

# The Impact of Growth Markets in the Downstream Sector

## *The Parameters for Connectivity and Services: Beyond Outer Space Law*

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### Abstract

The downstream sector, as it develops further, is casting clearer light on legal issues surrounding the demarcation between space-based and terrestrial services, particularly in relation to connectivity and outage. Loss of connectivity may have a variety of causes; it can be the result of natural or debris-induced interference. Other potential occurrences are frequency interference, jamming, hacking and black-outs. Interruptions in service can lead to errors in data monitoring and collection. The loss of signal in space (SiS) is not an issue governed by classic space law under the international treaties; the treaties focus on impact-related damage, and have a victim-orientated character. Their provisions are less suited for non-core space activities such as the downstream sector provides; physical damage to or from a space object does not generally occur at that level, unless collision or debris-based. The legal position remains a subject of much discussion; it is also linked to space traffic management (STM); in the absence of binding STM rules, fault and allocation of liability remains a toothless tiger for negligence based damage in outer space.

This paper looks at the increasingly important service level agreement (SLA) regulating the delivery of downstream services. It emphasises the need for greater perception about the demarcation of duties relating to space and non-space based services, as well as precision in the term 'user'; it also looks at the interaction between service level agreements (SLA) and general rules of law. With integrated sat-based navigation/communication apps on the increase, and the resort to liability disclaimers and waivers, the question of who ultimately remains responsible, if not liable, for ensuring connectivity despite interference continues to remain relevant.

### I. Introduction

#### I.1. Developments in Satellite Based Services

Satellite operators traditionally sell data service provision on the basis of contracts regulating satellite capacity. Geostationary communication satellites

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operate the main networks for primary services which feed the secondary services. These satellite communication operators deliver at primary level to their customers (governments, broadcasters, enterprises).<sup>1</sup> The telecommunication satellites provide the connections through their in orbit communication fleets and ground station networks infrastructure. Much of the capacity is leased to customers such as broadcasting companies to provide the required capacity using transponders.<sup>2</sup> The customer uses uplink frequencies for transmissions to the satellite, which are then transmitted by the satellite back to Earth.<sup>3</sup> Signals and data, once processed, can be integrated into a variety of further tools.

## **1.2. Digital Agenda**

Communication networks provide a vast spread of telecommunication-based services, of which integrated satellite-based signal positioning, timing and navigation services and satellite based internet are but a few. At the same time, software development has opened up a range of general and special services available through the infrastructures provided by these networks. The ongoing trends towards a digital society, fully dependent on internet-based information services, means that connectivity, as a system of individual connections made available through technical and logistical infrastructures linking devices and people, has become an essential commodity for all, whether governments, financial and industrial sectors, administrative institutions, or citizens. Implementation of the Digital Agenda for Europe has been set a deadline of 2020.<sup>4</sup>

Satellite technologies played a decisive role in achieving the first Digital Agenda target, closing the remaining gap through blanket coverage of the EU with basic broadband (2 Mbps) in 2013.<sup>5</sup> At terrestrial level, the internet service provider (ISP) assumes the principal obligations of ensuring connectivity towards the downstream customer. Behind this service, however, is the original

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- 1 Despite the signs of market growth in the so-called secondary or downstream EO markets that are developing in line with technology, commercial revenue from EO satellites is not yet on a par with that of the major communication satellite fleets. For recent advances in the DCM3 EO satellites, See below, n. 12.
  - 2 Growing interest in acquiring EO data will enable observation satellites to lease out capacity to customers interested in particular, See [www.bbc.com/news/world-asia-india-33473694](http://www.bbc.com/news/world-asia-india-33473694) [last accessed 1st September 2015].
  - 3 Huth, Oliver and Roelandt, Rafael (2011). *Specific Aspects and Characteristics of Satellite Capacity Agreements in the Satellite Communications Business*. In: Smith, Lesley Jane and Baumann, Ingo (eds). *Contracting for Space, Contract Practice in the European Space Sector*. Farnham: Ashgate, pp. 395-396.
  - 4 Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, "A Digital Agenda for Europe", COM(2010) 245.
  - 5 [http://europa.eu/rapid/press-release\\_IP-13-968\\_en.htm](http://europa.eu/rapid/press-release_IP-13-968_en.htm) [last accessed 1st September 2015].

provider of the primary network facility. At that level, space activities are involved.

