IS THE SPEED OF LAW FASTER THAN THE SPEED OF LIGHT: CONSIDERATIONS OF THE IMPACT OF SPECIAL RELATIVITY ON THE OPERATION OF LAW IN THE CONTEXT OF DEEP SPACE MISSIONS

Alex Simmonds[*]

ABSTRACT

Travel to, exploration—and potential colonization—of Mars has been a long-held ambition for certain spacefaring nations. Questions arising the methods of propulsion, landing sites, habitation, nutrition, and the challenges of traveling for extended periods in isolated conditions make for fertile and useful debate. This article considers the substantive challenges such a journey would pose for the operation of the rule of law and various legal matters arising between a crew in deep space/on Mars and individuals based on Earth, specifically as regards the time delay factor involved in communication between such parties as per the theory of Special Relativity. When, for example, would a legislative enactment on Earth bind individuals 20 minutes away at the speed of light? Regarding commercial matters, how would time delay impact contractual formation, and how does the law relating to criminal intention operate if the consequences thereof are not felt instantaneously? This article raises both philosophical and practical considerations and ultimately concludes that valuable research should be conducted prior to any such deep-space missions. At the very minimum, soft law guidance on time delay matters should be established, and, more ambitiously, a Deep Space Legal Framework ought to be considered. This would serve as a counterbalance to any anxious legal uncertainty between deep space crews and Earth-based entities whilst

[*] Lecturer in Law, University of Dundee, Scotland. The author would like to extend special thanks to Dr. Erika Nesvold, Dr. Nic Ross and Dr. Pascal Lee.

also, very importantly, ensuring the safe passage of the rule of law from the Earth into the deeper reaches of the solar system.

I. INTRODUCTION

This article is a substantive development on a paper that was presented in Frisco, Texas, on May 27th at the International Space Development Conference 2023, *"In Space the Other Side Should Have the Right to Be Heard."*[1] That paper concerned the theoretical position in which an Earth-based individual would be either involved in a legal dispute with an individual on Mars—or en route to Mars—or be called on to adjudicate a legal dispute between two other individuals in circumstances where the rules of natural justice/procedural fairness may cast doubt on their suitability for such a task. It held that, in legal disputes involving individuals in deep space, certain communication techniques associated with a legal investigation—specifically the process of cross-examination—may lose their effectiveness owing to the associated time delay. The process of cross-examination—which gets its strength from the unbroken sequence of questions and answers- as stated by the English Judge, Lord Denning[2]—would not be able to function effectively since those on the receiving end of the question would have a significant amount of time in which to contemplate further questions owing to the involved time delay. A Mars-based individual could potentially have a wait of around 48 minutes to receive the next question during live proceedings.[3] This would undermine the effectiveness of such a device as a means of uncovering objective truths by means of a legal or quasi-legal enquiry.

This article takes this theme a step further, addressing a significant gap in the legal and scientific literature by questioning the potential impact of time delay on substantive rule of law and common legal problems. It is built upon the premise that, given the range of human interaction and relationships, the possibility for a legal dispute to arise between an Earth-based entity and an

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[1] Alex Simmonds, *In Space the Other Side Should Have the Right to be Heard*, 28 COVENTRY L. J. 23 (2023).

[2] *See* Jones v. National Coal Board, 2 Q.B. 55, 65 (1957).

[3] Thomas Ormston, *Time Delay Between Mars and Earth,* EUR. SPACE AGENCY (Aug. 5, 2012), https://blogs.esa.int/mex/2012/08/05/time-delay-between-mars-and-earth/.

individual in deep space will be ever-present on deep-space journeys. This is more likely when we consider that such missions could last upwards of two years or more. Given the well-known discourse in this area,[4] it is likely that the first individuals to venture into "deep space" will be traveling towards Mars, therefore, this article will make frequent references to Mars as a probable/theoretical location throughout. Regarding the parameters of what "deep space" could be classified as for the purposes of this article, this could be any distance away from the Earth which results in a significant time delay as regards communications between Earth and the individuals in question. As suggested in the conclusions, the question of how long any given delay would have to be before it becomes a valid concern is beyond the scope of this article but nonetheless remains an important matter.

The scientific basis for time delay can be taken from the second postulate of Einstein's theory of Special Relativity,[5] namely that: "[a]ny ray of light moves in the 'stationary' system of co-ordinates with the determined velocity *c*, whether the ray be emitted by a stationary or by a moving body."[6] Hence Velocity=light path/Time interval[7]

Presently, any communications between those based on Earth (referred to throughout this article as Earth-based entities) and those in "deep space" (for the purpose of this article defined as any distance from Earth incurring a significant time delay) will be carried by radio waves which are themselves carried at the speed of light. As a space traveler moves further away from Earth, the amount of time taken for radio waves to reach the traveler from Earth will increase consonantly with this principle. This is already a documented phenomenon as can be seen from the Apollo missions whereby there was a delay of around three seconds for answers to questions asked at Mission Control to come back to Earth from the

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[4] *See e.g.,* Nadia Drake, *Elon Musk: A Million Humans Could Live on Mars by the 2060s*, NAT'L GEOGRAPHIC (Sept. 27, 2016), https://www.nationalgeographic.com/science/article/elon-musk-spacex-exploring-mars-planets-space-science.

[5] *See* Albert Einstein, *On the Electrodynamics of Moving Bodies* (June 30, 1905), https://www.fourmilab.ch/etexts/einstein/specrel/specrel.pdf.

[6] *Id.* at 4.

[7] *Id.*

astronauts orbiting the Moon.[8] Using Mars as a reference point using an Ultra High Frequency antenna it can generally take between five and twenty minutes for radio signals to travel between Earth and Mars,[9] and as long as 24 minutes.[10]

That legal jurisdiction extends to those in space is relatively uncontroversial.[11] As has been written, "[t]he general principle governing jurisdiction, including criminal jurisdiction, in outer space provides that the State of registry exercises jurisdiction over the space objects recorded in its national space registry and the persons on board these objects, regardless of their nationality."[12]

In line with current levels of technological progress and ambition, it is highly likely that the United States (US) will be the State of registry for the first deep space missions, but, in theory at least, the State of registry could be that of any spacefaring nation or, potentially, one used as a flag of convenience. Regardless of which State has jurisdiction over the mission, the potential legal problems are likely to be the same, and certain legal rules in a variety of areas may not be able to withstand the stresses of deep space travel brought about by Special Relativity. Therefore, this article examines the potential impact of time delay factors in respect of the promulgation of laws on Earth and their effective commencement times in deep space on four key areas: contract law; tort law; criminal law; with an emphasis on commercial law dimensions. The exercise will largely be framed in terms of English law but will also include some reference to the rules and practices of other jurisdictions.

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[8] *See*, *e.g.*, *Apollo Flight Journal*, *Apollo 8, Day 4: Lunar Orbits 7,8, and 9*, NAT'L AERONAUTICS AND SPACE ADMIN., https://web.archive.org/web/20110104032114/ http://history.nasa.gov/ap08fj/15day4_orbits789.htm (last visited July 29, 2023); *How Did Apollo 11 Communicate with Earth?,* APOLLO11SPACE, https://apollo11space.com/how-did-apollo-11-communicate-with-earth-2/.

[9] NASA Science, *Mars 2020 Mission Perseverance Rover,* https://Mars.nasa.gov/Mars2020/spacecraft/rover/communications/ (last visited July 29, 2023).

[10] *See* Drake*, supra* note 4.

[11] *See* Helen Shin, *Oh, I Have Slipped the Surly Bonds of Earth: Multinational Space Stations and Choice of Law*, 78 CAL. L. R. 1375, 1376 (1990). *See also* Julian Hermida, *Crimes in Space, A Legal and Criminological Approach to Criminal Acts in Outer Space*, 31 ANN. AIR & SPACE L. 4 (2006); Michael Chatzipanagiotis, *Criminal Issues in International Space Law*,18 EUR. J. L. REFORM 105 (2016).

[12] Hermida, *supra* note 11 at 6.

It should be established that the author does not hold this article out as having explored every potential area of law that time delay could impact on deep space journeys but, rather, that it seeks to explore some of the most likely to occur—save for arguably some of the matters involving criminal law. The criminal law matters are themselves an important area for discussion as they raise several interesting philosophical points regarding the nature of the law itself which are worthy of consideration.

The article concludes with the assertion that, regarding certain areas of law, a common legal framework should be devised in advance of any proposed deep-space operations to counter some of the anticipated difficulties arising. Such a framework could take the form of soft law guidance, or a binding multilateral agreement put forward ahead of any deep space operations. Such a framework will be of particular relevance to commercial and contractual matters, particularly those regarding contractual formation.

II. TIME DELAY PROMULGATION AND PUBLICATION OF LEGISLATIVE ENACTMENTS

Before we examine the potential impact of time delay on specific areas of law, one fundamental area that must be considered is that of promulgation—or enactment—of laws on Earth. This could affect any kind of legal dispute arising. As outlined previously it is a relatively uncontroversial point that crew members on deep space missions will still be bound by the laws of Earth-based jurisdictions. It almost goes without saying that, as a matter of judicial notice, Earth-based jurisdictions are in the habit of regularly passing laws on a range of matters, both civil and criminal, through their local governmental legislative apparatus. In line with the opening point, there is no reason why relevant legislation passed in such a manner would exclude those presently in deep space or forming part of an expedition on Martian soil. Legislation in most—if not all—jurisdictions, will have what is known as a "commencement date" or some equivalent term, which determines when, exactly, a piece of legislation will come into force or "become law." In the United Kingdom (UK) this will be at midnight on the day of "Royal Assent," the stage in the law-making process whereby the reigning Monarch—at least

nominally—signs the law into force unless some other date is specified.[13]

As outlined, time delay factors associated with Special Relativity would mean that the full text of a legal enactment as it comes into force would not be visible to those in deep space or on Mars for potentially up to 24 minutes. If a crew member or Mars explorer were to contravene the provisions of an enactment which would be in force on Earth at, for arguments sake, midnight UK time, at 15 minutes past midnight, but the full text of the Act were not available to them owing to special relativity until 24 minutes past midnight, could they be said to be in contravention of a legitimately promulgated law?

