Law, Technology and Time[1]

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1 The views in this note are the author's personal views only and do not reflect those of any employer past or present.

Law unfolds in time. Time is increasingly being made available to us by technology in new modes, durations and forms. The interplay between law, technology and time is increasingly complex and underpins some of the most central institutions in our society. The question of how law adapts and shapes our understanding of time is one that needs to be examined closely.[2]

In the simplest – and perhaps simplistic – short history we can give here clocks were developed in monasteries, in order to establish routines, but the way technology makes time available has had much more complex consequences. The modern watch was key to the way industrial organization evolved and developed.[3] Technology has always made time – in itself deeply subjective – available in new formats and modes. The way we section our days and nights into hours, minutes and seconds would not be possible without some kind of device that allows us to keep time. Time, as we understand it today, is produced by technology, so maybe it is not surprising that we should see new temporalities develop as technology changes.

Information and communication technologies are dependent on time being available as a resource to us.[4] Information is closely related to time and order, and communication is self-evidently dependent on time – whether it is asynchronous email or synchronous video conferencing. Time is essential for security, quality and robustness in these systems. Our technologies change time in at least three ways that are interesting to us here.[5]

Technology produces new *modes* of time that can be offered as services. We will use just one such mode – ephemerality – as an example for us to look more closely at. Furthermore, technology produces new *units of time*. From the micro slices of time in which algorithms trade to the growing durations of time for which we can sustain legal agreements of different kinds. Finally, technology produces new *forms* of time: time as a service, subscription time in different worlds and entirely new forms of time offered to solve different kinds of problems.

In the following we will touch on these different changes – modes, units and forms – and raise a few of the questions that follow. The purpose is not to solve

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2 There is a flourishing field of study of the time and law. One example is the scholarly network involved in the project Regulating Time, *See* "www.kent.ac.uk/law/time/index.html" hosted by the University of Kent. Professor Arden Rowell has led research on the issues at Harvard, *See* "/hls.harvard.edu/academics/curriculum/catalog/default.aspx?o=68902". At Vrieje Universiteit Amsterdam there is a centre for research on Law and Time, "rechten.vu.nl/en/research/organization/research-institutes-and-centres/Centre-for-Research-of-Time-and-Law/index.aspx" and a number of different articles on different aspects of the relationship between law and time have bene published.

3 There are several histories of time keeping and technological innovation in time. An accessible and rich introduction is available in Berg Eriksen, Trond, *Tidens Historia*, Atlantis Stockholm 2000.

4 The framework of technology making the world available is built on an interpretation of the philosophy of technology offered by German philosopher Martin Heidegger. *See* e.g. Heidegger, M. *The Question Concerning Technology* in Heidegger, Martin. The Question Concerning Technology, and Other Essays. Harper & Row, New York 1977.

5 The distinction made here is for our study, and relevant to us as a schema for exploration, but not necessarily reflecting different kinds of time from a physical perspective.

any of the issues, but rather provide a surveyable landscape of the issues and questions in order to understand where more work is needed.[6]

1 New Modes of Time

Technology has allowed us to access new kinds of temporality as products or services. By designing and shaping systems it is now possible to offer customers temporalities that were not accessible before in the same way.[7]

The perhaps most obvious example of this is *ephemerality*. Products and services can now be designed to store, access or publish information for only limited amounts of time. More and more social media are now offering ephemerality as a feature in messaging and publishing services of different kinds.[8]

Ephemerality raises questions around, at least, contracts, privacy, copyright and free expression. When time becomes an integral part of publishing and sharing content we need to examine if the underlying law has any way of taking into account the fact that the content was offered with the clear intent of ephemerality, and if that should matter. In the following, we will examine ephemerality in more detail than the other areas outlined above to explore possible angles of attack on the overall subject, and give one example of a single case of the intersection of time, technology and law.

1.1 Contracts

Is it possible to contract about ephemerality? To offer a service that guarantees ephemerality of different durations? The answer seems trivially to be yes, if the technology allows for the construction of such services, why should it not be possible to contract around them? If I want to sell you a service for publishing an image for just a very brief time, it seems obvious that I should be able to do that.

