation and Competition" at 127, online (pdf): <https://www.wipo.int/edocs/pubdocs/en/wipo_pub_944_2013-chapter3.pdf>.

52 Rosborough, *supra* note 29 at para 27.

53 Frauke Henning-Bodewig, "Unfair competition law — an annex to IP law? A consumer protection law? A legal field in its own right?" in Peter Drahos, Gustavo Ghidini & Hanns Ullrich *Kritka,* eds*, Essays on Intellectual Property* (Northampton, Massachusetts: Edward Elgar Publishing Inc., 2017) at 91.

(a) Technological Protection Measures in Canadian Copyright Law

Technological protection measures (“TPMs”), colloquially referred to as “digital locks,”[54] are a feature of copyright law that had been developed during the 1990s as the result of international efforts to safeguard against digital piracy through digital rights management (“DRM”) technologies. These international efforts culminated in protections for TPMs in the WIPO Copyright Treaty (“WCT”) and the WIPO Performances and Phonograms Treaty (“WPPT”).[55] The WCT and WPPT required states to adopt legal protections preventing the “circumvention of effective technological measures that are used by authors in connection with the exercise of their rights. . .and that restrict acts, in respect of their works, which are not authorized by the authors concerned or permitted by law.”[56] Functionally, the scope of things that can constitute a TPM under this definition is quite broad. It can include region-locking for content stored on physical media, watermarking, print blocking, copy blocking, download blocking, “read only” permissions, and many other techniques. Importantly, the “work” being protected by the TPM can include computer software.

The appearance of TPM protections in these international agreements in the late 1990s was met with much speculation and concern,[57] including how (or if) Canada would meet these obligations, citing the ambiguities, potential pitfalls, and harm to the public interest.[58] In the meantime, Canada’s neighbour to the south was busy envisioning an even more restrictive approach to TPMs. The United States settled upon §1201 of its *Digital Millennium Copyright Act* (“DMCA”),[59] which extended TPM protections to any mechanisms “which may control access to a work.”[60] This stands in contrast to the conception of TPMs in the WCT and WPPT, which were related to the protection of “authors’ rights” or to the prevention of acts which were otherwise unlawful. Under the DMCA

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[54] Pascale Chapdelaine, “Digital Locks, Physical Objects, and Immaterial Works” in Pascale Chapdelaine, ed., *Copyright User Rights: Contracts and the Erosion of Property* (Oxford, UK: Oxford University Press, 2017) at 129.

[55] Jorg Reinbothe & Silke von Lewinski, *The WIPO Treaties 1996: The WIPO Copyright Treaty and The WIPO Performances and Phonograms Treaty Commentary and Legal Analysis* (Haywards Heath, UK: Tottel Publishing, 2002) at 139.

[56] *World Intellectual Property Organization Copyright Treaty*, 20 December 1996, 2186 U.N.T.S. 38542 art. 11 (entered into force 6 March 2002), online: <https://www.wipo.int/edocs/lexdocs/treaties/en/wct/trt_wct_001en.pdf> [*WCT*].

[57] H. Wiese, “Anti-circumvention Laws: A ‘Circumvention’ of the Copyright Balance in the Digital Age?” (2002) 7:5 Tolley’s Communications L. 146—54.

[58] Ian Kerr, Alana Maurushat & Christian S Tacit, “Technical Protection Measures: *Tilting* at Copyright’s Windmill” (2002-2003) 34:1 Ottawa L. Rev. 11 at 84.

[59] *Digital Millennium Copyright Act*, 17 U.S.C. § 1002(c) (Supp. V 1993) [*DMCA*].

[60] Timothy B Lee, “Circumventing Competition: The Perverse Consequences of the Digital Millennium Copyright Act” Policy Analysis 564 (21 March 2006) at 8, online (pdf): *Cato Institute* <cato.org/sites/cato.org/files/pubs/pdf/pa564.pdf> [perma.cc/LG3F-TNJG].

"access control" approach, circumvention of TPMs is unlawful even if the ultimate purpose of that circumvention is to facilitate lawful uses.[61]

The DMCA's notion of TPMs as access controls effectively created a parallel liability regime to copyright whereby circumvention of TPMs would be unlawful and independently actionable irrespective of the underlying copyright at issue. In adopting this approach, the DMCA version of TPMs has since become regarded as redefining the scope of permitted conduct for users and their ability to access and interact with digital technologies.[62] This view is well founded, because the "access control" approach broadened the protection for TPMs in two important ways. First, it broadened the types of measures that could constitute a TPM. The only formal requirement for protection under the DMCA is that the TPM "requires the application of information, or process or a treatment, with the authority of the copyright owner, to gain access to the work."[63] This means that even rudimentary measures such as passwords or encryption constitute TPMs. Second, by divorcing TPM protections from other rights protected by copyright, it allowed TPMs to be used to protect not only software but also, in effect, the hardware and devices which integrate it. Therefore, if a TPM protects computer software which in turn controls the complete functionality of a mechanical object, the TPM can then effectively protect uncopyrightable aspects of *things*.[64] This has profound implications in relation to innovation, competition law, consumer law, and intellectual property laws.

By the time Canada sought to introduce its own regime for TPMs in the late aughts and early 2010s, the United States' "access control" approach was the one that it ultimately followed. The introduction of TPMs into Canadian law through the 2012 *Copyright Modernization Act*[65] came notwithstanding intense prior scrutiny among the public, copyright scholars, and policymakers.[66] Nevertheless, the *Copyright Modernization Act* defined a technological protection measure as "any effective technology, device or component that, in the ordinary course of its operation. . .controls access to a work."[67] Likewise, "circumvent" was defined as ". . .to descramble a scrambled work or decrypt an encrypted work or to otherwise avoid, bypass, remove, deactivate or impair the technological protection measure, unless it is done with the authority of the

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61 *DMCA*, *supra* note 59, § 1201.

62 Chapdelaine, *supra* note 54 at 129.

63 *DMCA*, *supra* note 59, §1201(a)(3)(B).

64 Pascale Chapdelaine, *Copyright User Rights: Contracts and the Erosion of Property* (Oxford: Oxford University Press, 2017) at 144-49.

