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ARTICLE

THE COMMODIFICATION OF INFORMATION COMMONS: THE CASE OF CLOUD COMPUTING[†]

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Internet and digital technologies allowed for the emergence of new modes of production involving cooperation and collaboration amongst peers (peer-production). In contrast with traditional models of production oriented towards the maximization of profits, these alternative modes of production are, more often than not, oriented towards the maximization of the common good. To ensure that content will always remain available to the public, the output of production is often released under a specific regime that prevents anyone from subsequently turning it into a commodity (the regime of information commons).

While this might reduce the likelihood of commodification, information commons can nonetheless be exploited by the market economy. Indeed, since they have been made available for use by anyone, large online service providers can indirectly benefit from the commons by capturing the value derived from it. While this is not a problem per se, problems arise when the exploitation of the commons by one agent is likely to preclude others from doing the same—often as a result of commodification. This is especially true in the context of cloud computing, where the content holder has become as powerful as, if not more powerful than, the copyright owner. Nowadays, regardless of their legal status, information commons are increasingly controlled by large corporations who can precisely define the manner in which they can be used or accessed.

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Digital communities need to be aware of these risks. This Article proposes a theoretical and normative exploration of these issues based on an analysis of recent trends in cloud computing. It argues that, in order to reduce the likelihood of commodification but still benefit from the advantages offered by cloud computing, digital communities should rely on decentralized platforms based on peer-to-peer architectures, thereby escaping from the centralized control of large service providers while nonetheless preserving the autonomy of the commons they produce.

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I. INTRODUCTION[1]

This Article presents a reflection on the emergence of information commons, focusing mainly on the wealth of content that has become available on the Internet under specific licensing schemes which automatically grant users a predefined set of permissions (and obligations) regarding the potential usages that can be made of it. In particular, the Article analyzes the impacts, opportunities and dangers of cloud computing technologies and

1. The authors thank Mayo Fuster Morell for her thoughtful comments regarding an earlier version of this paper.

describes alternatives for developing sustainable commons-based peer production of information.

The main issue addressed in this Article when assessing such impacts relates to the concept of "commodification"—the transformation of non-market resources into commodities that can be freely exchanged on the market. Karl Polanyi, an influential economic historian who wrote on commodification, suggested that—particularly since the beginning of the 20th century—our society moved towards a universal market system brought about by the progressive commodification of all aspects of life.[2] For Polanyi, one of the main problems of this ideal market system would be the subordination of social and political life to market considerations, something previously unheard of in human history.[3]

The issue of commodification is closely related to the notion of "enclosure" that characterizes most of the narrative around the privatization of commons-based resources. Initially, the notion referred to the processes "of fencing off common land and turning it into private property" that took place in England between the fifteenth and nineteenth centuries;[4] throughout the years, "enclosure" has come to be applied to processes of privatization of common property in general. Not surprisingly, the notion has been put into direct opposition with the traditional conception of the commons.[5] Today, with the advent of the information society, enclosure is progressively moving towards the realm of information. As clearly expressed by Howard Besser, "[j]ust as the coming industrial revolution provided an excuse for the wealthy to enclose the commons grazing land, the current information age is providing an excuse for the content industry (publishers, motion picture studios, music distributors, etc.) to fence off access to our information commons."[6]

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2. KARL POLANYI, THE GREAT TRANSFORMATION 75 (2001).

3. *See id.*

4. J. Boyle, *The Second Enclosure Movement and the Construction of the Public Domain,* 66 LAW & CONTEMP. PROBS. 33, 33-34 (2003), *available at* http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1273&context=lcp (last visited Oct. 12, 2014).

5. *See* DAVID BOLLIER, SILENT THEFT 48-49 (2002); Boyle, *supra* note 6, at 37-40; LAWRENCE LESSIG, THE FUTURE OF IDEAS 20-23 (1st ed. 2001).

6. Howard Besser, *Commodification of Culture Harms Creators,* DIGITAL LIBRARY OF THE COMMONS 6 (2002), *available at* http://hdl.handle.net/10535/901 (last visited Oct. 12, 2014). *See also* Anthony McCann, *Enclosure Without and Within the "Information Commons,"14:3*

Commodification represents, in our view, a more complicated issue, to the extent that, in order to turn a commons into a commodity, enclosure must be accompanied by the creation of artificial scarcity and excludability. This is particularly relevant in the context of information, which is by its nature less rival and less easily excludable than other kinds of resources.[7] While copyright law is responsible for turning information into a commodity that can be exchanged on the market for information goods, several initiatives have emerged in recent years—such as the Free Software Foundation or Creative Commons—whose objective is to help authors bring back information into the realm of the commons by means of contractual licenses specifically designed for that purpose. Yet, in spite of their legal status, modern technologies can be (and increasingly are) used by commercial actors to exploit these resources as if they were private commodities, by commercially exploiting them on the market while precluding others from doing the same.

This can be achieved, amongst other things, by means of specific technologies designed to restrict the way in which information can be consumed by end-users. In this regard, the Article will focus, in particular, on the use of online platforms and cloud computing technologies to limit the ability of users to actually access and reuse information commons. The functionality of the user-interface of many cloud-based services can, in fact, be designed in such a way as to restrict the use of information in a way that often goes beyond the limits imposed by default under copyright law, and regardless of the terms and conditions of the licenses under which such information has been made available to the public. These practices are especially problematic in the case of information commons, as artificial scarcity or excludability might actually counter the underlying justifications for which this resource had been created in the first place: to be freely available on the Internet or to be freely used and reused by the public.

Thus, after analyzing the impact of cloud computing architectures on the production, dissemination and reuse of information commons, the Article concludes by presenting a series

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INFO. & COMM. TECH. L. 217, 232 (2005) (arguing that the "process of enclosure is driven by market concerns").

7. In economics, rivalry and excludability are categories that describe a resource's characteristics. A resource is rivalrous if it is hard for more than one person to consume it at the same time; it is excludable if it is easy to exclude others from using it. They are not binary, but relative categories: a resource is more or less rivalrous than another one, and not rivalrous in an absolute sense.

of possible alternative approaches to highly centralized online platforms that might fare better in terms of user freedoms and autonomy.

The overall structure of the Article is as follows: Part II presents the notion of information commons, and the relation between its recent prominence and peer-production. Part III explores cloud computing and its potential benefits to information commons, particularly with regard to online collaboration. Part IV defines commodification—distinguishing it from commercialization and cooptation—and discusses how it can happen to information commons (particularly through cloud computing). Finally, Part V examines the governance model of provider-based cloud computing, and proposes that there are alternative governance approaches that could avoid commodification while achieving many of the benefits offered by cloud computing.

While the reasoning is based on historical analysis and empirical examples related to information commons and cloud computing, the approach is more theoretical and exploratory than it is descriptive. The main interest of this Article is to draw attention to the possible contradictions between the practices and values underpinning information commons and provider-based cloud computing, to explore alternative scenarios where commodification can be less likely. To be sure, more empirical research is needed in this area; the alternatives mentioned here should be taken as preliminary pointers.

II. INFORMATION COMMONS

People share things, and they have done so for a long time: Medieval England's Charter of the Forest, with the rights to *herbage*, *pannage*, *chiminage,* etc.,[8] France's *communals*,[9] Spain's millenary *huertas*,[10] Brazil's *faxinais* and *terras de quilombo,*[11] and

8. The Charter of the Forest was a companion to the Magna Carta and formalized a number of traditional common rights to forests, such as those to pasture and wood. PETER LINEBAUGH, THE MAGNA CARTA MANIFESTO: LIBERTIES AND COMMONS FOR ALL 42 (2008).

9. The Main Cell of Peasant Communal Property in Feudal France. MARC BLOCH, LES CARACTÈRES ORIGINAUX DE L'HISTOIRE RURALE FRANÇAISE (1952), *available at* http://classiques.uqac.ca/classiques/bloch_marc/histoire_rurale_fr_t1/histoire_rurale_fr_t1.html (last visited Oct. 12, 2014).

10. Collective arrangements to share and maintain irrigation systems. ELINOR OSTROM, GOVERNING THE COMMONS 69-82 (1990).

11. *Faxinal* is a mode of shared land usage that exists in Brazil; it is believed to have its origins in Portugal. *Terras de quilombos* are lands shared by runaway slaves and their descendants in Brazil. *See generally* ALFREDO

many more. Historical and ethnographic records attest that plenty of commons—continued practices of common property and sharing by communities—have existed successfully over the years. These examples suggest that, in many circumstances, humans seem to be better described as the *homo reciprocans* of certain economic theories,[12] motivated to cooperate in order to improve their environment, than the *homo economicus* of classical economics—a creature that combines rational decision-making with a strictly self-interested human nature.

It is tempting to classify those early examples as belonging exclusively to the realm of "physical commons." After thorough examination, however, it becomes obvious that they involve much more than a mere set of physical goods. Indeed, most of those examples could not properly subsist without a complex mesh of practices, rights and agreements—whether formalized or not. In addition, there is in those examples a significant amount of information being shared, such as the fundamental pieces of knowledge regarding how to properly use and care for those common resources (i.e., when to sow, where to let cattle graze, how much should one fish, etc.) and how the community rules affecting them are determined.

Drawing a binary distinction between physical commons and information commons can, as those examples show, be difficult, and at times even undesirable.[13] Indeed, the majority of information commons also rely, to some extent, on material

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WAGNER BERNO DE ALMEIDA, TERRAS DE QUILOMBOS, TERRAS INDÍGENAS, "BABAÇUAIS LIVRES", "CASTANHAIS DO POVO", FAXINAIS E FUNDOS DE PASTOS (2008), *available at* http://novacartografiasocial.com/?wpdmact=process&did=MTguaG90bGluaw== (last visited Oct. 12, 2014).

12. The concept of *homo reciprocans* (as opposed to *homo economicus*) was introduced following the research of Ostrom and Fehr on "reciprocal fairness" that illustrated the natural tendency of individuals to respond in a reciprocal manner to the actions of other individuals in their environment. *See generally* S. Bowles et al., *Homo Reciprocans Fairness*, 4 ADVANCES IN COMPLEX SYSTEMS 1–30 (1997), http://www.umass.edu/preferen/gintis/homo.pdf (last visited Oct. 5, 2014); A. Falk et al., *Homo Reciprocans*, 1 (Institute for the Study of Labor Discussion Paper No. 2205, 2006), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=920647 (last visited Oct 5, 2014).

13. We do believe, however, that this distinction can be useful to provide a simplified account of reality for analytical purposes. In the context of this Article, the term "information commons" will thus be used to refer to those commons which are not exclusively based on information, but rather predominantly based on information (and only to a lesser degree based in physical goods).

resources: the Internet, as the backbone for modern information commons, requires, for instance, a significant amount of physical infrastructure and energy to work. Ignoring this and pretending that certain commons can be exclusively information-based is an analytical mistake that could lead to a careless assessment of the serious social-environmental problems with which we are currently challenged.[14] Today, however, one cannot deny that the role assumed by information in everyday life has become so important that it affects both our methods of socialization and our practices of sharing.

