

# Space Law Challenges for Recovery of Damage, Inflicted to Space Objects by Cyber Means

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## Abstract

The paper analyses existing models for recovery of damage, inflicted to space objects, and addresses major challenges, related to cyber damage: the issue of attribution, procedural issues of cyber damage recovery, possibility to recover space damage, inflicted during an armed conflict.

A proposal is made to consider cyber damage as direct damage under space law liability regime and evaluate resulting increase of space debris (damage to space environment) for the purposes of compensation amount. Within responsibility for violation of space law obligations cyber damage may be recovered as the result of violation of control over space objects or as harmful interference with space activities. Violation of due diligence obligation to protect space objects (as cyber threats became more vivid) and use of force by cyber means are basis for cyber damage recovery under general international law. Damage to space objects, inflicted during an armed conflict, is recoverable for violation of principles of distinction, proportionality and precautions in attack.

## 1. Introduction

On the background of ongoing technological developments more and more legal lacunas in regulation of space activities arise. One of them is recovery of damage, inflicted to space objects by cyber means (for purposes of the present paper further “cyber damage”).

The background of cyber damage recovery is traced to general issues of damage in space law, responsibility and liability,<sup>1</sup> analysis of existing practice

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1 S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl, Cologne Commentary on Space Law, Vol. 1, Wolters Kluwer Deutschland GmbH, Köln, 2009.; S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl, Cologne Commentary on Space Law, Vol. 2, Wolters Kluwer

of recovery of damage, inflicted by space objects,<sup>2</sup> the notion of “damage caused by space objects”.<sup>3</sup>

Discussions of general issues of cyber activities attribution,<sup>4</sup> correlation of cyber and space activities with existing rules of international humanitarian law (IHL) and right to self-defence<sup>5</sup> also contribute to understanding of legal framework and ways forwards.

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Deutschland GmbH, Köln, 2013.; F. von der Dunk, Liability versus Responsibility in Space Law: Misconception or Misconstruction?, Proceedings of the Thirty-fourth Colloquium on the Law of Outer Space (1992) 363-371.; W.F. Foster, The Convention on International Liability for Damage Caused by Space Objects, the Canadian Yearbook of Int. Law (1972) 137-185.; P.S. Dempsey, Liability for Damage Caused by Space Objects under International and National Law, IAC-11.E7.2.9, 62nd International Astronautical Congress, Cape Town, South Africa, 2011, 3–7 October.

- 2 J.A. Burke, Convention on International Liability for Damage Caused by Space Objects: Definition and Determination of Damages After the Cosmos 954 Incident, *Fordham Int. Law J.* Vol. 8, Iss. 2 (1984) 255-285.
- 3 E. Carpanelli, B. Cohen, Interpreting “Damage Caused by Space Objects” under the 1972 Liability Convention, IAC-13.E7.1.5x18256, 64th International Astronautical Congress, Beijing, China, 2013, 23–27 September.
- 4 C. Antonopoulos, State responsibility in cyberspace, in: N. Tsagourias, R. Buchan (Eds.), *Research Handbook on International Law and Cyberspace*, Edward Elgar Publishing Limited, Cheltenham, 2017, pp.55-71.; D. Livingstone, P. Lewis, Space, the Final Frontier for Cybersecurity?, 22 September 2016, <https://www.chathamhouse.org/sites/default/files/publications/research/2016-09-22-space-final-frontier-cybersecurity-livingstone-lewis.pdf>, (accessed 15.01.2021).
- 5 M. Roscini, Cyber operations as a use of force, in: N. Tsagourias, R. Buchan (Eds.), *Research Handbook on International Law and Cyberspace*, Edward Elgar Publishing Limited, Cheltenham, 2017, pp.233-254.; C. Focarelli, Self-defence in cyberspace, in: N. Tsagourias, R. Buchan (Eds.), *Research Handbook on International Law and Cyberspace*, Edward Elgar Publishing Limited, Cheltenham, 2017, pp.255-283.; T.D. Gill, International humanitarian law applied to cyber-warfare: Precautions, proportionality and the notion of “attack” under the humanitarian law of armed conflict, in: N. Tsagourias, R. Buchan (Eds.), *Research Handbook on International Law and Cyberspace*, Edward Elgar Publishing Limited, Cheltenham, 2017, pp.366-379.; F. Tronchetti, Legal aspects of the military uses of outer space, in: F. von der Dunk, F. Tronchetti (Eds.), *Handbook of Space Law*, Edward Elgar Publishing Limited, Cheltenham, 2017, pp.331-381.; D. Stephens, C. Steer, Conflicts In Space: International Humanitarian Law and Its Application to Space Warfare, *Annals of Air and Space Law Vol. XL* (2015) 1-32.; E. Morozova, Limits imposed by outer space law on military operations in outer space, 42<sup>nd</sup> Round Table on Current Issues of International Humanitarian Law on the 70<sup>th</sup> Anniversary of the Geneva Conventions, Sanremo, 2019, 4–6 September.; L. Jie, How does IHL apply in outer space and which challenges exist for applying existing rules in outer space? 42<sup>nd</sup> Round Table on Current Issues of International Humanitarian Law on the 70<sup>th</sup> Anniversary of the Geneva Conventions, Sanremo, 2019, 4–6 September.; Д.В.Богдан, О применимости норм международного гуманитарного права к космическому пространству, Юстиция Беларусі 12 (2019) 35-38.; Д.В.Богдан, О принципах международного