The edge cases are not difficult to find, however: what about data retention duties? Litigation and discovery issues?[9] It seems reasonable to assume that

6 The concept of a surveyable landscape or ”ubersichtliche Darstellung” is one rooted in the philosophy of Ludvig Wittgenstein. The idea is that when approaching a philosophical field or problem we first need to understand it from above, trace the contours of the landscape and understand its topology to then untangle our conceptual distinctions in detail. This note is a first attempt to outline a subject of study that the author aims to develop more in detail over time and does not make any claims for completeness.

7 This perspective builds on that of Nonet, P. *Time and Law*, Theoretical Inquiries in Law 8.1 (2007).

8 Examples include expiring messages and temporary postings on social media like Snap, Facebook and other services. The subject is the focus of a broad set of social studies and there is a good bibliography kept at ”thesocietypages.org/cyborgology/ephemerality-and-social-media-bibliography/”.

9 When Google recently added a confidentiality mode allowing emails to expire – essentially an ephemerality service – this raised serious questions about litigation and discovery. *See* e.g.

when there are legal requirements for something to be available in durable format, any contract offering ephemerality would be more complex to analyze and would require more thought.

As we start examining this, we find an interesting set of questions in contract law, that are illuminated by the possibility of offering ephemerality. These questions have to do with the boundaries of contract – what it is indeed possible to contract about – and it is well-known that that the freedom to contracts is circumscribed by several limits. From the well-known boundaries of *pactum turpe* to questions about possibility and time, contracts are limited in a number of different dimensions and ways. How long can a contract be? How short? Is there a minimum durability of a contract? A maximum?[10]

Here, then, it is possible to reverse the question and ask what the demands for durability are in law. What kinds of ephemerality can legally be offered if we consider the demands law make for our legal relationships to be durable?

There is a more general issue here, and issue that seems to belong to the philosophy of law, and that is what the relationship between law and durability is ontologically. Law as an institution stabilizes and upholds social structures, relationships, economic dealings and safety in society. What kinds of time and durability does law, in this role, require? And – as a meta-question – would not the contract itself need to be durable, or could that too cease to exist after a set time?

Law is, in some sense, dependent on memory. Law requires the ability to examine the past, and to predict probable futures. A completely amnesiac society, a society without any institutional memory or written record, would hardly be able to sustain anything that we would refer to as law. For such societies – or such social contexts – norms become the key choice instead. Norms are fluid and adaptable and require far less record and memory than law does – but even norms cannot exist without history.[11]

Ephemerality, then, seems to be inherently shifting the focus in social media from law to norms. Where there is no *record* of our interactions, word will stand against word. The evidentiary situation shifts, and when that is true for an entire social space, we should expect that to affect the normative structure of that space as well. Law always applies to a tract of time and space, a territory and a

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Patterson, D *Why Gmail's confidential mode is good for privacy, but may be bad for businesses* Tech Republic at "www.techrepublic.com/article/why-gmails-confidential-mode-is-good-for-privacy-but-may-be-bad-for-business/" Jun 11 2018.

10 The study and debate around which contracts are the oldest is an interesting one. There are those that argue that London real estate contracts rank among the oldest, dating back to the 1200s. *See* "/www.quora.com/What-are-some-of-the-oldest-contracts-still-in-place-that-include-some-regular-payments-like-a-lease-that-requires-the-user-or-tenant-to-pay-something". Other examples of long contracts reputedly include the one for the original Guiness Brewery, meant to last 9000 years.

11 There is an argument here around the evolution of legal systems. Those systems that could be made more durable seem to be able to outcompete those that rely on oral traditions and lack the ability to create institutional memories. If take the example of American Indian law, the majority of that body of legislation we have available to us was made available through the Western legal systems, interpreted and reformed through it. Oral traditions are typically outcompeted by those that have stronger institutional memories.

person.[12] The finer we fragment that space-time area of application, the harder it becomes to uphold any rules at all.

One key aspect of our analysis here then becomes how to handle breaches of ephemerality. What do we do when someone fixes – records – something that was offered ephemerally? An example will make this obvious: in many of the applications offered the ephemerality can be broken by either a) using system wide functions like the ability to take a screen shot of the content (type a circumvention) or b) by using specific applications that circumvent the ephemerality designed into the ephemerality application (type b circumvention).

Both of these practices break the ephemerality, but the first uses only technology that is available in the operating system. The second requires the installing and use of an application specifically designed for circumvention.