This, in turn, brings information commons to the forefront of contemporary discussion. Defined by James Boyle as the "opposite of property"[15]—or, in our case, *intellectual* property—information commons have been more precisely defined as "information and knowledge resources that are collectively created and owned or shared between or among a community and that tend to be non-excludable, that is, be (generally freely) available to third parties."[16]

Following Ostrom's in-depth analysis of local communities successfully producing and maintaining common-pool resources,[17] Kollock and Smith transposed the analysis to the digital world, analyzing the Internet as a "virtual commons" nurtured by online communities which substantially differ from traditional offline communities with regard to their size, their rules (or institutions), as well as their monitoring and sanctioning mechanisms.[18] One characteristic of these online communities is that they are for the most part concerned with the production and dissemination of information.[19]

It should be pointed out, though, that Ostrom's seminal work dealt with small to medium scale, predominantly physical

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14. The degradation caused by electronic waste, and by the mining of minerals necessary for the production of electronics (and the risk of impending shortage of some of them), are examples in which socio-environmental problems can be aggravated in the information society.

15. JAMES BOYLE, THE PUBLIC DOMAIN xiv, (2008), *available at* http://www.thepublicdomain.org (last visited Oct. 12, 2014).

16. Mayo Fuster Morell, Governance of Online Creation Communities 5 (2010) (unpublished doctoral thesis, European University Institute), http://www.onlinecreation.info/outline_design (last visited Oct. 12, 2014).

17. ELINOR OSTROM, GOVERNING THE COMMONS 18-21 (1990).

18. Peter Kollock & Marc Smith, *Managing the Virtual Commons: Cooperation and Conflict in Computer Communities*, *in* COMPUTER-MEDIATED COMMUNICATION 116 (Susan C. Herring ed., 1996).

19. Donald Beagle, *Conceptualizing an Information Commons*, 25:2 J. ACAD. LIBRARIANSHIP 82, 86 (1999).

commons. More recently, the application of the Institutional Analysis and Design (IAD) framework—to which Ostrom's research is closely related—and its categories to analyze predominantly intellectual commons have been the subject of considerable debate. Authors have suggested, for instance, that the commonly accepted idea that open access systems are unsustainable might not apply to information commons;[20] others have opined that their definitions of boundaries are quite different from those in predominantly physical commons, and tend to be inclusive[21] and two-layered.[22]

For the purpose of this Article, we will not focus on a specific information commons, but, rather, on a particular kind of information commons that encompasses all initiatives geared to sharing content (i.e., literary, artistic, musical or dramatic works) or other subject matter (i.e., software or designs) that is theoretically eligible for protection under copyright law, but which have been licensed under a specific licensing scheme allowing for the resource to be freely used and reused by the public (subject to certain contractual conditions). Many online initiatives, such as Free/Libre Open Source Software (FLOSS) projects and Wikipedia, for instance, fall into this category.

It is not a coincidence that, on the Internet, content-based commons are among the initiatives involving the largest scale of collaboration today—but why has this come to be?

A. The Rise of Information Commons

In our view, one of the possible explanations for the prevalence of information commons in the digital realm is linked to both an opportunity and a threat that had to be faced by emergent communities.

The opportunity arose as a side effect of mass consumerism and media culture. Today, a significant slice of the world's population has access to tools that—in the words of Walter

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20. James Boyle, *Mertonianism Unbound? Imagining Free, Decentralized Access to Most Cultural and Scientific Material*, *in* UNDERSTANDING KNOWLEDGE AS A COMMONS 123-143 (Charlotte Hess & Elinor Ostrom eds., 2007).

21. Mélanie Dulong de Rosnay & Hervé Le Crosnier, *An Introduction to the Digital Commons* 7, http://biogov.uclouvain.be/iasc/doc/full papers/Dulong-LeCrosnier.pdf (last visited Oct. 12, 2014).

22. Miguel Said Vieira, *What Kind of a Commons is Free Software?*, *in* 739 PROCEEDINGS OF THE 6TH OPEN KNOWLEDGE CONFERENCE 1 (2011), http://ceur-ws.org/Vol-739/paper_10.pdf (last visited Oct. 12, 2014).

Benjamin—enable or facilitate "technical reproducibility."[23] While industries are always looking for cheaper ways to mass produce things, the personal computer can be regarded as one of the major steps in this direction: it is, among other things, a machine for reproducing information quickly and at virtually no cost—thereby strongly enhancing its characteristics of non-rivalry, since the consumption by one person does not affect the consumption by others. The advent of Internet and digital technologies encouraged people to produce information content on their own and distribute it worldwide with less reliance on intermediaries.

The threat, on the other hand, arises from the fact that, over the past century, information and culture have been one of the primary targets of commodification. Neoliberal economic theory posits that many areas of life are more efficiently managed when modeled as markets. Hence, the argument goes that society as a whole would greatly benefit if ideas and information were to be treated as commodities in a free market.[24]

But in order to treat something as a commodity, it must be possible to claim private property rights over it. This is where intellectual property rights (IPRs)[25] came into play. Although limited in time and subject to many more exceptions and

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23. Walter Benjamin, *The Work of Art in the Age of Mechanical Reproduction*, *in* ILLUMINATIONS 4 (Hannah Arendt ed., Harry Zohn trans., 1986).

24. The actual benefits this kind of policy brings to poorer countries are, at best, debatable. Empirical evidence, however, shows that this market for information and cultural goods is deeply unbalanced: IMF data shows that the USA had, in 1999, a net surplus of intellectual property exports that amounted to $23 billion USD, while no other country in the world even reached $1 billion USD in surplus. Alan Story, *Copyright*, *in* GLOBAL INTELLECTUAL PROPERTY RIGHTS KNOWLEDGE, ACCESS AND DEVELOPMENT 131 (Peter Drahos & Ruth Mayne eds., 2002). What is certain, therefore, is that the strengthening of intellectual property rights (IPRs) laws is in the direct interest of the conglomerates that trade with information commodities.

25. Expression commonly used to refer collectively to copyrights, patents, trademarks, and sui generis systems such as geographical indications (regarding controlled designations of origin for products), plant varieties, etc. Although usually lumped under this heading, those systems are significantly varied in terms of principles and functioning. This, along with the fact that they are not property rights strictly speaking, has led to criticism of the term as ideologically loaded. *See, e.g.,* Richard M. Stallman, *Did You Say "Intellectual Property"? It's a Seductive Mirage*, GNU.ORG, https://www.gnu.org/philosophy/not-ipr.html (last visited Oct 12, 2014) (arguing against the use of the phrase "intellectual property").

limitations than standard property rights,[26] both the scope and duration of IPRs have been progressively extended so that, today, the differences between IPRs and private property are in practice minimized:[27] for practical matters, IPRs can turn information into a private good, thus enabling it to be treated as a commodity. This change has been brought about by a series of diplomatic shifts started in the second half of the 20th century. While the evolution of intellectual property laws has a long legislative history (including reforms aimed at extending the scope and the subject matter of protection in the context of copyright law), some shifting points regarding the trend in commodification of information can be identified. One example was the creation of the World Intellectual Property Organization (WIPO), in 1970 (which was subsequently turned into a United Nations specialized agency in 1974). Unlike its predecessor, the United International Bureaux for the Protection of Intellectual Property (BIRPI), which was brought into existence with the more modest goal of administering international treaties,[28] WIPO's original mandate focused on promoting the protection of intellectual property internationally, and it actively pursued this mission. When it ceased being "fundamentalist enough,"[29] forum shifting sent it to the background, and the latest legal apex in the commodification of information arrived with the Agreement on Trade-Related Aspects of Intellectual Property Rights—the section of the World Trade Organization treaty dealing with IPRs. Also known as TRIPS, it raised and "harmonized" the possibilities of commodifying information and culture across the world. It was not a coincidence that this was such an important focus of lobbying

26. Property rights are not absolute as well and are subject to exceptions and limits—a common example being compensated expropriation by the state; even though usually subject to very strict conditions, it is a common fixture in national laws and would not be possible if property were regarded as fully absolute. IPRs, however, are generally markedly more restricted by exceptions and limitations.

27. A significant difference that remains between them is the fact that IPRs are limited in time. However, in copyright this duration can easily extend beyond a century; and in the case of patents, where duration is much shorter (usually 20 years), the continuous acceleration of technological change attenuates the effects of this limitation.

28. *See* Convention D'Union De Paris Du 20 Mars 1883 Pour La Protection De La Propriété Industrielle, Revisée A Bruxelles le 14 decembre 1900 et à Washington le 2 juin 1911. (Fr.), http://www.wipo.int/wipolex/en/details.jsp?id=12993 (last visited October 12, 2014).

29. THE COPY/SOUTH DOSSIER 81 (Alan Story, Colin Darch, & Debora Halbert eds., 2006), *available at* https://archive.org/details/thecopysouthdoss22746gut.

during the WTO rounds of discussions:[30] the economic weight of IPR-intensive industries (such as media and entertainment, pharmaceutical, agrochemical, and biotechnology companies) has risen tremendously over the past few years;[31] national laws limiting the breadth of intellectual property rights could pose serious obstacles to the expansion of those industries.

The flipside of the story is that the greater the amount of information that is turned into commodities by intellectual property rights,[32] the more limited the public domain and the amount of information that can be freely accessed and reused by society. There is, thus, a clear tension between the rise of IPRs and the type of commons that is the subject of this paper. This threat has been identified and thoroughly analyzed by many legal scholars,[33] most notably James Boyle who denounced the enclosure of information commons by reclaiming the need for a new movement (akin to the environmental movement) aimed at preserving the digital public domain. Boyle characterized that movement as

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30. *See, e.g.,* PETER DRAHOS, INFORMATION FEUDALISM 84 (2003), *available at* http://www.anu.edu.au/fellows/pdrahos/books/Information Feudalism.pdf (last visited Oct 12, 2014) (discussing differing views on harmonized intellectual property standards).

31. Between 1977 and 1999, the contribution of the USA's core copyright industries to its GDP grew by 360% according to data from Economists Incorporated; Alan Story, *Copyright*, *in* GLOBAL INTELLECTUAL PROPERTY RIGHTS 125, 130 (Peter Drahos & Ruth Mayne eds., 2002).

32. Eventually also by technological restriction measures that can go even further than the law in guaranteeing the privatized nature of information. *See generally* TARLETON GILLESPIE, WIRED SHUT (2007).

