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LEGAL CHALLENGES REPRESENTED BY LARGE SATELLITE INFRASTRUCTURES AND CONSTELLATIONS

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Ensuring Sustainability of Technology and the Law

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Abstract

The advent of large satellite infrastructures and constellations is a challenge for the structure of modern space law. Not only does it heighten the interdependency between frequency regulation under ITU law and authorisation of outer space activities at national level; it is also a timely reminder that the law requires to keep up with technological change, especially in times of an increasingly digital, cyber society. As the volume of commercial upstream activities that rely on large constellation infrastructures increases, so does the need to ensure level-pegging of the law, public and private, with the changes in concepts and philosophies underlying communication, as one of the formal bases of the law. With societies demonstrating high subscription levels to LBS devices and reliance on smartphones at above one per person, the corresponding rules relating to operational licensing, the duties arising from the provision of services, the terms of contract governing levels of service, including its loss, the sustainability of the outer space environment, can easily becoming a race as between potentially opposing interests of stakeholders and users.

This paper attempts to map out how connectivity, traditionally a subject belonging to telecommunications law, now by nature forms part of the foundations ensuring sustainability across the outer space environment and upstream, mid- and downstream level. Cubesat licensing now encompasses rules relating to information availability, transmission, networking goods and services. With this, the question arises whether the primary focus of space and telecommunications law will in future embrace the development of in-house privacy policies and private regulation through contract, or whether telecommunication and broadcasting law can, by virtue of standards, including data protection policies, retain regulatory stringency while maintaining the balance required to meet the vying goals of availability and principles of freedom and equitable opportunities under contract.

It also raises the question whether and which supervisory bodies might be needed to monitor this transition at international and national level; universal services have a strong (end) user-based philosophy, to which only lip service has been paid, at least till now.

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I. Introduction

The challenge for twentieth century legal rules is to provide a robust, yet flexible and forward-looking framework for connectivity and free flow of data that caters for the legitimate rights and obligations of all stakeholders. In the context of ICTs and the digitized economy, this means the provision of high-speed and quality connectivity, accessible and affordable for all (end)-users operating under optimal conditions. These parameters dictate the need for free flow of data across all digital value chains, while ensuring privacy, protection of sensitive data and respecting rights of ownership. Security is an equally important and highly demanding aspect requiring dedicated management (*integrity*). The foregoing patterns call for support in the form of governance and regulatory systems that incorporate the interests of all stakeholders, and that take existing rules of space and telecoms regulation into account. In the meantime, the user community has grown to encompass an extensive group of professional satellite service operators/ service providers, users, and end users of commercial and open free services, whether at industry, client or consumer level. These services are accompanied by a variety of legal rights and obligations, which have rarely formed the subject of any thorough legal analysis.

This paper takes a look at the distinctions that arise between space law and telecoms as regards 'connectivity;' it briefly shows how solutions to the challenges for greater access to spectrum, which include space traffic management (STM), are currently being addressed. It discusses how technological developments will impact on future demands for sustainable space, and describes how the solutions developed at the level of SLAs and other user contracts are crafted to respond to the increasing demands for uninterrupted connectivity.

II. The Challenge of Big Data to Space and Telecoms Law

II.1. Spectrum Demand

Today's new technologies pose extensive demands on the management and allocation of frequency in response to the demand for increased spectrum.[1] The capacities required to operate mobile, fixed and broadband, digital HDT, as well as new generation 5G communication networks are immense.[2] Such communications systems 'run' or are based in regulatory terms on two

1 The ITU RADIO REGULATIONS (2012) are international treaty rules that govern the use of radio frequency spectrum for geostationary and non-geostationary satellite orbits; these can be accessed online: http://www.itu.int/pub/R-REG-RR.