65 S.C. 2012, c. 20 ["*CMA*"].

66 See Ian Kerr, "Digital Locks and the Automation of Virtue" in Michael Geist, ed., *From "Radical Extremism" to "Balanced Copyright": Canadian Copyright and the Digital Agenda* (Toronto: Irwin Law, 2010); Carys Craig, "Digital Locks and the Fate of Fair Dealing in Canada: In Pursuit of 'Prescriptive Parallelism" (2010) 13:4 J. World Intellectual Property 503-39.

67 *CMA*, *supra* note 65 at s. 47 (amending s. 41 of the Act).

copyright owner."[68] Therefore, the same concerning implications of the DMCA's "access control" approach had made their way into Canadian law.

It would not be until 2017 that the effects of these changes would be tested by the courts in Canada. That test came in the Federal Court decision in *Nintendo of America v. King*,[69] which addressed TPMs used by Nintendo on its game consoles. The Respondent company offered for sale and installation so-called "mod chips" which were soldered into the circuitry of Nintendo's consoles. The mod chips acted to simulate or replicate the presence of a legitimate Nintendo game cartridge and essentially fool the system into running the unofficial game supplied by the user. Importantly, the mod chips allowed users to play both home-made games as well as infringing copies.

In assessing Nintendo's claims that their TPMs had been unlawfully circumvented, the Federal Court agreed that the physical shape of Nintendo's game cartridges is analogous to a "lock and key" and therefore constituted effective TPMs.[70] It did not accept the Respondent's argument that, by simulating or replicating Nintendo's TPMs, the mod chips failed to actually "circumvent" them. The Court noted that the list of acts that constitute circumvention are non-exhaustive. It found that simulating or replicating a TPM is sufficient to find circumvention if the effect is nevertheless the same.[71] In the end, Nintendo was awarded over $12-million in damages, including statutory damages, lost revenues, and punitive damages. *Nintendo v. King* remains a sobering example of the very real consequences for TPM circumvention under Canadian copyright law.

Canada's legislative approach to TPM anti-circumvention and the decision in *Nintendo v. King* jointly show that Canadian copyright law treats unlawful circumvention of TPMs seriously and that appropriate damages will be awarded. It confirmed the access control model of TPMs whereby their use and implementation by manufacturers within the closed innovation paradigm would be incentivized. In taking the very strict and unequivocal approach that the Court did in *Nintendo v. King*, Canadian anti-circumvention law provides the closed innovation paradigm with a powerful tool to use in adopting an approach of exclusivity and control. While this approach is undoubtedly within the prerogative of firms such as Nintendo, strong protections and significant damage awards have the effect of creating a disincentive for others to engage in follow-on innovation.

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[68] *Ibid.*

[69] *Nintendo of America Inc. v. King*, 2017 FC 246, 2017 CarswellNat 650, 2017 CarswellNat 7098 (F.C.) [*Nintendo v. King*].

[70] *Ibid.* at para 86.

[71] *Ibid.* at para 94-100.

(b) Effects on Market Competition

Beyond the *Copyright Act,* exclusivity and control over innovation has its legal limits. Thanks to strong TPM protections, the shortline is now faced with the sobering reality that their efforts to achieve interoperability with uncopyrightable aspects of OEM machines may constitute TPM circumvention and be subject to harsh penalties. The increasingly closed innovation strategy adopted by OEMs suggests that these tactics may run afoul of Canadian competition law.[72] Though a fulsome review of competition law is beyond the scope of this analysis, the following briefly canvasses the extent to which OEMs' tactics in excluding shortline participation amounts to an abuse of dominant position under Canada's *Competition Act*.[73]

Firms are considered "dominant" if they substantially or completely control a class or species of business through market power.[74] The exercise of defining the relevant market for the purposes of competition law has been the subject of enormous discussion, debate, and literature.[75] Accepting for the sake of this brief analysis that the OEMs of TPM-protected agricultural equipment fall within the 'agricultural equipment market,' the question then becomes focused on the degree to which these OEMs possess the requisite market *power*. Market power is ordinarily determined through assessing the ability to determine or influence both price and non-price dimensions of competition in a market.[76] This would include the ability to create barriers to entry for competitors by use of an anti-competitive act. Such acts include "foreclosing access to scarce facilities or resources to withhold them from the market."[77] In other words, they include the exclusive use of a bottleneck in a market to deny entry to others. Importantly, these anti-competitive acts do not need to be oriented toward directly competing firms. They include foreclosing access to key inputs or facilities in the downstream or secondary market over which the target firm can exert complete control.[78]

The agricultural equipment market is comprised of only a handful of OEMs, and each possesses significant market power. John Deere is by far the largest

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[72] Heppner, *supra* note 38.

[73] R.S.C. 1985, c. C-34, s. 78(1) [*Competition Act*].

[74] *Canada (Director of Investigation & Research) v. NutraSweet Co.*, 1990 CarswellNat 1368, 32 C.P.R. (3d) 1 (Competition Trib.) at para. 73.

[75] Miguel S. Ferro, "Chapter 2: Brief history of market definition" in Miguel S. Ferro, *Market Definition in EU Competition Law* (Northampton, Massachusetts: Edward Elgar Publishing Inc., 2019) at 8.

[76] *Toronto Real Estate Board v. Commissioner of Competition*, 2017 FCA 236, 2017 CarswellNat 6861, 2017 CarswellNat 8751 (F.C.A.) at para. 89, leave to appeal refused 2018 CarswellNat 4555, 2018 CarswellNat 4556 (S.C.C.).

[77] *Competition Act, supra* note 73, s. 78(1)(e).

