INTERNATIONAL UTILIZATION AND MANAGEMENT OF SPACE SYSTEMS

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Policy planning for the development of large space structures is lacking, and there is an urgent need for leadership with regard to the institutional relationships associated with space platforms. Geostationary platforms and orbital antenna farms are two present designs for future space information stations which may alleviate the problems of orbital arc congestion, excessive costs, and telecommunications and teleservices. Component ownership may serve as the guiding concept in multiple participation in such space stations. The United States Government, through NASA, could spur the development process by maintaining the space station frame in cooperation with an institutional entity (Space Industrialization Corporation) which would eventually bridge the transition from government ownership to the private sector. Private sector users could immediately benefit from space applications, and other nations could participate in and benefit from the space stations. Suggested norms for international cooperation include right of participation, orbital priority, equal rates, and optimal system efficiency.

> As important as the question of destinations are questions of directions and routes. A destination may seem very desirable, but if there is "no route" from here to there (or if we cannot find the direction that sets us on this route), then the destination is irrelevant.
>
> Herman Kahn
> Towards the Year 2000

Those involved in the early exploration and development of outer space have long recognized the benefits that can be derived from the expanded utilization of outer space.[1] In addition, with the advent of the National Aeronautics and Space Administration's Space Transpor-

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1. Among the major space-related reports that describe the benefits which can be derived from outer space are: ROCKWELL INTERNATIONAL SPACE DIVISION, SPACE INDUSTRIALIZATION (Apr. 14, 1978); SCIENCE APPLICATIONS, INC., SPACE INDUSTRIALIZATION STUDY (Apr. 15, 1978); SPACE APPLICATIONS BOARD, NATIONAL RESEARCH COUNCIL, FEDERAL RESEARCH AND DEVELOPMENT FOR SATELLITE COMMUNICATIONS (1977); and SPACE

tation System (STS), it is apparent that the technological capability to develop a wide-scale beneficial utilization of outer space now exists. It should also be recognized that one of the next steps in translating the STS capability into beneficial and greatly expanded space applications is the development of large space structures and space platforms.[2]

Even though this logical progression may be evident, policy planning for operational space platforms has barely started. At present there has been almost no inquiry into the nature of the institutional relationships, either domestic or international, which could or should be involved in operational large space structures and platforms designed for space applications. This lack of inquiry is extremely unfortunate because it substantially hinders progress towards the implementation and development of feasibility studies and preliminary plans for large space structures.

In testimony before the House Subcommittee on Space Science and Applications during June 1978, it was suggested that one solution to the problem of overcrowding in the geostationary arc is to utilize large multipurpose space platforms, which also has the benefit of providing for economies of scale and an increase in services. The Report on International Space Activities prepared by the House Subcommittee stated

> While the choice of technical design is important, until institutional arrangements are made there are likely to be few commitments by users. Without adequate user support the resulting insufficient funds will halt technical progress. Thus, priority must be given to resolving which institutional arrangements will best serve technical development.[3]

The question, then, is how to proceed to find the directions and routes that will lead to an optimum system which will maximize benefits to users. There is need for leadership with regard to the institutional relationships associated with space platforms to assure the most rapid and economic implementation of the system.

APPLICATIONS BOARD, NATIONAL RESEARCH COUNCIL, PRACTICAL APPLICATIONS OF SPACE SYSTEMS (1975).

2. The concept of large space structures, and in particular multipurpose space platforms located in geostationary orbit, was presented to the House Subcommittee on Space Science and Applications, in June 1978, by Delbert Smith; *See Panel Discussions on International Space Activities: Hearings Before the Subcomm. on Space Science and Applications of the House Comm. on Science and Technology*, 95th Cong., 2d Sess. 85-91 (1978). *See also* D. SMITH, MULTI-PURPOSE SPACE PLATFORMS: INSTITUTIONAL ALTERNATIVES (1978).

3. SUBCOMM. ON SPACE SCIENCE AND APPLICATIONS OF THE HOUSE COMM. ON SCIENCE AND TECHNOLOGY, 95TH CONG., 2D SESS., INTERNATIONAL SPACE ACTIVITIES 42 (Comm. Print 1978).

I. Space Information Station Defined

The term *space station* means a man-made object or facility in outer space established with a purpose, such as providing goods or services. In addition, the term is applicable to a space facility which is larger than a conventional space satellite and which is intended to be stationed in outer space for a relatively long-term period of use. Such a facility may or may not provide for human habitation, and it is apparent that most space stations in the near future will be unmanned. The term space station should not, therefore, be restricted to any one type of outer space facility, nor should it entail any specific connotation of design or habitability.

