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The concept "via satellite" describes a system of interdependent parts. These parts are grouped into two fundamental categories—the earth segment and the space segment. The focus of this article is directed at the system components which comprise the space segment. Although terrestrial parts of the system will not be further discussed, it should be remembered that since the parts of a satellite system are interdependent, factors which influence the status of the space segment may also influence the status of the earth segment.¹

Space Segment Components

The components of the space segment are further placed into operational and support groups. The operational rubric includes those components which directly address the purpose of the system. For example, the operational components of a contiguous spot beam satellite,² include the transponder, antenna and switching subsystems. The operational space segment of an earth observation satellite includes data acquisition and recording subsystems.³ Other types of satellites—such as those

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J. Martin, *Communications Satellite Systems* 148-65 (1978).

²Contiguous spot beam satellites, which ably exemplify the next generation of large space communications systems, bring the advantages of focused satellite energy to a broad area. These satellites continuously cover a large area, such as the continental United States, with dozens of contiguous independent spot beams. The resulting ground pattern can be visualized as a map of the states covered with from 40 to 400 contiguous circles. The size, and hence number, of multibeam footprints is a function of several technical and demand-oriented trade-offs. Goldman, Jr., & Edleson, *On Several Communications Satellite Designs Using Large Space Antennas*, in *IEEE Pac. Telecom. Conf.* 3B-5 (1979). Interconnectivity between beams can be accomplished by combining a moderately sized switching matrix with use of beam trunking techniques for concentration of non-uniformly distributed traffic. Ohm, *System Aspects of a Multibeam Antenna For Full U.S. Coverage*, in 3 Int'l Conf. on Com. 49.2.1 (1979). Conservative spectrum utilization, coupled with wide-area coverage and simplified ground station design, make contiguous multibeam satellites very attractive as the backbone for broadly based all-digital communications networks. Staelin & Harvey, *Architectures and Economics For Pervasive Broadband Satellite Networks* in 3 Int'l. Conf. on Com. 35.4.1, 35.4.6 (1979); see also Yeh & Reudink, *The Organization and Synchronization of A Switched Spot-Beam System*, in *Digital Satellite Communications* 191, 191 (1978); Burgess & Schmidt, *Satellite Constellations Using Multiple-Beam Satellites with Onboard-Switched TDMA*, in *Satellite Communications: Future Systems* 468 (Jarett, ed. 1976).

³See generally, *Hearings on Earth Resources Data and Information Services Before the Subcomm. on Space Science and Applications of the House Comm. on Science and Technology*, 96th Cong., 1st Sess. (1979).

designed for broadcasting, meteorology, manufacturing, surveillance, defense or science—also have unique operational space segment components.

The support portions of the space segment provide indirect contributions to the purpose of the system. These "housekeeping" components normally include attitude control, structural/thermal control, electrical power, and propulsion subsystems. In contrast to the operational space segment, one may find that satellites engaged in providing very different services possess similar support components.

Meaning of Space Platform

The term "space platform" commonly encompasses some or all of the support components of a satellite system. Furthermore, the term "space platform" normally contemplates a set of support subsystems which may simultaneously interface with more than one set of operational subsystems. This is analogous to the manner in which physiological support systems such as circulation simultaneously facilitate "operational" systems such as vision, locomotion and comprehension.

However, it should be emphasized that the term "space platform" has not yet attained a positive legal status. The lack of a treaty or statutory definition for space platform in no way limits the application of law and policy to this set of support subsystems. Indeed, the law simply describes those functions of space platforms which are under regulation.⁴

Since a space platform is "an object which is beyond, intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere," any "transmitters or receivers," including "accessory equipment," attached thereto become subject to the comprehensive space station and space service regulations of the International Telecommunications Union.⁵ Since a space platform is, after launch, a "space object," it also becomes subject to the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space ("Outer Space Treaty")⁶ the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of

⁴D. Smith, *Space Stations: International Law and Policy* 89-184 (1979).

