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COMMERCIAL INFRASTRUCTURE PARTICIPATION IN THE SPACE STATION FREEDOM PROGRAM

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Abstract:

The evolution phases of Space Station Freedom offer the private sector the opportunity to provide commercial infrastructure to NASA and other users of the Space Station. This paper discusses the opportunities for infrastructure beyond the baseline Space Station and describes several approaches to initiating the provision of commercial infrastructure. These approaches include unsolicited proposals from the private sector, commercial development of infrastructure, and commercial operation of infrastructure.

Throughout the twentieth century, NASA and its predecessor, the National Advisory Committee for Aeronautics (NACA), have inspired innovation in the U.S. aeronautics and space industries. By forging ahead and developing new technologies, NASA will continue to enhance commercial development in these industries into the next century. Space is the next frontier and Space Station Freedom is our stepping stone to the resources and opportunities beyond Earth's boundaries. And, like past frontiers, governments must provide the leadership to learn about space and facilitate the growth of commercial space activities. The Bush Administration is a strong advocate of the government role in encouraging the commercial development of space. The National Space Council has developed guidelines for U.S. commercial space policy. NASA's role in cultivating the space industry has been further defined by the Advisory Committee on the Future of the U.S. Space Program (Augustine Committee). The Committee's recent report calls for NASA to use the relationship between NACA and industry as a model. In response to these policies and recommendation, NASA is investigating opportunities for the private sector in the Space Station Freedom Program.

The U.S. government has a rich history of supporting new research and technology development with potential commercial spinoffs. Exhibit 1 shows the involvement of the U.S. government in the

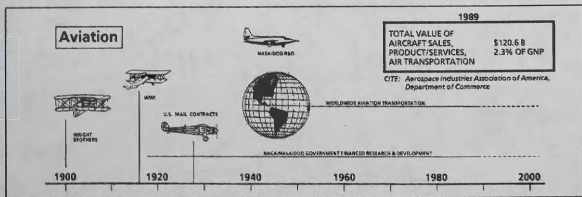


Exhibit 1

development of a commercial aviation sector. For example, the government developed and transferred new aeronautical technology to the private sector through NACA and the War Department. The U.S. Postal Service served as the initial anchor customer for air transportation. Through government leadership and business involvement the aviation industry has become one of our nation's leading contributors to economic growth. A key theme in past successes has been the government facilitating the development of commercial infrastructure and services which ultimately support a wide range of government and private sector markets. NACA served as a research organization developing new aeronautical designs that the private sector could not produce. The airline industry credits NACA with developing a streamlined shape for early airplanes, allowing the increased speed and reduced costs required in making air transportation a viable business. NACA fostered its relationship with industry by encouraging close communications, welcoming suggestions from industry and academia regarding subjects for new research. The results of NACA research were published and made available to the relevant industries, in this way transferring state of the art government-developed technology to the private sector.

The Space Station Freedom program is an ideal forum for NASA to strengthen its agency-wide effort to emulate the NACA model in stimulating commercial space infrastructure and services. NASA can transfer its advanced space technology for commercial use and may serve as a customer for commercial services on Space Station Freedom. The U.S. commercial space program is still in its infancy, as shown in Exhibit 2, with an extensive potential for growth. Within a time period comparable to the growth of aviation, space could certainly generate substantial new industries. And, as in the past, government and industry cooperation is necessary to capitalize on the riches of this new frontier.

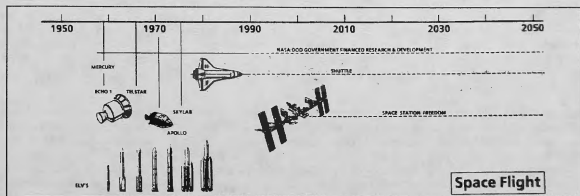


Exhibit 2

COMMERCIAL INFRASTRUCTURE OPPORTUNITIES IN THE SPACE STATION FREEDOM PROGRAM

Commercial infrastructure provision involves the development and operation of systems and services for users of the Space Station Freedom on a for-profit basis. Freedom will develop infrastructure to support a U.S. commercial space economy.

Just as ground-based businesses require infrastructure in the form of buildings, power, transportation and communication services in order to operate, Space Station Freedom crews and users will need similar types of infrastructure. The buildings in this case are the "modules";

transportation will be provided by the Space Shuttle and possibly expendable launch vehicles (ELVs); and communications will require voice and high speed data transmission services via satellite. The potential for commercially provided infrastructure is only beginning to be explored.