The concept of *large space structures* is a fundamental general concept which means facilities which are constructed in outer space from equipment and materials inserted into orbit. Conventional space satellites are launched into space as one completed unit, and although particular satellites may have deployable antennas, solar panels, and other equipment that must be extended, they do not require actual construction in space. Thus, construction in space is one distinctive feature which characterizes large space structures and distinguishes them from conventional satellites or similar objects in space. A second distinction is that such space structures are usually conceptualized as much larger pieces of equipment than conventional satellites. The magnitude of the structures may range from several scores of meters to several kilometers depending on the design and intended utilization of the structure.

Most space stations will be large space structures in that they will be constructed in space as opposed to inserted into orbit as one unit. Additionally, these stations will be larger than conventional satellites. Some facilities, however, which are known as space stations are not large space structures. Skylab, for example, was launched into orbit as one unit rather than constructed in orbit. Thus, Skylab is not a large space structure even though it is a facility which is both significantly larger and heavier than a conventional satellite, and is considered by some to be a space station.

The concept of a space information station involves a large space structure or frame which is placed in geostationary Earth orbit and utilized as a support facility for numerous types of communications and other applications equipment. The station, equipped with power and control systems, would accomplish functions presently performed by Earth resources (meteorological or communications satellites), only on a much larger scale.

There are several plans, designs, and concepts for space information stations, including the following from the United States: the NASA Marshall Space Flight Center's Geostationary Communications Platform;[4] the COMSAT Laboratories' Orbital Antenna Farm (OAF);[5] the Rockwell International's Electronic Mail Satellite;[6] the General Dynamics Corporation's Convair Geo-Truss Antenna;[7] the Jet Propulsion Laboratory's Mobile Communications Satellite;[8] the Grumman Aerospace Corporation's Public Service Platform;[9] the NASA Langley Research Center's Soil Moisture Spacecraft;[10] and the McDonnell Douglas Astronautics Company's Geosynchronous Information Services Platform.[11]

A review of two such plans serves as an illustration of the types of designs which are envisioned for these stations. All the plans call for stations placed in geostationary orbit. Although the designs are distinguishable, the basic premises and ideas for the stations are similar.

A. Geostationary Platform

One of the most prominent designs for a space information station is one which was created at NASA's George C. Marshall Space Flight Center.[12] The Geostationary Platform, as the Marshall space information station is referred to, would be approximately 82 meters by 31 meters and would weigh around 18,000 pounds.[13] The most prominent feature of the platform design is a large 30-meter antenna which, if constructed, would be the largest antenna located on any object in space. Other features include power modules with solar arrays at either end of the platform, attitude control equipment, an assortment of "payloads" or modules such as smaller antennas operating at various frequencies and providing several types of information applications,

4. W. CAREY & E. HAMILTON, GEOSTATIONARY PLATFORMS (Mar. 1978) (George C. Marshall Space Flight Center).

5. Edelson & Morgan, *Orbital Antenna Farms*, 15 ASTRONAUTICS AND AERONAUTICS, Sept. 1977, at 20-27.

6. Convault, *Langley to Press Structures Technology*, AVIATION WEEK & SPACE TECHNOLOGY, Sept. 4, 1978, at 103. *See also* design presented by F. Zylius and R. Donovan of Rockwell International as described in Fleisig & Bernstein, *Serving the Public Via Platforms in Space*, Paper No. AAS78-015, in 1978 GODDARD MEMORIAL SYMPOSIUM 6-8, (American Astronautical Society Mar. 1978).

7. Fleisig & Bernstein, *supra* note 6, at 7-8.

8. *Id.* at 9-10.

9. *Id.* at 9, 11.

10. Convault, *supra* note 6, at 97, 98, 103.

11. H. Wolbers & F. Shepphird, *Geosynchrous Information Services Platforms in the Year 2000*, Paper No. 78-1636, in A.I.A.A. CONFERENCE ON LARGE SPACE PLATFORMS: FUTURE NEEDS AND CAPABILITIES 9 (Sept. 1978).

12. These and other details are derived from W. Carey & E. Hamilton, *supra* note 4.

13. *Id.* at 17.

and electronic switching equipment required to interconnect antennas to each other and to other platform support equipment.