33. *See generally* NIVA ELKIN-KOREN & NEIL WEINSTOCK NETANEL, THE COMMODIFICATION OF INFORMATION (1st ed. 2002) (on the commodification of information); Howard Besser, *Commodification of Culture Harms Creators*, AM. LIBR. ASS'N. (2002), http://www.ala.org/offices/oitp/publications/ infocommons0204/besser (exploring the harms that such commodification could bring to both creators and society as a whole); Anthony McCann, *Enclosure without and within the "information commons,"* 14 INFO. & COMM. TECH. L. 217–40 (2005) (on the concept of "enclosure" as it relates to information commons); Charlotte Hess & Elinor Ostrom, *Ideas, Artifacts, and Facilities*, 66 LAW & CONTEMP. PROBS. 111 (2003) (investigating the reasons for the growing enclosure of information commons); LUCIE M.C.R. GUIBAULT & P. B. HUGENHOLTZ, THE FUTURE OF THE PUBLIC DOMAIN (2006) (on the recent expansion of copyright, database right and patent rights which might ultimately hinder the public domain); Séverine Dusollier, "Scoping Study on Copyright and Related Rights and the Public Domain," WIPO, UN doc. CDIP/4/3/REV./STUDY/INF/1, 7 May 2010, at http://www.wipo.int/edocs/ mdocs/mdocs/en/cdip_4/cdip_4_3_rev_study_inf_1.pdf (on the need to protect the public domain by means of a positive definition thereof).

"*environmentalism for information*."[34] By analogy to physical land grabs that characterized the post-feudal society in sixteenth century England and Wales, Boyle describes the recent expansion of intellectual property rights as the "second enclosure movement"[35]—a trend reflected by the growing commodification of knowledge and information in modern Western societies.[36]

It is as a response to this threat that commons based on digital information (a clear and extreme embodiment of "technical reproducibility") emerged—as illustrated by Richard Stallman's account of an experience that strongly influenced him with regard to the concept of free software: Stallman, a programmer at the Massachusetts Institute of Technology, was trying to fix bugs in the driver of a printer, which, unlike previous printers in that lab, ran with a proprietary driver. Given that the company refused to disclose the source code to the driver—and also made anyone who had access to the source code sign nondisclosure agreements—Stallman was ultimately unable to overcome the many problems of that driver.[37]

While free software already existed as a custom (in fact, many accounts suggest that most software was at that time effectively treated as if it was free for anyone to use and modify), it did not exist as a formalized movement, nor were there ways to avoid its private appropriation. Stallman, therefore, devised a technique that came to be paradigmatic: he turned copyright on its head in order to guarantee (and enforce) the possibility of sharing. He did this by developing, in 1989, a license (the GNU General Public License, or GPL) which used the author's rights vested in a work to ensure that such work is and will always remain freely

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34. JAMES BOYLE, THE PUBLIC DOMAIN: ENCLOSING THE COMMONS OF THE MIND 230-48 (2008), *available at* http://thepublicdomain.org/thepublicdomain1.pdf.

35. According to James Boyle, the "second enclosure movement" attempts to put fences around the intellectual commons of ideas and facts in a manner analogous to the enclosure and transfer of property rights from the public to the private sphere during the first enclosure movement in England that fenced off common areas between the fifteenth and nineteenth centuries. James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, 66 LAW & CONTEMP. PROBS. 33 (2003), http://www.law.duke.edu/shell/cite.pl?66+Law+&+Contemp.+Probs.+33+%28WinterSpring+2003%29.

36. LUCIE M.C.R. GUIBAULT & P.B. HUGENHOLTZ, THE FUTURE OF THE PUBLIC DOMAIN (2006).

37. RICHARD M. STALLMAN, FREE SOFTWARE, FREE SOCIETY 159 (1st prtg., 1st ed. 2002), *available at* http://www.gnu.org/philosophy/fsfs/rms-essays.pdf.

accessible to the public, without many of the restrictions imposed by default under the regime of copyright law. Intended to promote and preserve the commons, this license is geared to facilitate sharing amongst individuals, subject to only specific conditions—the most important of which are the requirement to share the source code along with the software itself, and the so called "copyleft clause" which asserts that all works derived from GPL-licensed works should also be distributed under the GPL license. A short manifesto in itself, the GPL can be seen as a landmark in the free software movement—initiated under the leadership of Richard Stallman—and it is now regarded by many scholars as a commons in itself.[38]

Many other licenses developed later on were admittedly inspired by the GPL license, using copyright to build and to preserve the information commons. Most prevalent nowadays are the Creative Commons licenses: a set of licenses establishing a regime of "some rights reserved" (as opposed to the "all rights reserved" proposed by default under the law). The common characteristic of these licenses is that they all assert the right to share and to copy, provided that proper attribution is given. Additional conditions can also be incorporated into the license in the way that better suits the preferences of each author: the copyleft clause, the non-commercial clause (which only allows for non-commercial uses of the work), and the non-derivatives clause (which precludes the production of derivative works and is thus incompatible with the copyleft clause). Today, Creative Commons licenses are the most used licenses in some of the largest information commons initiatives outside the FLOSS movement, such as Wikipedia and the open access scholarly publishing movement.

B. Commons-Based Peer Production

Most initiatives concerned with the production and dissemination of information commons have explored the opportunities provided by Internet and digital technologies in ways

38. *See, e.g.*, Charles M. Schweik, *Free/Open-Source Software as a Framework for Establishing Commons in Science*, *in* UNDERSTANDING KNOWLEDGE AS A COMMONS (Charlotte Hess & Elinor Ostrom eds., 2007); R. VAN WENDEL DE JOODE, J.A. DE BRUIJN & MICHEL VAN EETEN, PROTECTING THE VIRTUAL COMMONS (2003), *available at* http://hdl.handle.net/10535/25; Miguel Said Vieira, *What Kind of a Commons is Free Software?*, 739 PROCEEDINGS OF THE 6TH OPEN KNOWLEDGE CONFERENCE (2011), *available at* http://ceur-ws.org/Vol-739/paper_10.pdf.

that go far beyond the near-costless reproduction and distribution of digital content. Indeed, with the advent of Internet and digital technologies, new ways of production progressively emerged—often involving online cooperation and collaboration amongst peers—which can be regarded as a new type of collective action in the information realm.[39] If the hypothesis of the *homo reciprocans* is to be believed, peer production initiatives are genuinely among its manifestations, as they emphasize collaboration over rational maximization of self-interest.

Thanks to digital technologies, many users have become producers of information.[40] A variety of affordable digital devices can be used to record, process, combine or edit digital content. Given that the costs of production are low, a greater number of people can produce information content without any significant investment beforehand. This is one of the reasons why most user-generated content is distributed for free—often under an expectation of fame, popularity, or deferred reciprocity.[41]

The worldwide scope of the Internet also provides the means for users to socialize and to contribute together to common projects regardless of their individual location. This encourages collaboration rather than competition and facilitates *peer production*—a process whereby interactions amongst peers are not performed on the basis of economic transactions, but rather on the basis of solidarity and social relationships.

In the context of peer production, the traditional model of production based on a hierarchical subdivision of tasks gives way to a more dynamic system of production based on more symmetrical relations between peers and a self-governed

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39. Yochai Benkler & Hassan Masum, *Foreword*, *in* COLLECTIVE INTELLIGENCE xi–xx (Mark Tovey ed., 1st ed. 2008).

40. While there are controversies about the actual extent of this change, it is clear that, in comparison to the situation with earlier mass media, digital technologies provide more opportunities for people to produce (and not only consume) information.

41. N. Geach, *The Future of Copyright in the Age of Convergence,* 23 INT'L REV. L. COMPUTERS & TECH. 131-142 (2009). Regarding user expectations when creating, *see contra* Eben Moglen, *Anarchism Triumphant: Free Software and the Death of Copyright,* 4 FIRST MONDAY, Aug. 2, 1999 at (1999) (arguing that this could happen even without any expectation at all, as an end in itself; "It's an emergent property of connected human minds that they create," and in most cases we do it simply "[b]ecause we can": because it's pleasurable and inherently human), *available at* http://firstmonday.org/ojs/index.php/fm/article/view/684.

subdivision of labor. According to Michel Bauwens,[42] the system of peer production is characterized by the following attributes: distributed architectures, self-organized task-forces (i.e., individual contributions are not determined *a priori*, but rather based on voluntary self-identification of interests with *a posteriori* reputation and validation systems), and a great deal of transparency (regarding individual collaborations, metrics, documentation of the project, etc.). Online communities often rely on this new model of production to promote collaboration and to coordinate a large variety of actors using each others' contributions to create something that is often greater than the sum of its parts.

There exists a positive interaction between peer production (as a particular mechanism of production) and information commons (as the potential output of such production). While one does not always imply the other, in practice, the majority of initiatives relying on peer production are generally concerned with the production of information commons. This combination has been described by Yochai Benkler as *commons-based peer production*,[43] a new way of production that combines the contributions of a widely distributed network of individuals collaborating together towards the creation of information commons.

III. CLOUD COMPUTING

Cloud computing is a term whose definition is difficult to establish. Defined by the National Institute of Standards and Technology (NIST) as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction,"[44] cloud computing basically refers to any application

42. Michel Bauwens, *The Political Economy of Peer Production*, CTHEORY (2005), http://www.ctheory.net/articles.aspx?id=499.

43. Commons-based peer production is a term coined by Benkler to describe a particular mode of socio-economic production that has emerged on the Internet. Yochai Benkler, *Coase's Penguin, or, Linux and "The Nature of the Firm,"* YALE L.J. 369–446 (2002), *available at* http://www.jstor.org/stable/10.2307/1562247; YOCHAI BENKLER, THE WEALTH OF NETWORKS (2006), *available at* http://cyber.law.harvard.edu/wealth_of_networks/Main_Page.

44. For a more detailed overview of the characteristics of Cloud Computing, see "The NIST Definition of Cloud Computing." P. Mell and T.

or service running on a distributed network and relying on virtualized resources (i.e., resources that have been aggregated into a common pool to be subsequently shared amongst users) which can be easily accessed by common Internet protocols.[45]

Today, however, the term is often used to describe a new business model rather than a new technology;[46] it has also been argued that its meaning can be stretched enough to refer to practically any use of the Internet.[47] Indeed, it can be said that the cloud is, essentially, "the Internet as it evolves towards more centralized computing capacities and virtual . . . storage."[48]

In this Article, we refer to cloud computing platforms as an online infrastructure with huge computational power that is able to store and process very large amounts of data.[49] As the amount of data keeps growing at an exponential rate (whether it is publicly available on the Internet, or privately held in personal files and databases), it becomes increasingly difficult to store everything locally, either for individuals or organizations. Data is thus increasingly stored on remote servers (or data centers) that constitute the infrastructure of the cloud. This is generally done through highly distributed architectures made up of several data centers located in various parts of the world, but nonetheless subject to centralized governance by one or more identifiable entities—such as Google, Amazon, Facebook, and so on.

While the new opportunities offered by cloud computing technologies can be used to facilitate the production, distribution, and use of information commons, the shift towards centralization is likely to have a considerable impact on the governance of these commons—increasingly controlled by large corporations rather

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Grance, *The NIST Definition of Cloud Computing*, NIST Special Publication 800-145, Sept. 2011, *available at* http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.