⁵ITU Radio Regulations, Jan. 1, 1981, art. I. The International Telecommunication Convention (Madrid, 1932), 49 Stat. 2391, TS No. 867, created an International Telecommunication Union (ITU) of irregularly convened "Plenipotentiary Conferences" to revise constitution-like conventions, periodically convened "Administrative Conferences" to revise the detailed Radio Regulations appended to Conventions, separate "Consultative Committees" to study telephony and radio, and the "Berne Bureau" (now the IFRB) to keep track of the rapidly growing number of frequency assignments being made. G. Coddington, *The International Telecommunication Union* 131-64 (1952); For a close examination of early ITU space service definitions, see D. Smith, *International Telecommunication Control* 163-66 (1969).

⁶Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter "Outer Space Treaty"), Jan. 27, 1967, [1967] 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205 (effective Dec. 3, 1968).

Objects Launched into Outer Space ("Rescue and Return Agreement")⁷, the Convention on International Liability for Damage Caused by Space Objects ("Liability Convention")⁸ and the Convention on the Registration of Objects Launched into Outer Space ("Registration Convention").⁹ Regional and domestic legal authority bearing on space utilization also encompasses space platform functions. Notwithstanding the absence of a legal definition, space platforms are clearly surrounded by a substantial and growing legal milieu.

Traditional Legal Interest in Space Platforms

Traditionally, there has been relatively little interest in the separate legal status of space platforms and in legal issues pertaining to operational subsystem interface with space platforms. As a matter of historical technology development, satellite support subsystems ordinarily interfaced with only one set of operational subsystems. The one-to-one correspondence between sets of support and operational subsystems led to a tendency to imbue the space segment with a single legal personality and to ignore any "intrasatellite" legal issues.¹⁰

The historical lack of legal attention to space platform questions is not, however, demonstrably attributable only to the one-to-one physical correspondence between sets of support and operational subsystems. Satellite manufacturers ordinarily subcontract many space segment subsystems to other companies, many of which are in other countries.¹¹ Indeed, space segments are often initiated as joint ventures of entities within two or more countries.¹² Whether or not subcontracts or joint venture participation follows an operational/support division, it is clear that international as well as wholly domestic multi-party satellite manufacturing generates a multitude of legal questions. Legal problems arise because more than one entity or "party" has a judicially enforceable right to affect the character of a satellite system or subsystem.

The relatively well-known nature of legal rights and responsibilities incident to satellite development and production allow most of these legal issues to be solved by

⁷Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched Into Outer Space (hereinafter "Rescue and Return Agreement") April 22, 1968, [1969] 19 U.S.T. 7570, T.I.A.S. 6599, 672 U.N.T.S. 119 (effective Dec. 3, 1968).

⁸Convention on International Liability for Damage Caused by Space objects (hereinafter "Liability Convention"), March 29, 1972, [1973] 24 U.S.T. 2389, T.I.A.S. 7762 (effective Oct. 9, 1973).

⁹Convention on Registration of Objects Launched Into Outer Space (hereinafter "Registration Convention"), January 14, 1975, [1978] 28 U.S.T. 695, T.I.A.S. 8480 (effective Sept. 15, 1976).

¹⁰The history of U.S. satellite technology and policy development is documented in *D. Smith, Communications Via Satellite* (1976).

¹¹Ford Aerospace, for example, provides major satellite components to France's Aerospatiale, which is prime contractor to build three satellites for the Arabsat Consortium. *Av. Wk. & Sp. Tech.*, Nov. 9, 1981, p. 22.

¹²E.g., Franco-German TVSAT-TDF-1 program; ESA satellite program.

custom or contract. However, the legal rights and responsibilities of entities participating in an operational satellite system were by no means certain. It is in this arena of post-production satellite activity that recent events indicate sharp differentiation of legal rights and responsibilities along operational/support lines.

Contemporary Legal Interest in Space Platforms

Traditionally, one entity controlled the bundle of property rights to both the support and operational groups of system components. Intrasatellite legal problems were rare, as conflicting interests were nearly absent. Accordingly, interest in space platforms was low.