Specific legal issues, related to cyber damage, are researched by M. Mejía-Kaiser<sup>6</sup> and S.A. Kaiser,<sup>7</sup> who detail technical peculiarities of space objects functionality and propose future developments of international law.

Meanwhile the research of legal regime for cyber activities, including relating to space objects, and proposals for future developments of law do not provide answers to modalities of financial recovery of suffered damage under existing regulation.

The objective of the present work is to provide legal solutions for recovery of cyber damage based on current legal framework. With this purpose types of cyber damage are presented (Section 2) and existing legal regulation of recovery of damage, inflicted to space objects, is analysed (Section 3). Then the author gives the discussion on topical legal challenges, related to cyber damage to space objects: attribution of cyber activity, determination of applicants and respondents in recovery claims and legality of damaging space objects with multiple launching states (Section 4). Models for recovery of cyber damage are proposed (Section 5) and, finally, conclusions are made (Section 6).

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## 2. Cyber Damage: Types, Means of Infliction, Consequences

Based on classification of vulnerable infrastructure given by S.A. Kaiser and M. Mejía-Kaiser<sup>8</sup> types of cyber damage may be given in the following way: on-ground damage (“terrestrial segment”), damage in space (“space segment”) and damage “to peripheral systems, necessary for the operation of space systems” (not necessary connected to terrestrial segment of particular space object). The disruption of communication links between ground and space segments<sup>9</sup> as cyber damage, from our perspective, shall be included into damage to peripheral systems.

Means, by which cyber damage can be inflicted, are diverse: with the use of the Internet, Universal Serial Bus devices, transmission through a powerful radio signal.<sup>10</sup>

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гуманитарного права, применимых к деятельности в космическом пространстве, Актуальные проблемы МГП и СМИ 1 (2020) 26-33.

6 M. Mejía-Kaiser, Space Law and Unauthorized Cyber Activities, in: K. Ziolkowski (ed.), Peacetime Regime for State Activities in Cyberspace. International Law, International Relations and Diplomacy, NATO CCD COE Publication, Tallinn, 2013, pp.349-372.

7 S.A. Kaiser, M. Mejía-Kaiser, Cyber Security in Air and Space Law, German J. of Air and Space Law 2 (2015) 396-410.

8 *Ibid.*, p.404.

9 Mejía-Kaiser *supra* note 6, p.350.

10 *Ibid.*, pp.351-355.

Cyber damage may lead to a variety of consequences, among which, but not limited to, are unauthorized usage of space object information, damage to space object soft- and hardware, manipulation of space object in unauthorized ways, including infliction of damage to other space objects, detriment to economic and society development in communication, transport, energy, financial, agriculture, environment and other sectors (as nowadays many of them are dependent on space-based infrastructure).<sup>11</sup>

### 3. Current Framework for Recovery of Damage, Inflicted to Space Objects

Existing international law treaties regulate general issues of recovery of damage in peace time and during armed conflict without any specification given to cyber means. National pieces of regulation, related to space activities will not be considered, as currently limited number of states has developed national space law.

Art.VI of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (OST)<sup>12</sup> declares state responsibility for all national space activities irrespective of entity, which carries it out, governmental or non-governmental.