45. BARRIE SOSINSKY, CLOUD COMPUTING BIBLE 4-22 (1st ed. 2011).

46. I. Foster et al., *Cloud Computing and Grid Computing 360-degree Compared*, GRID COMPUTING ENVIRONMENTS WORKSHOP GCE '08 1–10 (2008), *available at* http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4738445 (last visited Aug. 24, 2012).

47. RICHARD M. STALLMAN, FREE SOFTWARE, FREE SOCIETY 212 (2d ed. 2010).

48. David Lametti, *The Cloud: Boundless Digital Potential or Enclosure 3.0?*, 17 VA. J.L. & TECH. 195(2012), *available at* http://www.vjolt.net/vol17/issue3/v17i3_190_Lametti.pdf (last visited Oct. 5, 2014).

49. Although this is not always mentioned in debates about cloud computing, it is possible to design cloud platforms that are based on decentralized architectures; this will be discussed later in this Article.

than the communities for which (and by which) they have been produced.

In this regard, although cloud computing can refer to three distinct categories of services that distinguish themselves according to the type of resources involved—Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)—for the purpose of this Article, we will focus mainly on the latter, as the one most likely to affect information commons.

In the context of cloud computing, SaaS refers to a new way of delivering software functionalities by providing a variety of online applications that can be accessed directly from a web-browser, without the need for users to download any application onto their own devices. The key idea is to separate the ownership and possession of software from its actual use.[50] Resource-intensive applications running on large data centers become accessible from thin client interfaces running on low-resources user devices. Consumers do not need to manage the underlying infrastructure necessary for the service to run: the network infrastructure, operating system, storage devices, and application preferences are all controlled and configured by the cloud provider. As opposed to more traditional client-server applications, which require users to install specific-purpose software on their own devices, SaaS relies on modern Web 2.0 functionalities that only require users to run a web browser. In spite of the increasing complexity of underlying software, users merely interact with the application through the user-interface provided by the cloud provider, without any knowledge of the technical implementation of the applications they are running; most or all of the back-end processing and storage is made in the cloud infrastructure, and not in a user's own devices. While this represents a powerful advantage to users who need no longer worry about configuring or updating their software, SaaS also presents a series of risks in terms of user freedom and autonomy. Cloud providers can, indeed, modify the software at any time, or diversify the operators that contribute to providing the underlying services without the need for any kind of intervention from users, who are often unaware of any changes made in the back-end infrastructure of the cloud. As we will see later, this is also likely to limit the ability for users to control and exploit information commons, since neither the information content nor

50. M. Turner, D. Budgen & P. Brereton, *Turning Software into a Service*, 36 COMPUTER 38–44 (2003), *available at* http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1236470.

the software applications dealing with such content are any longer under the control of end-users.

A. Value of Cloud Computing

Cloud computing offers a series of advantages and opportunities to a large number of Internet users and operators. Most of these advantages are related to the concept of *elasticity* (i.e., the automatic reconfiguration of computing resources according to actual needs) and *utility computing* (i.e., the provision of hardware and/or software resources on a pay-as-you-go basis rather than as a lump sum).

Online operators and intermediaries can benefit from being able to use an indefinite amount of computing resources without having to plan ahead. Since they only have to pay for the actual amount of resources they use, online operators can provide a service to users with no considerable investment in time and money for acquiring the hardware and setting up the software necessary for the initial bootstrapping. Cloud computing allows them to start small and only acquire additional computing resources at a later stage, when the need actually arises. Cloud computing also protects online operators from the risk of wasting unused computing resources—which will be automatically released and redistributed as needed. Indeed, in order to minimize the waste deriving from excess capacity, cloud computing redistribute resources amongst different operators according to their individual needs to make sure that resources are always assigned to the most efficient use.[51]

Users, on the other hand, can benefit from cloud computing through facilitated access to data: as it is exported into the cloud, data is no longer trapped in any personal computer or user device. Software applications and users' documents can thus be accessed from anywhere, at any moment,[52] and regardless of the device used to connect into the cloud (as long as there are no compatibility or interoperability issues with the cloud computing

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51. For more details, see *A View of Cloud Computing*. M. Armbrust et al., *A View of Cloud Computing*, 53 COMM'S ACM 50–58 (2010), *available at* http://dl.acm.org/citation.cfm?id=1721672 (last visited Oct. 5, 2014).

52. To the extent that it does not belong to any given computer or device, data becomes ubiquitously available to anyone with an Internet connection. Yet, even if one cannot pinpoint the data to a specific machine in the cloud infrastructure, the data still "belongs" to a specific technical device: the cloud as a whole—as opposed to users' personal devices. This means, for instance, that if the cloud infrastructure is down users will be unable to access the data.

interface).[53] Cloud computing can also facilitate user collaboration, since documents stored in the Cloud can be accessed simultaneously by a variety of users—who can enjoy the benefits of sophisticated applications without having to install them on their computer.

B. Cloud Computing and Information Commons

Cloud computing can provide significant benefits to the development and sharing of information commons. Most of these benefits—which are mainly related to the storage and access to data via the cloud interface, as well as the collaborative production or editing of such data—can be roughly classified in the following way:

	Storage/Access	Development/Editing
Centralized platform	single point of reference; up-to-date content	aggregation of multiple contributions; versioning
Online ubiquity	accessible from everywhere and at any time	distributed and asynchronous collaboration
Elasticity	scalability of resources (pay-as-you-go); reduce the risks of overcapacity or unpredicted resource shortage	automatic management of software applications (invisible to end users); evolving user interface

Let us consider, for instance, a scenario in which a few hundred people collaborate in compiling and updating a complex database containing information about scientific experiments. The initiative in this example is intended to be an information commons: the results are to be shared—even if subject to certain rules concerning access and provisioning.

As the database grows over time, local storage by each individual can become increasingly difficult to achieve due to the sheer size of accumulated data. Such local and independent storage is an even less practical alternative when the records in the database are constantly being edited. Cloud computing could facilitate the task by providing a platform to aggregate all

53. As an example, Adobe Flash—used in a variety of cloud interfaces—is not currently supported in quite a few operating systems and architectures. It was not supported for some time in Apple's iOS, and will not be supported in the latest Android version. In addition, there is no fully working free software replacement for it.

individual contributions in an automated way. This would both ensure a single point of reference to access the most up-to-date instances of all the database's records and enable people to keep track of all previous versions of the records, so as to refer back to them whenever necessary.[54] While the online and ubiquitous character of the cloud infrastructure (as being time-, location- and device-independent)[55] could simplify global collaboration and make the database available to a larger public, the scalability of the cloud architecture could significantly reduce downtime, as well as the costs involved in maintenance and the over-provisioning of hardware resources. Finally, cloud computing could provide users with a sophisticated interface to access or query the database (an interface that could implement some, though not all,[56] of the access and provisioning rules pertaining to this database), by deploying specialized web applications for online collaboration that would be immediately accessible to users, without any kind of intervention on their part. This management of the cloud's back-end software is invisible to final users.

As this example illustrates, cloud computing is a useful means to facilitate the storage and access to data, as well as to encourage collaboration around it. By automating the aggregation of data or information into a scalable and ubiquitously available platform, cloud computing constitutes an important step in developing information commons through digital technology. This is particularly true in the field of scientific collaboration, where the ability to aggregate large amounts of data from different sources is an essential requirement for the global-scale collaboration and extensive data analysis that characterizes many current research projects.[57]

More and more information commons are being produced through a mechanism whereby users are invited to contribute individually to a large project that is ultimately made up of a very large number of separate contributions. The large-scale aggregation of all contributions can produce something which, taken as a

54. MICHAEL MILLER, CLOUD COMPUTING (2008).

55. But *cf. supra* notes 54 and 55, regarding the relative aspect of this ubiquity.

56. As an example, this platform could track and display the licenses that each database record is distributed under, but it certainly would not be able to enforce such licenses.

57. J.T. Dudley & A.J. Butte, *In Silico Research in the Era of Cloud Computing*, 28 NATURE BIOTECHNOLOGY 1181-85 (2010), *available at* http://www.nature.com/nbt/journal/v28/n11/full/nbt1110-1181.html?ref=nf7 (last visited Oct. 5, 2014).

whole, is much greater than the sum of each of the individual parts. Cloud computing can, as we have argued, facilitate this process by simplifying the procedure of collaboration and cooperation amongst users. This encourages the establishment of new models of production based on the management of voluntary-based human resources, sometimes referred to as crowdsourcing[58] or—somewhat ironically—Human as a Service (HaaS).[59]

This can be most clearly observed in the context of the FLOSS movement, which has been the pioneer in this field. Many FLOSS applications are produced not by any given individual or company, but by a distributed community of users—often passionate and enthusiastic volunteers—relying upon a shared online platform to collaborate asynchronously in the development of the code. Given the inherently distributed character of this type of production, it is very helpful if the source code resides in one place that is always and unconditionally available to everyone. Several platforms have thus been created to facilitate peer collaboration and software development—many of which rely on cloud computing technologies; for instance, GNU Savannah, a central point for development, distribution, and maintenance of Free Software (https://savannah.gnu.org), and SourceForge, a web-based source code repository that acts as a centralized location for software developers to control and manage FLOSS development (http://sourceforge.net).

Although initiated by the FLOSS movement, the same model can be applied, by analogy, in the realms of scientific, literary, musical or audiovisual works. There are, to date, a significant number of initiatives providing tools for the production and dissemination of information commons on cloud computing platforms—a number that is likely to grow in the coming years. Wikipedia is probably the most renowned example, but it is not the only one. Kune, for instance, is a newly developed web application based on cloud computing technologies, intended to encourage collaboration amongst peers so as to promote the creation and facilitate the sharing of free culture. It allows users to

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58. Gioacchino La Vecchia & Antonio Cisternino, *Collaborative Workforce, Business Process Crowdsourcing as an Alternative of BPO*, *in* CURRENT TRENDS IN WEB ENGINEERING 425-30 (Florian Daniel & Federico Facca eds., 2010), *available at* http://www.springerlink.com/index/V3245264Q5872523.pdf.

59. *See generally* Farzad Sabetzadeh & Eric Tsui, *Delivering Knowledge Services in the Cloud*, 2 INT'L. J.KNOWLEDGE & SYS. SCI. 14, 14–20 (2011), *available at* http://www.irma-international.org/viewtitle/61131 (discussing a more detailed overview of this new trend in cloud computing).

create an online group space for the creation of collaborative documents, build community websites, hold and plan meetings in real time, interact or share contents with other users of the same group or with other people within the social network (http://kune.ourproject.org). The Kopfschlag project has applied this model in the domain of the arts by creating an online canvas that anyone can edit, draw or erase, contributing thereby to a continuously evolving collaborative work of art (http://kopfschlag.com/). In the domain of academic research, there are several platforms—such as CiteULike, Zotero and Connotea—aimed at allowing users to store, manage and share bibliographical information (including comments and folksonomical tagging). In the field of computer graphics, BlendSwap is a repository of models (files detailing objects and characters) for Blender, a FLOSS for 3D animation; models can be shared under certain Creative Commons licenses (CC-0, CC-BY, CC-BY-SA), and users can favorite, comment, and download them (http://blendswap.com).