Recently, in the pacesetter fixed satellite service, there has been a clear trend toward carving multiple separate legal interests out of operational space segment components, while retaining unified control of support subsystems. Hence, transponders have been leased with varying degrees of preemptibility, judicially assigned, publicly allocated, openly auctioned, and privately sold. As a result, the bundle of satellite property rights are being diversified.

While distribution of legal interests in operational subsystems is very efficient risk-sharing, it is also generating certain legal issues which might not otherwise exist. One such set of issues concerns the entire nature of customary commercial practice involving entities which have obtained an interest in an operational space subsystem such as a transponder. This industry practice provides an essential frame of reference for measuring reasonable performance of contractual obligations. It also facilitates the prevention of subsequent legal disputes by providing parties with a reasonable basis upon which to negotiate and contractually plan for events which may interfere with performance.

The recent separation of operational and support subsystem property rights in the space segment has generated peculiar liability issues. There are no clear answers to questions such as whether the creation of separate transponder property rights frees the support subsystem owner from liability for libelous broadcasts, deceptive advertising, privacy claims and other media torts. Accordingly, no clear answers exist as to the extent of liability for direct and indirect damages incurred by the owner of a support subsystem when contractual obligations to operational subsystem lessees or grantees are not met in whole or in part.

The rising popularity of creating operational space segment property rights also creates new problems for the insurance industry. Previously, a single insurance contract covered all relevant satellite systems. Today, RCA Satcom and Western Union Westar satellites are receiving multiple layers of insurance. Owners and lessees of support and operational subsystems aboard these satellites are each seeking to reduce risk by procuring separate insurance policies. This trend is already challenging both the financial and legal creativity of the insurance industry.¹³

¹³See Margo, *Some Aspects of Insuring Satellites*, *Ins. L. J.*, Oct. 1979 at 555-597; *Space Flight and Insurance* (Munchener Ruckversicherungs-Gesellschaft, 1980); Merrett, *Insurance and Space Projects* (Paper delivered at International Conference on Doing Business in Space, Smithsonian Institution, (Nov. 12, 1981, Washington, D.C.).

A particularly vexing consequence of the new trends in satellite subsystem ownership relates to the appropriate regulatory categories for ownership interests of less than a complete satellite. As satellite ownership becomes increasingly fragmented, it becomes correspondingly difficult to associate particular treaty and statutory obligations (e.g. coordination, tariffs, permissible business practices) with specific entities. This problem of pinpointing legal responsibility becomes still more problematic when subsystem owners are domiciled in different countries.

One consequence of the contemporary operational/support segmentation in satellite property interests is particularly far-reaching and encompasses all those issues mentioned above. This consequence entails a fundamentally new regulatory and business perception of the space segment as being comprised of a legally distinct satellite support subsystem, or "space platform," which interfaces with one or more legally distinct operational subsystems. It is becoming necessary to question the need of burdening the owner of a set of support subsystems, or "space platform," with legal considerations which only relate to separately ownable operational subsystems.

The development of new commercial norms, regarding transponder leasing, highlights this new type of interchange between platform and operational interests.¹⁴ The need for clarification and improvement of intrasatellite liability and insurance questions demonstrates the utility of distinct legal treatment for platforms and operational subsystems. In addition, regulatory ambiguities and contradictions which arise from treating diversely controlled satellites as under unitary control prompts separate legal consideration toward space platforms.

The traditional inattention to the legal aspects of space platform interface may be explained as due to a failure of the law to conceive of separate legal estates in a space platform and in an operational payload. Recent events, however, have ably demonstrated the attractiveness of severing spacecraft ownership.¹⁵ As innovative satellite ownership structures continue to evolve, they will certainly be accompanied, as the pioneer concepts now are, by a new body of space platform law and policy.¹⁶

A Space Platform Scenario

The nature of space platform legal and policy issues may be profitably explicated through examination of a plausible scenario. One may imagine the formation of a geostationary space platform company, *Geoplat, Inc.*, with the avowed aim of meeting demand for platform services, *i.e.*, satellite support subsystems, at any point in the

¹⁴*Transponder Leasing*, *Satellite Communications*, (Oct. 1981) at 34. See also Bockstiegel, *Present and Future Regulation of Space Activities by Private Industry*, in *Space Activities and Implications* 133-149 (1981) (Centre for Research of Air and Space Law, McGill University).