[78] *Canada (Commissioner of Competition) v. Toronto Real Estate Board*, 2014 FCA 29, 2014 CarswellNat 150, 2014 CarswellNat 5433 (F.C.A.) at para. 14, leave to appeal refused 2014 CarswellNat 2755, 2014 CarswellNat 2756 (S.C.C.).

manufacturer of agricultural equipment, with North America being its top sales region globally.[79] Deere is in most cases the default platform for shortline innovation, in Canada and elsewhere. Its deep involvement in the development of agricultural technology and ability to unilaterally determine the fate of equipment dealers[80] amounts to a significant degree of market power and influence. In using embedded systems and TPMs to preclude shortline participation in the market, it is denying access to an essential facility in this secondary market. Though an analogous finding of abuse of dominance through TPMs and technological design has yet to be brought before the Canadian Competition Bureau for decision, anti-trust decisions from the United States[81] and competition decisions from the European Union[82] suggest that such a finding is not out of the question.

5. THE COPYRIGHT ACT'S APPROACH TO INTEROPERABILITY AND TPM CIRCUMVENTION

Despite the heavy-handed ruling in *Nintendo v. King,* the *Act*'s protection for TPMs is not absolute. There are exceptions allowing circumvention for the purposes of enforcing the law,[83] encrypting research (where necessary),[84] preventing the collection of personal information,[85] making works perceptible for persons with perceptual disabilities,[86] broadcasting through undertakings,[87] accessing telecommunications on radios (generally),[88] and, finally, for the purposes of computer program interoperability.[89] While it is difficult to discern a coherent policy rationale behind these exceptions when viewed together, they individually represent various extensions of the public interest, whether on the

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[79] E. Mazareanu, "John Deere — statistics & facts" (11 March 2021), online: *Statista* <www-statista-com.eui.idm.oclc.org/topics/2724/john-deere/> [perma.cc/76EA-BHFC].

[80] Meghan Foley, "Former John Deere Dealer Closing After 84 Years" (28 February 2013), online: *FarmEquipment* <www.farm-equipment.com/articles/8588-former-john-deere-dealer-closing-after-84-years> [perma.cc/3KPM-D587].

[81] *Lexmark Intern., Inc. v. Static Control Components, Inc*., 387 F.3d 522 (6th Cir., 2004) (U.S.).

[82] *IMS Health GmBH & Co. OHG v. NDC Health GmbH & Co. KG. (IMS)* (C-418/01), [2004] E.C.R. I-5039, [2004] 4 C.M.L.R. 1543 (C.J.E.U.).

[83] *Copyright Act, supra* note 4, s. 41.11(1)-(3).

[84] *Ibid.,* s. 41.13(1)-(3).

[85] *Ibid.,* s. 41.14(1)-(2).

[86] *Ibid.,* s. 41.16(1)-(2); see Lucie Guibault & Anthony Rosborough, "Copyright in the Public Interest: Canada's Perceptual Disability Framework" in Jani McCutcheon & Ana Ramalho, eds, *International Perspectives on Disability Exceptions in Copyright Law and the Visual Arts* (New York, NY: Routledge, 2021).

[87] *Copyright Act, supra* note 4, s. 41.17.

[88] *Ibid.,* s. 41.18(1).

[89] *Ibid.,* s. 41.12(1)-(7).

basis of education, national security, human rights, access to information, or research and innovation.

(a) The TPM Interoperability Exception (s. 41.12)

Of all the anti-circumvention exceptions in the *Act,* the TPM interoperability exception is the most robust. This is likely because TPMs are often manifest through computer programs or used in relation to them. The exception's thoroughness in the *Act* could also be attributed to the fact that it had been introduced as the result of significant debate and compromise among parliamentarians. During these debates, there was concern about the potential for TPMs to serve large (American) corporate interests at the expense of authors and the public.[90] Interestingly, the TPM interoperability exception was described interchangeably throughout these debates with the notion of "compatibility," evidencing that perhaps the technical nuances of computer programs and interoperability may have been overlooked by parliamentarians at the time. Though no clear consensus was reached on the purpose or objective of the TPM interoperability exception, (then) Government Member of Parliament Peter Braid remarked that the exception would allow "third-party companies to undertake reverse engineering for interoperability, security testing and encryption research," and that, "as a result. . .companies could develop new products and software solutions, even if they needed to circumvent digital locks to do so." Braid stated in subsequent committee hearings that the overall intent of the TPM interoperability exception was to "encourage follow-on innovation in the ICT sector."[91]

Though it is fair to assume that parliamentarians at the time did not foresee how TPMs could later be used in myriad industries and applications, the context in which the TPM interoperability exception came about is telling. It was envisioned as a release valve to the potential for overprotection given to rightsholders vis-à-vis anti-circumvention provisions. Particularly, it was envisioned as leaving a door open to innovators to create novel solutions, including products, on top of existing technologies regardless of underling TPMs. In this vein, the spirit of the exception speaks directly to the challenges and efforts of Canada's shortline. Unfortunately, however, the wording and structure of the exception fails to accomplish these goals.

Before delving into the inadequacies of the TPM interoperability exception, it is worthwhile to examine an excerpt of its wording with some precision. It provides that the general prohibition on TPM circumvention does not apply:

. . .to a person who owns a copy of a computer program or a copy of one, or has a licence to use the program or copy, and who circumvents a technological

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[90] *House of Commons Debates,* 41-1, No. 78 (10 February 2012) at 1310 (Hon. Joyce Murray).

[91] *Legislative Committee on Bill C-11,* 41-1, No. 10 (12 March 2012) at 1750 (Hon. Peter Braid).

protection measure that protects that program or copy for the sole purpose of obtaining information that would allow the person to make the program and any other computer program interoperable.[92]

Therefore, to fall within the confines of this exception, quite a few circumstances must be present. First and foremost, the TPM being circumvented must principally protect a computer program. The person performing the circumvention must also own or have a licence to use the program. The *sole purpose* of circumvention must be to "obtain information" that facilitates interoperability, and the ultimate interoperability that is achieved must be in relation to a second computer program that is independently created. Finally, the exception contains its own caveat — the process of achieving interoperability must not include any acts which would otherwise constitute copyright infringement or contravene any Act of Parliament or any legislative act of a Canadian province.[93]

The Federal Court in *Nintendo v. King* briefly addressed the TPM interoperability exception in the context of that case. The Respondent mod chip installer had defended its circumvention of Nintendo's TPMs on the basis that it allowed users to play games which they created, or so-called "homebrew" games.[94] The Respondent provided none of its own evidence to support this defence, but the Court inferred that this contention amounted to a defence of interoperability. The Court did not accept that the primary reason for circumvention was to enable users to play these homebrew games and then identified two additional considerations: first, that there are otherwise "legitimate paths" for third party developers to have their games available on Nintendo's consoles; and second, that "there is no need for any TPM circumvention to achieve interoperability."[95] Taken together, these considerations suggest that circumvention of a TPM for the purposes of interoperability requires some degree of necessity. It also suggests that where an OEM provides some internal process for accommodating third-party products or services, circumvention may not be 'legitimate.'