In addition, cloud computing platforms can be particularly useful to promote access to and dissemination of information commons, even if the tools they provide are not focused on facilitating collaborative production as such. Wikimedia Commons, for instance, is a database of over 13 million freely usable media files to which anyone can contribute. It makes available public domain and freely-licensed educational media content (images, sound and video clips) to everyone, and is mostly maintained and populated by volunteers (http://commons.wikimedia.org). Similarly, the Internet Archive is a non-profit digital library offering free access to books, movies, and music that ultimately belong to information commons, either because they are part of the public domain or which have been released under a free/open license (http://archive.org). In the field of music, a number of platforms have been set up to facilitate access and dissemination. A popular example is ccMixter, a searchable repository of samples (uploaded and categorized by users) which are licensed under free/open licenses and which can be either downloaded or directly streamed onto the website. The platform also comes along with a series of tools to promote interaction between users (such as user profiles and forums), while allowing them to bring value to the repository by writing reviews or adding "trackbacks" indicating that certain samples have been used in a derived work (http://ccmixter.org).

Oftentimes, the flexibility and dynamicity of digital communities based on the logic of collaboration and incremental innovation can produce results that are as good—if not better—than

those of large corporations. It is not uncommon for FLOSS to be considered more reliable than its commercial counterparts[60]—and the same can be said for many products released under free/open licenses.

IV. COMMODIFICATION OF THE COMMONS

Given the perceived value of information commons, large online service providers are often tempted to capitalize on them. Indeed, although they cannot directly appropriate the commons' resource pool, market actors can nonetheless benefit indirectly by capturing value derived from the information commons. An increasing number of commercial platforms—such as Flickr, Vimeo, or SoundCloud—have identified the economic potential of information commons, and are nowadays providing the means for users to upload content produced by them or by others into their platforms, provided that it has been released under a free/open license. While this might not be a problem as such, this situation could result in a series of unintended consequences that were hard to foresee before the advent of cloud computing. Among the most pernicious of those consequences is the fact that, in certain cases, cloud computing technologies can be used by commercial actors to extract value from the information commons in ways that might hamper their development or restrict their availability to the rest of society.

A. Definition

Commodification is the process through which something becomes a commodity. Commodity, in turn, is a concept that can be defined in many (often complex) ways. For the purpose of this Article, we have adopted an operational definition of commodity similar to that of Karl Polanyi: a private good, produced through a

60. Internet web servers are a strong case in point; according to a long-running survey by an independent Internet services company, FLOSS has always accounted for the largest percentage of web servers. *See, e.g., Jun. 2014 Web Server Survey*, http://news.netcraft.com/archives/2014/06/06/june-2014-web-server-survey.html (last visited Oct. 5, 2014) (a survey covering 968 million websites, noting that as of Jul. 2014 at least 66.91% of the active servers run FLOSS with the top proprietary software option accounting for 11.88%); *75% of Top 10k Websites Served by Open Source Software* (2012), http://royal.pingdom.com/2012/05/22/75-percent-top-10k-websites-served-by-open-source-software (last visited Oct. 5, 2014) (another survey made by a different company in 2012, covering only the Internet's top ten thousand websites showed a very similar distribution).

process that is mostly driven by market needs or considerations (as opposed to a process driven by direct needs or considerations of a community).[61]

Applying this definition of commodity to information commons (namely, when information commons are the subjects of a commodification process) involves a peculiarity. To turn a commons into a commodity, it must firstly be turned from a common good (i.e., a good that is owned, used and/or cared for by a community) into a private good through the process of *enclosure*. This is due to two main reasons. First, in order to legitimately offer a commodity in a market, one must be able to exert exclusive rights (such as those connected to private property) over it.[62] Second, if a commodity can be shared amongst several individuals, it will be less scarce (and thus less valuable as a commodity) than if it were exclusively controlled by one person.

To better understand the concept of commodification as applied to information commons, it is useful to distinguish it from similar but distinct phenomena that can occur within or around the commons.

One of these is the process of *commercialization*, i.e., the act of offering something for sale. While commodification presupposes commercialization, the reverse is not always true. There are, in fact, many possible ways for commercial or non-commercial actors to extract economic rents from the use or exploitation of information commons without negatively affecting their viability as a commons. For example, although FLOSS can sometimes be sold commercially, such a sale does not involve the commodification of the software (which remains shareable and free—in the strong sense of this word—despite the sale), nor does it imply that the production thereof was necessarily driven by market needs. In this example, commercialization occurs *inside* the commons, to the extent that it is directly affecting its resource pool; however, commercialization can also occur *around* the commons, by indirectly leveraging the contents of the resource pool. This is

61. KARL POLANYI, THE GREAT TRANSFORMATION 72 (2001).

62. It is also possible that the whole community jointly agrees to dispose of all or part of the things they share in a commons; in this case, the good can be commoditized while it is still common property. While this "voluntary" case of commodification of a commons is worthy of analysis, we will not examine it in this Article for reasons of simplicity. Additionally, it should be noted that, while the right of alienability is but one right in the bundle that constitutes property rights, and while a commons may exist even without common property *per se*, alienability is critical to the process of commodification.

the case of many "indirect sale-value"[63] and "freemium"[64] business models, in which profit comes not from the sale of the commons resource pool, but rather from the sale of products or services related to it. In the context of FLOSS, this type of commercialization is generally achieved through the sale of proprietary versions with additional features, specialized hardware that is compatible with the software, support or customization services. In the context of literary works, this is achieved through the sale of abridged audio versions, deluxe editions, and so on. Finally, commercialization *around* the commons can also be achieved by means of advertising. Providing information commons for free in order to attract a substantial users base and subsequently selling users' data for the purpose of behavioral advertising is nowadays a frequent business model which, although definitely involving some degree of commodification, does not necessarily imply commodification of the commons' resource pool itself.

Thus, while commodification does constitute a threat to information commons—to the extent that they can no longer be freely enjoyed by the community—commercialization is not, as such, antithetical to the commons. Many of these cases are, indeed, based upon the provision of previously unavailable services or products; ones that can satisfy communities' needs, without posing threats to the commons they are structured around. Additionally, the benefits derived from advertising and previous examples could potentially be used to provide resources for the development of more information commons.

A second phenomenon that must be distinguished from the commodification of information commons is the one of *cooptation*, i.e., transforming the structure of an information commons in such a way as to no longer reflect the aims and needs of its community. Cooptation can be a consequence of commercialization happening *around* the commons (as in the cases outlined above), but it is a more subtle and nuanced phenomenon. Let us consider two possible examples of cooptation.

One is the case of FLOSS becoming the object of interest of a few companies whose businesses are based on providing services or selling hardware somehow related to that FLOSS. Those companies are likely to contribute to the development of

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63. ERIC S. RAYMOND, THE CATHEDRAL AND THE BAZAAR 134–40 (Rev. ed. 2001). Eric Raymond is a leading figure in the open source software movement.

64. CHRIS ANDERSON, FREE: THE FUTURE OF A RADICAL PRICE 22-23 (2009), *available at* https://archive.org/details/FreeTheFutureOfARadicalPrice.

that software. In some cases, they might participate simply in order to keep themselves up-to-date in the state of the art of their technical fields, but many will also be inclined to contribute in order to ensure that the software is being developed in ways which are compatible with the businesses they run around it—a logical motivation, considering incompatibility would mean losing their revenue. In this case, cooptation would take place whenever the influence these companies exert over the development of the software is so large (e.g., because of the amount of community members that the company can employ for paid work, or because of their interference in the governance structure of the commons) that it eventually supersedes the influence of other actors, thus effectively making the needs of those companies a priority over the community's needs.[65] Since the commons' resource pool remains free, it is in theory always possible for the community to fork[66] in order to follow a different direction; yet, apart from the fact that forking is generally rare (it is undertaken only as a last resort, as communities acknowledge that otherwise it wastes too much effort),[67] the fact that the company employs many members of the community introduces an additional imbalance favoring the primacy of the company's interests.[68] The second example is that of many blogs licensed under free/open content licenses. Most of those blogs resort to advertisements (either in the form of banners and text ads, or through sponsored posts and paid product placement) in order to earn money. In this case, cooptation would occur if the content and general editorial direction of those blogs were transformed in such a way as to make them more attractive to

65. For instance, if some of those companies sell servers with heavily multithreaded processors, in the circumstance that a choice had to be made between alternative development paths enhancing either multithreaded or single-threaded performance, that company could use its influence over the project to guarantee that the multithreaded path be the chosen one (even if the community's needs are closer to the opposite choice).

66. In the context of software development, "forking" is the act of splitting a project, by taking the code which has been implemented until now, to further develop it in a different direction than the original project, in such a way that it becomes difficult to share future code between the two projects. Forking usually implies a similar schism in that project's community. RAYMOND *supra* note 65, at 72.

67. STEVEN WEBER, THE SUCCESS OF OPEN SOURCE 64 (2004).

68. As an example, Android is a FLOSS operating system in which such imbalance is evident in its governance structure. *See, e.g.,* Miguel Said Vieira, *What Kind of a Commons is Free Software?*, *in* 739 PROCEEDINGS OF THE 6TH OPEN KNOWLEDGE CONFERENCE 9-10 (2011), http://ceur-ws.org/Vol-739/paper_10.pdf (last visited Oct. 5, 2014).

advertisers (for instance, by focusing on content that is seen as more advertising-friendly, that promotes more click-throughs, or that is geared to increasing search engine hits).

As mentioned above, cooptation is ultimately a nuanced process: in both examples, there is a continuum of gray areas (rather than a binary measure) of cooptation. It is—unlike commercialization *inside* or *around* the commons, which could potentially help in funding the maintenance of the commons—a process strictly detrimental to commons, although it does not necessarily involve commodification *per se.*

B. Commons into Commodities

Commons are generally driven by the needs of their communities; with information commons, communities can be remarkably large and porous to new members.[69]

Information commons create value for society by allowing anyone to freely use and reuse them. As opposed to market goods, which are meant to be exchanged as commodities on the market, information commons are intended to fulfill the underlying needs of the community by which (and for which) they have been produced. While, in a market economy, goods or services provided by commercial suppliers are subsequently offered to the consumers in exchange of a specific consideration—whose value is ultimately determined through the market mechanisms of supply and demand—in the context of information commons, goods or services are produced directly by the community in order to fulfill their own needs (or needs they deem important), and are subsequently made available (often for free) to other members of the community (or different communities) who might express the same or similar needs. This is particularly relevant in the case of Open Access[70] and Open Educational Resources (OER),[71] which

69. Access to technology, Internet infrastructure and technical knowledge, and even language and gender issues can still be barriers to participate (particularly in a more active way). However, the situation is considerably better than with most physical commons, where the scarcity and more rival character of resources limit membership in a much stronger way. Because of that, membership requirements in physical commons can be more "arbitrary," restricting the community to those born in a certain area, for instance; while in information commons, the requirements to join as a user can be as low as agreeing to follow copyleft rules (which only apply when the user wants to redistribute the good).