## **II. Markets for Satellite-Based Services**

### **II.1. Distinguishing between Primary and Secondary Markets**

Primary and secondary communication services markets should be distinguished. Primary networks deliver satellite based infrastructures that feed via ground stations into terrestrial networks. Secondary markets exist where space-based signals and data (of whatever type) are processed, distributed and integrated into further terrestrial based services and products, normally developed by internet-driven software tools. Not all devices, however, offer real-time based services. Whether for 'smart city' concepts, autonomous-driven cars, or other digitally managed facilities, access to and use of these products and services depend on the provision of the major communication networks.<sup>6</sup> Broadband Internet provision, already part of the existing digital agenda,<sup>7</sup> is now to be extended in the form of mobile platforms for Internet communication into areas of the world where communities are not yet covered by the larger communication networks.<sup>8</sup> Nanotechnology will drive such downstream digital projects further downstream.

### **II.2. Special Features of Secondary Markets**

Some downstream services are real-time based; GNSS tracking systems, integrated with high resolution EO data, can be combined to deliver positioning, navigation and tracking services. They can be integrated with information overlays, whether with weather forecasts or environmental indicators; much of the data used in such products is based on the data collected by meteorological satellites. Newer integrated applications are becoming available via smart phones or internet-accessible 'apps' which are rapidly forming a tertiary sector. Internet service providers, (ISPs) secure its availability, relying on the major telecommunication providers. A few examples of the broad range of satellite driven integrated tools include precision farming software, environment-based

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6 On the full impact of loss of satellite connection, See the 2013 BBC report, [www.bbc.com/future/story/20130609-the-day-without-satellites](http://www.bbc.com/future/story/20130609-the-day-without-satellites) [last accessed 1st September 2015].

7 On the exact content of the smart city and future agenda items, See e.g. <http://ec.europa.eu/digital-agenda/en/smart-cities>; on their limitations, See [www.economist.com/news/briefing/21585002-enthusiasts-think-data-services-can-change-cities-century-much-electricity](http://www.economist.com/news/briefing/21585002-enthusiasts-think-data-services-can-change-cities-century-much-electricity).

8 Planet Labs is a highly innovative US based company specialising in nanosatellite technology and launches; it recently purchased the Rapid Eye constellations from the communication giant Blackbridge, with a view to expanding its market in spatial imagery, See <https://www.planet.com/pulse/blackbridge/> [last accessed 1st September 2015].

security activities and other forms of ‘security’ or operational monitoring systems.<sup>9</sup>

All these systems are subject to regulatory provisions governing the authorisation of electronic communications for the relevant markets;<sup>10</sup> downstream digital products are serviced via licensed communication and information platforms.<sup>11</sup> Distribution takes place thereafter via terrestrial transmitter networks, relaying signals to the networks serving the individual communication platforms. More recently, information services are combining EO data with terrestrial communication systems to develop new types of products and services for a broader customer spectrum.<sup>12</sup> This in turn is giving rise to further, tertiary markets.

### III. Game Change

#### III.1. ‘Agile Aerospace’

As a result of downsizing, access to broadband satellite connectivity is becoming more manageable and less expensive. This marks a new game change for traditional operators, as well as satellite manufacturers now wishing to join the growth of downstream providers.<sup>13</sup> Traditional operators are witnessing new forms of competition from start-ups, looking to combine classic space industry experience with the latest software technology solutions.<sup>14</sup> Moore’s law predicates changes in the oligopolistic sources of connectivity and supply, offering alternatives to traditional operator/provider sourcing

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9 The ESA and EU Copernicus websites contain further information on the various types and sectors of downstream technologies for the categories of programme services and users (land, marine, emergency, security and atmosphere).

10 Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services, OJ L 108 of 24.04.2002.

11 The regulations governing electronic communications are harmonised for the EU in the so-called Regulatory framework for electronic communications, available online at <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV:l24216a#amendingact> [last accessed 1st September 2015].

12 See information on the latest EO satellite constellation launched in July 2015 by the UK Surrey Satellites, [www.sstl.co.uk/News-and-Events/2015-News-Archive/SSTL-announces-the-successful-launch-of-the-DMC3-T](http://www.sstl.co.uk/News-and-Events/2015-News-Archive/SSTL-announces-the-successful-launch-of-the-DMC3-T) [last accessed 1st September 2015].