In their turn, Art.IX OST taken with Art.III OST (obligation to carry out space activity in the interest of maintaining international peace and security and promote international co-operation and understanding), Art.VI OST (responsibility for national space activities) and Art.VII OST (liability for damage, caused by space object) justify OST application as legal basis for debris pollution claims,<sup>13</sup> what may take place after cyber-caused space objects collision.

Also states bear responsibility for OST and other obligations violation under general customary international law of responsibility, codified in Articles on Responsibility of States for Internationally Wrongful Acts (ARS).<sup>14</sup>

Specific here is use of force, prohibited under Art.2.4 UN Charter.<sup>15</sup> Thus, when cyber attacks amount to use of force<sup>16</sup> (due to cyber nature additional factors shall be evaluated such as the purpose of attack, repetitiveness and other military activities<sup>17</sup>), responsibility is triggered. On the other hand, use

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11 *Ibid.*, pp.350-351; Livingstone *supra* note 4, pp.23,36.

12 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (London, Moscow and Washington, D.C. 27 Jan. 1967), 610 UNTS 205, *entry into force* 10 Oct. 1967.

13 Commentary (2013) *supra* note 1, p.193.

14 The United Nations, Draft Articles on Responsibility of States for Internationally Wrongful Acts with commentaries, 2001, [https://legal.un.org/ilc/texts/instruments/english/commentaries/9\\_6\\_2001.pdf](https://legal.un.org/ilc/texts/instruments/english/commentaries/9_6_2001.pdf), (accessed 15.01.2021).

15 Roscini *supra* note 5, p.233.

16 Focarelli *supra* note 5, p.265.

17 Tronchetti *supra* note 5, p.355.

of force by cyber means also triggers the right to self-defence<sup>18</sup> under Art.51 UN Charter.<sup>19</sup>

Compensation in state responsibility is secondary and covers “any financially assessable damage including loss of profits insofar as it is established” (Art.36.2 ARS). Damage under compensation may be direct or incidental, caused to state or to its nationals and demanded under diplomatic protection, based on “causation, remoteness, evidentiary requirements and accounting principles, which seek to discount speculative elements from projected figures”.<sup>20</sup> Even in circumstances, precluding wrongfulness, state shall compensate inflicted injury (Art.27 ARS).

Meanwhile the Convention on International Liability for Damage Caused by Space Objects (LIAB)<sup>21</sup> specifies regulation for recovery of damage, inflicted by *space objects*, during lawful activities and is *lex specialis*.

The Convention operates with two regimes of *liability: absolute* and “*fault-based*”. However, “*fault*” is not clarified and is widely discussed in doctrine. The conclusion is that fault for LIAB purposes is either *intent* (willful misconduct) or *negligence* (failure to take reasonable care).<sup>22</sup>

Initially LIAB covered only direct damage, resulted from space object physical collision,<sup>23</sup> including collision with space debris<sup>24</sup> and crashes on the Earth.<sup>25</sup>

Currently, the doctrine considers LIAB as basis for recovery of indirect damage, when:

- it follows from “the initial damaging event”;
- it may not occur locally or immediately, but as a consequence of or during a chain of events after damaging event;
- it is not too remote, is foreseeable;
- it would not occur, if there had been no initial damage;
- estimation period for damage is one year from initial impact;<sup>26</sup>
- and includes economic loss.<sup>27</sup>

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18 *Ibid.*, p.255.

19 *Ibid.*

20 Commentaries *supra* note 14, pp.99-101,105.

21 Convention on International Liability for Damage Caused by Space Objects (London, Moscow and Washington, D.C. 29 March 1972), 961 UNTS 187, *entry into force* 1 Sep. 1972.

22 Dunk *supra* note 1, pp.365-366; M. Mejía-Kaiser, ESA’s Choice of Futures: ENVISAT Removal or First Liability Case, IAC-12.E7.5.11, 63<sup>rd</sup> International Astronautical Congress, Naples, Italy, 2012, 1–5 October, p.9.

23 Commentary (2013) *supra* note 1, pp.111,115,126,129,133,174.

24 *Ibid.*, p.133.

25 *Ibid.*, p.175.

26 Foster *supra* note 1, p.158; Carpanelli *supra* note 3, pp.3,6-7; Commentary (2013) *supra* note 1, pp.126-127,174.

27 Commentary (2013) *supra* note 1, p.112.

The reasoning is Art.XII LIAB referring to compensation in amount, necessary to restore the victim to condition, “which would have existed if damage had not occurred” (*restitutio in integrum*), what shall cover indirect damage.<sup>28</sup> Here, we shall point out, that space debris increase (damage to space environment) may be used to raise compensation amount under LIAB as evaluation of *restitutio in integrum*.