2 The European Space Operations Association (ESOA) has contributed to various Ofcom consultations given the current demands placed on satellite operators and providers, e.g. regarding spectrum sharing, and management of satellite filings, online: https://www.esoa.net/positions/consultations.

main fields of international law; firstly, treaty rules of international space law that traditionally focus on the launching and risk-management of satellites; secondly, the international rules of frequency management falling within the scope of ITU law. Both systems have their own implications when flown down into the specific national regulatory context.[3]

The technology push of the past decade has increased the user expectations regarding speed and access to space-related information, as well as society's dependency on ground based and on-orbit infrastructures in response to the data demand.[4] There have been concerns to reduce latency time, with the focus on providing increased communication capacity, and with governments willing to invest in such structures. The sheer volume of data continues to drive the interest in developing fast data transfer relay solutions, such as ERDS.[5] The ability to access communication networks remains an important characteristic of ensuring and maintaining competition between regulatory cultures and societies; some continue to lose out on socio-economic value by being caught in the so-called 'digital divide.'[6] A failure to regulate or legislate can constitute as much of an unfounded policy decision as a speculative investment.[7] Currently, regulation for space and telecoms abounds, but there are gaps between those disciplines and related issues for those managing data at the level of data processing and retention, as well as under the civil law.[8]

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3 Not all States, even if active in space, have introduced a national space law. The UN GA Resolution 68/74 was passed in an effort to encourage all States to implement the authorization and monitoring requirements contained, inter alia, in Art VI OUTER SPACE TREATY (OST). For telecommunications, the National Regulatory Authorities (NRA) apply the telecoms licensing rules that derive directly from ITU law. These have since been harmonised within the EU Single market Framework for electronic communications, with rules dating from 2002, 2009, online: https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/Copy%20of%20Regulatory%20Framework%20for%20Electonic%20Communications%202013%20NO%20CROPS.pdf.

4 For the call for greater transparency in response to the growing use of data, see 'LIVING WITH TECHNOLOGY; THE DATA REPUBLIC' (26 March 2016), in: ECONOMIST, Special report, online: http://www.economist.com/node/21695195/print.

5 On the technology and objectives of the European Data Relay System, EDRS, online: http://www.esa.int/Our_Activities/Telecommunications_Integrated_Applications/EDRS.

6 For an insight into current analyses of the digital divide, see the ongoing Stanford University project on the causes and sources of digital divide, online: http://cs.stanford.edu/people/eroberts/cs201/projects/digital-divide/start.html.

7 For an economic assessment of these markets, see: W. SAUTER, PUBLIC SERVICES IN EU LAW (2015).

8 L.J. Smith, *The impact of growth markets in the downstream sector*, The parameters for connectivity and services; beyond outer space law (2015), in: 58th *Proceedings of International Institute of Space law*, IISL, Eleven, 2016, 471-482.

II.2. Co-Dependency

The current phase of ensuring fast-speed communication by relying on space-based technology is not a race between disciplines, but an exercise in ensuring that the respective systems of space and telecommunication are upheld at regulatory levels by all states. Legal certainty is ensured when states all adopt the same or similar regulatory approaches, particularly where the rules derive from common international provisions. Whereas space law focuses on the perspective of responsibility and liability for space-object induced damage, telecommunications law focuses on connectivity.[9] Both require structures for authorization and licensing, operating as associated yet separate disciplines, within their separate structures, and both have sensitive time lines.[10] Space-related activities are driven by secure but longer time lines simply because of the development involved.

Technology forces the regulators to require adherence to common denominators, one being the periods for filing frequency notices under the Radio Regulations.[11] Over the last decade, the subject of sustainability ('Space Traffic management, STM') has been included in the list of the common denominators between space and telecoms regulation.[12] Without sustainable space, satellites risk interference and satellite damage, with potential loss of functionality, and a corresponding risk of loss to the user communities.[13]

Connectivity is an exercise in bridging regulatory regimes and requires foresight and discipline. Space and telecoms law may be seen to be in competition, but they are co-dependent. Any gaps in regulatory content through licensing are thereafter filled by contract terms. This opens the way for divergences, with variable standards and non-transparent practices. Contract solutions that are only automated and technology-driven do not necessarily reveal the most balanced of interests or 'smart results'.[14]

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9 F. Lyall, THE INTERNATIONAL TELECOMMUNICATIONS UNION (2011).

10 Id.

11 For access to the Radio Regulations (2012), see n. 1 above.

12 L.J. Smith, *Thoughts On A Consensual Orbital Debris Removal Scheme*, in: Simpson, Williamson, Morris (eds.), 2016; SPACE FOR THE 21st CENTURY, Discovery Innovation Sustainability, ATWG.