13 This is the name given to the strategy developed by Planet Labs in relation to their focus on developing newer markets combining communication and imagery to deliver secondary and tertiary services.

14 Canadian based Urthcast, which is active in the imagery market with cameras on the ISS, can be accessed under <https://www.urthecast.com/>; Planet Labs is developing large constellations of nano-satellite ‘doves’ to provide connectivity and imagery, <https://www.urthecast.com/>, both falling into the start-up categories [last accessed 1st September 2015].

that is strongest when made available from powerful outer space feeds, for which new alternatives are now being sought.<sup>15</sup>

### **III.2. Cross-Over Markets**

The secondary and tertiary sectors are interesting sectors for existing incumbents who are currently exploring their own market potential.<sup>16</sup> This will lead to changes between the larger industrial players within the sector, and to the economics of aerospace.<sup>17</sup> The extent to which some services are offered free, or in exchange and/or combination with other products, reflects a new form of value exchange. At individual consumer level, it involves relational contracts; personal data has become a new currency, enabling participation in information and service markets, giving access to new player mix.

### **IV. Downstream Markets as Demarcation of Space to Non-Space Risk**

The foregoing explains why it is important to distinguish between space based and non-space based services. Risk and liability for space-based services may arise across the three domains of navigation, communication and observation. The exact position in law in each case of loss of service depends on the damaged party's role and duties within the chain of service or product delivery. Distinctions are drawn between those who are parties to the services contracts (operators/customers), those who are mid- to end users (purchasers of integrated service products and information), as well as those external to and not involved in the operations (third parties).

The downstream sector that is not operating with real-time linked data is one step removed from the direct delivery chain, both from the perspective of causation, as well as contract law. Technology development is driving this sector fast. The interruption of a downstream service is and cannot be imputed by contract provisions to the primary level satellite operator provider. This

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15 'Airbus Group starts \$150 mln. venture fund, Silicon Valley base, [www.reuters.com/article/2015/05/29/airbus-group-idUSL5N0YK4XF20150529](http://www.reuters.com/article/2015/05/29/airbus-group-idUSL5N0YK4XF20150529) [last accessed 1st September 2015].

16 Google is developing new forms of broadband supply to be delivered from stratosphere-based satellite balloon facilities, See Project Loon at [www.google.de/loon/how/](http://www.google.de/loon/how/) [last accessed 1st September 2015]; Elon Musk, founder of SpaceX, is providing capital to such ventures, See Der Spiegel, January 27<sup>th</sup>, Heft 5/2015, pp. 75-78.

17 The concerns of potential abuse of dominant positions by information platforms; the European Commission has re-opened its investigation into the systematic programming by Google which recommends the use of its own preferred information services. The initial investigation started in 2010, and proceedings are still underway See Commission Commissioner statement at [http://europa.eu/rapid/press-release\\_MEMO-15-4781\\_en.htm](http://europa.eu/rapid/press-release_MEMO-15-4781_en.htm) [last accessed 1st September 2015].

also applies in relation to satellite based services, and particularly those provided to the general public free of charge.<sup>18</sup>

## **V. Service Level Agreements (SLAs)**

A service level agreement (SLA) is a dedicated technical agreement for managing other aspects of operations. SLAs are used to provide and deliver large telecommunications infrastructures and services. They are technical instruments commonly used to specify, agree and control performance levels, traditionally within larger space projects, as well as for ISPs when delivering connections to their customers. These agreements are designed to ensure operative monitoring, control and technical coherence. SLAs generally specify technical requirements for operational levels with percentages of connectivity, and the standards required for the individual service level in question.

The leverage used to achieve performance under contract is by pegging the service with so-called key performance indicators (KPIs); these KPIs specify the operative and connection level required in percentages. Exact details depend on the service, including the links to in situ or on orbit services. These specify minimum and maximum outage tolerance, as well as cases of justified interruption, such as maintenance.