70. Open Access (OA) is the practice of providing unrestricted access via the Internet to peer-reviewed scholarly journal articles. *See, e.g.,* OPEN ACCESS, SPRINGER, http://www.springer.com/open+access?SGWID=0-169302-0-0-0 (last

effectively contribute to establishing a universal right to education and access to knowledge for everyone.

In addition to favoring use and reuse by the community, information commons also encourage people to build upon them, to subsequently produce new works that will become themselves part of the commons (either immediately, whenever the derivative works have been released under a free/open license, or at a later time, after the copyright has expired).[72] In the realm of arts, Creative Commons licenses[73] considerably facilitated the practices of remix, mashup, or the making of derivative works, by allowing people to build upon previous works without having to incur the costs of clearing the copyright in these works. Depending upon the license, works derived from the information commons will either become immediately available to the public under an identical (in the case of copyleft licenses) or similar regime, or they will be subject to the copyright regime and thus only benefit society at a later time, after the exclusive rights have expired.

While any work released under a free/open license will contribute to increasing the pool of information commons, licenses precluding the making of derived works or imposing restrictions over commercial uses of the commons could reduce potential benefits that can emerge from those works (in particular, the possibility that certain derived works are produced and added to the commons). Those are, however, widely used types of licenses: according to an estimate in 2007, at least half the works using their

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visited Oct. 23, 2014); OPEN ACCESS, ELSEVIER, http://www.elsevier.com/about/open-access (last visited Oct. 23, 2014); ABOUT OCW, MIT OPENCOURSEWARE FREE ONLINE COURSE MATERIALS, http://ocw.mit.edu/about (last visited Oct. 23, 2014); ABOUT US, BIOMED CENTRAL, http://www.biomedcentral.com/about (last visited Oct. 23, 2014).

71. Open Educational Resources (OER) describes any educational resources that are openly available for use and reuse by educators or students, without the need to pay any royalties or license fees. *See, e.g.,* FREE ONLINE COURSE MATERIALS, MIT OPENCOURSEWARE, http://ocw.mit.edu/index.htm (last visited Oct. 23, 2014).

72. While it is not unusual to refer to a single "information commons" as one wide pool that includes all content in the public domain, under free/open licenses, or that qualifies as fair use, we refer here instead to *many* instances of information commons (which can sometimes be superposed or linked, as when there are compatible licenses). In this sense, the public domain is one of those many instances of commons.

73. The Creative Commons copyright licenses and tools forge a balance inside the traditional "all rights reserved" setting that copyright law creates. *See* ABOUT THE LICENSES, CREATIVE COMMONS, http://creativecommons.org/licenses (last visited Oct. 23, 2014).

licenses used those with clauses precluding commercial usage—including the making of derived works.[74]

This can be detrimental to the extent that using the commons—either commercially or not—is likely to result in previously unavailable products or services that could ultimately benefit society. The use of these licenses is therefore discouraged by many online communities concerned with the preservation and the promotion of information commons,[75] on the grounds that information commons cannot be, in themselves, directly harmed by commercial usages, since they will, at least in principle, also remain accessible to others in a non-commercial way.

What is true in principle is, however, not necessarily true in practice. Indeed, many mechanisms can be employed to turn information commons into a commodity.

One of such mechanisms—albeit somewhat controversial—is to acquire the copyright in a work and subsequently revoke the license. This issue was raised in the *CyberPatrol*[76] case, in which the copyright in software released under the GPL license was transferred to a third party which purported to revoke the license. Although the court ultimately did not rule on the issue, the general opinion is that even though the copyright owner may decide that a work be no longer released under a particular license, that cannot impinge upon the rights of any previous licensee who legitimately obtained a license. Any formerly issued license will continue to be valid provided that no breach has occurred.[77]

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74. Giorgos Cheliotis, *Creative Commons Statistics from the CC-Monitor Project*, *available at* https://wiki.creativecommons.org/images/7/71/Statistics-from-the-CC-Monitor-project_eng.pdf.

75. *See, e.g., Open Definition,* OPEN DEFINITION, http://opendefinition.org/od/index.html (last visited Oct. 23, 2014). Among the conditions it requires for a work to be considered open is that it "may not restrict the work from being used in a business" or in any other endeavor.

76. Microsystems Software, Inc. v. Scandinavia Online AB, 226 F.3d 35, 38 (1st Cir. 2000). The defendants developed a software capable of decrypting the database of Mattel's web-filtering software and Mattel sued for copyright infringement, as a result of which the defendants assigned the copyright in their software to Mattel. On the belief that the software had been released under the GPL, the case generated strong controversies in the FLOSS community. While many claimed that revocation of the GPL license was impossible, the Free Software Foundation nonetheless admitted that revocation is potentially a problem, as the GPL specifically states that "the recipient automatically receives a license from the *original licensor.*" GNU GENERAL PUBLIC LICENSE V2.0, GNU PROJECT, http://www.gnu.org/licenses/gpl-2.0.html (last visited Oct. 23, 2014) (emphasis added).

77. This view has been formalized by the Creative Commons licenses, according to which the "licensor reserves the right to release the Work under

When the law does not allow for the commons to be turned into a commodity, contracts and technology can be used instead as mechanisms to dictate the extent to which a particular piece of content can be used. This can be done, for instance, by incorporating protected material into an information commons (e.g., adding a preface to a book that has entered the public domain) and subsequently relying on contractual provisions and/or technological measures to introduce an additional layer of protection to the work as a whole. While several of these practices have been precluded by certain free/open licenses,[78] they can nonetheless be employed to acquire control over information that is not subject to copyright protection, such as facts, ideas, or any work whose copyright has expired. Indeed, these practices of so-called *copyfraud*[79] are commonly employed by a number of publishers, such as the Bibliothèque Nationale de France claim of exclusive rights over the public domain books part of the Gallica collection[80] by virtue of the addition of prefaces, edits or footnotes, and Cengage Gale's[81] provision of access to public domain

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different license terms or to stop distributing the Work at any time; provided, however that any such election will not serve to withdraw this License (or any other license that has been, or is required to be, granted under the terms of this License), and this License will continue in full force and effect unless terminated [by a breach]." *License*, CREATIVE COMMONS, http://creativecommons.org/licenses/by/3.0/us/legalcode(last visited Oct. 23, 2014). Accordingly, as long as the license has not expired and that none of its provisions have been breached, the license is deemed to be valid and legally effective with regard to every work it has been applied to, and any change in the terms and conditions of the license will not have any effect on the copies that have already been released but will only affect the license for the new copies of the work. *See* Mikko Välimäki & Herkko Hietanen, *The Challenges of Creative Commons Licensing*, COMPUTER L.REV. INT'L 173, 173–78 (2004), http://cat.inist.fr/?aModele=afficheN&cpsidt=16349058.

78. Certain licenses are incompatible with the application of technological measures of protections to the extent that they prevent or restrict the access to and/or the legitimate exploitation of a work. *See generally* ABOUT THE LICENSES, CREATIVE COMMONS, http://creativecommons.org/licenses/ (last visited Oct. 23, 2014). Whereas others are incompatible with the application of any technological measures of protection, whether or not they have been designed to prevent or restrict the legitimate exploitation of a work. *See, e.g.,* GNU FREE DOCUMENTATION LICENSE V1.3, GNU PROJECT, http://www.gnu.org/copyleft/fdl.html (last visited Oct. 23, 2014).

79. Jason Mazzone, *Copyfraud*, 81 N.Y.U. L. REV. 1026 (2006).

80. *See A Propos*, GALLICA, http://gallica.bnf.fr/html/propos (last visited Oct. 23, 2014).

81. *See Cengage Learning*, GALE, http://www.gale.cengage.com (last visited Oct. 23, 2014); Jonathan Gray, *Did Gale Cengage Just Liberate All of Their Public Domain Content? Sadly Not*, OPEN KNOWLEDGE FOUNDATION

material whose use is limited by paywalls, restrictive licenses, and clickwrap agreements.

Moreover, some people claim that the mere act of digitization gives rise to a new right over the resulting digital copy[82] (for example, in countries such as the UK, where the photo of a work can be considered original enough to attract a new copyright).[83] Although this claim has thus far never been endorsed in the case law (and has actually been condemned by both the Public Domain Charter of Europeana[84] and the Public Domain Manifesto[85] of the International Communia Association), several corporations—such as Google, ProQuest, or Brightsolid, to name a few—contractually implemented such a right by means of contractual provisions incorporated within the digitized copies of public domain works in order to prevent users from subsequently exploiting them commercially.[86] Contracts and technology can,

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BLOG (Jan. 9, 2013), http://blog.okfn.org/2013/01/09/did-gale-cengage-just-liberate-all-of-their-public-domain-content-sadly-not/.

82. *E.g.*, Andreas Rahmatian, *Copyright Protection for the Restoration, Reconstruction and Digitisation of Public Domain Works*, *in* COPYRIGHT AND CULTURAL HERITAGE: PRESERVATION AND ACCESS TO WORKS IN A DIGITAL WORLD (Estelle Derclaye ed., 2011), http://ssrn.com/abstract=1927428 (denouncing the fact that the restoration, reconstruction or even merely the digitization of public domain works might result in the unfortunate consequence of having a number of public domain works brought back into the realm of copyright protection, even if there is no original contribution on the part of the persons or institutions in charge of restoring or digitizing these works).

83. *See* Sawkins v. Hyperion Records, (2005) EWCA Civ 565 (holding that a photograph of a two dimensional artistic work, such as another photograph or a painting, will be subject to copyright if a significant amount of skill, labor and judgment went into its creation).

84. THE EUROPEANA'S PUBLIC DOMAIN CHARTER 2, http://pro.europeana.eu/c/document_library/get_file?uuid=d542819d-d169-4240-9247-f96749113eaa&groupId=10602 (last visited Oct. 23, 2014) (stipulating that "works that are in the Public Domain in analogue form continue to be in the Public Domain once they have been digitized").

85. THE PUBLIC DOMAIN MANIFESTO, http://www.publicdomainmanifesto.org/manifesto (last visited Oct. 23, 2014) (stating that "digital reproductions of works that are in the Public Domain must also belong to the Public Domain. Use of works in the public domain should not be limited by any means, either legal or technical.").