In the case of *R v. Logan*,[14] British soldiers stationed in Hong Kong were found to have committed an offense at 2:30 AM, Hong Kong standard time, on the 1st of January 1957 contrary to the UK Army Act of 1955 which too had a commencement date of the 1st of January 1957.[15] The argument at trial was that, given the fact that Hong Kong is eight hours ahead of the UK, the Act itself could not yet be said to be in force since the time for commencement had not yet been reached in the UK.[16] The argument ran that, given it was still December 31 in the United Kingdom, a statute with the commencement date of January 1 could not yet be said to be in force.[17] This argument was rejected by the Lord Chief Justice, Lord Goddard:

> If an Act is said to come into force on January 1, it comes into force on the day which is January 1 in the particular place where the Act has to be applied…[T]he fact that it became January 1 in Hong Kong a few hours before the clock would actually show January 1 in England does not make any difference. As the Act comes into force on January 1, 1957, in Hong Kong, it comes into force on the day which is January 1 in Hong Kong.[18]

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[13] *Royal Assent,* THE PARLIAMENT OF THE U.K., https://www.parliament.uk/about/how/laws/passage-bill/lords/lrds-royal-assent/ (last visited July 29, 2023).

[14] R v. Logan (1957) 2 QB 589, 589.

[15] *Id.*

[16] *Id.* at 589-90.

[17] *Id.* at 590.

[18] *Id.* at 591.

How time will be determined on board any deep space voyage is yet to be seen. It is interesting to note, however, that the International Space Station runs on Greenwich Mean Time,[19] a time which has, historically in England and Wales, been fixed by statute for the purposes of laws applying within the UK. Section 1 of the Statutes (Definition of Time) Act 1880 provides that:

> Whenever any expression of time occurs in any Act of Parliament, deed, or other legal instrument, the time referred shall, unless it is otherwise specifically stated, be held in the case of Great Britain to be Greenwich mean time, and in the case of Ireland, Dublin mean time.[20]

This is carried forward by Section 9 of the Interpretation Act 1978 which states:

> Subject to section 3 of the Summer Time Act 1972 (construction of references to points of time during the period of summer time), whenever an expression of time occurs in an Act, the time referred to shall, unless it is otherwise specifically stated, be held to be Greenwich mean time.[21]

On this reasoning, then, it would seem that crew members in deep space or on Mars could become instantly bound by any law enacted on Earth, despite the restraints of space-time. This is, of course, pending the outcome of any arguments regarding Special/General Relativity in this sense. Given that a mission into deep space towards Mars would potentially be traveling at around 39,600 km/h[22]—not remotely close to light speed—factors of time dilation may not come into play in any significant manner.

An argument based on Special Relativity, however, could postulate that any given legal enactment on Earth, by means of the associated time delay between two points in Space-Time, may not, in a relative sense, have been promulgated as regards a crew in deep space 20 minutes away at the speed of light. If we take the

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[19] Deborah C. Navarro Morales et al., *Time Perception in Astronauts on Board the International Space Station,* NPJ MICROGRAVITY 9, 5 (Jan. 19, 2023), https://www.nature.com/articles/s41526-023-00250-x.

[20] Statutes (Definition of Time) Act 1880, 43 & 44 Vict. c. 9 § 1 (UK).

[21] Interpretation Act 1978 ch. 30 § 9 (UK).

[22] NASA Science, *Mars Perseverance Rover–Cruise,* https://Mars.nasa.gov/Mars2020/timeline/cruise/ (last visited July 29, 2023).

case of *R v. Logan* once more and consider the facts as if they were slightly different, we may see how such an argument could be mounted.

With Special Relativity, the associated time delay between Earth and Mars could, as has been repeatedly stated, be as much as 24 minutes. Light will, in such cases, take 24 minutes to reach Mars. Effectively, therefore, Mars—at such a juncture—could be said to be 24 minutes *behind* rather than *ahead* of Earth. In *R v. Logan* it was January 1 when the defendants actually were at the time they committed the offence—the commencement date of the statute itself—hence, they came within the ambit of the statute as this was consistent with the commencement date. If the defendants had been in South Georgia and the South Sandwich Islands, which is two hours behind the United Kingdom in Coordinated Universal Time (UTC), then they would have still been in December 31 at the time the Act came into force on January 1 and hence, it could be strongly argued that they would not able to be charged under it. The counterargument could run that the Act simply applies to all material places since, as per the Interpretation Act 1978,[23] any provisions as to time are to be taken to mean Greenwich Mean Time (GMT), and the statute simply comes into force in all material places at midnight GMT on the date specified. However, the question of whether this could be logically sustained in the context of deep space travel would not be as easy to resolve. On one level, it could be argued that, from the perspective of travelers more than 20 minutes away, true Greenwich Mean Time has not yet occurred in reality, unless there is an argument to say that the law simply moves faster than the speed of light.

Let's say we accept this argument and say that, for the purposes of promulgation at least, the law effectively travels faster than the speed of light—as soon as a law comes into force on Earth it immediately comes into force for all those subject to its jurisdiction regardless of their position in time and space. One possible counterargument which goes to the heart of legal legitimacy is that of making the law available. This principle was recognized by Thomas Hobbes in his seminal work, *Leviathan*, "[t]he want of

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[23] Interpretation Act, *supra* note 21.

means to know the law, totally Excuseth: For the Law whereof a man has no means to enforme himself, is not obligatory."[24]

Moreover, as the famed jurist Lon Fuller stated in *The Morality of Law*, "[a] formalized standard of promulgation not only tells the lawmaker where to publish his laws; it also lets the subject—or a lawyer representing his interests—know where to go to learn what the law is."[25]

Although any given legislative enactment in question could be "available" in one sense—it may be online in draft form as is commonly the case in a lot of jurisdictions[26]—in another sense the actual law is not yet published since it has not yet passed the commencement date.

As the revered Lord Bingham of Cornhill said:

> . . . no one should be punished under a law unless it is sufficiently clear and certain to enable him to know what conduct is forbidden before he does it; and no one should be punished for any act which was not clearly and ascertainably punishable when the act was done.[27]

Further, as evinced by Lord Diplock in *Fothergill v. Monarch Airlines*:

> Elementary justice or, to use the concept often cited by the European Court, the need for legal certainty demands that the rules by which the citizen is to be bound should be ascertainable by him (or, more realistically, by a competent lawyer advising him) by reference to identifiable sources that are publicly accessible. [28]

This, of course, presupposes that crew members on deep space missions have access to published laws at all, as Gardner stated:

> According to the ideal of the Rule of Law, the law must be such that those subject to it can reliably be guided by it, either to avoid violating it or to build the legal consequences of having

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[24] THOMAS HOBBES, LEVIATHAN CH. XXVII (1651).

[25] LON L. FULLER, THE MORALITY OF LAW 43-4 (2d ed. 1969).

[26] *See, e.g.,* UK Parliament, *Draft Legislation*, https://www.parliament.uk/site-information/azindex/draft-legislation/ (last visited July 29, 2023).

[27] R v. Rimmington (2006)1 AC 459, 482 (House of Lords).

[28] Fothergill v. Monarch Airlines Ltd., (1981) AC 251, 279 (House of Lords).

> violated it into their thinking about what future actions may be open to them. People must be able to find out what the law is and to factor it into their practical deliberations. The law must avoid taking people by surprise, ambushing them, putting them into conflict with its requirements in such a way as to defeat their expectations and frustrate their plans.[29]

For argument's sake, let's assume that, in theory, a deep space crew would have access to some form of internet via radio transmission, albeit one whose "transmissions" would be subject to considerations of Special Relativity, and, thus, theoretical access to all relevant statute laws and legislative enactments back on Earth. This still admits the prospect of applicable enactments being "unavailable" or "undiscoverable" for a period of up to 24 minutes from the date of their publication. Notwithstanding this consideration—or the other less desirable position of having no access to any laws at all—the ancient argument of "ignorance of the law is no excuse" or *ignorantia juris non excusat*, could possibly be attempted here—and, optimistically perhaps, in support of the position previously stated that the law moves faster than the speed of light.

According to Blackstone's Commentaries of England, this rule is originally of Roman origin,[30] and can be found across many legal systems, including the United States where it has been said that "[t]he general rule that ignorance of the law or a mistake of law is no defense to criminal prosecution is deeply rooted in the American legal system."[31]

Moving against such an assertion, the common law has analogous instances whereby "ignorance of the law" has been found to be a defense. Consider, for example, the case of *R v. Bailey*,[32] concerning the captain of a vessel—The Langley—who was indicted for "maliciously shooting" at another vessel, called the Admiral Nelson.[33] The Act under which the captain was indicted was passed on the May 10, 1799, and the offence occurred on June 27 of the same year.[34] The defendant was ultimately pardoned since there was no

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[29] John Gardner, *Introduction, in* PUNISHMENT AND RESPONSIBILITY: ESSAYS ON THE PHILOSOPHY OF LAW, 2ND EDITION, xxxvi (H.L.A. Hart ed. 2008).

[30] 4 WILLIAM BLACKSTONE, COMMENTARIES 27.

[31] Cheek v. U.S., 498 U.S. 192, 200 (1991).

[32] R v. Bailey, 168 E.R. 651 (1800).

[33] *Id.* at 651.