These additional caveats of 'legitimate paths', and 'necessity' are inconsistent with the interoperability exception's purpose and intent – to encourage follow-on innovation in the ICT sector. One scenario envisioned by parliamentarians when enacting this provision was to allow third-party software companies to develop and sell 'patches'.[96] But the necessity and legitimacy requirements prevent the exception from accomplishing these goals. Innovation is often a cumulative process of exploration and discovery. To require innovators to demonstrate that their actions are necessary and legitimate stifles this process significantly. The

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92 *Copyright Act, supra* note 4, s. 41.12.

93 *Ibid.,* s. 41.12(6)-(7).

94 *Nintendo v. King, supra* note 69 at paras 113-119.

95 *Ibid.* at para 123.

96 *House of Commons Debates,* 41-1, No. 78 (10 February 2012) at 1045 (Hon. Peter Braid).

overall result of *Nintendo v. King's* additional caveats is not only a very narrow interoperability exception, but one divorced from its objective of encouraging innovation.

Overall, the statutory requirements in section 41.12 and the Court's decision in *Nintendo v. King* result in a very limited exception. It extends to a very narrow class of potentially interoperable technologies and upon an even narrower set of circumstances. To understand the reason for this restrictive approach, it is necessary to look to how the corresponding TPM interoperability exception in the United States' DMCA came about.

When the United States was developing its own TPM interoperability exception, of principal concern was preserving the ruling in *Sega v. Accolade,*[97] which affirmed the right to reverse engineer software and computer programs.[98] The *Sega* case confirmed that where the only way of accessing unprotected aspects of a computer program requires creating an intermediate copy, such copying should not constitute infringement. The prospect of the DMCA's anticircumvention provisions potentially stymieing these victories for the US software industry largely contributed to an interoperability exception that viewed computer programs as the sole subject of concern.[99]

Yet another reason why the computer program interoperability exception is construed narrowly is that it is intended to work in conjunction with the general computer program interoperability exception found at section 30.61 of the *Act*. In essence, section 30.61 states that it is not an infringement of copyright to reproduce a computer program for the purposes of making that program interoperable with another one.[100] Therefore, the TPM interoperability exception allows circumvention of the TPM which protects the computer program, and the general interoperability exception at section 30.61 allows copying of that program after circumvention. In this sense, the provisions are intended to work together. Given that a circumventor can only take advantage of the TPM interoperability exception if section 30.61 first applies, they are in some ways inseparable.

(b) Inadequacies of s. 41.12

The TPM interoperability exception in the *Act* suffers from several inadequacies when tasked with accommodating the needs of innovators working with computerized machinery and embedded systems. These inadequacies stem largely from the genesis of this exception and its historical link to computer programs and the software industry. But the "ICT Sector" is now ostensibly every sector. As the current global microchip shortage reveals,

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97 *Sega Enters. v. Accolade, Inc.*, 977 F.2d 1510 (9th Cir., 1992) at 1527-1528.

98 Aaron Perzanowski, "Rethinking Anticircumvention's Interoperability Policy" (2009) 42:5 U.C. Davis L. Rev. 1549 at 1569.

99 *Ibid.* at 1570.

100 *Copyright Act, supra* note 4, s. 30.61.

almost every manufacturer is now manufacturing "electronics."[101] Therefore, the way TPMs are now being used in equipment to lock down physical components illustrates a need to reassess the priorities of Canada's interoperability framework under the *Act*.

(i) Restriction to Program-Level Interoperability

The key requirement of the TPM interoperability exception is that it permits circumvention of only those TPMs which protect "computer programs." The *Act* defines a computer program as ". . .a set of instructions or statements, expressed, fixed, embodied or stored in any manner, that is to be used directly or indirectly in a computer in order to bring about a specific result."[102] This creates ambiguity in the case of TPMs, which protect not only computer programs, but also jointly protect other types of works subject to protection. Even further, it has become increasingly difficult to classify a work as purely a "computer program," particularly with the proliferation of dynamic and interactive computer games[103] and other so-called "complex" copyright works.[104] Where the computer program ends and the hardware begins is also difficult to delineate in today's world of embedded systems.[105] As drafted currently in the *Act,* it is not clear how (or if) the TPM interoperability exception would apply in light of the modern computing paradigm.

Secondly, the "computer program" requirement is closely related to a further requirement that the TPM must only be circumvented for the sole purpose of making *the protected computer program* interoperable with another. This means that, where TPMs protect uncopyrightable formats, interfaces, or standards,[106] and reverse engineers only require access to those features, their reverse engineering efforts would be unlawful if the overarching program is not ultimately the sole subject of interoperability. This is even the case where those uncopyrightable features are used to achieve interoperability with another system.

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[101] Mark Sweeney, "Global shortage in computer chips 'reaches crisis point'" (21 March 2021), online: *The Guardian* < www.theguardian.com/business/2021/mar/21/global-shortage-in-computer-chips-reaches-crisis-point > .

[102] *Copyright Act*, *supra* note 4, s. 2.

[103] Julian Stein, "The Legal Nature of Video Games — Adapting Copyright Law to Multimedia" (2015) 2:1 Press Start 43 at 44.

[104] Andy Ramos et al., "The Legal Status of Video Games: Comparative Analysis in National Approaches" (2013) at 23, online (pdf): *World Intellectual Property Organization* < www.wipo.int/export/sites/www/copyright/en/creative_industries/pdf/video_-games.pdf > [perma.cc/EP2B-BGRX].