How should we understand such circumvention legally? From a contracts standpoint it depends on the contractual context. Assume that the service provider, as a part of the terms and services, prohibits any circumvention of the offered ephemerality. What does that mean for me if I find that someone has circumvented the ephemerality of the product and fixed or recorded something that I posted in a more durable format? Are there grounds for the assumption of implicit contracts or agreements of some kind between the users of such a service? What recourse should be available? Are there any differences in my position depending on if the party circumventing the service has used only system services or installed a particular application for the purposes of such circumvention?

As technology makes time available in smaller portions, and with shorter duration, we will find ourselves contracting about those new time products in different ways. This may well require a closer examination of the legal concept of time overall.

1.2 Privacy and Data Protection

Ephemerality is sometimes offered as a privacy enhancing technology. The idea is that a key part of the privacy challenge with the Internet and the Web is that things are available for eternity once they are shared or published, and so offering the ability to publish ephemerally is a way to strengthen privacy protection.[13]

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12 *See* for a deeper analysis of this Tur, R. *Time and Law* in Oxford Journal of Legal Studies Vol. 22, No. 3 (Autumn, 2002), pp. 463-488, pointing out that this view originates in Hans Kelsen's theory of spheres of personal, temporal and spatial validity.

13 *See* e.g. the Office of the Privacy Commissioner of Canada, *Privacy Enhancing Technologies – A Review of Tools and Technologies*, "www.priv.gc.ca/en/opc-actions-and-decisions/research/explore-privacy-research/2017/pet_201711/". The OPC interprets ephemerality as data minimization: "Another category of tools or techniques used to implement data minimization is that of ephemeral communications. These tools have been developed in response to the permanence of Internet conversation, which arose once computers began to mediate our online communications. Computers naturally produce conversation records, and these data were often saved and archived. These tools, on the other hand, claim to automatically expire messages, videos, and other content."

This raises the question of how we deal with time in data protection law, generally. There are some tangential aspects to this – such as the fact that under European data protection law, the dead have no privacy. If I process data about you at time *t* and you are no longer alive at that time, then that processing is not processing of personal data.[14]

Furthermore, one of the basic data protection principles seem to *require* a certain ephemerality: you can only store personal data for as long as it is required to fulfill the purpose for which you collected it. So, the principles of data minimization and purpose specification seem to imply time considerations.

This raises an interesting question about privacy by design and ephemerality. Are there indeed requirements, *generally*, for services to design in ephemerality? Does it follow from the general design imperative offered in privacy by design that not only should we expect services to only store information for the duration needed for fulfilling the purposes for which that information was collected, we should also expect them to design the processing generally of data to be as short as is possible, and hence also express purposes in such a way as to minimize the time information is processed for?

In this perspective, ephemerality can then be examined as a part of the constraints on purpose specification, and we could argue that there is a time dimension to such specification that requires the purpose to be designed in such a way that it is optimally ephemeral.

If ephemerality is offered as privacy enhancing technology, it seems reasonable to assume that the design of that ephemerality needs to be robust. We could question if ephemerality – marketed and sold as privacy protection – should be open to type a circumvention at all, and what safeguards need to be put in place to ensure that it is not open even to type b circumvention.

What reasonable expectations of privacy do we have in a service context where ephemerality is offered, and what measures should we expect such service providers to take? Is it reasonable here to extend and use the state of the art analysis required for the analysis of information security measures in systems that process personal data offered under European law? Is there a state of the art standard for ephemerality design (and does the type a / type b distinction help us determine where that particular standard falls?).

In data protection law the other glaring example of ephemerality is, of course, the right to be forgotten. This right is intriguing in that it introduces a very specific kind of ephemerality – and so highlights for us that there are taxonomies of ephemerality in any information system that we need to think about.

The right be forgotten is essentially – if somewhat simplified – a right to exclude certain kinds of information from *discovery*.[15] It is not strictly a right of

14 Some argue that this is changing with the GDPR, *See* e.g. Harbinja, E. *Does the EU Data Protection Regime Protect Post-Mortem Privacy and What Could Be The Potential Alternatives?*, (2013) 10:1 *SCRIPTed* 19 "script-ed.org/?p=843".

15 Although there are those who argue that we *See* this now shifting to include the original publishing as well, *See* e.g. Nunziato, Dawn Carla, *The Fourth Year of Forgetting: The Troubling Expansion of the Right to Be Forgotten* (2018). 39 U Pa J Int'l Law 1 (2018); GWU Law School Public Law Research Paper No. 2018-30; GWU Legal Studies Research Paper

ephemerality, since the underlying information often still remains published and available. What this shows us is that not only can we design ephemerality on the web, we can also design ephemerality in different services and user interactions with the web.