In time of armed conflict IHL applies as *lex specialis*. Many IHL norms are of customary nature, which also are codified in four Geneva Conventions dated 1949 (GC).<sup>29</sup> Besides Art.1-3, common for four GC, applicable to any armed conflict irrespective of its place and persons involved, core principles of IHL are also applicable to space activities,<sup>30</sup> including cyber-related:

- principle of distinction (only attacks on combatants and military objectives are legal, duty to protect civilian population and civilian objects);<sup>31</sup>
- principle of proportionality (acts, causing incidental or excessive damage to civilians and civilian objects, are prohibited);<sup>32</sup>
- principle of precautions in attack (demands to minimize damage to civilians and civilian objects during armed activities).<sup>33</sup>

Space law also continue to apply during an armed conflict.<sup>34</sup> When states have integrated civilian-military space industry<sup>35</sup> it complicates space object clarification as legitimate target (only *military* objects of an opposite party of armed conflict). Thus, register of space objects – public primary source of information about them – shall be consulted for verification of whether the object is military or civilian.<sup>36</sup> On the other hand, change of space object

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28 Burke *supra* note 2, p.282.

29 Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (Geneva, 12 Aug. 1949), Final Record of the Dipl. Conf. in Geneva of 1949, Vol.I, Fed. Polit. Depart., Bern, pp. 205-224, *entry into force* 21 Oct. 1950.; Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (Geneva, 12 Aug. 1949), Final Record of the Dipl. Conf. in Geneva of 1949, Vol. I, Fed. Polit. Depart., Bern, pp.225-242, *entry into force* 21 Oct. 1950.; Convention (III) relative to the Treatment of Prisoners of War (Geneva, 12 Aug. 1949), Final Record of the Dipl. Conf. in Geneva of 1949, Vol. I, Fed. Polit. Depart., Bern, pp. 243-296, *entry into force* 21 Oct. 1950.; Convention (IV) relative to the Protection of Civilian Persons in Time of War (Geneva, 12 Aug. 1949), the Geneva Conventions of Aug. 12, 1949, Int. Committee of the Red Cross, pp.153-221, *entry into force* 21 Oct. 1950.

30 Gill *supra* note 5, p.372.

31 Jie *supra* note 5, p.2; Stephens *supra* note 5, p.14.

32 Jie *supra* note 5, p.4; Stephens *supra* note 5, pp.21-22.

33 *Ibid.*, pp.27-28.

34 Богдан (2019) *supra* note 5, p.36; Богдан (2020), p.27.

35 Jie *supra* note 5, p.3.

36 Morozova *supra* note 5, pp.10-11.

functioning regime triggers change in protection regime. Military objects, used *purely* for civilian purposes, enjoy protection while civilian, used *purely* for military purposes, lose it. Simultaneously, change in civilian object functionality demands higher standard of prove than military.

This is also true in respect of space stations as a special kind of a space object. When a space station consists of several modules, belonging to different states, attack on a whole station to target an enemy without complete evidences that civil personnel of other states is absent is contrary to principles of distinction and precautions in attack.<sup>37</sup>

#### 4. Challenges for Recovery of Cyber Damage

Cyber possibilities for damage causation were not known at time of OST and LIAB adoption. At the same time each technological evolution should not create an impression that lack of regulatory framework leads to possibility of any behavior.<sup>38</sup>

The key in “updating” existing legal rules without their amendment is interpretation. *The Navigational Rights Case* clarified that “terms used in a treaty must be interpreted in light of what is determined to have been the parties’ common intention” and meaning is “intended to follow the evolution of the law”.<sup>39</sup> However, we shall carefully preserve the balance and do not interpret treaties too broadly and include external notions and content.

##### 4.1. Attribution of Cyber Acts to a State

Attribution is an element of an internationally wrongful act, which also comes to our attention during fault-liability usually under LIAB. The difficulty in identification of cyber activity perpetrator is considered to be an obstacle for attribution, but studies show that cyber activities tracing is possible.<sup>40</sup>

Nevertheless, the major problem of cyber activity attribution is that we can identify the *object*, used for action, but hardly ever the *person*, committing it.<sup>41</sup> With this we cannot be sure whether particular cyber action against space objects can be attributable to a state, as attribution rules requires conduct, not mere usage of state equipment.