The 30-meter parabolic antenna is one of the key features of the platform.[14] It would operate at the "C-Band" which is the frequency band utilized by most commercial communication satellites today. The C-band is also referred to as the 6/4 Gigahertz band because the "up-link," or transmission from Earth to the satellite, is by microwaves at a frequency of 6 Gigahertz and the "down-link" or transmission from the satellite to Earth is at 4 Gigahertz. This antenna would provide 40 "spot beams" to Earth and would provide coverage to the major metropolitan areas of the United States from the platform's preferred location in geostationary orbit above the Western Hemisphere.[15]

The platform would be available to numerous users.

> The goal of the communications equipment on this Geostationary Communication Platform (GCP) is to supply all of the services expected from the current and planned U.S. domestic communications satellites (Westar, Satcom, and Comstar), mobile communications satellites including maritime and aeronautical satellites, broadcasting satellites (ATS-6 and CTS), space research, meteorlogical and Earth observation satellites (TDRS, SMS, and GOES), and provide for experimental communications.[16]

The Geostationary Platform design envisions a separate electronic module for each mission and would not, except for design and physical size, differ greatly from the electronic packages of equipment serving today's single-mission satellites.[17] A typical module for a communications mission would consist of transponders connected to the antenna systems servicing the mission. The transponders would operate at appropriate frequencies and bandwidths and would be composed of elements such as low noise receivers, frequency conversion equipment, intermediate and high-power output amplifiers, filters, and multiplexers. In addition, due to an ability to house heavier and larger equipment on board the platform, modules could also include complex processors to perform signal processing and interconnect or "cross-strap" communication links from different missions. Such processing is presently accomplished in the ground stations for existing communications systems.

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14. *Id.* at 19.
15. *Id.* at 3, 19.
16. Fordyce, Jaffe, & Hamilton, *Switchboard in the Sky*, SPACEFLIGHT, June 1978, at 206.
17. *Id.* at 207.

B. Orbital Antenna Farm

A second design for a space information station is representative of the plans which could be generated from the private sector. This design, called the Orbital Antenna Farm, was developed at COMSAT Laboratories[18] by determining antenna patterns (on the basis of desired coverage, capacity, power density, and cofrequency isolation) and working backward to the design of the structure.[19]

This design is one which would permit the station to expand as the need arises.[20] More "arms" could be added to carry additional modules, special modules, and improved antennas, and to increase existing services.[21] Manned or unmanned space vehicles may visit from time to time to service the DAF by replacing, repairing, or modifying units.[22]

II. TIMELINESS

Consideration of the institutional questions cannot wait. While the advantages of space platforms in providing permanent stations in outer space to engage in space applications (ranging from remote sensing to materials processing) may be generally known in the particular application area of satellite communications, implementation of space stations is necessary to provide specific advantages that will be needed in the near future. Among these are the advantages of alleviating geostationary orbital arc congestion, reducing costs through economies of scale, and providing advanced telecommunications and teleservices.

A. Orbital Arc Congestion

Orbital arc congestion can serve as one example of this urgency. Saturation of the orbital arc above the United States in the 4/6 Gigahertz frequency band is nearly complete, and the 11-12/14 Gigahertz band is filling with applicants. The result of this congestion for the United States can be examined by assessing projected U.S. telecommunications traffic growth in terms of satellite transponder requirements. Although estimates for 1990 vary from a need for 450 transponders to 650 transponders, it is certain that there is a rapidly accelerating traffic growth projection curve. The situation is further aggravated when international demands for orbital arc positions are con-

18. COMSAT Laboratories is the research and development center for the Communications Satellite Corporation (COMSAT) and affiliated entities. A. Galfund, *COMSAT Laboratories: Developing Tomorrow's Technology Today*, SATELLITE PATHWAYS, COMSAT (Nov.-Dec. 1978), at 5.
19. Edelson & Morgan, *supra* note 5, at 26.
20. *Id.*
21. *Id.*
22. *Id.*

sidered. Space information stations represent a technological means by which the capacity of the orbital arc can be expanded. This expansion is due to a station's capacity for increased radiated power, large antennas, and spot-beam techniques[23] which would allow a substantially higher transponder capacity. Orbital arc congestion alone is therefore a strong argument for the necessity of space information stations.