As we look at the way content is processed on the web we can discern at least the following different categories of processing. Content can be discovered, hosted, curated, published and monetized in different ways. Ephemerality can apply to each and every one of the categories. In some cases, it is trivial: curated content (editors' picks) is by nature ephemeral. The standard cases we have been discussing are about ephemerality in hosting and publishing (in social media services for example), but all the other cases have analogues.

The right to be forgotten introduces the idea that there is a specific requirement for discovery services to design a very particular kind of ephemerality, that can be requested by legal subjects.

This ephemerality is one where legally published material no longer is discoverable after a certain time. The ephemerality is triggered by a complex weighing of an equation of different factors – public interest and time being among the most prominent – and companies are required to design, maintain, offer and execute this ephemerality on their own. (It may in fact be more helpful to think of this as a mandated ephemerality, than as a right to be forgotten, since "forgetting" is subjective and hardly assessable in any objective way.)

Further, we can ask what *baseline* assumption of ephemerality we should reasonably work with in analyzing problems of data protection, if any. This baseline can be described in different ways, but the perhaps most interesting is to think of it as a kind of "bit rot" where information constantly rots and disappears from our shared information sphere.

This process of "natural ephemerality" is driven by hardware failure, format obsolescence and noise effects – and continuously changes the information landscape. If someone specifically collects and preserves information in order to ensure that it escapes bit rot – is this then a violation of an expectation of privacy built on "natural ephemerality" or should this be looked at as a specific kind of processing of personal data – even if it just entails a targeted storage effort?[16]

Ephemerality also enters into the discussion of data protection when we examine what processing of personal data really is – and if there is a lower bound at which something is stored for such a short time that it cannot actually be considered processing of personal data.[17] Imagine a system that learns to distinguish cancers in x-rays, and that the system is trained using medical

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No. 2018-30. Available at SSRN: "ssrn.com/abstract=3191068 or "dx.doi.org/10.2139/ssrn.3191068".

16 Imagine an Internet Service set up to preserve all social media messages, even if these had been deleted by the original poster, just to have "on record" that someone actually said this or that. A perpetual "black book" used to ensure that transgressions of different kinds were not forgotten. How would such a "memory service" be analyzed? Would it fall under the right to be forgotten? Would copyright claims come into focus in the analysis? The design of social memory is largely unexplored as social media is still very young.

17 The likely answer here is that since time is not at all mentioned in the definition of processing it does not matter how short the duration of the processing is. But is this the right analysis?

images, but only needs access to an individual picture for less than a few hundredths of a second, and then aggregates it into a learning model and safely can erase the data set used to learn – does it then matter that the system used the data set only ephemerally? Should it matter? Now, there are other, interesting, reasons (not least the detection of bias and the explainability of the system) that seem to recommend recording and saving data sets, but it seems equally possible to design systems that "forget" the data sets once they have been integrated into the model used in order to safeguard privacy.

Data protection and time will increasingly become an increasingly pressing issue as we start examining long term archiving, data degradation and other similar problems with technology. We have still to explore how social memory is designed on top of social media, and need to think through what the long term storage of information looks like from a legal standpoint.

1.3 Free Expression

The ability to say something, to state it, for only a short duration of time seems a strengthening of the general ability to express ourselves freely. The fear of being held to that view or opinion or punished for it can be assuaged by the design of that duration and the audience for the message, as the risk of the message being transmitted to anyone outside of the circle we wish to reach is minimized. It seems reasonable that people would express more if they could avoid the risk of it being held against them by others or in the future.

There are naturally also risks here – cyberbullying without a trace, hate speech evaporating and evidence being lost, terrorism propaganda disappearing as security services try to track these groups down – but overall the right to freely express oneself seems to increase with ephemerality. The harm also seems to be reduced – even if hate speech is delivered through such a service, it disappears after a set time.

In fact, we seem here to have a candidate for a legal solution to a conundrum suggested by French philosopher Simone Weil.[18] Weil asserted that for a sound democracy to be possible, an arena of absolute free speech was absolutely necessary, an arena where all views – however vile – could be expressed was required to engage with and ultimately defeat ideas that could otherwise fester and gain ground again. At the same time Weil knew what words could do, how propaganda and hate speech could poison a populace, so she was conflicted. She solved that conflict by introducing a distinction that she realized and admitted was very difficult to sustain legally: she argued that anyone should be able to state or say anything freely, but if they *meant* it they should be held accountable for it.