[34] *Id.* at 652.

way that he could have known of the Act, having been at sea during the time of the enactment through to the time of the offence.[35] Technologically speaking, this is a similar position to the crew of a deep space mission vis-a-vis time delay. In neither case is there a possibility of bringing the details of the enactment to the attention of the relevant persons at the material times. Although the time delay under discussion would stand to be a much shorter period, the principle still stands—the law would not be available owing to time delay and hence, would not have any prospect of being discovered. It would arguably be contrary to the rule of law to make a crew member liable—or convict them of an offence—in such circumstances.

A similar case from Canada, *R v. Ross*,[36] concerned a hunter who entered the Vancouver Forest District without obtaining a written permit for the purposes of hunting on September 10, 1944.[37] This district had been declared as off-limits from 12-noon on September 8 by order of the Minister of Lands under the Forest Act.[38] The defendant had left home on September 7[39] and it was accepted that he had no way of knowing about the order and, hence, his conviction was quashed.[40]

If, then, as seen above, the concept of the law moving faster than the speed of light could potentially be inconsistent with aspects of the rule of law itself, it could be suggested that the way forward as regards deep space missions is to explicitly temper the principle of *ignorantia juris non excusat* for such scenarios.

One potentially analogous approach can be sourced from the United Kingdom's Joint Service Manual of the Law of Armed Conflict, where it is stated that, "[s]hould anyone, ignorant of the fact that an armistice has been made, commit an act of hostility by taking ground or capturing prisoners, he will not be punishable for that act although the State to which he belongs is bound to restore the ground or prisoners taken."[41]

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[35] *Id.* at 653.

[36] R. v. Ross, 3 DLR 574 (1945)(Canada).

[37] *Id.* at 575

[38] *Id.*

[39] *Id.*

[40] *Id.* at 577.

[41] UK Ministry of Defense, *The Joint Service Manual of the Law of Armed Conflict*, 265, ¶ 10.22.1 (2004), https://www.gov.uk/government/publications/jsp-383-the-joint-service-manual-of-the-law-of-armed-conflict-2004-edition (last visited July 29, 2023).

Roughly transferring this practice to the deep space scenario would equate to travelers in deep space not being liable or "punishable" for any such act undertaken in contravention of any such legislative enactment which, by reason of time delay, they could not possibly have seen.

A potentially more nuanced approach could be adopted. Not all the world's jurisdictions have such a hard and fast rule in this area[42]—as Ashworth has suggested

> the defense should be based on an appropriate objective standard—what could reasonably be expected of an individual in the defendant's position—perhaps a little broader than the defense in Germany and Sweden. The grounds of excuse would be negligence-based, what could 'reasonably be expected,' and it would be proper for this to be subject to capacity-based exceptions for those unable to perform this citizen's duty.[43]

Such a formulation would be a sensible one to adopt in the context of deep space travel, providing an unfussy and straightforward solution to the time delay problem as it stands in respect of new enactments. Moreover, it has been suggested that such assessments should be carried out by the Courts save for situations in which it is plain that the Defendant clearly knows that the conduct is harmful,[44] the most notable commentator in this regard perhaps being Lon Fuller who stated that "to the extent that the law merely brings to explicit expression conceptions of right and wrong widely shared within the community, the need that enacted law be publicized and clearly stated diminishes in importance"[45]

Consistent with this is the ruling of the Privy Council in the case of *Christian v. The Queen*,[46] whereby some Pitcairn Islanders were charged with several serious sexual offenses contrary to the Sexual Offences Act 1956.[47] The statute law of the United Kingdom

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[42] *See* S v. De Bloem, 1977 (3) SA 513 (S. Afr.) (finding that ignorance of law can be an excuse).

[43] A.J. Ashworth, *Excusable Mistake of Law*, 1974 CRIM. L. REV. 652, 654.

[44] Douglas Husak & Andrew von Hirsch, *Culpability and Mistake of Law*, in ACTION AND VALUE IN CRIMINAL LAW (Stephen Shute, John Gardner & Jeremy Horder eds. 1993).

[45] Fuller, *supra* note 25, at 92.

[46] Christian v. The Queen (2006) UKPC 47.

[47] *Id.* ¶ 1.

was said to apply on the Pitcairn Islands by virtue of the Pitcairn Order 1970, but it was accepted that:

> None of the relevant statutes or legal texts were sent to the island. Nor had any publications such as Halsbury's Laws of England been provided. There is no evidence that anyone on Pitcairn was aware of the provisions of sections 1 and 14 of the Sexual Offences Act 1956 prior to the commencement of the police investigation in 1996.[48]

Despite this, the defendants were convicted on the basis that the Act, rather than creating new offenses that the islanders could not be taken to have been aware of, merely augmented the existing common law offenses which, essentially, they were being prosecuted for. As stated by Lord Hoffman:

> This feature of the legislation makes it possible to reconcile the failure to promulgate the fact that the 1956 Act was to be part of the laws of Pitcairn with the principle of legality. The islanders brought the common law of England with them when they settled there. Rape and indecent assault were part of the criminal law of the island long before the Justice Ordinance 1966 and the Judicature Ordinances 1961 and 1970 were enacted. No objection could have been taken on the ground of lack of promulgation if the prosecution of the appellants had been brought under the common law.[49]

Therefore, the precise nature of any laws passed can have a bearing on whether ignorance of any subsequently promulgated rules can constitute a sound defense, particularly when they may serve to supplement existing provisions.

As formed part of the discussion in the case of *R v. Ross*,[50] the extent of promulgation can also determine whether or not ignorance of a particular rule is a sound defense. As stated by County Court Judge Harrison:

> Briefly, amongst other things, before a public Act can receive the Royal assent and become law it must first, in the form of a bill, be presented to and deliberated upon and conveyed or

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[48] *Id.* ¶ 68.
[49] *Id.* ¶ 85.
[50] Ross, *supra* note 36, at 576.

> passed, through its different stages at different times and on different days, by the action of the members of the Legislative Assembly in concourse duly assembled in the proper place designated for that purpose, at which the public, including representatives of the press, are generally permitted to be present. Therefore the proceedings necessary to enact and bring into force an Act or law binding upon the public give to it a certain measure of publicity, and it is not difficult to understand why it is a general rule of law that one cannot successfully plead ignorance of such an Act or law.[51]

On this basis, it could be argued that any deep-space crew could indeed find themselves bound by any new enactment, providing it could be said to be a primary source of legislation. In other words, a legislation that has gone through whatever the equivalent of the parliamentary process is in the relevant jurisdiction, regardless of the time delay factor. It could be said that the new law would have been widely publicized enough through the legislative process for any crew member to have theoretically appraised themselves of the contents thereof, thus negating any technical defense on the law not technically being published until about 20 minutes after the official commencement date.

However, the position can be markedly different when it comes to secondary legislation such as statutory instruments, ordinances or bylaws, and the like. An example of this is the case of *Lim Chin Aik v. The Queen*,[52] which concerned section 6 of the 1952 Singapore Immigration Ordinance, of which the defendant had allegedly contravened.[53] The instrument itself had not been published indeed it was accepted that the full extent of the ordinance's publication was that the relevant Minister signed it and then sent it to the Deputy Assistant Controller for Immigration.[54] No effort had been made beyond this to bring the ordinance to the attention of either the defendant or the public at large. This was held not to have gone far enough and, as Lord Evershed stated, "[i]t seems to their Lordships that, where a man is said to have contravened an order or an order of prohibition, the common sense of the language presumes that he

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[51] *Id.* at 575.

[52] Lim Chin Aik v. The Queen (1963) A.C. 160 (Privy Council).

[53] *Id.* at 1.

[54] *Id.* at 2.

was aware of the order before he can be said to have contravened it."[55]

It is worth noting that non-publication (or issuance) of a statutory instrument is a complete defense under English law under §3(2) of the Statutory Instruments Act 1946,[56] which states that:

> In any proceedings against any person for an offence consisting of a contravention of any such statutory instrument, it shall be a defense to prove that the instrument had not been issued by [or under the authority of] His Majesty's Stationery Office at the date of the alleged contravention unless it is proved that at that date reasonable steps had been taken for the purpose of bringing the purport of the instrument to the notice of the public, or of persons likely to be affected by it, or of the person charged.

In the case of our deep space crew, is simple publication on the government website in willful ignorance of the time delay factor really taking "reasonable steps?" Arguably not unless the timing of the publication is such that the delay factor is extinguished—such as the instrument being formally published around 24 minutes, or whatever the material time happens to be—earlier than the publication date/time for Earth-based entities.

Overall, the fairest approach to take regarding promulgation and deep space travelers would be for any Earth-based domestic adjudicating authority to assess whether, against the backdrop of time delay, a defendant's "ignorance" of the law could be said to be reasonable on a case-by-case basis. As has been shown, this would be a complicated exercise since a large range of factors must be considered, particularly regarding the nature of the alleged transgression and the actual type and extent of promulgation of the law in question. There may even be some argument as to whether *ignorantia juris non excusat* applies to all legal areas or just some.[57] Moreover, in the interests of fairness and common sense, any decision-maker must also observe the fact that complete knowledge of

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[55] *Id.* at 5.

[56] Statutory Instruments Act, 1946, 9 and 10 Geo. 6 ch. 36 (U.K.).