13 L.J. Smith, *The Impact of Growth Markets in the Downstream Sector*, n. 8 above.

14 Economist, *Not-so clever Contracts* (30 July 2016), online: http://www.economist.com/news/business/21702758-time-being-least-human-judgment-still-better-bet-cold-hearted.

III. Universal Services

III.1. Concept

Universal service is a legal concept by which any person, irrespective of his/her income, location and abilities, should have access to and the use of communications services.[15]

Universal service has developed from an industrial policy instrument aimed at deployment of telecommunications infrastructure, into a social policy concept that enables disadvantaged end-users (in remote digitally-divided locations; disabled, living on support and/or low incomes).[16]

The roots of the modern universal service concept lie in the public service nature of telecommunications services, which the state has a special interest and obligation to provide.[17] As a result of liberalization of trade in telecommunications services, universal service rules were introduced in most countries around the world, as well as at the WTO and EU level, with a view to securing public service tasks by the government.[18] Nevertheless, not all governments have followed through, with various countries continuing to operate without broadband, let alone sufficient fixed telephone coverage. This is where satellite mobile services have become able to bridge the digital divide, and contributed to the socio-economic benefits from space.[19]

III.2. Universal Service-Connectivity in Space and Telecoms Law

As indicated, the development of broadband communications and new generation access networks has introduced new perspectives into the legal discussion on connectivity. On the one hand, there have been lengthy discussions within the universal service debate whether the current universal service scope is up to date (e.g. covers broadband), or whether it should be revised.[20] Based on the premise that broadband is the essential infrastructure of the future, guarantees of legal certainty and improvements in investment climate across the regulatory framework and its interplay with competition

15 O. Batura, UNIVERSAL SERVICE IN WTO AND EU LAW, LIBERALISATION AND SOCIAL REGULATION (2016).

16 See W. Sauter, n. 7 above, O. Batura, n. 15 above.

17 Id. n. 15.

18 Id. n. 15.

19 See Economist, *Planet of the Phones* (28 February 2015), online: http://www.economist.com/news/leaders/21645180-smartphone-ubiquitous-addictive-and-transformative-planet-phones.

20 O. Batura, n. 15 above; S. Levin, Universal Service and Targeted Support in a Competitive Telecommunications Environment, in: *Telecommunications Policy*, 34, 92-97 (2010); M. Finger/ C. Jaag, THE ROUTLEDGE COMPANION TO NETWORK INDUSTRIES (2016).

law and State aid rules have been investigated.[21] Some voices have raised the question of a complete reform of universal service to render it more user-oriented and more appropriate for the new ICT environment. The latter has changed significantly, due to the development of Internet, revolution of mobile communications and the convergence between broadcasting, computer and telecommunications technologies.[22]

IV. Communication Contracts

IV.1. Smart Contracts

Contracts are increasingly taking the place of statutes or legislation in response to the need to lay down rules of the road for contractual dealings in the field of downstream space-based information services.[23] Performance obligations, rights and duties and financial commitments are set by the stakeholders, with little to no regulatory influence, other than the fact that these services form part of approved or licensed operations, and only provided in that context to the users. The accompanying standard-form contracts are not necessarily part of that same approval process.

Contracts typically seek to fill the gaps between the disciplines of space and telecoms, and are designed to ensure reduction of barriers to connectivity and maintaining the free flow of data. Such barriers or issues can arise when it is unclear to what extent national rules are applicable. Various leading judgments have demonstrated over the past few years that not all jurisdictions are willing to approve automated data managing systems, with issues such as contracting out of stricter mandatory rules leading to businesses avoiding standards relating to management of personal data being denied, The Google and Facebook judgments of the European Court of Justice show that public policy will stop outsourcing of legal rules to foreign jurisdictions, where minimum standards of data management and treatment are not upheld.[24] These decisions are significant, in that they recognise the power of the net communities as contractual relations, where personal data is exchanged against access to the platforms.

The decisions ensure some regulatory/higher control over digital storage or smart contracts relating to upstream or downstream services. The subject

21 M. Finger/ C. Jaag, n. 20 above; further W. LEMSTRA/ W. MELODY, THE DYNAMICS OF BROADBAND MARKETS IN EUROPE; REALISING THE DIGITAL AGENDA 2010 (2015).