B. Teleservices

Of prime importance is the ability of space information stations to deliver teleservices. This is the objective of the space information station and should determine not only the eventual technological configuration but also participation in the system and benefits to be derived from the system.

A new vision has begun to emerge based on the NASA decade of user experimentation on the ATS and CTS broadcasting satellites from 1969 to 1979. Experimentation began on an *ad hoc* and somewhat serendipitous basis and continued through a period of gradual formalization. User experiments have explored and demonstrated the potential of space communications technology for social purposes. Significant advances have been achieved in these areas and much more has been accomplished than the testing of a wide variety of possible applications. These developments have in fact signaled the emergence of a new kind of activity which has been termed *teleservices*, and have demonstrated that space systems and the unique teleservices offered to mankind will make a difference in our lives.

During this experimental period, ideas were rampant, but those who took their ideas, created experiments, and saw them through to completion were few. The early experiments had an "amateur" quality about them in the positive British sense of the word. Hardware was adapted for a variety of purposes, while concepts and systems were developed by chance as often as by design. Conceptual studies were undertaken with little knowledge of the effect they would have on a later demonstration program. Legal and institutional issues were even considered, and these turned out to have a significant effect on both the institutional cycle of the space technology integration model and the form of the operational space system of the 1970s.

A comprehensive program for communication satellite development in speculative service areas was absent. Generally, the early experimental community comprised a series of individuals and

23. Morgan & Edelson, *The OAF Concept Extended* in A COLLECTION OF TECHNICAL PAPERS 123 (A.I.A.A. 7th Communications Satellite Systems Conference San Diego, Apr. 1978).

university-based groups who proposed and undertook experiments on an independent basis. There was, however, an undercurrent of optimism with regard to the potential of the communication satellite as a means of delivering worthwhile services.

It is to the lasting credit of NASA that throughout this early experimental period it continued—through the Office of Applications—to encourage and support a wide variety of experiments. The early experimental period is over, however, and the experimentation of the 1980s will take place within the framework of space information stations. The old optimism must be maintained during the 1980s.

There are lessons to be learned from the user experiments in terms of space applications and institutional accommodations. It is obvious that there will be new experimentation, but for some time to come improvements, refinements, and subtle variations of the basic experiments will be emphasized. The basic experimental work has been completed and the first chapter of the larger story of communicating via satellite has been written. The question remains as to whether we will be able to benefit from what we have learned by applying the basic principles to what we must do next. The experiments have provided guidelines as to how to structure institutions to provide a comprehensive program of teleservices that can effectively respond to the technological imperative of the 1980s.

There is an institutional cycle which for the past ten years has characterized NASA experimentation and revealed both an experimental and a technological imperative. As the process of space technology integration continues, decisions will need to be made as to the roles for the governmental and the private sectors. These decisions will determine the form and substance of future space information stations.

Thus we need to learn from the experimental period how to structure future experiments and how to make a reality of "participatory technology." Our historical insight needs to be reflected in the consideration of institutional options for space information stations. Moreover, by considering these institutional options at an early stage, it is possible to integrate the experimental format with the provision of operational services.

There will be new problems to consider during the 1980s with regard to teleservices delivery. Communications technology occupies a particularly significant relationship to the general principle of parity since the benefits, naturally more available to urban dwellers, can be provided to rural residents in order to produce parity. The technological apparatus can be utilized to bring other urban benefits to rural residents. Therefore, it is a general principle of parity that the benefit of communications technology and services which are available to urban residents be made available to rural residents on an equivalent basis in terms of quality and rates.

There may be parallels between rural telecommunications parity and the communications problems of developing nations that should be considered in experimentation with space information stations. Perhaps the unique communications problems of the Pacific basin should be given priority in future research and development efforts. In any event, the space system that is developed should be the beneficiary of the reasoned development of a balanced strategy that considers various opportunities.

III. COMPONENT OWNERSHIP

The United States is now experiencing a significant level of private sector involvement in numerous space applications. This involvement complicates the institutional planning process by making it necessary to formulate configurations which take into account both public and private interests. Because it is desirable to foster an expanded future role for the private sector in space industrialization, the variety of interests that can be assimilated into space station designs require earnest study. This has posed a major barrier to the technological planners currently attempting to create preliminary designs and feasibility studies.[24] Planning activities involve institutional assumptions as related to factors such as traffic patterns and operational transitions from satellites to space stations. Several studies of large space structures have been based on institutional assumptions which may or may not represent likely or even viable institutional configurations. Thus, leadership in the investigation and selection of domestic institutional alternatives for space stations could not only aid technological planners, but could hasten the development of space stations and the subsequent acquisition of benefits from the expanded utilization of outer space.