[57] *See* Osei-Bonsu v. Wandsworth London Borough Council, (1999) 1 All ER 265 (obiter statements of the Court of Appeals).

the law in any case is a complete legal fiction. As Robert Goodin stated:

> Providing every US household with a copy of the US Code—all 364 volumes of it—might maximize promulgation. Doing that would maximize the extent to which people could possibly access the law. But doing so would do little to increase the probability that they would actually know the law.
>
> Lawyers are rightly sensitive to the importance of promulgation. But the problem here in view is not one that can be solved by promulgation. The problem is that there is simply too much law for people to sift through. Giving everyone a copy of the US Code, or putting it all on the internet, will not help with that. The problems are the same searching so much text electronically as working through a hard-copy index. In conducting a search of either sort, the problem is simply that you don't know what you don't know.[58]

As important as publication is to the rule of law, the reality is that, like ordinary citizens, busy personnel on deep space missions are simply, as a matter of fact, not going to be aware of each and every piece of legislation and rule that is promulgated, regardless of the surrounding publicity. As has been shown, the time delay factor simply compounds this situation. Given the exceptional circumstances of any crewed deep space operation, some form of temperance is surely necessary, and a relaxation of any blanket application of *ignorantia juris non excusat* as regards newly enacted legal instruments should be agreed upon as opposed to simply assuming that the law travels faster than the speed of light. Issues of practicality and technicality aside, if humankind is to take the rule of law into deep space and potentially to other worlds, surely it should do so on a sound footing that respects legal legitimacy.

III. TIME AS AN ESSENTIALLY LOCAL CONCEPT

Moving away from issues of promulgation, there is significant authority to support the position that time ought to be regarded as

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[58] Robert E. Goodin, *An Epistemic Case for Legal Moralism*, 30(4) OXFORD J. LEGAL STUD. 615, 619 (2010).

a "local" concept in terms of certain legal matters arising.[59] The case of *Curtis v. March*[60] concerned a trial in England during a time in history where Greenwich Mean Time was not uniformly followed across the country.[61] The trial was held in Dorchester and on Greenwich time, despite the fact that Dorchester did not follow Greenwich time. The resulting trial was overturned on the basis that, as per Pollock CB, the relevant time should have been the time of the place itself—Dorchester time.[62]

This reasoning was followed in a recent case, *Euronav NV v. Repsol Trading SA*,[63] which involved a dispute over a charter party, specifically whether a potential breach of a demurrage clause should be assessed under the time zone where it arose or where the contract was formulated.[64] In this case, the alleged breach occurred in Los Angeles, but the argument was that the correct time zone should be that of the party alleging the breach, who was in Spain.[65] Ultimately, it was decided that the correct time should be the "local" time, i.e. that where the events arose, in this case, Los Angeles.[66] In reaching this conclusion, Henshaw, J quoted extensively from "Carver on Charterparties:"

> The charter may specify the particular time zone by which the relevant time is to be determined, e.g. GMT or UTC. If not, local mean time should be used. (para. 7-015)[67]

Henshaw's conclusions included the following:

> (v) The use of local time at the place of discharge gives rise to a single, clear and easily ascertainable date and time of completion of discharge. It tends to promote certainty and reduce the risk of confusion.

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[59] Euronav NV v. Repsol Trading SA, ¶ 29 (2021) EWHC 2565 (Comm.).
[60] Curtis v. March, (1858) 3 Hurl & N 866, 157 ER 719 (Court of Exchequer).
[61] *Id.* at 866.
[62] *Id.* at 867-8.
[63] *See* Euronav NV, *supra* note 59.
[64] *Id.* ¶ 5.
[65] *Id.*
[66] *Id.* ¶ 53.
[67] *Id.* ¶ 35.

> (vi) It is inherent in a date-based system that different time zones may apply to the events which define the start and end of the period, if they are in different countries.
>
> …
>
> (viii) If it were appropriate to determine both dates using a single time zone, it would be more logical for that to be the time zone of the place of discharge. As already noted, the completion of discharge is a significant physical event, with a natural date, usually recorded in contemporaneous documents, and with several consequences under the contracts relating to the voyage.[68]

Rules and solutions such as this could become very important as regards the time delay factor. The approach taken here is simply to make time a local concept in these particular transactions. In relation to the making of payments in shipping matters, Henshaw pointed out

> Time Charters (7th ed.) states:
>
> It is suggested that, again in the absence of express agreement, the last moment for timely payment should be calculated by reference to the place where payment is to be made so that (for example) a payment to be made in New York and due on 30 April is timely if effected late in the afternoon that day in New York even if the ship is then in the Far East so that for her it is 1 May.(§ 16.22)[69]

It is worth taking into consideration this useful mechanism as regards legal certainty in matters involving deep-space crews. A blanket solution given the time delay factor could—in certain areas—be applied so as to avoid any potential confusion and ensure efficiency. Moreover, less scope for legal argument in such cases is likely to be more beneficial as regards the limitation of costs. It is worth considering whether such a solution could be formulated with respect to the following areas outlined in this article or tendered as a more general solution to the time delay problem overall.

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[68] *Id.* ¶ 61.
[69] *Id.* ¶ 35.

IV. CONTRACT LAW

Basic principles of contract law underpin a large range of commercial transactions. In English law, for a contract to come into existence, there must generally be a valid offer coupled with a valid acceptance which is supported by consideration and underwritten by the parties' desire to be legally bound by the agreement—commonly known as an intention to create legal relations.[70] The parties must also have the capacity (be old enough) and have a sound mind to enter into the agreement and of sound mind.[71]

On a deep space mission, it is possible that a contract may be formed between a crew member and an Earth-based party. Given the significant amount of media attention that initial ventures will attract, this could be anything ranging from a sponsorship contract to securing the rights to publication of a crew-member story, or negotiations/eventual amendments in pursuit of such ventures. It could also potentially extend to purchasing of property and real estate back on Earth or entering into rental or tenancy agreements with people on Earth, and, least dramatically of all, perhaps, online banking transactions and agreements.

It is also possible that, if it were to offer a significant commercial advantage, a company could desire registration aboard a spacecraft, particularly if engaged in the exploitation of resources on a distant celestial body, asteroid, or other such venture, making those aboard a spacecraft liable for the conclusion or negotiation of contracts regarding any commercial extractions. Associated contractual liabilities could arise even in the absence of any such "registration."

A. Communication of Offer and Acceptance

Regardless of the circumstances contractual liabilities arise in—they could be myriad—the time delay factor outlined previously is likely to have an impact. The old question of when exactly a

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[70] *See* HUGH BEALE, CHITTY ON CONTRACTS 4-207 (35th ed.). *See also* Ryan Catterwall, *The Limits on Intention in Contract,* 13(9) L.Q.R. 571 (2023), For an interesting case example on contractual intention see the case of *Blue v. Ashley* [2017] EWHC 1928 (Comm).

[71] *Id.* Chapter 12. Regarding minors, *see R. v Oldham Metropolitan BC Ex p. Garlick* [1993] 1 F.L.R. 645 (EWCA) at 662. For a case involving mental incapacity *see Imperial Loan Co. v. Stone* [1892] 1 Q.B. 599 (EWCA).

contract has been formed is noteworthy. When an Earth-based entity makes an offer, when does valid acceptance occur? Is it when the crew member speaks the words of acceptance into the microphone/presses "send" on the relevant electronic interface, which signifies assent, or when the words themselves/electronic communication arrives on the Earth 15 minutes later, having been carried on the radio waves? Under the authority of *Brinkibon Ltd v. Stahag Stahl und Stahlwarenhandelsgellschaft mbH,*[72] where instantaneous communications are employed, a contract will be formed in the place where acceptance is received. However, the viability of employing this rule in all circumstances was doubted by Lord Wilberforce:

> Since 1955 the use of Telex communication has been greatly expanded, and there are many variants on it. The senders and recipients may not be the principals to the contemplated contract. They may be servants or agents with limited authority. The message may not reach, or be intended to reach, the designated recipient immediately: messages may be sent out of office hours, or at night, with the intention, or on the assumption that they will be read at a later time. There may be some error or default at the recipient's end which prevents receipt at the time contemplated and believed in by the sender. The message may have been sent and/or received through machines operated by third persons. And many other variants may occur. No universal rule can cover all such cases; they must be resolved by reference to the intentions of the parties, by sound business practice and in some cases by a judgement where the risks should lie.[73]

Sound business practice or the law, then, must consider the strange state of contractual limbo which would exist for up to 24 minutes when the words of acceptance would be traveling to Earth on radio waves. Perhaps the clearer analogy to draw in such instances is with acceptance by post in the case of *Adams v. Lindsell*,[74] where, for the sake of commercial certainty, it was held that where post is the desired form of acceptance, acceptance will take

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[72] Brinkibon Ltd. v. Stahag Stahl und Stahlwarenhandelsgellschaft mbH, (1983) 2 AC 34 (UKHL).

[73] *Id.* at 42.

[74] Adams v. Lindsell (1818) 1 B & Ald 681 (KB).

place on the actual "posting" of the acceptance, and there is no requirement to show that the acceptance has been communicated.[75] Using this analogy, the provider of the radio services and/or high gain antenna would effectively take the position of the post officer—a mere "agent" rather than a party to any such contractual matters.[76] Revocation of an offer by post, on the other hand, is only valid on receipt.[77]

Regarding this inter-temporal period of limbo, Lord Herschell had the following to say:

> I think that a person who has made an offer must be considered as continuously making it until he has brought to the knowledge of the person to whom it was made that it is withdrawn. This seems to me to be in accordance with the reasoning of the Court of King's Bench in the case of Adams v. Lindsell.[78]

Taking into account the parameters of the Theory of Special Relativity, it could be said that words of an offer which are carried 24 minutes across the radio waves at the speed of light, in a philosophical sense, have more in common with instantaneous methods of communication since, much like the light received from the sun on planet Earth eight minutes after they depart, the words of the offer relative to the deep space traveler could in one sense be regarded as having arrived contemporaneously with their initial utterance. Accordingly, if this position is taken, the "postal rule" analogy will collapse entirely, and the rules relating to instantaneous communications may apply instead.

It has been held that Fax is a form of instantaneous communication because parties should be able to know—as a matter of fact—whether their communication has been received or not by electronic means.[79] Take Lord Denning's statement in the seminal case of *Entores Ltd v. Miles Far East Corporation*:

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[75] Brinkibon, *supra* note 72, at 37, (citing *id.).*

[76] Household Fire and Carriage Accident Insurance Co. v. Grant (1879) LR 4 Ex D 216 (KB), per Thesiger LJ.