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37 Богдан (2020) *supra* note 5, p.30.

38 Antonopoulos *supra* note 5, p.57.

39 The International Court of Justice, Dispute Regarding Navigational and Related Rights (Costa Rica v. Nicaragua) Judgment of 13 July 2009, 2009, [https://www.icj-cij.org/files/case-related/133/133-20090713-JUD-01-00\\_EN.pdf](https://www.icj-cij.org/files/case-related/133/133-20090713-JUD-01-00_EN.pdf), (accessed 15.01.2021), pp.242-243.

40 Kaiser *supra* note 7, p.399.

41 Antonopoulos *supra* note 5, p.62.

Proposals for cyber activity attribution are that either state discloses, who operated its devices, traced for cyber activity, or presumption is made that cyber activity is attributable to territorial state.<sup>42</sup>

Both of these seem to be non-working options: a state, violating its obligations, hardly ever will disclose this voluntarily; and *the Corfu Channel Case* by the International Court of Justice established that mere existence of dangerous items on state territory does not impose violation of obligations on this state.<sup>43</sup>

We support the point of view that the solution for problem of cyber acts attribution is found in more flexible approach to evidence. For the sake of unlawful cyber activity attribution such evidences shall be evaluated as expert technical knowledge, press reports and statement of public officials of concerned state.<sup>44</sup>

#### **4.2. Applicants and Respondents in Recovery of Cyber Damage**

Under international space law applicants and respondents are states. Within the regime of state responsibility a state is eligible to file a claim against respondent when: it suffered injury (Art.42 ARS); breached obligation is *erga omnes partes* (Art.48.1.a ARS), owed to a group, to which an injured state belongs, and such obligation protects the collective interest;<sup>45</sup> breached obligation is owed to an international community as a whole (Art.48.1.b ARS). A special case is diplomatic protection of nationals. Injury to nationals (physical and juridical persons) is considered as injury to a state,<sup>46</sup> thus state is eligible to file a claim, receive compensation for further payment to nationals.<sup>47</sup> Conditions for diplomatic protection are exhaustion of local remedies by nationals and nationality link between the applicant state and injured nationals (Art.1 and Art.14 of Articles of Diplomatic Protection<sup>48</sup>).

At the same time Art.IX LIAB directly refers to diplomatic protection. When a state of nationality does not file a claim for damage, nationals may resort to a state, on whose territory the damage was sustained, or to a state, where private persons are permanent residents (Art.VIII LIAB). Despite LIAB does not prohibit usage of local remedies, that can be done by respective national law of a state.<sup>49</sup>

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42 *Ibid.*, pp.62,64.

43 *Ibid.*, p.63.

44 *Ibid.*, p.64.

45 Commentaries *supra* note 14, p.126.

46 The United Nations, Draft Articles on Diplomatic Protection with commentaries, 2006, [https://legal.un.org/ilc/texts/instruments/english/commentaries/9\\_8\\_2006.pdf](https://legal.un.org/ilc/texts/instruments/english/commentaries/9_8_2006.pdf), (accessed 15.01.2021), p.22.

47 Commentaries *supra* note 14, pp.99,110.

48 *Supra* note 64.

49 Dempsey *supra* note 1, pp.4-5.



In any event, cyber damage to public and private space objects is recoverable. Recovery of damage to space environment raises additional questions. Here, as outer space is general sphere for space activities, it seems that many more actors than one or several, whose space object was damaged, may be found injured.

Legal nature of outer space (*res communis omnium*) gives right to anyone, who considers growing debris as an injury, right to file a claim for protection of space environment.<sup>50</sup> Obligation to protect space environment under Art.IX OST is *erga omnes partes*, thus any OST party also may file a claim.<sup>51</sup> Both cases leave room for further deliberations on actor, whom compensation may be awarded. From our perspective, compensation for space environmental damage *per se* shall not be awarded. The reason is that if it shall be paid, it shall be given to all 110 OST parties,<sup>52</sup> not only to initial applicant. This does not follow the idea of international responsibility – cessation of wrongful activities and restitution of situation before the breach of an obligation, but rather serves as penalty.

#### **4.3. Plurality of Launching States of a Space Object and Compliance With IHL**

As space law treaties do not cease its force during an armed conflict, space objects having plurality of launching states, do not “lose” those, who are not party to an armed conflict.