[105] Janine Ungvarsky, "Embedded System" in *Salem Press Encyclopedia of Science* (Hackensack, NJ: Salem Press, 2020).

[106] Pamela Samuelson, "Questioning Copyrights in Standards" (2006), online: *UC Berkeley* < escholarship.org/uc/item/2sp0139g#main > [perma.cc/Y3B4-T8XV].

A third and related point is that by envisioning interoperability as existing only between two distinct computer programs, the exception fails to address data interoperability.[107] Data interoperability refers to the ability for systems and services which produce, exchange, and utilize data to have clearly identified and shared expectations for the meaning and composition of that data.[108] As it stands currently, the *Act*'s allowance of circumvention only for program-level interoperability ignores the importance of input and output data in relation to computer programs. According to the *Act*'s current approach, circumventing a TPM for the purposes of accessing data to achieve technical interoperability does not fall within the scope of the exception. As distinct copies of computer programs play a lesser role in the modern digital environment and make way for web-based applications and software as a service ("SaaS"),[109] the *Act*'s failure to address this type of data interoperability is palpable.

For Canada's shortline industry, the TPM interoperability exception's limitation to computer programs means that the proprietary interfaces used by OEMs such as John Deere and others can only be reverse engineered if the onboard computer's program is ultimately made interoperable with another program. This does not reflect the modality of innovation that the shortline operates within. Further, the language of "sole purpose" in the exception means that achieving program interoperability must be *the only purpose* for the circumvention. Unfortunately, program interoperability is not even *a* purpose for the shortline industry's circumvention, let alone the 'sole' purpose. Their add-on equipment must be able to make use of and exchange information with the tractor or combine's software. Though this requires the free exchange of data, formats, and interfaces, it does not involve the creation of an entirely distinct computer program. By restricting the application of the TPM interoperability exception to computer program-level interoperability in this way, the *Act* fails to accommodate broader classes of interoperable technologies and, by extension, broader modalities of innovation.

(ii) Missing Definition of "Interoperability"

The TPM interoperability exception also fails to define "interoperability." It provides the freedom to engage in circumvention activities that enable interoperability without defining precisely what this means. Though an inference can be drawn from the wording of the *Act* that interoperability is a relationship between two computer programs, no other specifications are

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[107] Justin (Gus) Hurwitz, "Digital Duty to Deal, Data Portability and Interoperability" (2020), online: *SSRN* < ssrn.com/abstract = 3733744 > .

[108] Data Interoperability Standards Consortium, "What is Data Interoperability?" (2021), online: < datainteroperability.org/#:~:text = Data%20interoperability%20addresses%20the%20ability,and%20meaning%20of%20that%20data > [perma.cc/A8VB-52HP].

[109] Walter L. Baker, Michael V. Marn & Craig C. Zawanda, *The Price Advantage*, 2nd ed (Hoboken, NJ: John Wiley & Sons, Inc., 2010) at 246.

explicitly provided. Section 41.12 allows circumvention to "obtain information that would allow" for interoperability, but the lack of clarity on this point is less than helpful. How a prospective circumventor should judge the necessity of information to allow for interoperability is also not clear. And unfortunately, neither "interoperable" nor "interoperability" are defined anywhere in the *Copyright Act* or any other federal legislation.

The US DMCA, with its interoperability framework analogous to Canada's, does include a definition of interoperability: "the ability of computer programs to exchange information, and of such programs mutually to use the information which has been exchanged."[110] This definition is consistent with the DMCA's overall computer programs approach to interoperability, but it also falls short of addressing broader subject matter that may assist the shortline industry. It is ambiguous with respect to *degree*: To what extent must these programs be able to mutually use the exchanged information? What if only portions of it are capable of being mutually used? To what extent must the exchanged information flow in both directions? None of these questions are remedied by the DMCA's definition. If Canada could be said to be deficient here by its lack of definition, the US DMCA is deficient for addressing it poorly.

Providing some contrast, the European Union's *Computer Programs Directive* defines interoperability as "the ability to exchange information and mutually to use the information which has been exchanged."[111] While this definition's lesser focus on "computer programs" may illicit the notion that it is more inclusive and receptive to data interoperability, it too suffers from many of the same ambiguities as the DMCA. It suggests that, though the use of the exchanged information must be mutual, the exchange itself might not be symmetrical. This again raises the same questions of degree as presented by the DMCA. And in any event, the *Computer Program Directive*'s object of protection, after all, is copyright in computer programs. Therefore, in looking for a treatment of interoperability beyond this narrow context, neither the DMCA nor *Computer Programs Directive* can provide much guidance.

A survey of numerous definitions of interoperability throughout legal literature,[112] technology studies, and business reports reveals that these varying definitions form a spectrum between technical, legal, or "political" conceptualizations.[113] It reveals that interoperability is a highly context-specific concept, and it is not a binary one.[114] As the DMCA's ambiguities demonstrate, it is always a matter of degree and dimension. One example of a working

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[110] *DMCA*, *supra* note 59, §1201(f).

[111] Council Directive 91/250/EEC, 1991 O.J. (L 122) 42 (EC).

[112] Wolfgang Kerber & Heike Schweitzer, "Interoperability in the Digital Economy" (2017) 8:1 JIPITEC 38 at 40.

[113] Gasser & Palfrey, *supra* note 20 at 4.

[114] John Weigelt, "Driving Innovation Through Interoperability" (December 2008), online: *Open Source Business Resource* < timreview.ca/article/215 > [perma.cc/HBQ8-TWLW].

definition that has garnered some support in the literature is interoperability as "the ability to transfer and render useful data and other information across systems (which may include organizations), applications or components."[115] This definition is much more attuned to the realities of modern ICT innovation because it moves beyond computer programs and includes both data 'and other information' as the subject of transfer across systems. It also recognizes that interoperability is not merely confined to the domain of systems or programs but also includes individual components or hardware within larger systems.

Though it could be argued that the *Act*'s omission of a definition for interoperability is better than a poorly worded one, the effect for the shortline industry is largely the same. In leaving such a context-specific, technical, legal, and political concept to be determined by drawing inferences through statutory interpretation is inadequate. Though a robust and inclusive definition of interoperability in the *Act* would not alleviate all the difficulties created by broad TPM protections, it is *part* of the solution. If the merits of interoperability and innovation are to be touted by parliamentarians, an effective next step would be to define the scope of permitted innovative activity.