[77] Byrne & Co v. Van Tienhoven & Co (1880) 5 CPD 344 (Court of Common Pleas).

[78] Henthorn v. Fraser, 31 (1892) 2 ch. 27 (Court of Appeal) at 31.

[79] *See* JSC Zestafoni Nikoladze Ferroalloy Plant v. Ronly Holdings Ltd. (2004) EWHC 245 (Comm.) at 75.

> Lastly take the Telex. Suppose a clerk in a London office taps out on the teleprinter an offer which is immediately recorded on a teleprinter in a Manchester office, and a clerk at that end taps out an acceptance. If the line goes dead in the middle of the sentence of acceptance, the teleprinter motor will stop. There is then obviously no contract. The clerk at Manchester must get through again and send his complete sentence. But it may happen that the line does not go dead, yet the message does not get through to London. Thus the clerk at Manchester may tap out his message of acceptance and it will not be recorded in London because the ink at the London end fails or something of that kind. In that case the Manchester clerk will not know of the failure but the London clerk will know of it and will immediately send back a message "not receiving". Then, when the fault is rectified, the Manchester clerk will repeat his message. Only then is there a contract. If he does not repeat it, there is no contract. It is not until his message is received that the contract is complete.[80]

It is quite pertinent to note that Lord Denning went on to suggest that:

> In a matter of this kind, however, it is very important that the countries of the world should have the same rule. I find that most of the European countries have substantially the same rule as that I have stated. Indeed they apply it to contracts by post as well as instantaneous communications. But in the United States of America it appears as if instantaneous communications are treated in the same way as postal communications. In view of this divergence, I think we must consider the matter on principle; and so considered, I have come to the view I have stated, and I am glad to see that Professor Winfield in this country (55 Law Quarterly Review at p 514) and Professor Williston in the United States of America (Contracts I S 82) takes the same view.[81]

Such a unified approach would be useful for deep-space scenarios. It has also, however, been theorized in the academic literature that Earth-based email communication is not necessarily a form of instantaneous communication either:

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[80] Entores Ltd v. Miles Far East Corporation (1955) 2 All ER 493, at 495.

[81] *Id.* at 496.

> The speed of email messages depends, in these cases, on whether one or more of these service providers are busy with millions of applications from other internet users. Considerable delays may occur in email communication between when a message is sent and when it is received by the recipient. These delays result from the complex path over which the email is sent. For example, if person A in Aberdeen sends an email message to person B in Belfast, usually there will be no direct link between the computer systems. This explains why, on occasion, an email takes a longer time than usual to reach the recipient… To this end, it can be said that email is not an instantaneous form of communication, because as explained previously, there can be gap in time between dispatch and deemed receipt.[82]

How "instantaneous" any form of communication needs to be before it is "truly instantaneous" does not appear to have been the subject of any significant judicial scrutiny. It is worth noting the authors further comments on the postal rule and the position that the rule could be valuable in the sense that it at least promotes legal certainty:

> In fact, it can be said that this rule is efficacious as it is cognizant of both of the business convenience of the offeree and the fair allocation of risk, as it establishes a finite date for the contract and avoids circular communication. (Watnick, 2004) Any delay which occurs between sending and receiving post letters creates potential risk for both of parties due to the uncertainty as to preciously when the message is deemed to have been received. This justification may be considered as the corner stone for application of the postal acceptance rule. Relying on contract formation in posting or dispatch, established a definite time for confirmations between parties if they ask for it, without any need for further communications. This can be understood as Treitel (1991) concludes that "courts in applying the postal rule aim to bring a rationale of necessity and predict that if the contract were to come into force it can best be achieved on sending the acceptance.[83]

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[82] Marwan Al Ibrahim et al., *The Postal Acceptance Rule in the Digital Age,* 2 J. INT'L COM. L. & TECH. 47 (2007).

[83] *Id.*

By way of a brief comparative exercise, it is interesting to note that in Germany, it is stated that an offer which has been made in the absence of the parties—or inter absentes—"may be accepted only up to the point in time at which the person making the request may expect the receipt of the reply under regular circumstances."[84]

Moreover, regarding a late acceptance, the German position—rather logically—states that "[l]ate acceptance of an application shall be deemed to be a new application."[85]

Clearly such an approach may be difficult to reconcile with issues of time delay as technically there would always be a "late acceptance" and that deep space travel would not be classed as "regular" circumstances.

Furthermore, looking to the international stage, the Vienna Convention on Contracts for the International Sale of Goods states:

> Article 18 (2)—An acceptance of an offer becomes effective at the moment the indication of assent reaches the offeror. An acceptance is not effective if the indication of assent does not reach the offeror within the time he has fixed or, if no time is fixed, within a reasonable time, due account being taken of the circumstances of the transaction, including the rapidity of the means of communication employed by the offeror. An oral offer must be accepted immediately unless the circumstances indicate otherwise. [86]

This would appear to be a sensible approach to take overall as regards deep space transactions as account must be taken of the transactional circumstances and "rapidity of the means of communication employed by the offeror" as stated.

Two further instructive instruments to observe in this context are the United Nation's Convention on the Use of Electronic

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[84] Bürgerliches Gesetzbuch [BGB] [Civil Code], §147 ¶2.

[85] *Id.*

[86] Vienna Convention on Contracts for the International Sale of Goods art. 18(2), Apr. 11, 1980, S. Treaty Doc. No. 98-9, 1489 U.N.T.S. 3 [hereinafter Convention on Contracts for Int'l Sale].

Communications in International Contracts,[87] and the UNCITRAL Model Law on Electronic Commerce.[88]

Article 10 of the Convention states, regarding dispatch and receipt of electronic communications pursuant to contractual relations generally:

> 1. The time of dispatch of an electronic communication is the time when it leaves an information system under the control of the originator or of the party who sent it on behalf of the originator or, if the electronic communication has not left an information system under the control of the originator or of the party who sent it on behalf of the originator, the time when the electronic communication is received.[89]
>
> 2. The time of receipt of an electronic communication is the time when it becomes capable of being retrieved by the addressee at an electronic address designated by the addressee. The time of receipt of an electronic communication at another electronic address of the addressee is the time when it becomes capable of being retrieved by the addressee at that address and the addressee becomes aware that the electronic communication has been sent to that address. An electronic communication is presumed to be capable of being retrieved by the addressee when it reaches the addressee's electronic address.[90]

This approach is mirrored in Article 15 of the UNCITRAL Model Law. These instruments make interesting reference to the time of receipt under which the actual deemed time of receipt will be that of the time the communication becomes capable of being retrieved by the party in receipt. In the case of deep space interaction this would be a helpful clarification as regards offer and acceptance in both directions and, coupled with influences from Article 18 of the Vienna Convention on Contracts for the International Sale of Goods, in particular a reference to the "rapidity of the means of

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[87] Convention on the Use of Electronic Communications in International Contracts, art. 10, Nov. 23, 2005, 2898 U.N.T.S. 3 [hereinafter Convention on the Use of Electronic].

[88] U.N. Commission on Int'l Trade Law, Model Law on Electronic Com., art. 10, (June 12, 1996), available at: https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/19-04970_ebook.pdf.

[89] Convention on the Use of Electronic, *supra* note 87, art. 10(1).

[90] *Id*. at art. 10(2).

communication," would be a useful device when considering the nuances of offer and acceptance within such circumstances.

One further area in terms of contractual acceptance which could be adversely impacted by time delay would be the situation regarding revocation of an offer, in particular, the situation as regards how much time must have elapsed to make an offer no longer open to acceptance. The classic English authority on this point is *Ramsgate Victoria Hotel v. Montefiore*,[91] which concerned the purchase of shares. The general rule in English contract law is that what constitutes a reasonable amount of time before an offer becomes technically revoked is dependent on the subject matter.[92] In this case, a period of six months had elapsed between the offer being made and the prospective purchase of the shares and the Court determined that the offer was no longer capable of being accepted.[93] The need for certainty as regards such contractual dealings has been mentioned in the literature,[94] and is obvious to discern fluctuations in the value of currencies and the value of shares for example.

In our deep space scenario consider the purchase of shares. Could it be argued that up to 24 minutes could be considered a "long" time for the sake of share purchases? Consider an offer from an Earth-based entity for the purchase of 200 shares at the rate of $10 per share. Twenty-four minutes later the value of the shares may have increased to $100 per share. Would the offer still stand in these circumstances, or would it be deemed to have become extinguished through lapse of time? It may be that any such dealings in respect of potentially volatile subject matters between Earth-based entities and deep space travelers must be conducted solely on Earth through a representative vested with power of attorney or some other such authority. At the very least, such transactions will necessarily be subject to a form of caveat acknowledging the time delay and potentially outlining an acceptable "margin of fluctuation" by which the transaction would fail to be determined. As an example of such caveat might be: "on the basis of any given time

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[91] *Ramsgate Victoria Hotel v. Montefiore*, (1866]) LR 1 Ex 109 (Court of Exchequer).

[92] *See* BEALE, *supra* note 70, at 4-127.

[93] *Ramsgate Victoria Hotel v. Montefiore , supra* note 91, at 111.

[94] Office of Fair Trading, *Unfair Contract Terms Guidance*, 61 ¶ 14.1.5 (Sept. 2008) https://assets.publishing.service.gov.uk/media/5a7c7f43ed915d48c241023b/oft311.pdf.

delay, this offer will become void if the subject matter has fluctuated by up to and including X% at the time of receipt."

Communication of revocation may also prove problematic here too. As the Vienna Convention on the International Sale of Goods states under Article 15(2), "[a]n offer, even if it is irrevocable, may be withdrawn if the...withdrawal reaches the offeree before or at the same time as the offer."[95] Owing to the principles of Special Relativity this would be virtually impossible.