Consequently, infliction of cyber damage to space objects with at least one launching state, which is not party to a conflict, is illegal for attacking state under principles of distinction, proportionality and precautions in attack. Further any launching state, not involved into an armed conflict, is eligible to file a claim for inflicted damage. Meanwhile those launching states, who participate in armed conflict, lose their right to file a claim for damage as their *military* objects are eligible targets.

Currently several states have capabilities to launch space objects, thus it seems hard to justify cyber damage to a space object with plurality of launching states. Special case is that all of them shall belong to one security block and thus shall all be involved in an armed conflict *on one side*. However, if one of them is protecting power or keeps neutrality this case does not work and damage still shall be considered illegal. Maybe, that is a hidden obstacle for a space war.

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50 Commentary (2009) *supra* note 1, p.177.

51 *Ibid.*

52 Status of International Agreements Relating to Activities in Outer Space as at 1 January 2020, [https://www.unoosa.org/documents/pdf/spacelaw/treatystatus/Treaties Status-2020E.pdf](https://www.unoosa.org/documents/pdf/spacelaw/treatystatus/Treaties%20Status-2020E.pdf), (accessed 15.01.2021).

## 5. Models for Cyber Damage Recovery Under Existing Legal Framework

Techniques of cyber damage infliction, from our point of view, are not crucial for the purposes of responsibility and liability for damage caused.

On the other hand, responsibility and liability for cyber damage may vary depending on its consequences, what directly influences recovery of inflicted damage. For the purposes of current legal research and formulation of legal models for recovery of cyber damage, we propose to divide cyber damage on:

- 1) cyber damage, harming estimated functionality of space objects (CD-I), “pure cyber damage”;
- 2) cyber damage to space objects resulting in infliction of damage on the surface of the Earth or to aircraft in flight (CD-II) and
- 3) cyber damage to space objects resulting in infliction of damage to other space object (CD-III).

In other words, both CD-II and CD-III consist of CD-I and additional inflicted damage. We shall notice that mentioned *additional damage* is inflicted *by space object* and thus its recovery shall be governed by discussed above legal approaches.

CD-I, in its turn, is damage inflicted *to* space object, not by it. In combined scenarios (CD-II and CD-III) CD-I shall be recovered by respective liable/responsible state under regress procedure. Meanwhile, new approaches for recovery of cyber damage shall be proposed and let us formulate them in turn.

### 5.1. Recovery of Cyber Damage Under LIAB

CD-I is caused by cyber interference. This addresses us to notion of damage under LIAB and possibility of its infliction by means other than physical collision with a space object.

During LIAB drafting cyber means were not treated as a real instrument for damage causation. At the same time each space object is aimed to receive and transmit signals. Bearing in mind necessity of up-to-date approach to legal regulation, based on technical background and taking into consideration modern technological development we propose that:

when CD-I is inflicted by a space object, located in a place elsewhere than on the surface of the Earth, such damage shall be considered as direct damage under Art.III LIAB and be subject to recovery;

when CD-I is inflicted by a space object, located in a place elsewhere than on the surface of the Earth, to ground element or peripheral systems of another space object this also shall be covered as direct damage under Art.II and Art.III LIAB respectively and be subject to recovery;

damage to space environment as the result of space debris increase shall be considered for *restitutio in integrum* and evaluation of compensation, but not

as special type of cyber damage, recovered under LIAB. Approaches to compensation estimation are subject to further deliberations.

There is a room for deliberation whether such infliction of damage is lawful activity and can be considered under liability regime instead of responsibility. Our position is that damage to ground systems is subject to absolute liability in any event. In their turn damage to peripheral systems and to a space object in a place elsewhere than on the surface of the Earth shall be considered as intent (as international wrongful act) or negligence (if incidentally due to some reasons cyber activity of a space object harmed another one), what is covered by “fault” in Art.III LIAB.

Contrary to proposed above, if CD-I is inflicted not by a space object, LIAB shall not apply and other rules shall be enforced.

## 5.2. OST as a Ground for Recovery of Cyber Damage

Can cyber activity, aimed at damaging space objects, be considered as national *space* activity, which shall be *authorized* under Art.VI OST? Is cyber activity, targeted at space object, *a priori* attributable to a state?

There is no agreed definition of “space activity”, but place of such activity does not play role: space object launching, supervision, monitoring, etc. are conducted from the ground, but are space activity. With this either cyber damage is inflicted from space or from the Earth, its focus on a space is decisive. Does this activity have another element – state authorization? That is doubtful that a state will authorize cyber damaging actions (in peacetime).