86. Google Books, for example, allows users to download the digitized copies of public domain books. However, Google also imposes a series of restrictions on the use of those copies. According to Google Books' Terms of Service, users can only use them "for personal, non-commercial use" and are under the obligation to maintain "attribution" by preserving all watermarks, including Google's. GOOGLE BOOKS TERMS OF SERVICE (2011), http://books.google.com/intl/en/googlebooks/tos.html (last visited Oct. 5, 2014).

therefore, potentially be used to supersede the law, turning public domain information into a commodity whose exploitation can be regulated as if it qualified for copyright protection.[87]

C. Commodification Through Cloud Computing

Cloud computing provides the underlying infrastructure for the establishment of a whole new layer of commodification, which applies not only to public domain information but also to copyrighted content released under free/open licenses.

Given that information stored in the cloud is made available to the public through a specific, provider-controlled user interface (be it a graphical user interface, or an application programming interface), cloud providers can unilaterally determine the extent to which and the manner in which information commons can be accessed, used, or reused. If—as clearly expressed by Lawrence Lessig—code is the law of the internet,[88] then, in the context of cloud computing, the user interface can become *de facto* law. In this lies one of the most relevant aspects of commodification through cloud computing: the fact that it makes IPRs, previously the main tool for commodification, easily ignorable.

Indeed, as the main content holders, cloud providers have become as powerful as, and sometimes more powerful than, copyright owners. In a context in which everything the user can do is determined by the technical specifications of the cloud computing platform, the provisions of copyright law are becoming less and less relevant. By exporting a growing amount of content into the cloud, copyright owners can no longer enjoy direct access to such content and are thus left with little practical means of control over it. The cloud provider, on the other hand, has the power to specify the terms and conditions regulating the access to and the usage of any piece of content stored on its servers.[89] This can be seen, for instance, in the case of many online platforms—such as Facebook, Twitter, Vimeo, and YouTube—which provide access to online content through restricted user interfaces that do

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87. For more details on the use of contracts for the commodification of information, *see, e.g.*, Margaret Jane Radin, *Regulation by Contract, Regulation by Machine*, 160 J. INST. & THEORETICAL ECON. 1 (2004), *available at* http://ssrn.com/abstract=534042.

88. LAWRENCE LESSIG, CODE: VERSION 2.0 5 (Basic Books 2006), *available at* http://codev2.cc/download+remix/Lessig-Codev2.pdf.

89. Primavera De Filippi & Smari McCarthy, *Cloud Computing and Data Sovereignty*, 3 EUR. J. L. & TECH. 1, 4 (2012), http://ejlt.org/article/view/101/234.

not always allow users to download the content locally into a file for further reproduction, redistribution, and/or reuse (and thereby potentially ignore the provisions of the license under which the content has been released).

By limiting the extent to which users control their content, cloud computing itself, as a service sold to communities, is commodified; its characteristics have less to do with communities' needs than with the provider's profit motivation. But commodification can also happen here in a second and less obvious direction: when commons are turned into commodities, and are used to "pay" for cloud computing services.

One of the techniques used to reach that goal is the practice of crowdsourcing.[90] Today, the production of content or information is frequently not done by online operators, but rather by a large community of users participating in online platforms. In the last few years, a large number of such platforms have been deployed to facilitate social interactions through the dissemination of user-generated content.

While some of these platforms, such as Wikipedia and OpenStreetMap, are actually governed as a commons—i.e., by the community and for the community—the majority of them are nowadays controlled by large corporations that unilaterally stipulate the ways users can access or interact with the content.[91] Indeed, although they cannot claim any right over such content, cloud operators can nonetheless determine—by contractual or technical means—the manner in which content can be produced and the extent to which it can accessed, used, or reused through the user interface.[92]

Encouraging digital communities to produce and share information is a means for online service providers to maximize their profits by exploiting the output of peer production in order to reduce their own costs of production. Online operators can subsequently reap the benefit thereof by offering a service whose value is, for the most part, derived from the commercial exploitation of this content. This is the case of Facebook, whose

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90. Crowdsourcing is a process based on the outsourcing of small tasks or problems to a distributed and decentralized group of individuals. As opposed to many forms of outsourcing directed towards specific entities or individuals (*e.g.*, contractors), crowdsourcing is directed towards an undefined public that voluntarily and autonomously decides to take on one or more of these tasks.

91. David Lametti, *The Cloud: Boundless Digital Potential or Enclosure 3.0?*, 17 VA. J.L. & TECH. 217-18 (2012), http://www.vjolt.net/vol17/issue3/v17i3_190_Lametti.pdf (last visited Oct. 6, 2014).

92. De Filippi & McCarthy, *supra* note 91.

business model relies—in addition to selling user data to advertisers—mainly on the content produced by its user-base; but also Flickr, Twitter or many other companies that do not actually produce any content themselves, but merely exploit the content generated by others for its own profit.

Oftentimes, terms of use also require users to automatically transfer the copyright in any content produced onto the platform, or *a minima* to grant the service operator a universal, perpetual and unconditional license for exploiting such content.[93] In spite of its legal status, content can thus be freely exploited by cloud operators[94]—whereas, to the extent that they no longer control the content they have produced (hosted in the infrastructure of the cloud provider), users cannot freely dispose of it—regardless of whether or not it has been released into the commons.

Finally, the advent of cloud computing raises another fundamental concern with regard to the freedom to use and reuse information commons. Given that content is only available through the interface of the cloud, users can only access the *source* of such content to the extent that this feature has actually been provided for by the cloud operator. In the case of FLOSS, access to the source code is a prerequisite for users to exercise their freedom to understand, edit, and modify the code—a requisite that pushed towards the creation of a new software license (Affero GPL) specifically designed to ensure that source code is made available to the community, even when it only runs in a server and is accessed through a web interface, and has not been otherwise distributed (a situation in which the GPL would not require making the source code available).[95] Similarly, in the context of

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93. *See, e.g.*, Facebook's terms of use: "you grant us a non-exclusive, transferable, sub-licensable, royalty-free, worldwide license to use any IP content that you post on or in connection with Facebook (IP License). This IP License ends when you delete your IP content or your account unless your content has been shared with others, and they have not deleted it." Facebook, STATEMENT OF RIGHTS AND RESPONSIBILITIES (2013), https://www.facebook.com/legal/terms (last visited Nov. 1, 2014).

94. Flickr, for instance, hosts pictures released under a variety of licenses, including Creative Commons licenses. A large number of pictures are released under a license that does not allow for commercial use (CC-BY-NC). Yet, to the extent that Flickr constitutes the infrastructure on which the pictures are hosted, they can essentially bypass the terms of the license and exploit these pictures commercially (e.g., as a result of advertisements).

95. The Affero GPL license requires the operator of a network server to provide the source code of the modified version running there to the users of that server. It was meant to avoid the problematic situation whereby software released under a GPL license would be modified by one party and subsequently

information commons, access to the source file is often necessary—or to the least instrumental—to the creation of derivative works. Therefore, by not providing the means for users to download the source files of content stored in the cloud, cloud providers can negatively affect some of the freedoms granted to users under the license.

V. GOVERNANCE AND ARCHITECTURE DESIGN

A. Decentralized Peer-Production

As mentioned in previous sections, commons production models are mostly geared towards the satisfaction of a community's direct needs; as a result, the output of production cannot be regarded as a commodity (in Polanyi's terms). Even if certain communities do actually sell some of their common resources, most frequently this form of commercialization is not aimed at the accumulation of surplus, but rather at guaranteeing the sustained existence of the common resources, or, eventually, at financing the production of other resources to fulfill further needs of the community.

Relatedly, Ostrom's extensive research found that the most successful and enduring commons displayed a significant level of self-organization and democratic community participation.[96] While Ostrom's research was then restricted to physical, small-scale commons, there are already studies suggesting that self-organization and democratic participation are also features of ongoing and arguably successful information commons projects.[97]

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run on a server, without subsequently making the modified source code available to the community, given that running the software does not actually qualify as a "redistribution" thereof. *See GNU Affero General Public License* (Nov. 19, 2007), http://www.gnu.org/licenses/agpl.html for more details.

96. Three of the eight design principles identified by Ostrom as characteristic of enduring commons are related to self-organization and community participation: collective choice arrangements ("3. Most individuals affected by the operational rules can participate in modifying the operational rules"), monitoring ("4. Monitors, who actively audit CPR [common-pool resource] conditions and appropriator behavior, are accountable to the appropriators or are the appropriators"), and minimal recognition of rights to organize ("7. The rights of appropriators to devise their own institutions are not challenged by external governmental authorities"). ELINOR OSTROM, GOVERNING THE COMMONS 90-102 (1990).

97. Mayo Fuster Morell, *Governance of Online Creation Communities*, 233–55 (2010), http://www.onlinecreation.info/outline_design.

Highly centralized, hierarchical models of production often discourage input from the members of the community, so that users' needs tend to be ignored or denied. In those models, the risk of the community breaking down is therefore considerable, unless there is a strong leader or a significant level of cohesion.

While Ostrom's research focused on material commons, those traits can easily be observed in the context of intellectual commons. Wikipedia and the Debian project[98] are good examples of this. Even though they do implement some limited form of hierarchy, their structure and organization is ultimately based on democratic principles that dictate most of the wide-ranging decision-making processes. These projects are also permeable to new members and their contributions: anyone can edit Wikipedia (in most articles, even without being a registered member)[99] or contribute to Debian, and can do so voluntarily, self-selecting their preferred tasks—as is typical of peer production initiatives. In the case of the Debian project, even if some of the most substantive ways to contribute (package maintenance, for instance) require specialized technical knowledge, many others do not (translations, legal issues, communications, advocacy, etc.); and since 2010, non-technical contributors can also attain the official status of Debian Developers, and thus vote in the most important decisions concerning the project.[100]

B. Centralized Cloud Environment

Commodities, according to Polanyi's definition, are mainly produced to satisfy market needs and considerations. Oftentimes, commodities are directly *pushed* into the market, and profit is taken as an indirect measure of people's needs. Rather than being determined by those communities' needs, production is gauged according to the overall profits: if one commodity sells well, more of it will be produced until market demand is satisfied—that is, not because they reflect effective societal needs, but merely because some can buy it at a profitable price for the producer. Matters are

98. Debian is an operating system (a GNU/Linux distribution) and probably the largest existing free software project, including more than 29000 packages (pieces of software). Many popular GNU/Linux distributions, such as Ubuntu and Linux Mint, are Debian-based.

99. With the exception of "protected" articles: a small number of controversial or highly vandalized pages, which are temporarily "locked" for edits, but still open for discussion on their respective "Talk" pages.

100. *General Resolution: Debian Project Members*, DEBIAN (2010), http://www.debian.org/vote/2010/vote_002.

further complicated through advanced and ubiquitous advertising and branding practices, which have the effect of blurring peoples' effective needs.

In the context of cloud computing, where most online operators are profit-oriented, information commons are not produced by the community for the community; they are produced—by the community—to ultimately satisfy the interests of cloud operators. While this usually involves furthering the interests of the community—a precondition to maintain a satisfied, productive user-base—answering to the community is only a means to reach another end, which is mostly oriented towards the maximization of profits.