There are various approaches to matters of contractual formation in general as can be seen from the forgoing. Given the potential for contractual transactions to arise during a deep space mission it is of paramount importance that the law in this regard is agreed upon prior to departure. This is more pertinent for multinational crews considering that different legal systems will deal with such matters in different ways. Further comparative law research in this area would be useful to determine the different approaches to this conundrum globally from which inspiration could be drawn as regards suitable rules to incorporate regarding any time delay factors in respect of contractual formation and other factors.

B. Contracts Where Time Is "of the Essence"

Related to the discussion of how time is to be described in general earlier in this article, contracts where time is stipulated to be "of the essence"[96] will surely have to be considered in a new light or be drafted in such a way as to factor in respect for the time factor issue. For example, the case of *Union Eagle Ltd. v. Golden Achievement Ltd.,*[97] concerned a 10-minute delay in the payment of a purchase price for a flat and parking space in Hong Kong.[98] The consequence of the delay was that the prospective purchaser lost their deposit on the property.[99] They sued for specific performance.[100] It was held that, since "time was of the essence" with respect to the contract in question, the equitable remedy of specific performance

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[95] Convention on Contracts for Int'l Sale, *supra* note 86, at art. 15(2).

[96] *See* Union Eagle Ltd. v. Golden Achievement Ltd., [1997] UKPC 5 (Privy Council).

[97] *Id.*

[98] *Id.* ¶ 2.

[99] *Id.* ¶ 1.

[100] *Id.* ¶ 2.

was not available.[101] Certainty in such transactions was held to be of vital importance and, therefore, the consequence of the default stood. As the Court outlined:

> No objectionable uncertainty is created by the existence of a restitutionary form of relief against forfeiture, which gives the court a discretion to order repayment of all or part of the retained money. But the right to rescind the contract, though it involves termination of the purchaser's equitable interest, stands upon a rather different footing. Its purpose is, upon breach of an essential term, to restore to the vendor his freedom to deal with his land as he pleases. In a rising market, such a right may be valuable but volatile. Their Lordships think that in such circumstances a vendor should be able to know with reasonable certainty whether he may resell the land or not.[102]

In English law there are various kinds of "time clause," as Sir Terence Etherington stated in *Urban 1 (Blonk Street) Ltd. v. Ayres*.[103] Expressions such as "a response must be received by 1200 Earth/Mars / "Deep Space" Time" may become common-place in certain future boilerplate agreements between spacefarers and Earth-based entities. Some degree of certainty is then needed as regards the time delay factor in such matters.

As previously speculated, it is likely that any substantial dealings as to property between crewmembers and Earth-based entities will be actioned through intermediate documents or deposits required prior to certain completion dates or deadlines in the case of sale of land are most likely to be delivered by an Earth-based agent of the crew-member. Assuming that one common legal transaction which is likely to be required by crewmembers will be payment of monies—for whatever purpose—it is worth noting that § 10(1) of the Sale of Goods Act 1979 states that stipulations about time in

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[101] *Id.* ¶ 3.

[102] *See Union Eagle*, *supra* note 96, ¶ 12.

[103] *Urb. 1 (Blonk Street) Ltd. v. Ayres,* [2014] 1 WLR 756 (High Court), ¶ 12 ("(1) It is necessary to distinguish between three types of contractual time provision. They are those which are conditions in the technical sense that any breach of them, however slight, is a repudiatory breach of contract which entitles the other party to terminate the contract immediately; those which are warranties in the technical sense that any breach of them, however serious, will only ever entitle the other party to damages and not to terminate the contract; and those which are so-called innominate terms . . . .").

the case of payments are "not of the essence" unless the contract states otherwise.[104] Whether this provision has parallels in other jurisdictions will ultimately remain to be seen but, essentially, this would appear to be a sensible position to adopt regarding deep space transactions. However, such an adoption should be tempered so as to include reference to the likely time delay impact.

Even in the absence of any such explicit term being inserted in such contracts, including where time is "of the essence," under English law it is probable that a term would be implied in relation to time delay in this regard. Implied terms can be implied in fact,[105] as well as law.[106] Terms implied in fact are terms that are implied to give business efficacy to the contract or those which both parties would consider obvious.[107] Such a test could effectively produce the outcome that, in circumstances involving time delay, it would be "obvious" that both parties would take this into account but where would this leave a contract where time is stipulated to be "of the essence"? Would an implied term as to being mindful of time delay have the effect of overruling an express term as to time being of the essence?

As has been shown, a time delay factor could have wide-reaching implications for a range of transactions where the legal foundations are largely shaped by principles of contract law. The presenting issues, however, are not insurmountable. Different jurisdictions deal with these matters in different ways and the international instruments examined show how approaches can be tailored to new developments—electronic commerce, for instance. A useful exercise going forward in this area would be a comprehensive comparative study of a range of legal systems in areas of basic contractual formation to determine the most appropriate way forward.

VI. TORT LAW

Contract law is not the only area likely to suffer complications because of time delay. Aspects of tort law and criminal law could also be affected by this phenomenon.

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104 1979 c. 54. S10(1).

105 The Moorcock, [1889] 14 PD 64 (App. Ct.).

106 Liverpool City Council v. Irwin, [1976] UKHL 1.

107 *See generally*, The Moorcock, *supra* note 105.

As described by Winfield, "*[t]ortious liability arises from the breach of a duty primarily fixed by the law; such duty is towards persons generally and its breach is redressable by an action for unliquidated damages*."[108] A cornerstone of tort law is the law of negligence, which this section will largely concern itself with. The seminal case of *Donoghue v. Stevenson* is the most revered touchstone for the modern law of negligence in the UK.[109] In particular, statement of Lord Atkin is held to have shaped the modern definition:

> The rule that you are to love your neighbour becomes in law, you must not injure your neighbour; and the lawyer's question, Who is my neighbour? receives a restricted reply. You must take reasonable care to avoid acts or omissions which you can reasonably foresee would be likely to injure your neighbour. Who, then, in law is my neighbour? The answer seems to be - persons who are so closely and directly affected by my act that I ought reasonably to have them in contemplation as being so affected when I am directing my mind to the acts or omissions which are called in question.[110]

The modern law of negligence in the UK has been refined by various judicial statements since this case. For the purposes of this article the most important areas are that of the "standard" of care—judged by the standard of the "reasonable person."[111] This standard was summarized by Lord MacMillan:

> The standard of foresight of the reasonable man is, in one sense, an impersonal test. It eliminates the personal equation and is independent of the idiosyncrasies of the particular person whose conduct is in question. Some persons are by nature unduly timorous and imagine every path beset with lions. Others, of more robust temperament, fail to foresee or nonchalantly disregard even the most obvious dangers. The reasonable man is presumed to be free both from over-apprehension and from over-confidence, but there is a sense in which the standard of care of the reasonable man involves in its application a subjective element. It is still left to the judge to decide

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[108] PERCY H. WINFIELD, THE PROVINCE OF THE LAW OF TORT 32 (1931).

[109] *Donoghue v. Stevenson,* [1932] A.C. 562 (HL).

[110] *Id.* at 580.

[111] *See* Muis v. Glasgow Corp. (1943) A.C. 448 (H L).

> what, in the circumstances of the particular case, the reasonable man would have had in contemplation, and what, accordingly, the party sought to be made liable ought to have foreseen.[112]

The standard of care is thus variable and will sometimes depend on the capacity in which the defendant was acting at the time of the alleged negligence. Lord Denning described the standard of care for road users in the case of *Nettleship v. Weston*:

> The learner driver may be doing his best, but his incompetent best is not good enough. He must drive in as good a manner as a driver of skill, experience and care, who is sound in mind and limb, who makes no errors of judgment, has good eyesight and hearing, and is free from any infirmity.[113]

Likewise, for those exercising a specific skill, this standard was famously announced by McNair, J. in the case of *Bolam v. Friern Hospital Management Committee*:[114]

> In the ordinary case which does not involve any special skill, negligence in law means a failure to do some act which a reasonable man in the circumstances would do, or the doing of some act which a reasonable man in the circumstances would not do; and if that failure or the doing of that act results in injury, then there is a cause of action. How do you test whether this act or failure is negligent? In an ordinary case it is generally said you judge it by the action of the man in the street. He is the ordinary man. In one case it has been said you judge it by the conduct of the man on the top of a Clapham omnibus. He is the ordinary man. But where you get a situation which involves the use of some special skill or competence, then the test as to whether there has been negligence or not is not the test of the man on the top of a Clapham omnibus, because he has not got this special skill. The test is the standard of the ordinary skilled man exercising and professing to have that special skill. A man need not possess the highest expert skill; it is well established law that it is sufficient if he exercises the

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[112] *Id.*

[113] Nettleship v. Weston, (1971) 2 Q.B. 691, 699.

[114] Bolam v. Friern Hosp. Mgmt. Comm. (1957) 1 W.L.R. 582 (Q.B.).

> ordinary skill of an ordinary competent man exercising that particular art.[115]

Professionals are held to a higher standard of care as regards negligent acts in appropriate circumstances. Relevant standards are all tempered by what is known as "reasonable foreseeability." As Viscount Simonds stated in *Overseas Tankship (UK) Ltd. v. Mort's Dock & Engineering Co. (The Wagon Mound)*:

> For it does not seem consonant with current ideas of justice or morality that for an act of negligence, however slight or venial, which results in some trivial foreseeable damage the actor should be liable for all consequences however unforeseeable and however grave, so long as they can be said to be "direct." It is a principle of civil liability, subject only to qualifications which have no present relevance, that a man must be considered to be responsible for the probable consequences of his act. To demand more of him is too harsh a rule, to demand less is to ignore that civilised order requires the observance of a minimum standard of behaviour.[116]

Regarding the intersection of reasonable foreseeability and the standard of care expected of professionals, time delay could be a significant variable in such matters. Suppose that the time delay between Earth and Mars is 20 minutes at the time of a specific medical problem which none of the crew members on Mars are qualified to deal with—it may be a situation where the crews doctor needs to seek a second opinion. When a medical expert on Earth issues any advice in response to a question, the advice may not necessarily be suitable to the patient's condition after the 20 minutes the advice takes to be carried by the radio waves to Mars. The patient's situation may have deteriorated—or improved—or other symptoms may have manifested themselves. Should the advice be acted upon by the doctor on Mars in such an instance? Would they be negligent for doing so or would the medical expert on Earth be negligent for not qualifying their advice with reference to the given time delay? While this may seem like a mere practical consideration it would be one that is certainly worth considering in a legal sense.