To help solve the dilemma of multiple participation with regard to space information stations while aggregating services, the *component ownership* concept was formulated. A space information station would be composed of component parts, modules, and systems. These components could be distinguishable for ownership purposes. The component ownership concept classifies the types of ownership into four categories or groups. A particular entity could be involved in one or more of the following categories at a given time.

24. *E.g.*, the technological planners of NASA.

A. Group A

Group A signifies ownership, operation, management, and maintenance of the station's frame together with those systems that are necessary to the entire space stations, such as the power system, the tracking and control system, and the interconnection systems. Group A may also involve ownership, operation, management, and maintenance of shared-component systems. For example, a large 30-meter antenna designed to be shared by several users could be owned by a Group A entity. The Group A entity would lease space on board the station at a uniform and equitable rate available to all Group B entities (see below). Although a question may arise as to variable rates for what may be considered prime locations on the space station, such rates could be fairly and practically offered. Rates for shared-use systems could similarly be uniform and equitable and based on measurable units of utilization. The Group A entity would serve as a technical coordinator between all users of the platform and could possibly assume a role as broker of the Group B ownership rights.

B. Group B

Group B signifies ownership, operation, and possibly maintenance of individual components or systems on the station. These individual components or systems are referred to as modules, although the various modules may be extremely different in size and sophistication. A module may be a single transponder, a set of transponders and computerized switching equipment, or a large antenna and related equipment.

Group B entities could include a subsidiary of the Group A entity, one or more independent public or private corporations, or any of the Group C or Group D entities. The reason that a separate subsidiary would be required of a Group A entity for module ownership is to help protect against preferential treatment and cross-subsidization for the modules owned by the Group A entity *vis-à-vis* those belonging to others.

The Group B owners would lease module capacity to users either on a unit of measure basis or a proportion of module use basis. There would be no requirement that module capacity rates be uniform for several reasons. First, there would presumably be competition between module owners that would serve as an incentive to minimize rates. Second, each module owner would be receiving space and services from the Group A entity at equal fixed and variable costs. Therefore, due to the use by Group B owners of a variety of modules of different sizes, sophistication, and efficiency, such differences would be reflected in rates charged by these owners. Finally, any Group C or D entity could become a Group B module owner if it so desired. Group B entities could possibly engage in functions in addition to ownership and operation of modules, including module brokerage and module manufacture.

C. Group C

Group C entities would consist of service providers and direct module users. This category would include most of the present and planned operational space segment owners, including international and regional organizations. Public agencies or private corporations that operate domestic satellite communication systems would also be Group C entities. Group C entities would have the option to become Group B owners if they desired to have direct ownership and control over their space-segment equipment. If these options were exercised, the Group C entities would be in a very similar situation to what they are today in that they would have complete ownership and control of their space-segment hardware. Several of these entities, however, may wish to lease their space-segment capacity from a Group B owner. In this way the Group C entity could economize in overhead costs while taking advantage of economic rates offered by the competing Group B owners. In addition, it may be possible for a Group B entity to own and operate a module that is significantly larger than would be used by a single Group C entity, *e.g.*, a large antenna and related switching equipment. In this case, several Group C entities could avail themselves of the economies of scale inherent in shared use without assuming total fixed costs for the module.

Group C entities that are service providers would provide their services on a rate basis. Similar to the Group B situation, there would be no requirement to equalize rates between the service providers. Rates would be different as a result of technical and operational efficiencies and capabilities of the service providers, just as it is with present-day satellite communications services. The component ownership concept provides an institutional structure that allows existing operational entities from all states, as well as international organizations, to continue to provide their services while availing themselves of the favorable attributes of a space information station. A Group C entity could operate systems whereby such entity or its customer owns the ground terminals, and/or an interconnection between its space segment and those of a competitor for particular services.

D. Group D

Group D represents end users which include public agencies, private corporations or organizations, and individuals. Although Group D entities may have Group B or C ownership for a particular system (as in the case of a public-service satellite organization that may choose to operate a small module, or a corporation that chooses to operate its own in-house teleconference system), such occurrences would be atypical. Normally, Group D entities would provide the revenue base that would support the systems and entities involved with the space information station.