To distinguish between "just saying" and "meaning" is no small task, but ephemerality actually offers a shot. If we fix a view and record it for permanent

18 Weil, S. *The Need for Roots*, Octagon Books 1979.

duration, we could arguably be said to mean it more than if we just say it in a forum where it will only exist for a short duration of time.[19]

As we are struggling today with balancing free expression with other rights, it seems worthwhile to at least examine if there is room in law or legal reform to consider a free expression standard that varies with the ephemerality of the views and opinions expressed. One could argue that this would also re-establish the press as a more credible source, as they have a specific form of expression – publishing – that comes even with archival duties under at least Swedish law. Such fixation of views and quality of recording them should be taken very seriously as compared with a 24-hour view expressed in an ephemeral medium.

On the other hand, one could equally argue that such a variance in standard would mean that the vilest views could be expressed in cowardly ephemerality and so escape accountability and erode any sense of social responsibility for the views and opinions we express. It is worth exploring and would reconcile the Weilian paradox at least to a degree.

1.4 Copyright

Ephemerality also presents a number of challenges from a copyright perspective. Copyright is based on the concept of a work, and one question then becomes what duration we require of something to consider it a work and so be afforded protection as intellectual property.

On a more trivial level we also encounter the question about copies and duration. This question has been extensively analyzed in discussions of caching and the general conclusion there is that even a temporarily fixed copy is indeed a copy.[20] One possible difference here, in regimes that allow for fair use, is that duration could be considered in determining if a particular use is fair use or not.

1.5 Triggers and Other New Modes

Here we have examined ephemerality in some detail, but technology also offers other new modes of temporality. Another one is the notion of a "trigger" or "reminder". Here, service providers offer products or services that trigger at some specific event or time in the future. The development of intelligent assistants that trace and learn our routines and needs opens up the possibility of services that remind and trigger in different ways and hence of a delegated authority that is triggered in time if we do not actively intervene.

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19 This is evident in the case of the private conversation or dinner debates one might engage in, where the limit is the audience. The suggestion here is that publicity might exist along two dimensions, the *size* of the audience and the *permanence* of the statement.

20 But this is a simplification. *See* e.g. Hugenholtz, P. Bernt. *Caching and Copyright. The Right of Temporary Copying*. European Intellectual Property Review 11 (2000).

Here time is made available as a pattern and a tree of possibilities, and we can through-out these different possibilities set up events and triggers that will lead to certain consequences. A trivial example is the assistant that tracks our reminder to buy milk and pings when we are close to the supermarket. Events can be defined as space-time points that trigger certain actions. A less trivial, and more dramatic service, are the many service online that offer to send passwords and final words to your friends and family after your demise. Such services sell timed actions where time is unspecified, but with longer duration than a shopping list. The offer here is often actions against potential futures and raise a number of different issues that also deserve to be explored.

Here, however, it is enough for us to note that as technology changes it offers us new temporalities that deserve legal consideration. Ephemerality is the example we have looked at most closely here, but the availability of alternate futures is another interesting example. Technology not only offers new modes of time to interact with, but also offers new forms and units of time. As we turn to new units of time next, we will encounter some of the same issues there.

2 New Units of Time

Technology has always cut time in slices, divided it up into units of time. As technology advances, its ability to divide time up into ever finer units advances as well. Today we have examples of very short units of time as well as very long units of time that are made available through technology and how we approach them as legal concepts is worth exploring.

2.1 Micro-time

As science has advanced our understanding of time has changed. Human societies traditionally divided time into days and solar years, adding the lunar cycles. Our foundational unit of time today is the second – defined as "the duration of 9 192 631 770 periods of the radiation corresponding to the transition between two hyperfine levels of the ground state of the cesium 133 atom"[21] – and the shortest meaningful time unit our physics uses is the idea of "Planck time" – the time it takes light to travel one "Planck length".[22] We deal habitually with concepts like milli-seconds and nano-seconds as parts of seconds.

Technology, closely following science, increasingly is making time available in these thin slices. The perhaps most interesting example right now are so-called "high-frequency trades" – trades in different markets that can be made in milli- or micro-seconds. As technology allows us to conclude what is efficiently contractually relevant actions in ever smaller units of time, we need to consider from a legal perspective how to deal with finer and finer distinctions and divisions of time.