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[115] *Id.* at 586.

[116] Overseas Tankship Ltd. V. Morts Dock & Engineering Co., (1961) A.C. 388 (P.C.) at 422-23.

Similar issues could arise in respect of other professional communications. Economic loss caused by a negligently made statement is also part of the law of tort.[117] The legal basis for imposing liability was laid down by Lord Denning in *Hedley Byrne v. Heller and Partners Ltd.*:

> A reasonable man, knowing that he was being trusted or that his skill and judgment were being relied on, would, I think, have three courses open to him. He could keep silent or decline to give the information or advice sought: or he could give an answer with a clear qualification that he accepted no responsibility for it or that it was given without that reflection or inquiry which a careful answer would require: or he could simply answer without any such qualification. If he chooses to adopt the last course he must, I think, be held to have accepted some responsibility for his answer being given carefully, or to have accepted a relationship with the inquirer which requires him to exercise such care as the circumstances require.[118]

Consider the situation where there is a 15 minute time delay. If financial advice is given on Earth at 0:00 (midnight) it will arrive with the crew member on Mars at 0:15. Let's assume that something happens in the financial market at around 0:05 which would materially alter the advice given at 0:00 rendering it such that it would cause significant financial loss to the recipient in such circumstances. If the financial adviser does not act and utter a second communication as soon as possible, this could have potentially serious and undesirable consequences for both parties to this discussion, including a potential finding of negligence against the financial adviser. For this reason, any relevant time-sensitive professional advice given will have to be given subject to the impact of time delay. Individuals on Earth acting in an advisory capacity must be keen not to act in breach of any fiduciary duty or common law duty of care. It would be wise for certain contractual relations to contain disclaimers in respect of such instances, particularly where trading may be taking place on a volatile subject matter such as stocks or shares—or even property prices. A further solution—in

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[117] *See* Derry v. Peek (1889) 14 App Case 337 (HL); *Candler v. Crane Christmas & Co.* (1951) 2 KB 164.

[118] Hedley Byrne v. Heller, (1964) App. Case 465 (HL) at 486.

respect of markets which could be said to be less volatile and more static—would be for any such communications to be made subject to confirmation in writing after a "cooling-off" period; a Mars based entity could be required to follow up any advice received in writing after—in the case of a 15 minute time delay—no sooner than following the lapse of 15 minutes—to give time for any significant changes to be communicated.

As previously mentioned, agreements could also, in the alternative/additionally, perhaps stipulate an agreed "margin of error" in respect of an acceptable amount of financial loss that could accrue because of a time delay. Such a provision might read, "any acceptance of advice will be rendered null and void in the event of a depreciation of 2% (or greater) during a slower than ordinarily anticipated communication of such an acceptance owing to time delay arising from inter-spatial dislocation of more than 30 seconds."

Moving beyond the mere financial and advisory sphere, it is important to recall that other aspects of negligence may come into play—between the flight controller and a crew in deep space for instance. Any such instructions or advice from those based on Earth will necessarily be subject to such a delay. For this reason, any instructions or advice will necessarily have to take notice of the time delay factor, effectively adding an extra layer of legal complication to such matters. It would not be ill-advised for legal training in this area to be provided to relevant individuals to reduce any potential uncertainty or, in the alternative, that relevant waivers or disclaimers are signed prior to the commencement of any deep-space mission so that all parties acknowledge the legal risk inherent in such communications.

VII. CRIMINAL LAW

Although probably less likely to arise in fact than matters of negligence, the criminal law is also worthy of consideration in this overview,[119] particularly since the effects of long duration space travel to other celestial bodies are likely to be unpredictable as regards aspects of human behavior which has been widely

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[119] *See* Robin McKie, *NASA Astronaut 'Accessed Ex-Partner's Bank Account from Space Station*, GUARDIAN, (Aug. 24, 2019). https://www.theguardian.com/us-news/2019/aug/24/nasa-astronaut-allegedly-accessed-ex-partners-bank-account-while-living-on-iss,

documented.[120] Infractions of the criminal law between crewmembers in deep space is unlikely to be affected by time delay—save for the potential procedural issues should Earth-based authorities be called upon to resolve any such dispute.[121] However, there are numerous examples of where the spatial dislocation could potentially impact the law between Earth-based entities and crew members. For example, in English law, the common law offence of assault requires that the victim apprehend the infliction of immediate unlawful force—there is no need for physical contact between the defendant and the victim. In *Tuberville v. Savage*,[122] the court held that "[i]f it were not assize-time, I would not take such language from you." This statement was in respect to the placing of an individual's hand upon the hilt of their sword was not an assault as the victim would not have apprehended immediate unlawful force—the statement made was to the effect that he would have taken action if it were not for the fact that he would be prosecuted, therefore there was no immediate apprehension of unlawful force. Without considering the time delay factor the fact that in a deep space setting those on Earth would be separated by a great deal of distance from those in deep space means that it is unlikely that such an offence could be made out over the radio waves. However, other similar offences could well arise, including Threats to Kill under Section 16 of the Offences Against the Person Act 1861,[123] which states "[a] person who, without lawful excuse, makes to another a threat, intending that that other would fear it would be carried out, to kill that other or a third person is guilty of an offence."[124]

For the avoidance of doubt, it has been held that such offenses could be committed through electronic means.[125] In addition, The Malicious Communications Act of 1988 created the offence of

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[120] *See* George S. Robinson & Jeanne Hughes, *Space Law: The Impact of Synthetic Environments, Malnutrition and Allergies on Civil and Criminal Behaviour of Astronauts*, 19 JURIMETRICS J. 59, 65 (1978); *see also* ESA Press Release No. 24-1994, The HUBES Experiment: A Ground-based Simulation of a 135-day Manned Spaceflight (Aug. 22, 1994), https://www.esa.int/Newsroom/Press_Releases/The_HUBES_experiment_a_ground-based_simulation_of_a_135-day_manned_spaceflight.

[121] *See* Alex Simmonds, *In Space the Other Side Should Have the Right to be Heard*, 28 COVENTRY L. J. (2023).

[122] *Tuberville v. Savage*, [1669] 1 Mod Rep 3 (KB).

[123] Offences against the Person Act, 1861, §16.

[124] *Id*.

[125] *R. v. Braithwaite (Duran)* [2012] EWCA Crim 2053.

"sending letters etc. with intent to cause distress or anxiety"[126] which could also be done via electronic means.[127]

Regarding such criminal offences in general, the approach of many common law jurisdictions is to break a criminal offence down into, at its most basic level, an "Actus Reus"—guilty act—and "Mens Rea"—guilty mind. Save for strict liability offences which only require the Actus Reus of the offence,[128] the general proposition is that for a crime to come into existence both the Actus Reus and Mens Rea must coincide. In English law, this point is often illustrated in *Fagan v. Metropolitan Police Commissioner*.[129] In this case, the crime was complete at the time the Actus Reus and Mens Rea came together—when Fagan decided not to remove his car from the policeman's foot. The Actus Reus was complete as the car was on the police officer's foot at that moment in time. Fagan formed the Mens Rea when he decided not to remove the car. The Mens Rea and Actus Reus, therefore, overlapped at the same time and a crime came into existence at that instantaneous moment in time. With signals transmitted from Mars it is at least arguable in a philosophical sense, that there is, in fact, no Mens Rea at the time the actual time the harm is caused. With the time delay factor this would mean that any such spoken words as defined under the Malicious Communications Act would have criminal consequences even though they would not be capable of being heard for around 15 minutes. In this respect they would be analogous to postal communications under the Act and present no such legal difficulty. Moreover, there is authority to suggest that Actus Reus and Mens Rea do not necessarily have to be present at the same time for an offence to arise,[130] and the question of whether the harm or injury caused must be contemporaneous with the cross-over between Actus Reus and Mens Rea could be rather moot or philosophical. There are certain offences whereby *prima facie* is not a requirement.[131] It is likely in any case that courts will dispense with any philosophical

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[126] The Malicious Communications Act, § 1 1988 (UK).

[127] *Id*. § 1(2A).

[128] *See Sweet v. Parsley,* [1970] AC 132 (HL); *Gammon (Hong Kong) Ltd. v. Attorney-General of Hong Kong,* [1985] AC 1 (PC).

[129] *Fagan v. Metropolitan Police Commissioner*, [1968] 3 All ER 442 (QB).

[130] *See Attorney General for Northern Ireland v. Gallagher* [1963] A.C. 349, 382 (HL).

[131] *See generally* Offences Against the Person Act, 1861 (UK), § 31 (setting spring guns with intent to inflict grievous bodily harm).

considerations and take the pragmatic point of view that, in respect of communication and threat-related offences between Earth based entities and those in deep space, that Mens Rea and Actus Reus both travel at the speed of light once the offence is, according to its place in space time made out vis-à-vis the remote victim.

VIII. A PHOTONIC COUNTER ARGUMENT

All of the scenarios in this article involve radio communications of some kind or another. Radio waves have carried details of new laws, offers and acceptance and even criminal or tortious utterances and statements.