IV. Implementation of Space Information Stations

With an understanding that the timely implementation of space information stations is urgent, and that all existing entities could have roles in the component ownership concept of operational stations, the question becomes how the U.S. Government could spur the development process. The essential technology to be developed relates to the station's frame and communications switch which would eventually be owned and operated by the Group A entity.

There are several alternatives for the type of entity which could serve as the Group A frame owner. It is possible for a U.S. agency to assume this responsibility. For example, as an extension of its space transportation involvement, NASA could be granted a mandate to maintain a space station frame. This would facilitate the experimental development and the operational transition of a space information station.

Alternatively, the Group A entity could be a private sector corporation or consortium of corporations. During the June 1978 hearings before the House Subcommittee on Space Science and Applications, the private sector alternative for frame ownership was described as part of an "Americas Platform" institutional configuration intended to be a regional geostationary multipurpose platform.[25] In that plan the platform corporation, referred to as Platco,[26] would be overseen by a U.S. regulatory agency to ensure that public needs are met and international cooperation accomplished.[27] The significant need today is not so much the identification of the types of institutional alternatives that could be selected, but rather the selection of *an* alternative so that implementation of at least the first space station could commence.

25. D. Smith, *supra* note 2, at 31.
26. This term is simply the author's acronym for *platform corporation*.
27. D. Smith, *supra* note 2, at 31-32.

Subsequent to the June 1978 Subcommittee hearings an innovative institutional entity, referred to as the Space Industrialization Corporation, was described in legislation introduced by Representative Fuqua.[28] The concept of a U.S. corporation established in conjunction with a trust fund to administer and allocate federal funds for the purpose of encouraging and assisting space manufacturing by the private sector is a practical approach. The conversion of the Federal corporation to a private corporation at such time as the enterprise is financially stable[29] represents a unique plan with many desirable attributes, not the least of which would be a demonstration that operational systems publicly developed can effectively complete the transition to the private sector.

While the institutional configuration of the Space Industrialization Corporation (SIC) concept appears viable from the perspective of an appropriate configuration to promote, transfer, and integrate technology within the private sector, it may be possible to expand its mandate to encompass space information stations. Although the corporation's mandate is subject to interpretation, it appears that the SIC is primarily intended to facilitate space manufacturing.[30] Thus, the urgency for creation of the SIC is directly proportionate to the urgency of implementing manufacturing processes in space; the implication is that to the extent space manufacturing is not seen as urgent, there will be a delay in the creation of this worthwhile entity.

If the mandate of the SIC, however, was expanded to include the encouragement and development of space information stations, there might be significantly greater interest in early implementation of the SIC concept. A space station is a technological concept in need of an institutional configuration, and the SIC is a unique and viable institutional alternative in need of an urgent mandate. The linkage of these two concepts would be functional and desirable.

Specifically, the SIC would facilitate a relationship between NASA[31] and private sector users such that the NASA-developed large space structure technology could be combined with the modules, both experimental and operational, of participating private entities. In addition, the Group A ownership could reside in the SIC or in a consortium which the SIC would help form. In the context of the development and sharing of large space structure technology, space manufacturing would be encouraged as well.

28. H.R. 14297, 95th Cong., 2d Sess., 124 CONG. REC. H12506 (1978).
29. *Id.* §§ 101(d), 201.
30. *Id.* § 2(c)(11), (12).
31. *Id.* § 102(k).

Both the urgency and desirability for implementing space information stations and the fact that the SIC concept has been discussed during previous hearings[32] would suggest an expansion of the SIC concept.[33] This expansion would clarify the institutional questions associated with space stations. The private sector entities already involved in space, and those that may become involved in the future, would benefit by the adoption of the component ownership concept and the development of a space station frame by the Space Industrialization Corporation.

V. INTERNATIONAL INVOLVEMENT

The implementation of space information stations represents a significant opportunity for all states to enjoy greater benefits from space applications. During the June 1978 Subcommittee hearings, the "Americas Platform" institutional model was presented. This model could be used as the basis for an operational ownership configuration.[34] Of primary significance is the fact that the model was regional in nature.[35] The regional organization was chosen to emphasize that the nature of space information stations was not global, but rather hemispheric.[36] Space programs do not have to be global in scope in order to be labeled "international." The model was also designed to ensure cooperation among the many states in the hemisphere, while at the same time vesting ownership of the platform in the state which constructed it. An intricate infrastructure of organizations was described for the model which remains as viable now as it was then.