The evolution phases of Space Station Freedom offer commercial infrastructure providers the greatest opportunities to provide new or enhanced capabilities to the program. The evolution phases include decades of as yet undetermined growth and change to the initial design of Space Station Freedom. The private sector could provide infrastructure anticipated for Space Station evolution or develop systems and services not included in current plans. Three main areas present opportunities for commercial infrastructure. These are ground-based services, on-orbit services, and transportation services. Several examples of possible commercial infrastructure are described below.

One of the ground-based services that might be commercially provided is payload design and processing. The private sector is capable of performing such work, and in fact does so for many commercial payloads. Just as NACA left operational activities to the private sector, NASA could eventually transfer payload processing responsibilities to commercial operators. Space Station Freedom payloads would be delivered to the processing facility with instructions regarding integration requirements. The company would then test independent systems, perform spin tests, and integrate the payload into the Space Shuttle or other launch vehicle. NASA or any other owners of payloads planned for Space Station Freedom would reimburse the commercial payload processor based on a pre-determined pricing policy agreeable to both the provider and customer.

Power provides an example of an on-orbit infrastructure service. Just as government organizations pay utility companies for utilities, NASA and other users of Space Station Freedom could pay a commercial company to provide electrical power. Based on the NACA model NASA could continue its research and development of advanced space power systems and transfer new technologies to the private sector. Much of the technology planned for the near term power system is based on currently available solar power technology. A commercial provider could develop a system designed for integration with Space Station Freedom and would agree to supply a specified quantity of power. NASA could purchase the entire power supply, or all users could pay the commercial provider for the amount they require.

One of the transportation services required for the Space Station Freedom Program is logistics resupply. Although the Shuttle and possibly advanced launchers will be used for this purpose, in the near term the private sector could provide the same services using expendable launch vehicles (ELVs). NASA could pay for launch services in the same way commercial satellite owners and operators pay companies to launch their satellites. Allowing the private sector to perform operations would free NASA operators and the Shuttle for purposes beyond the scope of commercial service providers, in the same way NACA performed research beyond the capabilities of the airline industry at the time.

The market for infrastructure systems or services will be NASA, other U.S. government users, commercial users, and the Space Station Freedom International Partners (Canada, European Space Agency, and Japan). In general, greater opportunities exist for those services for which the market extends beyond the U.S. government. A company developing a commercial service will maintain ownership and control of its infrastructure elements and pricing methods.

NASA POLICY

The National Space Council has developed guidelines for U.S. commercial space policy. These guidelines provide specific mechanisms NASA and other government organizations can use to encourage the growth of private sector developments in space. The steps available to NASA include

serving as a customer for commercial infrastructure and other services, transferring government-developed technology to U.S. companies, and allowing the private sector access to government facilities and assets. These guidelines and the recommendations of the Advisory Committee on the Future of the U.S. Space Program provide NASA policy support encouraging commercial infrastructure and services for the Space Station Freedom program.

NASA can assist the private sector by reducing the risks associated with commercial participation in the Space Station Freedom program. NASA's Office of Commercial Programs provides assistance in the form of Space Shuttle flight opportunities, access to NASA ground facilities, and technical assistance to companies considering the development of commercial space infrastructure. NASA will also take additional steps to encourage the development of viable commercial infrastructure for Space Station Freedom. For example, NASA may serve as a long term customer for commercial infrastructure, award long term franchises for services, and provide technical assistance. Commercial infrastructure providers may also need to purchase services from other commercial providers. The buying and selling of systems and services between users and infrastructure providers will extend our market economy into space. However, the success of this new market will depend on traditional market forces.

BENEFITS OF SPACE STATION COMMERCIAL ACTIVITIES

Benefits to NASA:

Reduced Up-Front Expenditures

Commercial infrastructure allows NASA to defer expenditures on infrastructure from up-front development costs to operations costs as reimbursements to commercial providers for services used by NASA. Overall life-cycle costs may be reduced for NASA by using commercial infrastructure.

Investment of NASA Funding into New Research

Instead of using funds to provide systems based on those already developed, NASA can perform research in new areas to continue its role as leader in developing state-of-the-art space technologies.

Expanded Support Base for Space Station Freedom

New groups, the commercial infrastructure providers, will join NASA as integral members of the Space Station Freedom Program. This expanded support base may lead to further growth of space-based research and increased interest in providing infrastructure for activities in space.

Support for National Space Policy

NASA can demonstrate its support for the Administration's policy calling for increased commercial involvement in space by encouraging commercially provided infrastructure for Space Station Freedom.

Benefits to Industry:

Entry Into An Emerging Market

Space is a new economic market and related commercial activities are at an early stage of development. Space Station Freedom provides one of the first opportunities for the development of

many new space markets. As such, industry involved with Space Station Freedom will have an opportunity to be an initial entrant into the emerging space market.