Radio waves are themselves, photons. On the basis of Special Relativity,[132] it is widely accepted that photons do not experience time. Therefore, it could be argued that the law, then, does in fact, travel faster than the speed of light—the radio waves that carried the details of the laws or relevant communications at the speed of light themselves did not experience time—and, therefore, neither did the laws or relevant communications being carried!

There are a few counter-arguments against this, however. Firstly, the message as carried by the photons themselves is meaningless until it is given meaning by human perception. In other words, the signal itself does not become intelligible until it is displayed on an interface of some sort or converted into sound-waves. In respect of contractual matters involving offer and acceptance, this would draw some interesting parallels with the postal rule—[133]as here, whilst the letter is in transit there is likewise no way of knowing its contents. At the moment it is so manifested, the law or relevant communication itself is likewise manifested and the time difference between the manifestation of the enactment or communication as communicated from Earth and the meaningful manifestation of the enactment within a craft in deep space, is still present.

Secondly, even if it is accepted that photons move the law instantaneously, the actual date of the enactment being moved instantaneously will still be the date of the enactment as it was manifested on Earth and, therefore, be "time-stamped" between 5 and

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[132] *See* Einstein, *supra* note 5.

[133] *Adams v. Lindsell* (1818) 1 B & Ald 681 (KB).

22 minutes before the time it actually arrives at the relevant point in deep space.

Thirdly, if it is accepted that the law does not experience time when it is being carried by the photons and that the law is effectively moving faster than the speed of light, this would only be from the frame of reference of the photons themselves.[134] Relative to the frame of reference of the recipient in deep-space there would still be a delay.

IX. CONCLUSIONS

The time delay factor associated with deep space communications has the potential to cause legal issues across a range of areas. This can be handled in a variety of ways by the relevant legislative authorities.

Firstly, domestic legislatures can amend existing rules in certain key areas—including those outlined in this article—so that they take account of time delay. This is particularly important as regards promulgation of legal instruments—at what stage should such instruments be taken to bind those in deep space? Does the law, in such instances, move faster than the speed of light or should at least a nominal effort be made to inform the relevant crew members ahead of the publication of such instruments? On this point, legislation could be enacted in the guise of the Interpretation Act 1978,[135] whereby all relevant provisions are said to commence at midnight minus the commensurate time associated with time delay for those in deep space—or simply state that, in the cases of travelers in deep space, the enactment comes in on midnight of the day before. This would serve to uphold and maintain the legitimacy of the rule of law in such situations per the words of Hobbes, Fuller, Bingham and countless others since, providing the instrument is published and theoretically accessible ahead of the time of its eventual enactment on Earth, there should be no substantive objections regarding its effectiveness on the basis of non-discoverability.

If it is accepted that the law does indeed move faster than the speed of light, to safeguard its legitimacy, what must happen is that

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[134] Thanks to my student, Polina Myroshnychenko, (First Year English Law, University of Dundee) for this suggestion.

[135] The Interpretation Act, 1978 (UK).

relevant laws in their draft forms must be made accessible to any crew—most likely indirectly via an accessible internet or national websites—ahead of their publication and, just as importantly, crews must be explicitly aware of the fact that laws enacted on Earth at midnight will bind them from midnight at Earth time onwards regardless of any associated time delay.

Adopting the same approach, as that outlined in the Joint Service Manual,[136] regarding the laws of war, whereby means of analogy to action taken by forces in ignorance of an armistice is one possible solution or would be judging each incidence of "ignorance of the law" on a case-by-case basis appears to have been the usual practice in common law jurisdictions with the rule not appearing quite as cut and dry as may have been expected. Regardless of which approach may be the most suitable, at least a "soft law" arrangement on such matters would be highly desirable ahead of any such mission in future.

Turning away from the specific matter of time delay momentarily, regarding legality itself there are questions as to enforcement which will require an element of consideration. One of the (unsuccessful) arguments raised in the case of *Christian v. The Queen* was that because there was no police force or means of enforcing the relevant law on the Pitcairn Islands, that the law ceased to be law. As stated by Oliver, "this raises significant questions for philosophers and anthropologists as to the actual nature and meaning of 'law' if it is not accompanied by any enforcement provisions, whether formal or social."[137]

Regarding solutions to the live issue of time delay, it is wise to consider other practical solutions. Should deep space travellers be subject to a form of blanket legal liability insurance provided for by the mission operators covering all Civil Liability as was once proposed?[138] Whilst this may appeal to a sense of convenience and legal certainty, it breaks down on closer examination. Firstly, why should these individuals be above the law? Secondly, should an Earth-based individual or entity commit a legal wrong against the

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[136] *See Union Eagle*, *supra* note 96.

[137] DAWN OLIVER, JUSTICE, LEGALITY AND THE RULE OF LAW: LESSONS FROM THE PITCAIRN PROSECUTIONS 13 (2009).

[138] U.S. Congress, Office of Tech. Assessment, *Space Stations and the Law: Selected Legal Issues-Background Paper*, OTA-BP-ISC-41 (Aug. 1986).

interests of any of these individuals— such as breaching a contract—some form of legal framework must be engaged in order to resolve any such dispute. Would the blanket immunity solution be compatible with this idea? It is worth pointing out that, potentially, a legal dispute could arise between a crew member and another individual based anywhere on Earth—it goes without saying that different legal systems will approach different legal problems in different ways.

Although it is perhaps impossible to theorize every single substantive legal matter which could potentially be impacted by time delay, it is certainly possible to theorize potential solutions which may help to offset at least some of the more likely problems. One possibility would be for all legal transactions between crew members on board a deep space mission and Earth-based entities are to go through a fictional "Time Filter"—there should be a rule established by multinational agreement that, regardless of which jurisdictions law should take precedence, by implication, all legal transactions between Earth-based entities and crew members must automatically account for time-delay factors. One way of managing this arrangement could be to designate deep space missions as being within a particular legal "zone" as regards legal disputes once they cross a certain pre-determined threshold vis-a-vis time delay. Once a spacecraft crosses into this zone, it becomes subject to a form of "Deep Space Common Legal Framework." For example, once the ship reaches the threshold where a 1-minute time delay arises in terms of communications between the crew and all Earth-based entities, all legal disputes/transactions vis-a-vis the Crew—and any Earth-based entity—are resolved under the framework or at least made subject to it where relevant. The question of what a "reasonable" period delay would be for legal purposes under this would in and of itself be an avenue for future academic discussion.

Although it would be impossible to list all the potential areas that could be impacted by time delay, several basic general principles could certainly be considered ahead of time. Before the content/form of any such filter or framework is agreed, however, it may be pertinent for a more general discussion of the nature of legal transactions in the context of the Special Theory of Relativity; when, in law, is intention or a state of mind formed? When it is formed on Mars—which, in some cases, would effectively be 20

minutes into the past—or when evidence of such intention reaches Earth in the present? To make practical sense of such matters, the precise time that a material event happens on Mars should be converted to Earth time and vice-versa for evidential purposes—"Earth" time—whichever time zone that is deemed to be—will have to be timestamped and aligned with "Mars" time—whichever time zone that happens to be in on Mars should such a requirement arise.

Future beneficial research in this area could involve comparative studies of a range of the world's legal systems to determine an optimal approach to time delay in particular areas, particularly those most likely to arise. From this very brief survey of potential matters arising, there are certain areas which will be impacted by time delay. There must be some consideration as how best to counter such issues ahead of any crewed deep space voyages. It is worth considering for a moment, possible blanket measures to combat the time delay factor and whether these are feasible if not desirable.

Regarding matters of promulgation, the framework could specify that any Earth-based legal enactments which serve to bind any crew members as citizens of that country, are only deemed to bind such crew members once the relevant time delay has cleared. For example, an enactment on Earth with a commencement time and date of midnight on 1 January 2035 would bind those operating under the framework at 12:15 AM on the 1 January 2035 should the applicable time delay happen to be 15 minutes. This would avoid a lot of the potential issues with promulgation and publication as previously outlined.[139]

Moreover, contractual dealings—such as those associated with volatile subject matters such as shares as in *Ramsgate Victoria Hotel v. Montefiore*[140]—could operate under the *caveat emptor* principle; those making a contractual offer regarding any volatile subject

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[139] An alternative solution could be to broadcast the new legislation to a deep space crew ahead of time so that the new legislation arrives with the crew on the scheduled commencement date. For example, if the new legislation is set to come into force at midnight on a given day, and the time delay between Earth and the crew in deep space is calculated to be 20 minutes, the new legislation could be broadcast from Earth to the crew 20 minutes prior at 11:40 PM so that it arrives with the crew at midnight. This would then coincide with the time that the legislation comes into force on Earth. This solution was proposed by my space law student, Billy Westhead, and could be henceforth referred to as the 'Westhead Formula'.

[140] *See Ramsgate Victoria Hotel*, *supra* note 91.

matter liable to fluctuate markedly in value would be deemed to be on notice regarding the time delay factor which would therefore become part of the risk of the overall transaction. Pre-existing contractual and other arrangements would need to be "grandfathered" into the framework under some other legal mechanism, the kind of which is outside the scope of this article.

Furthermore, a comparative study of all relevant national legislation which time delay could potentially impact along with prominent international "soft law" instruments—as has been carried out to a lesser extent here—would be a very beneficial exercise for the purpose of uncovering any latent problems which could arise ahead of time. Although "deep space" travel in the context of this article could be decades away, it is the anticipatory function of law in this context which may assist in circumnavigating some potentially awkward legal complications.

While, first and foremost, any proposed legal solutions here are put forward for the sake of upholding legality and the rule of law, a highly important secondary effect will be to reduce levels of uncertainty amongst crew members within an already highly stressful and isolated environment as regards their legal position vis-à-vis Earth-based entities and authorities hopefully serving to streamline the process for any legal disputes arising. In this sense, attention to the law could be regarded as "mission critical."