Consequently, our opinion is that damaging cyber activity is not “space activity” under Art.VI OST and CD-I cannot be recovered on this basis.

Art.VIII OST declares that state, in whose registry space object is included, retains control over it. “Control” may be defined as “exclusive right and actual possibility to supervise the activities of a space object” (B.Schmidt-Tedd and S.Mick), include direction, cessation, modification and correction of a space object and its mission (G.Lafferranderie).<sup>53</sup> Meanwhile Art.IX OST prohibits harmful (anything, causing significant harm)<sup>54</sup> interference into ongoing space activities without prior consultations on this matter. From our perspective taken in conjunction Art.VIII and Art.IX OST are the basis for declaring violation of space law obligations in a case, when space object is damaged by cyber means or control over it is overtaken: it is interference in space object control, which shall belong to a limited number of states, influencing its activity.

This approach does not depend on means of infliction of cyber damage by space object, contrary to LIAB proposal. OST model would be the same, if cyber damage had been caused from any facility on the Earth.

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53 Commentary (2009) *supra* note 1, p.157.

54 *Ibid.*, p.177.

Recovery of damage to space environment in the light of growing number of space objects gives a floor for one more model of cyber damage recovery. Art.IX OST also contains provision of prohibition of harmful contamination, which form space debris may take.<sup>55</sup> In our opinion, this construction is secondary in relation to cyber damage to space objects. After establishment and recovery of cyber damage under LIAB or Art.VIII and Art.IX OST, damage to space environment may be recovered as a special category. Whether damage to space environment shall be broadened to “anticipatory” damage, arising from cyber damage, is subject to further discussions.

### **5.3. Recovery of Cyber Damage on the Basis of General International Law**

Meanwhile this does not solve the problem of hijacking, when a state, whose equipment was used for illegal actions, did not commit illegal actions itself. This situation is closely connected to a breach of due diligence obligation – obligation of conduct, arising from a state duty to prevent usage of its territory for unlawful actions.<sup>56</sup> In the light of cyber damage, inflicted via hijacking of ground or space element, it leads us to proper protection.

Damaging cyber activities directed at space objects are known from 1980s,<sup>57</sup> thus it is reasonable to expect up-to-date cyber protection on the ground and in space (firewalls, formation of cyber reaction teams, etc.). Since damaging cyber activity is detected, notice on this shall be done and actions taken to cease it, irrespective of their result.<sup>58</sup> If described above is not done by a state, or organs/persons under its control, a state shall be found responsible for violation of due diligence duty with further compensation for damage.

Recovery of sustained damage is done under general rules of state responsibility.

### **5.4. Recovery of Cyber Damage Under IHL Framework**

There are no doubts that IHL forms a very specific branch of international law, first of all, due to legitimization of use of force.

Peculiarities of armed conflict imply that there is no legal basis for recovery of cyber damage, inflicted to space object – legitimate target.

On the other hand, in a case of damage to a space object with plurality of launching states, those, who are not party to an armed conflict, may file a claim for recovery of damage under general rules of state responsibility.

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55 *Ibid.*

56 Antonopoulos *supra* note 5, pp.66-68.

57 Mejía-Kaiser *supra* note 6, p.352.

58 Antonopoulos *supra* note 5, p.69.

## **6. Conclusions**

Recovery of cyber damage is ambiguous question under current space and general international law regulation as reveals lacunas in law and inconsistency of legal norms with existing technologies.

The answer for provision of adequate legal protection and compensation for sustained damage seems to be in evolutionary interpretation of existing rules and careful understanding of ongoing practice of space activities.

Initially LIAB provides for recovery of direct damage from physical collision with a space object. Later the Convention started to be viewed with an intent to compensate indirect damage as well. Now that it is evident that direct damage may be caused by cyber means without direct collision, what is another step forward for LIAB application.

OST provision of control over space objects may be viewed as the basis for claims of treaty violation, when a space object is damaged by cyber means or is overtaken, with a demand of appropriate compensation.

Situation of an armed conflict justifies use of force against legitimate targets, thus, cyber damage to these space objects cannot be recovered. On the other hand, IHL protection of civilians and civilian objects and simultaneous application of space law treaties leave place for recovery of cyber damage, inflicted illegitimately (damage to civilian objects, use of force against a state not participating in an armed conflict, violation of IHL principles).