21 *See* Wikipedia.

22 Approximately 5.39 x 10 -44 seconds.

There is a foundational question here, of course, and that is if law indeed can deal with all different kinds of units of time. It is possible to argue that law is *biologically bounded* and so only possible and meaningful when we speak of biological time[23]. Such discussions would not just focus on high-frequency trading as a phenomenon but could dig much deeper and argue that law as a social institution runs on biological, not technical time. Institutions such as markets and democracies work only when run in biological time, one could argue, and even contemplate legislation to that effect.[24]

The issue of actions in micro-time is not confined to these actions alone. As evidenced by the so-called "flash-crash"[25], the macro-behavior of the systems in which such actions are allowed also changes as the majority of actions within a system shift to micro-time. The percentage of actions in micro-time potentially affect the macro-nature of that system as well.

Again, as we examine contract law, data protection, copyright and other aspects of law the same kinds of issues emerge. How short can a contract be? Is processing of personal data in micro-time different from macro-processing (what is the relationship of privacy to biological time?), are events in micro-time analyzable under the existing frameworks of copyright law and free expression? As we examine concepts like "expression", "work" and "copy" do we find that they collapse at some micro-time boundary?

Now, you may argue, why would we even care? One reason to try to understand this is because more and more communication in our information society will be between machines. Machine-to-machine communication will soon be the dominating form of communication, and as this new communication space develops it will develop in micro-time, and legal actions – increasingly complex – will happen in micro-time as well.[26] The reason it is worth thinking about this is that as we delegate more and more to our systems, they will engage in legally meaningful actions in micro-time to a larger and larger degree.

There are principled ways to address such a change. One way would be to say that all legal actions are independent of time, and that no legal concept changes with time at all. A "work", "contract" or "copy" is exactly that no matter what time-scale it occurs on. We just look for basic requisites and if they are present there is no real issue. The challenge with that is that the basic requisites are all

23 The concept of biological time is left undefined and naïve here – but could be built out around the notion of the pace, perception, attention and decisions of biological beings – we all share in biological time. We could also reduce this to be just human time, of course, but the notion of biological time seems more useful.

24 Concerns around high-frequency trading today focus on the volatility these technologies create, but the question of biologically bounded institutions is not a new one. The discussion ties back to observations by Herbert Simon on bounded rationality and human boundaries on artificial systems.

25 *See* for more details on this, Kirilenko, Andrei, et al. *The Flash Crash: High-frequency trading in an electronic market.* The Journal of Finance 72.3 (2017): 967-998.

26 *See* e.g. Weyrich, Michael, Jan-Philipp Schmidt, and Christof Ebert. *Machine-to-machine communication*. IEEE Software 31.4 (2014): 19-23.

legal concepts that have to do with human, biological time.[27] Take the idea that a contract is related to the idea of intent. Can intent be expressed in Planck time? In milli-seconds? Or are there better ways of regulating events in micro-time?

One possible way forward here is to simply aggregate the events in micro-time into legal macro-actions. A million high-frequency trades is simply one trade executed in segments, and the legally relevant unit of analysis is not the singular trades but the effective trade accomplished. Another possible way forward would be to introduce new conceptual frameworks around events in micro-time, and start to examine the best way of dividing risk for acceleration of actions.

2.2 Macro-time

Technology makes time available in thicker slices as well. It is suddenly possible for us to think about longer times and institutions than we could before. One example of this is the idea to construct a clock that revolves once in ten thousand years, conceived by the founders of the Long Now-foundation. We have the technology to build such a clock, and the construction is now under way. How do we regulate something like that? How do we contract about a ten-thousand-year project and what kind of legal entities can we envision that will be stable over such large periods of time? As we embark on projects like the Clock, the institutional embedding and legal framework will matter to the success as much as the engineering of the details and components, it seems. True longevity seems to be dependent on a rule framework and institutional mechanisms to adjudicate issues and disputes under said rules.

3 New Forms of Time

Finally, then, we come to the notion of new forms of time. Obvious, and close to trivial examples, include game time subscriptions and access to services over a specific time generally.