## **VI. Interruption**

### **VI.1. From Space Law to Contract**

Interference at primary source level (at the level of capacity provision) is treated separately from interruptions suffered at downstream or secondary terrestrial level. This is because of the demarcation drawn once the signal, and particularly data, is processed and distributed downstream. Different legal rules apply to these different market sectors. The more recent downstream markets operating at stratospheric level are moving the boundaries between international and national space law closer to the law of communication. This is assuming a central regulatory position at international and national level in the digital context.<sup>19</sup> Further demarcation is made for the provision between those services falling within the provider's reasonable

18 Smith, (2015) Liability for Satellite Navigation Systems, in: Frans von der Dunk (ed.), Handbook on Space Law, Edwin Edgar, USA; further, id., "Where's Paradise or Paradise Lost?" The EU's Satellite Navigation System Galileo – some comments on inherent risk, Paper, in: *Proceedings of the 50th Colloquium on the Law of Outer Space* (2007), IISL/AIAA, 346-358.

19 Article 1.160 ITU Radio Regulations (RR) describes harmful interference as: 'Interference which endangers the functioning of a radio-navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio-communications services service operating in accordance with Radio Regulations.'

control at the level of derivative satellite-data based services and products towards customers. The loss of service availability at the level of smart phones or receiver devices is therefore administered without any reference to the classic contractual concepts of underperformance, or breach of contract. A specific coverage is agreed under the SLA; any downtime is referred to as outage, which includes justified outage. Generally, remedies are given in the form of credits, operated through reduction in payments, or retention of an equivalent portion of the fee.

## **VI.2. Guaranteed Service**

Communication capacities can only be guaranteed to the extent that there are back-up facilities to cover any outage caused by the partial or total loss of signals in space (SiS), or loss of satellite services. Since not all forms of interference fall within the concept of harmful interference – which places responsibilities on member states to ensure its elimination under ITU law at national level,<sup>20</sup> the risk of interruption is carried by the providers.<sup>21</sup> Outages are dealt with by relying on notions of force majeure, interruptions beyond the provider's reasonable control, and justifiable interruptions for maintenance. Force majeure for example covers outage beyond the control of operators, such as the impact of space weather.

The loss of primary services can in practice lead to an inability to secure e.g. the utilities grid, timely financial transactions, or entire communication networks.<sup>22</sup> In such cases, short notice and short term capacity is likely to be in place already to avoid outage for specific important services and events.<sup>23</sup>

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20 The relationship between the ITU Constitution and the Radio Regulations is as follows; 'The legal framework of ITU comprises the basic instruments of the Union, which have treaty status and are binding on ITU Member States. These instruments are the Constitution and Convention of the International Telecommunication Union and the Administrative Regulations, which complement the Constitution and the Convention. The Radio Regulations (RR) form an integral part of the Administrative Regulations.' The Regulations therefore are fully binding on members; See [www.itu.int/pub/R-REG](http://www.itu.int/pub/R-REG) (accessed 1st September 2015).

21 On the notion of harmful interference under ITU law, See Smith, Lesley Jane, (2015) Contractual responses to the loss of satellite based services, in: M. Hofmann (ed), *Harmful interference from a regulatory perspective*, 3<sup>rd</sup> Luxembourg Satellite Symposium, 2014, Baden-Baden, Nomos, 65-83.

22 National and international bank transfers are operated via the code system developed by the Society for Worldwide Interbank Financial Telecommunication, SWIFT, details of which are available at [www.swift.com/](http://www.swift.com/) [last accessed 1st September 2015].

23 See Huth, Oliver and Roelandt, Rafael (2011). *Specific Aspects and Characteristics of Satellite Capacity Agreements in the Satellite Communications Business*, n. 3 above pp. 395-396.

## VII. Driving Downstream Markets and Liability

### VII.1. Satellite Data Policies

Satellite programmes such as the EU's Copernicus have been specifically introduced to drive the development of new downstream digital information product and service markets. The Copernicus programme on environment and security, formerly known as GMES, is the dominant focus for research and environmental monitoring projects operating with the Sentinel satellites and various contributory missions.<sup>24</sup> Such policies look to re-use and integrate processed data into subsequent products and services, allowing Europe's SMEs in particular to take up the technology-development challenge. Each specific downstream market created, depending on whether it is real-time operated, and whether or not it uses original or derivative data, opens up considerations relating to the impact of interference and the interruption of services.