¹⁵RCA is attempting to auction seven C-band satellite transponders for a total of \$90 million. *Sat. Wk.*, Nov. 16, 1981, p. 2. Hughes reportedly sold 12 C-band transponders to four parties for \$117 million. *Sat. Wk.*, Nov. 30, 1981, p. 7.

¹⁶*Supra* note 4, at 63-88, 185-207; S. Gorove, *Studies in Space Law: Its Challenges and Prospects* (1977); Fuqua, *Space Industrialization: Some Legal and Policy Considerations for Private Enterprise*, 8 *J. Space L.* 1 (1980).

geostationary orbit. Such a firm could, very plausibly, be started by one of the existing international joint venture satellite groups such as Ford Aerospace/Aerospatiale or Hughes/Spar Aerospace. It is also possible, however, that such a firm could be created by a national space administration, individual satellite manufacturers, or investors from outside the aerospace industry.

Geoplat would quickly ascertain where demand for platform services was greatest and target those areas for early market development. The firm would announce its intention to provide platform services at specified orbital locations, and would encourage potential customers in areas which could be served from such a location to consider platform compatibility in choosing among bids to construct satellites.

Geoplat as an entity, could enter into joint bids with an operational subsystem provider. Alternatively, the company could sell any desired number of transponders while reserving for itself the right to provide platform services at a specified rate.

Geoplat would certainly give serious consideration to orbital locations capable of providing desirable service to the continental United States (CONUS). It might, for example, plausibly announce its intention to offer platform services at a favored location for supplying direct broadcast satellite (DBS) service to the Eastern Time Zone of the United States.¹⁷ Potential DBS firms could have clear incentives to plan for platform compatibility since this option might be much less costly than the alternative of maintaining one's own operational and support subsystems.¹⁸ *Geoplat* could, at the same time, attempt to interest other potential customers in North and South America at different frequency bands and, when sufficient isolation could be provided, in the same frequency band.

Additional platforms would be planned as customer needs push initial designs to their mass, power, structural, frequency interference, or system integration limits. The platform concepts of *Geoplat* and its competitors would, undoubtedly, vary greatly. An initial start might be made by selling standard transponders off of a production line satellite such as the Hughes HS-376. A more advanced platform would be capable of providing 25Kw of power to several different types of operational subsystems

¹⁷Five companies have expressed a desire to co-locate direct broadcast satellites at 95° West longitude to serve the U.S. Eastern Time Zone. See Applications filed in FCC Docket No. 80-603, Interim Authorization of Direct Broadcast Satellite Service (1981).

Developmental U.S., Indian and Canadian direct broadcast satellite projects are fully described and analyzed, with an emphasis on societal integration of government-sponsored technology development, in *D. Smith, Teleservices Via Satellite* (1978).

¹⁸For example, the Focus company plans to initiate a DBS service with only a \$9 million investment because it will lease platform services from Western Union's Advanced Westar satellite. Firms desiring to maintain their own operational and support subsystems for a DBS service will have to invest well over five hundred million dollars. See e.g., Applications of RCA Americom, Satellite Television Corporation, Direct Broadcasting Co. in FCC General Docket No. 80-603.

See also B. Bowman, GEO Stationary Platforms: The Concept and the Promise (Paper delivered at IEEE Eascon 1981); Katz & Donovan, *The Design of Communications Systems on Large Space Platforms*, in 1 Int'l. Conf. on Com. 9.4.1 (1980); Astrain, *Telecommunications and the Economic Impact of Communications Satellites* (Paper delivered at 31st Congress of the International Astronautical Federation, Tokyo, 1980); Fordyce & Stamminger, *The Use of Geostationary Platforms for Future U.S. Domestic Satellite Communications*, in 3 Int'l Conference on Communications 49.4 (1979).