Long Term Profits And Return On Investment

Space Station Freedom's extended operational lifetime presents business with an opportunity to reap the benefits of space. Also, the economy in space could lead to larger markets for space infrastructure and services in the future.

Access To New Technology

Any activity associated with Space Station Freedom will involve extensive use of, or at a minimum, exposure to advanced space technology. This exposure will place companies in a position to develop new capabilities using the new technologies, either for ground-based or on-orbit services and products.

Market Expansion

Space Station Freedom users will include NASA, other government users, commercial users, and International Partners performing research, development and manufacturing in space. This wide variety of customers offers a diverse market for services, in addition to the ground-based market for products designed or produced on the station.

APPROACHES FOR NASA TO ENCOURAGE COMMERCIAL SPACE STATION INFRASTRUCTURE

Three approaches to identifying specific opportunities for Space Station Freedom commercial infrastructure have been identified by NASA:

- Receiving unsolicited proposals
- Soliciting proposals for commercial development
- Soliciting proposals for commercial operation.

Receiving Unsolicited Proposals

NASA encourages industry to submit proposals for elements or services, even if the proposals are not in response to a solicitation. Just as NACA encouraged the private sector to communicate their research and technology requirements, NASA's procedures, guidelines, and criteria allow full evaluation of unsolicited commercial infrastructure proposals for the agency as a whole and specifically for the Space Station Freedom Program. This applies to services which do not require the government to guarantee that it will serve as an initial customer. This will occur only infrequently since NASA will use the largest portion of the station and it would be difficult to build an adequate user base without the government as a customer. If NASA is to be a customer, the proposal evaluation will proceed according to the Federal Acquisition Regulations (FAR).

Soliciting Commercial Proposals

An alternative approach for encouraging the development of commercial infrastructure is for NASA to solicit private sector involvement. NASA in this way would demonstrate its commitment to

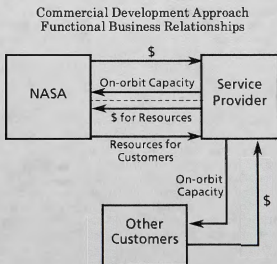
fulfilling the commercial policy guidelines of the National Space Council and emulate NACA's critical role in the early stages of the aeronautics industry. Soliciting commercial proposals would entail full and open competition under the FAR. In soliciting proposals, two possible approaches are:

- Commercially developing infrastructure or services to meet specified program requirements, or
- Commercially operating a portion of space station infrastructure.

These approaches will both help the private sector to participate in the Space Station Freedom Program by helping to lower business risks to a point where the a service becomes commercially viable. The Commercial Development approach would likely entail the private sector to accept somewhat higher risks than would the Commercial Operation approach. The following Exhibit depicts the relative levels of risk for each approach and compares them with the risks typically accepted by other commercial activities in space.

Commercial Development of Infrastructure

In what is viewed as the basic approach in providing commercial infrastructure, a company will secure private funding, develop a service to meet stated Space Station Freedom requirements and support users. Since the service would be designed to meet NASA requirements, NASA would commit to serving as an anchor customer, as recommended by the National Space Council. This would reduce business risks to a point where a company could obtain financing for the development of the service. Exhibit 3 illustrates the flow of infrastructure services and payments under this approach.



Using additional on-orbit capacity in either a laboratory module or pocket laboratory as an example, a company would fund the development of the new and lease the majority of on-orbit volume to NASA. The company could group the volume not used by NASA with support resources, such as power and data management capabilities, purchased from NASA, to offer complete on-orbit capacity to other users. These users could include: U.S. Government agencies if demand exceeds the volume

provided by NASA; and commercial, academic, and international organizations. Users would pay for using the module based on a predetermined rate structure (e.g. rack/month charge).

Since developing the module would require a considerable advance investment, contractual terms would most likely require a long-term lease for the majority of the module from NASA. This multi-year commitment of funds would require Congressional approval. Over time, as international markets materialize and as space is proven cost effective for commercial research, the number of users of space infrastructure such as the additional module will likely increase. When this occurs, the requirement for NASA to serve as an anchor customer will become less critical. NASA will have the opportunity to decrease its use of the module over time if the agency determines that it no longer requires continued use of a large portion of the supplemental on-orbit volume.

There are recent precedents for the Commercial Development approach. NASA plans to serve as an anchor customer for a Commercial Middeck Augmentation Module and will agree to a specified number of flights. This module will provide enhanced Shuttle experimentation capacity. Similarly, the Defense Advanced Research Projects Agency (DARPA) agreed to procure launch services for up to six flights from Orbital Sciences Corporation. In both cases, this assured government market enabled the infrastructure providers to develop the capacity to deliver commercial services. The role of government is expected to decrease as the number of commercial and other customers increases.