(iii) Ownership or Licence to Use the Computer Program

Yet a third deficiency of the *Act*'s TPM interoperability exception is that it requires ownership or a licence to use the computer program subject to TPM protection. In requiring ownership or a licence, this requirement under Canada's *Act* is more restrictive than the US DMCA, which only requires that the circumventor has the lawful right to use the program.[116] In any event, the requirement of ownership of a copy or licence to use the program renders the exception almost entirely useless for follow-on innovation in the shortline and other secondary markets which rely on embedded systems. This is because, for one, it is extremely unlikely that shortline firms would be granted a licence to use the OEM's proprietary software and associated tools. If OEMs were willing to provide copies or licences to their software, it would impair the purpose of their TPMs. Secondly, the ability to access and use the OEM software would be meaningless if the only use that could be made of it by the shortline industry is to achieve interoperability with another computer program. Even if it were possible to grant a statutory or compulsory licence to use OEM software to shortline firms, the limited purposes for which they could use the software results in a licence with little utility.

Though each of the three inadequacies noted above poses its own set of problems, they all point to a common theme: the TPM interoperability exception's sole focus on computer programs is overly narrow and fails to accommodate for embedded systems and other interoperable technologies. Each of the above inadequacies also demonstrates that, by reaching far beyond

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[115] Gasser & Palfrey, *supra* note 20 at 4.

[116] *DMCA*, *supra* note 59, §1201(f)(1).

computer programs and into the realm of computerized equipment, TPMs are being used in ways that are wholly divorced from copyright protection. As noted in section II, the vitality of innovation depends less on the nature of exclusive intellectual property rights than it does on *how* those rights are used by firms. In locking out innovation in the secondary market, OEMs are using TPMs to further a paradigm of closed innovation. To remedy the significant anti-competitive effects of this approach, an intervention is needed.

6. POTENTIAL SOLUTIONS

The challenges facing Canada's shortline industry demonstrate that the use of TPMs by OEMs have produced significant anti-competitive effects and may (in turn) have the effect of unduly restricting consumer choice. The TPM interoperability exception has proven inadequate and remains confined to a paradigm from which the ICT sector has largely moved on. Devising a solution to these problems requires a pragmatic mindset in envisioning both which solutions are *possible* and which are most *effective*. The following begins by addressing the possible, then assesses two potential ways forward and their efficacy.

(a) Canada's International Obligations

Canada's protection for TPMs is directed by two primary instruments under international law. Those are the WCT/WPPT agreements and the *Canada-United States-Mexico-Agreement* ("CUSMA").[117] The latter, sometimes called the "New NAFTA," came into force on 1 July 2020. Its domestic counterpart, the *Canada-United States-Mexico Agreement Implementation Act,*[118] came into force on 13 March 2020. In accordance with Article 20.90 of CUSMA, Canada has two and a half years to implement its obligations, including those in relation to copyright.

The WCT/WPPT agreements do not place detailed restrictions on state parties to enact further TPM exceptions other than the fact that they must ". . . provide adequate legal protection and effective legal remedies against the circumvention of effective technological measures. . .".[119] CUSMA, on the other hand, goes into further detail as to what 'adequate legal protection' and 'effective legal remedies' means. As for legal remedies, it requires states to enact criminal penalties for wilful circumvention of TPMs for the purpose of commercial advantage or financial gain.[120] This suggests that, once ratified in Canada, an analogous case to *Nintendo v. King* would be addressed by the criminal law.

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[117] *Canada-United States-Mexico Agreement,* 30 November 2018 (entered into force 1 July 2020) [*CUSMA*].

[118] S.C. 2020, c. 1.

[119] *WCT*, *supra* note 56, art. 11.

[120] *CUSMA*, *supra* note 117, art. 20.66(1).

With respect to 'adequate legal protection,' CUSMA requires states to confine their exceptions and limitations to TPM protection to a number of scenarios,[121] and among them is 'non-infringing reverse engineering activities.'[122] This permitted exception contains some notable differences when compared to Canada's existing TPM interoperability exception. It defines 'reverse engineering' activities as "... in relation to a *lawfully obtained* copy of a computer program, carried out in good faith. . .for the sole purpose of achieving interoperability of an independently created computer program with other *programs*."[123]

CUSMA's language is similar to the existing exception in the *Act,* but there are a few notable differences. The first is that CUSMA distinguishes between the act of reverse engineering and 'achieving interoperability.' In some respects, this reduces the uncertainty of whether a failed attempt to achieve interoperability would still fall within the existing exception. The second difference is that CUSMA stipulates that the computer program must be 'lawfully obtained' rather than owned or licensed. This implies that showing clear evidence of ownership or a licence is perhaps less important, and mere lawful possession only may be required. Finally, by referring to interoperability with 'other *programs,*' it implies that interoperability may be achieved by more than two programs working together.

Overall, CUSMA's reiteration of an interoperability exception for reverse engineering activities suggests that there is some room to broaden the existing TPM interoperability exception in the *Act*. It allows broadening the ownership or licence requirement, but it nevertheless reiterates the *Act*'s narrow view of potentially interoperable technologies to include *only* 'computer programs.' Expanding the scope of applicability to 'lawfully obtained' computer programs would do little to remedy the issues presented by TPMs that effectively control uncopyrightable interfaces and formats.

Though CUSMA falls short of offering a solution through its revised 'reverse engineering' exception, it does include a "catch-all" provision allowing states to enact general TPM exceptions and limitations. On this point, Article 20.66(1)(h) allows states to:

> . . .provide additional exceptions or limitations for non-infringing uses of a particular class of works. . .when an actual or likely adverse impact on those non-infringing uses is demonstrated by substantial evidence in a legislative, regulatory, or administrative proceeding in accordance with the Party's law.[124]

Therefore, the list of permitted exceptions and limitations to TPM protections in CUSMA is non-exhaustive. Further exceptions or limitations

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[121] *Ibid.,* art. 20.66(4).