Another phenomenon in this space is time as a key component in the changing nature of ownership, as ownership slowly transforms into different forms of rent or sharing. The sharing economy is, from one perspective, nothing but conceiving of an object owned as slices of time that can be rented and used by different people. Here we should also mention the transformation of the intellectual property markets from markets where one owned copies to markets where one licenses content for singular or delimited use across platforms, devices and markets. Your library is no longer a set of books you own, but a set of access and use licenses that translate across certain contexts.

Time is also offered as a service, and often a key service, in security systems and solutions. Time servers and synchronization of time across architectures

27 There is a question here about the biological roots of legal concepts, the humanity of the law, that could be interesting to examine closer.

becomes absolutely necessary when security measures depend on timed tokens or similar technologies.[28] Time can be produced in different ways, and the consequences of this can be unexpected. A recent example is the loss of several minutes due to a mis-calibration of the electrical grid in Europe, where a large set of devices dependent on the frequency of that grid lost a number of minutes due to one, relatively small, country's actions. This was an example of a new way of producing time in our networked society that turned out to have key vulnerabilities that could affect an entire region.

Each of these examples deserve closer study, but for the purposes of this note, we will draw our survey of the landscape to a close here, with a few thoughts about the future.

4 The Future of Time and Law

Our scientific understanding of time is incomplete. The more we understand about it, the more we scientifically can describe and study time, the more technological innovation based around new or changed concepts of time becomes possible and new questions arise. A few examples suffice to show the complexity of the subject.

If we, as a species, establish not only a presence on other planets in our solar system, but across our galaxy, we will have to understand how we synchronize time across vast distances. There are obvious limits to this as clock pulses will be limited by the speed of light as far as we understand now. A synchronized time for the Milky Way would require units of time that accept and work within those limitations and still allows for technological and social systems under a common time. An observation here is that there is a limit to what we can describe as a common reality and hence a society under vast distances. Societies have a maximum size that can be described as their ability to share a time, and these limitations will also matter for legal frameworks and rules.

Should we also understand time well enough to reverse or travel within it – something that has been declared impossible and possible at different times – we would have to craft rules and legal frameworks that determine what can be done in such circumstances and how we allow travel into the past to change the future. A curious aspect of such rules would be that they, themselves, could be changed and hence would be vulnerable to manipulation. Systems would need to be devised to make time travel laws tamper proof against events in the past, raising interesting questions about the immutability of the law as well as the metaphysical status of legislation that stands above, or beside, time.

As we delve into artificial intelligence, questions about intelligence and time also become key. Any artificial intelligence will run in computational time, approximating times that could be orders of magnitude faster than us. At the same time, should these artificial intelligences become orders of magnitude larger than us, they would have to operate with a constructed now that

28 *See* e.g. Mills, David L. *Internet time synchronization: the network time protocol*. IEEE Transactions on communications 39.10 (1991): 1482-1493.

synchronized across vast distances, just as with our galactic example. In both cases we might need to understand how to interact with, and legally coexist with, beings or intelligences that exist in paces that are incommensurable with our own.

Immortality and longevity are other examples of technical break-throughs, along cloning and uploads to digital media, that ask profound questions about basic concepts of law such as inheritance, identity and legal entities. The role of memory in understand legal capacity and liability would have to be examined as immortal beings out of necessity would have to externalize memories and store data sets outside of themselves, accessible at will, but not components of an acting subject in the moment legally relevant acts were undertaken.

Time, technology and law also present us with another perspective, one in which technology disappears, and unfolds in time through action with legal agency. Lawrence Lessig famously posited that we are regulated by laws, norms, markets and what he called code – technology. It is not fanciful to suggest that the long-term evolution of this model is one where more and more of markets, norms and law will be subsumed by or designed into code. As systems become more and more complex, and by virtue of that complexity also more opaque, we need to reconsider the way we analyze technology and move from process-based analysis looking at what technology does, to the outcomes of its use. This shift implies that technology may well achieve legal agency, even if only because of the complexity and not the consciousness of the systems at hand – as the easiest way to regulate systems that no longer open to mechanical analysis, but rather suggest biological metaphors.[29]

As technology moves from making time available to being made available in time through agency and action, the law and legal analysis of technology also needs to be examined anew.

29 This idea is not far off from the idea Daniel C Dennett articulates in his idea of different stances from which we describe systems. In Dennett's analysis we would assume an intentional stance rather than any other stance, because of the cognitive economy of that stance visavi any other. *See* Dennett, Daniel C. *The Intentional Stance*, MIT Press, Cambridge 1987.

Intellectual Property