22 O. Batura, *Universal Service in the EU Information Society policy* (2014), in: *info*, 16.6, 24-34; further O. BATURA, n. 15 above.

23 L.J. Smith/ I. Baumann (eds.), in: CONTRACTING FOR SPACE, AN OVERVIEW OF THE EUROPEAN SPACE SECTOR (2011).

24 C-131/12, *Google Spain v AEPD, Gonzalez*, Judgment of the ECJ (13 May 2014); C-362/14, *Schremm v Data Protection Commissioner Ireland* ('*Facebook*'), judgment of the ECJ (6 October 2015).

remains a critical issue in relation to the long-term treatment of all forms of data, and particularly personalized data. The reasoning for avoiding control and arguing that data is anonymised are counteracted by information that data can never be fully de-personalised.
Data exchange involves elements of mutual synallagmatic contracts, in which the consideration or payment is the exchange of personal data itself.[25] Contracts must ensure provision for data handling in terms of the applicable mandatory legal provisions.[26] Locating servers in orbit or in clouds does not limit these legal controls.

IV.2. Service Level Agreements (SLAs)

Service level agreements are a common form used by the telecoms industry to ensure that operators and users receive the level of services required. The level of connectivity aimed for is generally fixed at a minute figure just below 100 percent. Further characteristics include 'Outage' times to enable system updates and security checks (justifiable outages). In contrast, unjustified interruptions are penalised using the standard technique of key performance indicators (KPI). KPIs have become the measure of connectivity from a contractual performance perspective. They are put in place to ensure performance and compliance with technical requirements, be this for GNSS applications or telecoms. KPIs are a useful tool that enables reductions in service payments in proportion to the lower technical level.[27] They are also the only measure on which such communication networks can in fact be assessed to provide the level of services needed.

IV.3. Contracts as Measure of Technical Quality

Ensuring connectivity is one aspect of satellite operations; these look at the quality and level of technical service. Anything below the agreed maximum level leads to automatic reductions in financial exchange. In so far as data processing, storage and management are involved and depending on the type of data, these contracts require provisions on data protection, client anonymity and privacy. Given the general lack of specific space related regulatory instruments in this sphere, their implementation at user level is not monitored. Nor is sight of such contracts required in the course of satellite filing applications.[28] Some of the existing practices may also be seen to

25 C-381/98 *Ingmar GB Ltd., v Eaton Technologies*, judgment of the ECJ (9 November 1998).

26 In that case, the European Court of Justice already held one decade earlier that contracting out of mandatory provisions of EU law through choice of law clauses designed to restrict the benefits of mandatory EU law was against the European *ordre public,* see n. 25 above.

27 L.J. Smith, *The Impact of growth markets* (2015), n. 8 above.

28 For details of the subjects of consultations in which the satellite operators are involved, see ESOA, n. 2 above.

restrict private governance initiatives. Taken together, these issues combine to create restrictions on the effective functioning of the information society that impact on the space-based downstream economy.[29]

V. Competition between Legal Systems

V.1. Legal Transplants

A less well known, but nevertheless common form of legislating is to import legislative models or regulatory patterns through so-called 'legal transplants,' others refer to these as legal exports.[30] Legal models stemming from Europe would appear to offer suitable prototypes within the various discussions relating to protection, ownership and management of personality rights as data. The responses to the challenge are still to be examined. Transplants as to legal rules, but not yet as to how to deal with data protection and management in a downstream-data and cyber world, where business models are primarily linked to finance.

V.2. Game Change

The predominantly US-based large-small satellite constellations such as OneWeb or Planetlabs, are a symbol of the clear trend towards the large cubesat constellations; as little as five years ago, these were unimaginable, both technically as well as from a regulatory perspective.[31] With their advent, a game change is now taking place. There are economic reductions in costs which are counteracted by sorter satellite lifetime considerations. These developments are receiving a pro-active supportive response from the competent regulatory international organ, the ITU.[32]

One of the main considerations in these developments remains that, while demand for connectivity is highly exponential, spectrum, as a natural resource, is scarce.[33] The ITU has responded at regulatory level by including the subject of how to assess and manage frequencies for these new large

29 Ensuring the security of data and its management so that anonymity is guaranteed remains a major challenge.

30 L.J. Smith, *Legislating for Space, the example of Germany* (2009), in: Zeitschrift für Luft- und Weltraumrecht (ZLW) Heft 1/2012, 62-78.