[122] *Ibid.,* art. 20.66(4)(a).

[123] *Ibid.*

[124] *Ibid.,* art. 20.66(4)(h).

can be enacted where there is sufficient evidence of adverse effects before a legislative, regulatory, or administrative body. While the *Act* and CUSMA's conceptualization of interoperability may remain inadequate, the catch-all provision in CUSMA leaves the door open for other solutions.

(a) Regulations Under s.41.21 of the Copyright Act

As it turns out, the *Act* already contains a similar catch-all provision for new TPM exceptions and limitations that is largely consistent with CUSMA's approach. Namely, section 41.21 provides the government with the ability to enact regulations that excludes certain types of TPMs from protection if their use produces anti-competitive effects. Section 41.21 states:

"The Governor in Council may make regulations excluding from the application of section 41.1 any technological protection measure that protects a work. . . or classes of them, or any class of such technological protection measures, if the Governor in Council considers that the application of that section to the technological protection measure or class of technological protection measures **would unduly restrict competition in the aftermarket sector** in which the technological protection measure is used."[125]

While the *Act* and CUSMA's treatment of interoperability or reverse engineering may leave little room to expand the exception in a way that benefits the shortline industry, section 41.21 may allow for another approach to the solution — excluding altogether protection for TPMs that safeguard embedded systems in certain objects or equipment.

The benefits of this approach would be realized far beyond agricultural equipment. TPMs in embedded systems have been used to lock down a broad array of equipment and devices that do not principally embody copyright works. This has precluded diagnosis, reverse engineering, and repair of things like smartphones,[126] garage door openers,[127] coffee makers,[128] and printer toner cartridges.[129] It is also the reason why the ice cream machines at McDonald's restaurants are (to the notorious dismay of customers[130]) always broken, and

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[125] *Copyright Act, supra* note 4, s. 41.21.

[126] Hamza Shaban, "Right-to-repair' advocates claim major victory in new smartphone copyright exemption" (26 October 2018), online: *The Washington Post* <www.washingtonpost.com/technology/2018/10/26/right-repair-advocates-claim-major-victory-new-smartphone-copyright-exemption/>.

[127] See *Chamberlain Group, Inc. v. Skylink Techs, Inc.*, 381 F.3d 1178 (Fed. Cir., 2004) (U.S.).

[128] Jennifer Abel, "Here's a super-easy way to get around Keurig 2.0 DRM restrictions" (12 December 2014) online: *ConsumerAffairs* <www.consumeraffairs.com/news/heres-a-super-easy-way-to-get-around-keurig-20-drm-restrictions-121214.html>.

[129] See *Lexmark Intern., Inc. v. Static Control Components, Inc.*, 387 F.3d 522 (6th Cir., 2003) (U.S.).

[130] Monica Chin, "Meet the 24-year-old who's tracking every broken McDonald's ice-cream machine in the US" (22 October 2020) online: *The Verge* <www.theverge.com/

innovative efforts toward a solution have resulted in legal threats from their manufacturer.[131]

Regulations under section 41.21 of the *Act* could address these new and unforeseen challenges to innovation, diagnosis, repair, and servicing.[132] They could enable repurposing older devices and extending the lifespan of current ones, and they could help Canada move toward a circular economy.[133] Devising a Canadian solution requires taking all these benefits into account along with innovation. In drafting a regulatory response, it is helpful to look to similar approaches taken by United States and France.

(i) Reactive Approach: The DMCA Librarian of Congress Review Process

Despite acting as the high-water mark for 'access control' style TPM protections, the US DMCA framework includes an important administrative review process which assists in reducing their potentially adverse and far-reaching effects. Namely, the DMCA's section 1201(a)(1)(C) allows the Librarian of Congress to consider, every three years, whether certain classes or uses of TPM protections ought to be exempted based on their adverse effects on non-infringing uses. The last complete review to take place was in 2018, which included a renewal of an exception for "[c]omputer programs contained and controlling function of motorized land vehicles to allow diagnosis, repair, or modification of a vehicle function."[134] The 2018 review notes that this exemption extends to farm equipment and is intended to strike an "appropriate balance between encouraging marketplace competition and innovation while mitigating the impact on safety, regulatory and environmental compliance."

The US DMCA's Librarian of Congress process could be used to model a process in Canada whereby classes or uses of TPMs could be exempted from protection. This would be consistent with both the existing section 41.21 and Article 20.66 of CUSMA. Such a TPM review process could conceivably coincide with the statutory review process already embedded in the *Act* and which must occur every five years.[135] The last of these reviews in Canada took

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2020/10/22/21529477/mcdonalds-mcbroken-bot-ice-cream-machines-app-engineering >.

[131] Andy Greenberg, "They hacked McDonald's ice cream machines-and started a cold war" (20 April 2021), online: *Wired* < www.wired.com/story/they-hacked-mcdonalds-ice-cream-makers-started-cold-war/ >.

[132] See Bryan May (MP)'s Private Member's Bill targeting TPM protections, Bill C-272, *An Act to Amend the Copyright Act (diagnosis, maintenance or repair)*, 2nd Sess., 43rd Parl., 2020 (first reading 22 February 2021).

[133] Tomoko Yokoi, "Rethinking Ownership of Smart Products In Right-To-Repair" (17 October 2020), online: *Forbes* < www.forbes.com/sites/tomokoyokoi/2020/10/17/rethinking-ownership-of-smart-products-in-right-to-repair/?sh = 4ae6e37d437d >.

[134] U.S., Library of Congress, Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies, 37 C.F.R. 201, Docket No. 2014-07 (effective 28 October 2015).

place in 2019 and included testimony from 263 witnesses and garnered the submission of 192 briefs,[136] including on TPM issues.[137] With such a significant degree of interest among the public and policy experts, this process would serve as an ideal platform to hear submissions on potential TPM exemptions.

In any event, a review process of this sort would provide *ex-post* rulings. In other words, it would be reactive to the effects of TPM over-protection, and it would presumably require considerable effort among industry and policy experts to achieve and continually renew. Though policy experts and industry have shown their interest in this issue in the past, relying upon perennial rulemakings may not necessarily be the most effective approach.