Commercial Operation of Infrastructure

Another approach NASA could take to encourage commercial participation is to develop infrastructure both meeting its own needs and providing additional capacity for other users. The decision to provide excess capacity would be made specifically to encourage commercial involvement in Space Station Freedom infrastructure. NASA would lease the excess capacity to the private sector through a full and open competition under FAR. The private sector would then operate commercial services and market the available capacity to users outside the U.S. Government and to U.S. Government agencies whose demand exceeds NASA's available capacity. This type of procurement benefits industry by reducing the initial costs of providing infrastructure. NASA would fund the development of the system and commercial providers would cover the costs of lease, insurance, and any other operating expenses. At the same time, NASA would be assured of receiving the systems or services it requires.

Returning to the prior example, NASA would have selected an additional laboratory module as a viable candidate for commercial infrastructure. NASA would fund the production of the module although it might require only one-half of the available volume. The agency would then open the remaining capacity to leases by private sector bidders. The module's volume could be divided into parcels, containing the necessary support resources to allow for multiple service providers. Qualified bidders offering the highest price to NASA would be awarded the lease. Of the total volume offered to the private sector, a small portion might be leased to a small or disadvantaged business, and several larger portions might be leased to other companies. Commercial operators who won leasing rights would market the available on-orbit capacity and establish prices for commercial pressurized volume.

The duration of commercial operating leases would probably be relatively short, re-competing leasing rights possibly every four years. With each re-competition, the market price for the right to lease on-orbit capacity will be determined. Over time, commercial operators will determine the market size for on-orbit volume and thus establish an acceptable price range for leasing rights. As the value of performing research in space rises, commercial operators would raise the bids for leasing rights.

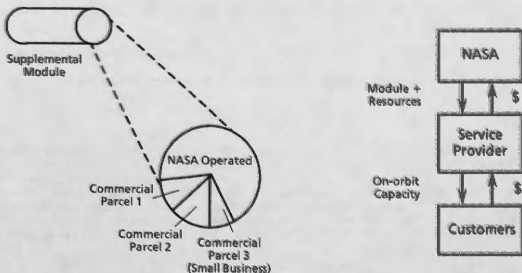


Exhibit 4

There is also broad precedent within the U.S. Government for the Commercial Operation approach. NASA uses the commercial operator approach in leasing rights to the private sector to market excess transponder capacity on TDRS. NASA funded the system, but will allow commercial operation of portions which it does not require. Other government agencies have lengthy experience in leasing commercial operating rights for government property.

The Commercial Operation approach allows the private sector to be introduced gradually to developing and operating large space systems. The initial investment under the Commercial Development approach prohibits many capable entrepreneurs from operating commercial infrastructure. This introduction through the Commercial Operation of Space Station Freedom infrastructure would provide experience for operators, insurers, and commercial users of infrastructure with a lower initial investment.

CURRENT NASA ACTIVITIES IN SUPPORT OF COMMERCIAL SPACE DEVELOPMENT

The NASA Administrator recently appointed a Director of Space Commerce Opportunities to manage commercial policies and activities for the entire agency. This will ensure that Space Station Freedom commercial infrastructure and services are in accordance with the goals and strategies of NASA as a whole. The Director has begun developing commercial space policy goals and objectives and will serve as a liaison between the agency and private sector companies interested in providing commercial systems and services to NASA.

Within the Space Station Freedom Program, NASA is evaluating planned station capabilities to determine which could be candidates for commercial provision. The initial evaluations are designed to identify any obvious obstacles preventing commercial provision of services to meet NASA requirements. As part of the study of potential commercial Space Station Freedom services, NASA will work with industry to ensure that the terms and conditions for the procurement of a commercial service:

- Ensure NASA that its requirements are met within safety and mission performance constraints
- Allow industry the maximum flexibility in the development of cost effective systems
- Provide for commercially feasible services which are cost effective for NASA.

* * * * *

NASA will continue the U.S. Government's history of stimulating new commercial industries through Space Station Freedom commercial infrastructure. Just as NACA spurred the commercial development of the aviation industry, commercial development and operation of Space Station Freedom infrastructure will foster the growth of a new industry with vast potential. New Space Station Freedom capabilities may be provided by and used by companies. Like past frontiers, our desire and instinct to explore and reach out has led us to space. Many of the riches of space are still undiscovered. Space Station Freedom will provide industry with the opportunity to discover these riches.