Whether and the extent to which data can be used and integrated into downstream services depends in part on the relevant satellite data policies. As a general principle, these policies all restrict unauthorised use and, in particular, the adaptation of satellite-based data. Further reference is made here to other work relating to the impact of data policies on availability of space based data.<sup>25</sup> Copernicus remains the exception rather than the rule relating to re-use of data in the field of data policies.

The restrictions on the re-use of data are dictated in part by considerations relating to copyright,<sup>26</sup> and the mission costs, as well as the law of liability; in some cases, there may be additional security considerations. It can nevertheless act as a break on development of secondary and tertiary downstream products. Where there is no direct control over subsequent processing, exploitation and distribution of data, generators and providers of data cannot assume any risk for defects or erroneous information that may result from the value-added process involved in developing the new product or service. This is why rights of redress are excluded against the prior contracting chain from the communication service to the data processor and provider.

24 See Regulation (EU) No 377/2014 of the European Parliament and of the Council of 3 April 2014 establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010 available <http://copernicus.eu/pages-principales/overview/> [last accessed 1<sup>st</sup> September 2015].

25 Examples of data policy are given in Smith, (2015) in: *The UN Remote Sensing Principles* (with Gabrinowicz, Harris, Schmid-Tedd), in: *Cologne Commentary on Space Law, Vol. III, (CoCoSL)* (eds. Hobe/ Schmid-Tedd /Schrogl), Heymann.

26 Proposal for a Directive of the European Parliament and of the Council on the dissemination of Earth observation satellite data for commercial purposes, COM(2014) 0344 final.



## VII.2. Liability

Clarifying the rules of law applicable to the downstream sector is attractive, and necessary. As indicated, the international treaty rules do not apply to activities not directly related to space. Instead, the rules of e-communication applicable for the EU member states at EU level – these include data protection and retention of data rules, laying down the technical side of how information is dealt with.<sup>27</sup> Interestingly, the Data retention Directive was declared invalid by the ECJ in 2014, so work is underway to develop a new system for addressing the subject.<sup>28</sup> Nor do these newer technologies lead to the application of classic media and broadcasting laws. Streaming is not broadcasting, but a special carrying technology; broadcast producers use streaming to distribute their produced content. The same applies to video on demand and youtube, along with other services: they provide a link and a platform, without editing control. In their place, the rules of competition law, contract and self-regulation apply.<sup>29</sup>

The general principles of contract law continue to apply in relation to services. A consumer purchase is effectively also a reduced form of service level agreement, although remedies are typically disclaimer or waiver-based. General rules of tort (or delict), whether manufacturers' or product liability, will apply to the equipment provided. The concept of 'defective product' applies to software, so defects at downstream level could even lead to interesting developments in this field in future. The position on fault-based liability to all downstream service inputs and data has not yet been stated clearly.

The rules applicable at the level of downstream service markets do not, however, equate product or services liability with liability arising from the loss of signal in space. Space law does not regulate product liability.<sup>30</sup> The newer move towards stratosphere-based downstream services may bring further insights into the reliance on classic concepts of product and services liability law.

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27 Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, OJ L 281 of 23.11.1995; Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services, amended by Regulation (EC) No 717/2007 of the European Parliament and of the Council of 27 June 2007 on roaming on public mobile telephone networks within the Community, OJ L 108 of 24.04.2002.

28 See [http://ec.europa.eu/dgs/home-affairs/what-we-do/policies/police-cooperation/data-retention/index\\_en.htm](http://ec.europa.eu/dgs/home-affairs/what-we-do/policies/police-cooperation/data-retention/index_en.htm) [last accessed 1st September 2015].

29 See generally, Batura, Olga: *Universal Service in WTO and EU law; Liberalisation and Social Regulation in Telecommunications* (Springer) *forthcoming* (2016).

30 Nevertheless, product liability claims relating to space activities are not excluded from domestic courts under Art XI.2 Liability Convention.