To do so, the majority of cloud computing platforms rely on centralized architectures combined with a hierarchical system of governance. Given that all hardware and software are controlled by the cloud operators, users can only interact with the platform according to the rules established by the service provider. Risks of cooptation increase, as service providers are likely to encourage the production of information commons according to the amount of profits that they might derive from it, rather than according to the actual interests of the community itself.

Besides, unless data portability or interoperability has been provided by the cloud operator, users willing to leave one platform might only do so at the costs of losing all data stored in the cloud. Insofar as users are locked into the platform (i.e., the costs of switching to another platform are higher than the benefits they might derive from it), the correlation between users' needs and cloud operators' interests is weakened, as profits are not necessarily linked to the satisfaction of actual users' needs.[101]

C. Decentralized Alternatives for Peer-Production

Previous sections have illustrated the existence of a clear and serious mismatch between information commons produced according to a community-centered and democratic approach, and those produced in the context of cloud providers' market-driven, centralized, and asymmetrical approach. This mismatch is one of the main culprits for the various possibilities of commodification that we have described so far. However, this does not necessarily mean that all forms of cloud computing are equally inadequate to the production or the dissemination of intellectual commons; it is

101. Primavera De Filippi & Luca Belli, *The Law of the Cloud v. the Law of the Land*, 3 EUR. J. L. & TECH. (2012), http://ejlt.org/article/view/156.

in fact theoretically possible to design a series of decentralized cloud computing platforms based on a peer-to-peer architecture.[102] Such platforms might allow communities to escape from the centralized control of large service providers, thereby increasing their autonomy as regards their own data, and reducing the risks of commodification.

Implementing decentralized infrastructures for cloud computing is not necessarily a trivial task (on the contrary), nor necessarily the most efficient option: centralized, large-scale providers often benefit from economies of scale in terms of costs, performance, and maintenance. However, the intensive use of file-sharing peer-to-peer technologies[103] as an alternative to centralized file-serving suggests that the peer-to-peer approach to cloud computing is not only feasible, but also promising. Apart from a clearly more adequate fit with the commons' model of governance, another reason for this is that personal computers connected to the Internet are often below their maximum usage capacity (in terms of processor cycles, memory usage, and bandwidth). Peer-to-peer approaches to cloud computing allow communities to tap and pool these "spare resources" (which would otherwise go unused) instead of purchasing them from cloud providers. Exclusive reliance on users' personal computers might introduce a series of concerns in terms of infrastructure reliability and resource availability (personal computers are more likely to fail, or to be turned off, than cloud providers' servers located on dedicated data centers); but most of these drawbacks can be lessened by means of planned redundancy, for instance.

Out of the several initiatives experimenting with a communitarian approach to cloud-related services,[104] Kune

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102. Or, at least, platforms that are less centralized than provider-based cloud computing.

103. The BitTorrent protocol, for instance, has been widely adopted in the FLOSS community, where releases of popular GNU/Linux distributions can attract thousands of simultaneous users, each of them usually downloading a seven hundred megabyte file. Since 2012, the Internet Archive has also begun sharing part of its collection through the BitTorrent protocol; nowadays, the files offered this way amount to almost a petabyte of data (one billion megabytes).

104. Examples of such initiatives include, *inter alia*, the FreedomBox: a low-power router provided with encryption and privacy tools, and free software to run personal servers, FREEDOMBOX, http://freedomboxfoundation.org (last visited on Oct. 22, 2014); Freenet: a distributed, anonymous file sharing and web publishing network, FREENET, https://FREENETPROJECT.ORG (last visited on Oct. 22, 2014); Tahoe-LAFS: a distributed, secure and fault-tolerant file system, TAHOE-LAFS, https://tahoe-lafs.org (last visited on Oct. 22, 2014); GlusterFS: another distributed file system, GLUSTERFS, http://www.gluster.org (last visited

(http://kune.cc) is probably the one that is the most explicitly intended to promote the creation and facilitate the sharing and exchange of information commons. Kune ("together" in Esperanto) is a project aimed at creating a network of interconnected sites (or nodes) where people can communicate, share, and collaborate with one another. To do so, Kune provides a collection of web tools for the collaborative management of online communities. These tools are meant for people to create groups or find persons with similar interests, to cooperate and work together in an online environment. While Kune can be assimilated to a cloud, it is based on a decentralized architecture using a federated protocol that connects through all nodes of the network and allows them to communicate with each other.

Another example with a wide range of applications is FreedomBox: a community project to develop, design, and promote the deployment of low-power personal servers running free software for distributed social networking, email, and audio/video communications. The project—currently led by the FreedomBox Foundation—was initiated in February 2010, by Eben Moglen (professor at Columbia Law School and a leading free software advocate) with the intent of providing a decentralized alternative to the growing centralization of information and power that is taking place on large cloud computing platforms. Grounded on the idea that most cloud-based services relying on proprietary software constitute a danger to users' rights to privacy, the FreedomBox was designed to work as a decentralized personal server running on a distributed communication platform based on a peer-to-peer (P2P) network. Described by Moglen as "a really good Web server that you can put in your pocket and plug in anyplace," the FreedomBox is essentially a small, "plug-sized" device running an operating system that features a "collection of social communication tools, distributed services, and intelligent routing in a package anyone can use."[105] The basic idea is to allow anyone to easily set-up their own personal servers, using FLOSS software to replace many provider-based web services. The list of applications a FreedomBox can run includes feed aggregators, photo sharing, webmail, blog (and microblog) publishing, link

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Oct. 22, 2014); as well as several federated social network and microblogging tools, such as Diaspora, DIASPORA, https://joindiaspora.com (last visited on Oct. 22, 2014); FRIENDICA, http://friendica.com (last visited Oct. 22, 2014); and STATUSNET, http://status.net (last visited Oct. 22, 2014).

105. *Flyer*, FREEDOMBOX FOUNDATION (Jul. 31, 2014), https://www.freedomboxfoundation.org/doc/flyer.pdf.

shortening/sharing, text chat, calendar and time-management systems, telephony systems, activity stream (as in current social networks), and online backup.[106] While much of the software already exists, it has been re-packaged and adapted so as to be able to run from cheap, low-power devices (from older personal computers to modern "plug-sized" computers),[107] and take advantage of cryptography and peer-to-peer technologies (such as mesh networking) to guarantee privacy, avoid censorship, and overcome localized connectivity problems. Besides, given that all the software it runs is open source, users can freely modify it to better suit their individuals needs.

In the context of social networks, Diaspora (Greek for "dispersion") is a free software application allowing people to run their own personal web server and to connect them together so as to implement a distributed social network (https://joindiaspora.com/). Released in November 2010, Diaspora was intended as an answer to the privacy concerns resulting from the growing centralization of social media. The software allows users to host content on their own server (or pods), which interact with one another to share specific user data, status updates, videos, photographs, and the like. Due to the federated architecture of Diaspora social network, content can be hosted anywhere: on a traditional web server, a cloud-based service, or directly onto user devices.

More generally, the Free Network Project (https://freenetproject.org/), started in 2000, aims at creating a distributed anonymous information storage and retrieval system. Described as "a peer-to-peer platform for censorship-resistant communication," Freenet is a "network within a network" featuring full anonymity through a strong layer of encryption. Devoid of any centralized structure, it relies on the infrastructure provided by all users connected to the network—which serve as intermediary nodes, routing small, encrypted packets of data throughout the network, without ever knowing the contents of these packets. Although Freenet never really made it into the mainstream, its distributed datastore is currently being used by many third-party

106. *Leaving the (Proprietary) Cloud*, DEBIAN, http://wiki.debian.org/FreedomBox/LeavingTheCloud (last visited Oct. 5, 2014).

107. As of October 2014, a FreedomBox-related web page lists forty-three existing plug-sized computers; twenty-nine of them are priced below $100 USD; *Target Hardware*, DEBIAN (Jul. 31, 2014), http://wiki.debian.org/FreedomBox/TargetedHardware.

applications, such as Flog[108] (a plugin for blogging over Freenet), Sone[109] (a microblogging platform and social network running on top of Freenet), and Infocalypse[110] (an anonymous, decentralized version tracking software application).

Finally, another interesting example tackling the issue of online storage is Tahoe-LAFS, a distributed, secure, fault-tolerant FLOSS file system, which can be used for the storage of personal files (https://tahoe-lafs.org). Data is stored across a variety of nodes in a redundant way (where the level of redundancy is configurable), so that even if some nodes are not online (or even if they have been completely lost due to hardware failure), files can still be accessed.[111] All data stored on Tahoe-LAFS is encrypted, so that—unlike what happens by default in most commercial cloud computing platforms—no one but the file owner can access its contents (not even those who actually control the nodes where that file sits). In practice, this means that a small group of individuals with only moderate technical knowledge and standard personal computers can provide *each other*, for free, online backup services that can be more secure (in terms of privacy, at least) than those offered by commercial providers.

Those are just a few of the various initiatives that have been taken so far, yet, it is important to note that those efforts, albeit extremely valuable, are not sufficient (as such) to counteract the trend towards the commodification of information commons: issues related to Internet governance and access to technology, which can undermine these efforts, must also be worked on. For these alternatives to actually have an impact upon society, they also must be widely available and easy to use, and, most importantly, the dangers of commodification must be clearly communicated to the public.

The most obvious of them is that commodification of information commons might reinforce our society's current inequality and power concentration by restricting access to information according to monetary capacity. There is also the risk that the production of information commons might be directed in

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108. *Plugin-Flog Helper*, GITHUB (Jun. 14, 2014), https://github.com/freenet/plugin-FlogHelper-staging.

109. *Sone*, FREENET (Feb. 27, 2014) https://wiki.freenetproject.org/Sone.

110. *Infocalypse*, MERCURIAL (Sept. 24, 2014), http://mercurial.selenic.com/wiki/Infocalypse.

111. With the default settings, all data can be accessed even when 70% of the nodes have failed (and the storage used in each node is only 3.3 times higher than a single copy of the data).

ways that are lucrative to the cloud operator, but that do not necessarily satisfy people's actual needs, or only satisfy those of a small minority. Finally, some dangers are more specific to cloud computing; in particular, the possibility that cloud providers end up with a disproportionate power over users (by lock-in, data mining, and "code as law" strategies, for instance). A directly related risk is that of wholesale privacy violations, both by advertisers (who can promote consumerism through the immensely increased effectiveness of online behavioral advertising), and by governments (who can coerce, negotiate with, or even outsmart providers in order to spy or politically persecute individuals). This last risk, which used to be dismissed as a conspiracy theory, has been proven to be a stark, worrying reality by the disclosures made by Edward Snowden since June 2013.[112]

Awareness of the risks resulting from the growing centralization of cloud computing platforms is the first step towards the provision of decentralized alternatives that are likely to be adopted by a sufficiently large number of users. Only then will it be possible to offer a community-oriented service capable of being an alternative to the services provided by commercial cloud operators.

112. *See generally* GLENN GREENWALD, NO PLACE TO HIDE (2014).