There are, however, alternate approaches to the international utilization of space information stations. The component ownership concept itself could provide a means by which non-U.S. governments, entities, or organizations could become Group B, C, or D entities. Such organizations may even participate in Group A ownership, for example, through methods established by the Space Industrialization Corporation.

The question of control is important to foreign entities utilizing and depending upon a U.S.-owned facility in space. The perception of lack of control may be a cause for inhibitions in the cooperation among states and could result in disputes over the limited geostationary orbital arc resources needed for space stations. The concern over control has

32. *See* note 28 *supra*.
33. *Panel Discussions on International Space Activities*, *supra* note 2, at 31-32.
34. *Id.*
35. *See* D. SMITH, SPACE STATIONS: INTERNATIONAL LAW AND POLICY (1979).
36. *Id.*

its basis in a concern for both access to the space facility and the continuity of space services which utilize the station. If a system of international guarantees of access could be developed, however, the need for an extensive and rather complicated set of institutional configurations (such as those associated with the Americas Platform model),[37] may be unnecessary.

The concept of *beneficial use* of space stations involves a set of international norms[38] which could serve to assure access and continuity to foreign entities which utilize a U.S.-owned space information station. In the future other nations may develop the capability to construct their own space stations, and then these norms would become reciprocal. Universal adoption of such norms would allow states with the capability to construct space stations to do so and thereby become Group A owners. Other states could be assured of receiving the benefits from the stations upon terms and conditions uniformly applied to all entities that utilize the station in similar capacities.

Norms, as established through custom or agreement, would serve as a basis to assure equitable distribution of benefits of space stations to all states under the component ownership concept. Six salient general norms are considered below.

A primary norm would provide for and encourage any capable state or states to own and operate a space station as a Group A entity. Most states presumably could not construct their own stations. If such states are to receive benefits, space facilities must be made available by those states capable of providing them.

A second norm is that of resource priority for space stations, since these structures promise service capability for a vastly greater number of users than conventional satellites. Orbital priority, for example, should be granted to space information stations over single-purpose communications satellites. In addition, spectrum priorities for space information stations should be acknowledged by such bodies as the International Telecommunications Union.

Another essential norm is the right of participation by each state as a Group B, C, or D entity. Further, various nations could participate in one or more of these groups at the same time. State participation could be through one or more government agencies or through one or more private sector entities.

A fourth norm involves the assurance that rates, services, and related matters would be available to all Group B entities on an

37. D. SMITH, *supra* note 2, at 31.
38. D. SMITH, *supra* note 35, at 85.

equivalent basis. It would be necessary to create a detailed body of rules, standards, and regulations in order to establish this norm. These proscriptions include a requirement that rates be based on an equitable apportionment of fixed and variable costs by the Group A entity or entities. Another element of this norm would be the requirement that the rates have a relationship to the cost of providing services.

A fifth norm would require that service policies be established to ensure that competitive modules and/or services would be available to each state in a region. This may entail financial assistance programs designed to provide services to those states that have difficulty dedicating sufficient capital or assuring sufficient utilization.

Finally, a system designed to encourage the optimal use of modules placed on a platform should be developed. For example, it may only be economically justifiable for several states to be Group D entities, although for reasons of national security, prestige, concern over reliability, assurance of service continuity, and technological trade secret safeguards, such states may wish to be Group B or C entities. Although the third norm provides for entity choice and may be effectuated under the fifth norm, it can be anticipated that exercise of this right by a large number of states would cause a proliferation of modules, the result of which would be wasted module capacity, inefficiency, and higher rates and costs. The system, therefore, should be designed to review and encourage an optimal level of shared use. Nations could voluntarily follow recommendations generated by the system.

VI. CONCLUSION

While the technological barriers can be overcome relatively quickly, the institutional questions pose a substantial barrier to the implementation of space stations.[39] These questions will continue to pose a barrier unless leadership is shown in providing direction for the institutional development of space information stations.

The component ownership concept, together with the suggested international norms, would provide a basis for the entities which are already involved in space activities to continue to do so while taking advantage of the beneficial attributes of space information stations. In addition, enlarging the mandate of the Space Industrialization Corporation to provide a focal point for analyzing and promoting definite institutional plans will greatly aid in the timely United States develop-

39. *See generally* D. SMITH, *supra* note 35.

ment of space information stations and provide the opportunity for international cooperation in such stations.