transmitting at an array of frequency bands. Low earth orbit platform designs would support operational science, manufacturing and earth observation packages. Larger platform options would probably require astronaut deployment and payload mating from the Shuttle payload bay in low earth orbit. However, automated platform deployment and payload mating, even in geostationary orbit, is also technically possible.¹⁹

It would be very desirable to extend platform or operational subsystems life via the replacement of station-keeping propellant, degraded platform components and dysfunctional operational packages. Both automated and manned geostationary maintenance capabilities are under consideration, although neither has received firm budgetary commitments.²⁰ In low earth orbit, however, manned life-extending modifications to the Salyut and Skylab space platforms have been accomplished,²¹ and a manned mission to reinvigorate the Solar Maximum Mission scientific satellite is planned for late 1982.²²

This space platform scenario highlights several important legal issues. Among them are: interparty and third party liability limits to platform expansion in time and space under the Outer Space Treaty; appropriate state of platform registry under the Registration Convention; allocation of fault pursuant to the space-based harm provisions of the Liability Convention; necessary levels of state supervision, as well as which state shall supervise under the Outer Space Treaty; and comportment with a myriad of domestic trade, business and national security regulations. Perhaps the most immediate of these legal issues concerns frequency coordination obligations with the ITU and, to a lesser extent, with Intelsat. In order for *Geoplant* and its operational subsystem lessees or grantees to obtain some measure of international protection for the spectrum frequencies they employ, there must be radio frequency coordination and registration in accordance with ITU procedures.²³ Hence an immediate issue for resolution is whether *Geoplant* or its operational subsystem grantees should coordinate and register frequencies with the ITU.

¹⁹The European Space Agency (ESA) is exploring this alternative. *Av. Wk. & Space Tech.*, Dec. 21, 1981, p. 52.

²⁰Bekey, The Potential Evolution of the Space Transportation System (Paper delivered at 32d Congress of the International Astronautical Federation, Rome, 1981).

²¹See, e.g., N. Kidger, *Salyut 6 Mission Report*, Nos. 1-6. 22 *Spaceflight* 50, 97, 146, 343 (1980), 23 *Spaceflight* 42, 74 (1981).

²²*Av. Wk. & Space Tech.*, Jan. 18, 1982, p. 38.

²³The procedure of coordination involves the exchange of prescribed information between administrations whose communications services may cause mutual interference and, if necessary, a negotiation process whereby the technical or operational characteristics of one or both systems are altered in a way which eliminates potential harmful interference without sacrificing satisfaction of either administrations' communications requirements. D. Leive, *International Telecommunications and International Law: The Regulation of the Radio Spectrum* 228-34 (1970); Rothblatt, *International Regulation of Digital Communications Satellite Systems*, 32 *Fed. Comm. L. J.* 393; 410-26 (1980).

ITU matters take on still greater importance if the platform's operational packages are to operate in a planned frequency band such as a 12 GHz for the broadcast satellite service. At these frequencies the ITU's standard frequency registration procedures are replaced with a comprehensive orbit/spectrum assignment plan.²⁴ A very important question concerns which countries will be charged with occupying an orbit/spectrum assignment—the country with jurisdiction over *Geoplat* or the country with jurisdiction over a particular transponder purchaser. This problem is exacerbated by the fact that frequency assignments under an ITU plan are specified in such a manner that the only countries which can register a space service at a given orbit/spectrum location are the countries to which those space transmissions are primarily directed.²⁵ Furthermore, determining the proper jurisdiction for multi-party space estates may be very difficult.

It appears most sensible and most consistent with ITU regulations to impose frequency coordination and registration obligations upon operational subsystems which employ spectrum and not upon the platform operator. To conclude otherwise would cause serious contradictions under ITU plans and, in unplanned bands, would encourage platform operators to overregister frequencies, when selling or leasing transponders, as a means of assuring an ability to satisfy customers not yet identified. Efficient orbit/spectrum management is clearly encouraged by associating frequency coordination and registration obligations with the operational space segment and not with the space platform.²⁶

A frequent special case of the suggested approach exists when ownership of a satellite estate has not yet been severed into separate operational and platform estates. In such a case, the single satellite owner coordinates and registers a space service because of ownership of an operational space segment, not because of launching, or intending to launch, a satellite.