31 F. LYALL/ P. LARSEN, SPACE LAW, A TREATISE (2011).

32 The ITU has included the subject of these constellations, balancing increased connectivity and management of interference in its WRC 2019 agenda, see Resolution 1380, WRC-2019, online: http://www.itu.int/md/S16-CL-C-0130/en.

33 On the impact of scarcity of spectrum and pricing behavior of operators, with a focus on India as one of the largest mobile markets, see Economist, '*Under the hammer*' (21 March 2015), online: http://www.economist.com/news/business/21646754-big-auction-wireless-spectrum-likely-thin-ranks-operators-under-hammer.

constellations.[34] Information and guidelines are already forthcoming, with the remaining regulatory issues already set for the next WRC agenda in 2019.[35] The concern is to ensure that interference, jamming of satellite signals and other sources of interruption falling under the notion of sustainability are all reduced to a maximum and met with appropriate regulatory provisions. The open question remains what are appropriate solutions for post-launch data management in a society, where Big Data and the Internet of things have acquired such a major socio-economic dimension.

VI. Automation, Space-Based Applications and Contract Law

The recent technological and economic evolution, in particular in robotics, automation and the Internet of Things, requires further in-depth study into legal aspects and concept of connectivity. No detailed legal research has been done on the relationship between connectivity and universal service against the backdrop of this technological change. The interplay, roles and responsibilities of public and private actors, including users, in the provision of connectivity require clarification, beyond the involvement of the state.
Interesting questions arise as to implications of connectivity on the existing legal framework with regard to the emergence of the formulation and architecture of associated rights and obligations. Some of these are new. These include new forms of regulation and governance over a field that is still under development. They must also take into account the ownership of such information which is now being traded – or exchanged – under uncontrollable conditions that cannot claim to have full consent of the individuals involved.

VII. Consideration on Growth of Space User Communities

VII.1. Space Traffic Management (STM)

Finally, the space community is facing a decisive moment in relation to 'responsible' consensus-building at international level. There are pressing issues of long-term sustainability, and changes brought about by increasing technological capabilities are continuously extending the group of active space nations. This has caused the subject of sustainability to be monitored and deliberated over several years, latterly within the same named Working Group under the Chair of Peter Martinez at UNCOPUOS level during its 59th session in

34 The response of the ITU to technical developments with large constellations included holding a stakeholder regulatory workshop in June 2016, for details online: http://www.itu.int/en/ITU-R/space/workshops/SISS-2016/Pages/default.aspx.

35 Above n. 32, online: https://www.itu.int/en/ITU-R/space/workshops/2015-prague-small-sat/Presentations/Planet-Labs-Safyan.pdf.

June 2016.[36] The Guidelines contain various sections, of which Part A forms the Agreed Guidelines with twenty eight provisions, Part B (Guidelines still under discussion) over which there is not yet consensus. The Guidelines are important directions towards achieving sustainability.[37] Debris remediation and exchange of information plays a large role in coordinating the safety of future operations.
While it appears to take longer to reach consensus at that level, the ITU regulatory system is meanwhile seen to move in tune and time with the changing technology. The ITU is currently taking a proactive role in discussing how its rules apply in a changing technology technological environment. Space law, where consensus-building appears to take longer – is at mid-stage development as regards ensuring sustainability; this can be seen in the discussion on managing space debris. The ITU, faced with equal concerns about STM, appears able to position itself more distinctly within its existing structures. This reflects the advantages of interpreting international rules within a context of technology-driven applications such as the Radio Regulations.

VII.2. Small Sats for Small States

Many smaller states are increasingly seeking to stake their interest in use and access to the GSO, continuing the call for equitable access on the basis of the ITU rules.[38] The case for access is also stated in a variety of documents, including the Outer Space Treaty, with its concept of "benefits and in the interests of all countries irrespective of their degree of economic or scientific development" (Art. I). Subsequent soft law documents such as the Space Benefits Declaration repeat the same principles.[39]
The interest of these states and stakeholders marks the new era of digital connectivity and convergence for space and telecoms. At the same time, there is a need to ensure that the responses from other stakeholders should converge too. That this group of new states is not willing to contribute to the remediation efforts required to prevent further deterioration or damage to the environment is understandable; it has had no access to the use of outer space or spectrum to which previous stakeholders have contributed.