Liability can only arise by virtue of a rule of law (international, national) or by contractual agreement on risk allocation. In its absence, parties are required to bear their own loss, a situation not new in the space sector, or resort to commercial insurance to cover the potential economic losses at stake.<sup>31</sup>

### **VII.3. Copernicus: Liability Disclaimer**

The approach adopted within the EU-Copernicus programme<sup>32</sup> to avoid potential contractual and fault or negligence liability issues for space-derived information in the downstream sector was to introduce a programme-wide exclusion or disclaimer for the re-use of Copernicus data. By requiring its registered client-customers to impose these disclaimers when Sentinel satellite-based content is extracted, processed and combined within further commercial service tools, the EU interrupts the chain between original and final sources of information data. This practice is not uncommon; other data policies are seen to adopt the same position regarding extraction and re-use of data in the development of commercial applications based on satellite-gathered information.<sup>33</sup>

Any remaining issues of liability are therefore subject to the terms of contract between supplier and customer. Whether a disclaimer will hold for all potential forms of liability, however, remains a question for the domestic courts.

### **VIII. Conclusion**

The contractual situation for real-time commercial customers serviced by satellite operators is dictated by their capacity requirements and the service levels agreed. SLAs are technical instruments regulating levels of performance, remedies in the form of credits, up to and including termination of contract. Interference is resolved from a functional perspective.

For downstream products and services, the impact of interference, whether or not harmful in terms of ITU law, falls within the sphere of responsibility of those further down the distribution chain from the satellite operators; they are responsible for what is within their 'reasonable control'.

Only if spacecraft-induced damage occurs and the interests of owners-operators and insurers start to drive indemnification will negligence or fault

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31 See the provisions of Outer Space Treaty and the Liability Convention relating to a party bearing its own loss, e.g. Art IV OST; Art VII LIAB.

32 Copernicus, previously known as GMES (Global Monitoring for Environment and Security), is the European Programme for the establishment of a European capacity for Earth Observation; accessible via [www.copernicus.eu/](http://www.copernicus.eu/) [last accessed 1 September 2015].

33 See Art 7 of the Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, OJ L 77/20 of 27.3.1996.

liability be examined in this sector; whether this occurs will also depend on other sources of interruption such as debris-related interference.<sup>34</sup>

Whether smart-use downstream services eventually combine their service provision to liability insurance will depend on the relevance of such services and the regulatory context, and increasing risks of debris induced downtime or outage.

These are interesting times for technology and the law; for downstream services, the undoubted benefits of online marketing, technologies enabling various types of data to be combined, whilst relying on the forces of new market exchange, may mould new customs for new markets. This in turn might lead to new interpretations of what relational contracts and user expectations actually involve in the digital era. Until such time as space traffic management becomes binding, the focus will remain on general principles of commercial law.

## References

- Batura, Olga: *Universal Service in WTO and EU law; Liberalisation and Social Regulation in Telecommunications* (Springer) 2016.
- Huth, Oliver, Roelandt, Rafael (2011). *Specific Aspects and Characteristics of Satellite Capacity Agreements in the Satellite Communications Business*, in: Smith, Lesley Jane and Baumann, Ingo (eds) (2011). *Contracting for Space, Contract Practice in the European Space Sector*. Farnham: Ashgate.
- Smith, (2015) *Liability for Satellite Navigation Systems*, in: Frans von der Dunk (ed.), *Handbook on Space Law*, Edwin Edgar, USA.
- Smith, Lesley Jane, (2015) *Contractual responses to the loss of satellite based services*, in: M. Hofmann (ed), *Harmful interference from a regulatory perspective*, 3<sup>rd</sup> Luxembourg Satellite Symposium, 2014, Baden-Baden, Nomos, 65-83.
- Smith, Lesley Jane and Kerrest, Armel (2013). *UN Convention on Liability Caused by Objects in Outer Space 1972*. In: Hobe, Stephan (ed). *Cologne Commentary on Space Law (CoCoSL)*, vol. II, Köln: Heymanns.
- Smith, Lesley Jane (2008), "Where's Paradise or Paradise Lost?" *The EU's Satellite Navigation System Galileo – some comments on inherent risk*, Paper, in: *Proceedings of the 50<sup>th</sup> Colloquium on the Law of Outer Space* (2007), International Institute of Space Law / American Institute of Aeronautics and Astronautics, 346-358.

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34 For an overview of the interaction between the national provisions of space law and the provisions of the Liability Convention, See Smith, Lesley Jane and Kerrest, Armel (2013). *UN Convention on Liability Caused by Objects in Outer Space 1972*. In: Hobe, Stephan (ed). *Cologne Commentary on Space Law (CoCoSL)*, vol. II, Köln: Heymanns.