There are also practical advantages to regulatory acknowledgement of severed satellite ownership and operational space segment responsibility for frequency coordination and registration. One such practical advantage is that space platform

²⁴An assignment plan is accomplished by dividing the bandwidth allocated to Ku band broadcasting-satellite service into many channels of lesser bandwidth, associating this group of channels with each orbital position in the geostationary orbit, and then assigning to countries the right to specific channels at specific orbital positions. Countries have from 2 (Brunei) to 65 (Soviet Union) channel assignments, with most countries being assigned 4, depending on their size, population and foreseeable communication needs. Mill, *World Administrative Radio Conference For The Planning of the Broadcasting-Satellite Service in Frequency Bands 11.7-12.2 GHz (In Regions 2 and 3) and 11.7-12.5 GHz (In Region 1)*, Proc. 20th Colloquium on the Law of Outer Space 346 (1978).

²⁵See Final Acts of the World Administrative Radio Conference, Appendix 29A, art. 12.9.1, reprinted in U.S. Dept. of Comm., Nat'l Tech. Info. Service, II Final Acts of the World Administrative Radio Conference (1979); Butler, *World Administrative Radio Conference For Planning Broadcasting Satellite Service*, 5J. Space L. 93, 98 (1977).

²⁶"[R]adio frequencies and the geostationary satellite orbit are limited natural resources that must be used efficiently and economically. . . ." International Telecommunications Convention (Malaga-Torremolinos, 1973) art. 33(2). See generally, Gorove, *The Geostationary Orbit: Issues of Law and Policy* 72 *Am. J. Int'l L.* 448-9 (1979); Sarkar, *International Telecommunication Convention And Its Impact on Institutions*, Proc. 17th Colloquium on the Law of Outer Space 82 (1974).

construction will be far less stifled by law and policy relating to operational subsystems than is now the case.²⁷ Space platform development can proceed while those interested in creating operational estates fight the bureaucratic battles. Strong economic incentives will arise to standardize compatibility aspects of platform and operational subsystem design. This will help to insure survivability in an uncertain market and regulatory environment.

Conclusion

A great amount of intellectual thought is needed with regard to the legal, economic and engineering implications of severed estates in space. Given current attempts at satellite transponder auctioning, even the casual observer of space affairs must be struck by the presence of a strong trend toward severed ownership of operational and support satellite subsystems. The creation of these severed estates in space marks, in many respects, a new plateau in the growth of space law and policy. For it is now very clear that one should frequently expect more than one entity to acquire a judicially enforceable right to affect the character of a space segment system. Accordingly, space segment legal rights and responsibilities may be associated with different parties and space law may become a critical management concern.

Thought must be given to the economic implications of separate platform and operational package ownership, so that space platform policy may be developed in such a manner as to encourage efficient investment in space hardware. Significant engineering development is needed with regard to system integration of separately designed support and operational space segment components. But, perhaps most importantly, additional legal and policy analysis is needed concerning the implications of severed satellite ownership for optimal utilization of the valuable space and spectrum resources upon which society so vitally depends.

It is, to a very great extent, space law and policy which regulates the flow of new space hardware. Additional study of the legal and policy implications of severed estates in space will uncover regulatory options which greatly encourage multiple satellite property interests, including independent space platforms. One such regulatory option²⁸ which limits frequency coordination and registration obligations to owners of operational subsystems, will free the platform owner from many legal burdens and, undoubtedly, encourage platform deployment. Other regulatory options should also be critically examined so that the legal artifacts of historical satellite development do not impede the ability of the law to support contemporary differentiation of operational and platform estates in space.

²⁷Direct broadcast satellite applicants feel they may not legally even make launch reservations, much less construct platforms, until their applications for authority to construct a satellite are officially granted. Opposition of United States Satellite Broadcasting Co., FCC Gen. Docket 80-603 at 20; UA-Columbia Cablevision Inc., 55 F.C.C. 2d 656 (1975).

²⁸*Id.*