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36 UNCOPUOS, Guidelines for the long-term sustainability of outer space activities, Conference Room Paper by Chair of Working Group on Long-term sustainability of Outer space activities, A/AC.105/2016/CRP.17 (16 June 2016).

37 For a comprehensive overview of the history of the deliberations and the development of the Guidelines, see Secure World Foundation, C. Johnson, the UN Guidelines on the Long-term sustainability of Outer space, Fact sheet, updated 2015, online: http://swfound.org/media/189048/swf_un_copuos_lts_guidelines_fact_sheet_december_2014.pdf.

38 See for example, the various studies of the International Astronautical Academy, IAA, SG 5.14, online: https://iaaweb.org/content/view/273/412/.

39 Res. 51/122 Declaration on International Cooperation in the Exploration and Use of Outer Space for the benefit and in the interests of all states, taking into particular account the needs of developing countries.

As long as the current plans of the NewSpace industry remain to see the goals of the Space Benefits declarations implemented, ensuring (include) connectivity as a universal service and expression of human rights, these developments will continue to find support.[40]

VIII. Conclusions

The technology push and convergence in the communication medium continues to place its demands on the scope of space and telecoms law, as two central yet distinct disciplines. The space law rules and requirements for responsibility and liability are crucial to ensure legal certainty as regards the state-to-commercial regulatory side of outer space operations. Besides ensuring capacity for connectivity at ITU and national level, there is little to no regulation of data transfer and establishing practice rules on how to manage and promote data flows.

Research into the impact of technology and space has focused until now mainly on the end-user, e.g. as regards cloud computing[41] and self-driven cars.[42] Various studies have been undertaken in relation to interference at the level of drones. A few legal scholars take a broader approach and address business-to-business relationships in the complex value chain, for instance, with regard to spatial and navigation data.[43] The greater part of the economics surrounding space involves public sector funding, whether this is delivering to government as clients, or government-own operator procurements.

Given the advances in technology, with the development of smart contracts, automation (robotics), where tasks are delegated to autonomous intelligent machines and users are not in a position to interrupt the automatic processes, there is potential for gaps. What is more, these developments challenge the traditional concepts of liability.[44] Chains of responsibility are further

40 S. Tully, *A human right to access the Internet? Prospects and problems* (2014), in: *Human Rights Law Review* 14:2, 175-195.

41 K. Hon/ C. Millard/ I. Walden, *Negotiating cloud contract: Looking at clouds from both sides now* (2012), in: STANFORD TECHNOLOGY LAW REVIEW 16:1, 79-129.

42 P. Marti/ P. Lanzi/ L. Bannon/ G. Sartor/ G. Contissa/ A. Masutti, *Liability and automation: issues and challenges for socio-technical systems (2011)*. M. Schellekens, *Self-driving cars and the chilling effect of liability law* (2015), in: *Computer Law and Security Review* 31:4, 506-517.
The recent death of a truck driver who crashed with a Tesla test car is currently being followed by the media (2011), online: http://www.wsj.com/articles/tesla-draws-scrutiny-from-regulators-after-autopilot-feature-is-linked-to-a-death-1467319355.

43 H. Onsrud, *Liability for spatial data quality* (2009), online: http://umaine.edu/scis/files/2012/12/LiabilityForSptlQlty.pdf; further L.J Smith, n. 27, above.

44 Marti et al.; Schellekens, both n. 42 above.

obscured. The complexity of responsibility and liability issues (esp. in service level agreements) remain, calling for further investigation.[45]

These developments highlight the important relations between international space law and ITU law; these two related disciplines are becoming increasingly interdependent, and their respective constitutional and their treaty characteristics more visible.

There is scope for some legal import, or legal transplants at national level, certainly for those exposed to the practice of licensing remote sensing and EO data systems. Questions arise as to which are the most appropriate instances to undertake the coordination between management and authorisation of space activities, spectrum and thereafter the data dealing practices. The convergence of telecoms and space is there; now is time to converge at the level of data 'contracting' practice.[46]

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