(ii) Proactive Approach: France's Regulatory Authority for Technical Measures

Though distinguishable from Canada's TPM framework on many fronts, France's *l'Autorité de Régulation des Mesures Techniques* (the "Regulatory Authority for Technical Measures" or "RATM") takes a proactive approach to TPM regulation. The RATM was created in 2007 with the sole purpose of promoting interoperability of media with embedded digital rights management systems and TPMs.[138] It was ultimately succeeded in 2009 by the High Authority for the Dissemination of Works and the Protection of Rights on the Internet ("HADOPI"), but, nevertheless, its approach to TPM regulation shows an alternative path to the DMCA.

In contrast to a statutory review process with rulemakings, the RATM framework created an independent regulatory agency which oversaw the use and implementation of TPMs. To further interoperability, the RATM could require technology providers to disclose proprietary information to market competitors for interoperability purposes. The RATM also promoted the use of certain technical standards among market participants, requiring them to comply with existing standards by reference or develop these standards directly.[139]

Though the RATM ended up being not as active as originally envisioned, offering only three opinions on TPMs between 2013 and 2014,[140] its regulatory design offers an example of a more interventionist approach to achieving interoperability through standards. It departs from the norm of technical standards being ordinarily left to voluntary participation among market participants and instead involves government directly in shaping the process. If

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[135] *Copyright Act, supra* note 4, s. 92.

[136] House of Commons, Standing Committee on Industry, Science and Technology, "Statutory Review of the Copyright Act", 42-1, (June 2019) (Chair: Dan Ruimy) at 11.

[137] *Ibid*. at 69-72.

[138] Jane Winn & Nicolas Jondet, "A New Deal for End Users? Lessons From a French Innovation in the Regulation of Interoperability" (2009) 51:2 William & Mary L. Rev. 547 at 547.

[139] *Ibid*. at 553.

[140] Trisha Meyer, *The Politics of Online Copyright Enforcement in the EU: Access and Control* (Palgrave Macmillan, 2017) at 169.

such an approach were adopted in Canada, it would likely require an administrative agency with broader competence than what is afforded by 41.21 of the *Act*. It would undoubtedly require involvement from the Canadian Competition Bureau to some degree and require creative thinking on the part of policymakers.

Canada should take inspiration from both the proactive and reactive approaches canvassed above. It should implement a regular review of TPM protections through an administrative body. This would allow for continuous oversight over the practice of locking down devices through embedded system design and the stipulation of standards. Under section 41.21, Canada could task an administrative body with hearing submissions from public interest groups and industry to issue case-by-case exemptions to TPM protection. These exceptions could apply to specific uses of TPMs as well as for specific product categories. In the case of the COVID-19 pandemic, one priority may be to allow circumvention of TPMs in all medical equipment, including ventilators.[141] For the shortline industry, this could include a blanket exception for TPMs in all agricultural equipment. More broadly, this process could also target specific end uses of devices to allow for circumvention of any TPM where it is in furtherance of repair, maintenance, or servicing.[142]

The United States and France show a potential way forward for strengthening Canadian innovation through regulating the scope of TPM protections. Canada can learn from these approaches. Both the existing exception at section 41.21 of the *Act* and Article 20.66 of CUSMA offer legislators the needed room to devise a solution that would enable innovation within the embedded system paradigm.

7. CONCLUSION

Interoperability is the language game of computerized systems and the lifeblood of modern innovation. The proliferation of computerized equipment and embedded systems has made achieving it crucial to market, consumer, and public interests. The foregoing demonstrates the use of technological design and intellectual property rights to preclude interoperability. It reveals that, in the case of OEM agricultural equipment, the key tool for a closed innovation strategy is the use of TPMs within embedded systems to lock down physical components and preclude shortline participation in the secondary market. Though the TPM interoperability framework in the *Act* shows many inadequacies, this analysis shows that there is a way out with potential avenues for crafting solutions. These

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[141] Courtney Linder, "Hospitals Need to Fix Ventilators. Why Won't Manufacturers Let Them?" (16 April 2020), online: *Popular Mechanics* <www.popularmechanics.com/science/health/a32144222/hospitals-ventilators-right-repair-covid-19/>.

[142] See Meghna Chakrabarti, "Can't Fix Your Smartphone? The Right-to-Repair Movement Wants to Change That" (1 November 2018), online: *Wbur* < www.wbur.org/onpoint/2018/11/01/right-to-repair-digital-locks-technology-smartphones-cars>.

solutions could offer benefits that transcend innovation in the agricultural sector and offer myriad social and economic benefits.

The primary contribution of this article is its assertion that the *Act*'s TPM interoperability framework does not address the realities of contemporary innovation. Computer programs are not as distinct as they once were, yet computer hardware has become ubiquitous. This requires reconceptualizing what interoperability should mean. This article appears to be the first in-depth analysis of the efficacy of the TPM interoperability framework and the first to question its restriction to computer programs. It observes that by providing broad protection for TPMs and leaving an interoperability exception which applies to a narrow class of interoperable technologies and even fewer circumstances, the legislative purpose and objective of the TPM interoperability exception are not being realized.

This analysis' inquiry into the ability to enact further exceptions and limitations to TPM protections under the *Act* could serve as a foundation for subsequent inquiries in related areas. Notably, this analysis could provide support for subsequent inquiries into permitted circumvention for other non-infringing uses, such as maintenance and repair of equipment with embedded systems. It could also serve as a starting point for an exploration into other models of TPM regulation beyond those surveyed here. Finally, it could serve as the basis for a deeper inquiry into how the use of TPMs in the manner demonstrated may be responded to under Canadian competition law.

In sum, despite its immense innovative capacity, the shortline industry cannot innovate its way around design techniques and intellectual property protections which have been weaponized against it. When it comes to devising a solution, this article demonstrates that the Canadian federal government has all the tools it needs. The door has been left ajar for a new approach to TPM regulation in Canada, and the shortline industry's woes reveal that the time has come to open it fully.