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COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

Hearing on
Space Commercialization
Room 2318; 9:30 a.m. - 12:00 noon
May 4, 1983

WITNESS LIST

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TESTIMONY

OF

DAVID HANNAH JR.

CHAIRMAN OF THE BOARD

SPACE SERVICES INCORPORATED OF AMERICA

BEFORE THE

SPACE SCIENCE AND APPLICATIONS SUBCOMMITTEE

COMMITTEE ON SCIENCE AND TECHNOLOGY

U. S. HOUSE OF REPRESENTATIVES

MAY 4, 1983

Mr. Chairman and distinguished members of the Subcommittee, I am David Hannah Jr., Chairman of the Board of Directors of Space Services Incorporated of America (SSI) of Houston, Texas.

I am pleased to have this opportunity to testify before you today on a most important topic: how government and industry can cooperate to fully tap the great national economic and social potential of the commercial development and application of space technologies. SSI believes that space represents a virtually unlimited frontier for economic growth--a frontier that the American free enterprise system is uniquely qualified to develop.

Space Services is a small company, founded in 1980. SSI's corporate objective is to use proven entrepreneurial techniques as a means for the private sector to help transfer governmentally developed space technologies to industrial and commercial applications. Our initial project is the development of a low-cost commercial launch vehicle--the Conestoga. On September 9, 1982, SSI became the first American company to successfully launch a rocket into outer space. The Conestoga I suborbital flight accomplished all mission objectives, including a demonstration of the ability of the company and the vehicle to inject a satellite into orbit. We now are proceeding with our plans to build an orbital launch vehicle and to place a commercial satellite into low Earth orbit in late 1984 or early 1985. Conestoga II is designed to launch a variety of relatively lightweight, low-orbiting satellites to provide remote sensing, data collection, and positioning services. We believe for several reasons that the Conestoga will complement, not compete with, the Space Shuttle and other expendable launch vehicles.

I mentioned that the Conestoga I mission met all of its objectives. In my opinion, one of the most significant accomplishments of Conestoga I was the demonstration of a private company's ability to obtain all governmental licenses and permissions necessary for a private sector launch. SSI received formal approvals from five federal agencies: NASA, the Federal Aviation Administration, the Federal Communications Commission, the Department of State, and the Bureau of Alcohol, Tobacco, and Firearms of the Department of Treasury. SSI cooperated informally with the United States Navy, the Coast Guard, and NORAD. In breaking this new regulatory ground, each of these agencies demonstrated both a remarkable degree of flexibility and a strong support for the concept of private space operations.

NASA and the FAA, in particular, were willing to work very closely with us in support of the Conestoga mission. Moreover, NASA's decision--with the consent of this subcommittee and others in the Congress--to sell us a solid rocket motor from their sounding rocket program inventory ultimately enabled SSI to undertake the Conestoga I mission. In many ways, then, I believe that Space Services' success is one rightly shared by the U. S. government and all our fellow citizens.

As we look to the future of commercial space operations, I believe governmental policy will continue to play a pivotal role. It is both symbolically and substantively imperative that the government send a clear signal encouraging the growth of this emerging high technology industry. Space applications are particularly capital-intensive, and investors carefully scrutinize all risks before providing seed capital for commercial space programs. The two greatest risks confronting almost

any commercial space venture--market size and acquisition of governmental approvals--are fundamentally influenced by governmental policy. Moreover, the viability of this industry in the coming years will be subject to the impacts of government programs or policies that encourage or discourage research and development of advanced space technologies and/or the subsequent transfer of such technologies to commercial entities. I would like to comment briefly on each of these three areas--regulation, market, and research and development and its transfer into commerce--as they relate to government policy.

Regulation. One of the clearest positive signals the government can send to the private sector is a serious effort to clarify and streamline the myriad applicable regulations and to coordinate the numerous agencies with authority over private space ventures. As I noted earlier, all of the government agencies working with SSI were very supportive and flexible in navigating these heretofore uncharted regulatory realms. Such cooperation was essential, because in current practice a negative opinion from any government agency would effectively prevent a private launch. Consequently, the fact that we received permissions from all interested agencies is itself a strong indicator of governmental support.

However, SSI did expend a great deal of time, effort, and money to obtain those permissions. We received the final license only one day before our scheduled launch date, six months after we began the multiple-applications process.

We already are beginning to identify and investigate the licenses and permissions required for our next mission. In 1981 our first attempted rocket launch (of the Percheron) required licenses from the FAA and the FCC. As I

noted, in 1982 the Conestoga I required five formal permissions and several additional cooperative arrangements. Our next mission will place a commercial satellite in orbit, which may further complicate this process--although at this point I cannot say with certainty which, if any, additional licenses or permissions will be required.

Early delineation of a reasonable regulatory regime for commercial space ventures constitutes one essential component of a governmental policy designed to encourage greater private sector involvement in space applications and operations. While a comprehensive analysis of specific improvements in the regulatory process is probably beyond the scope of these hearings, I would like to note that this committee has before it at least one legislative proposal (H.R. 1011) designed to streamline the launch approvals process. I would encourage this committee, as I did in my previous testimony in September 1981, to promptly address the need for a single federal agency with overall responsibility and authority for licensing private sector space launches, launch sites, and satellite applications. I continue to believe that the Federal Aviation Administration--which functioned so effectively both technically and administratively for the Conestoga I launch--is best qualified to play the lead agency role, supported by proper inputs from other government agencies, including NASA.

Market. Any entrepreneurial space venture also faces a second risk factor, the market for commercial space applications and the presence of competitors for a given market. Because space technology traditionally has been developed and operated by the government, it is understandable that the principal competitor for any entrepreneur in commercial space applications (with the exception of communications satellites) is the U. S. government--for example,

in transportation, NASA; in remote sensing, the National Oceanic and Atmospheric Administration; and in navigation/positioning services, the Global Positioning System of the Department of Defense.

It is extremely difficult to propose a formula for commercial development that would balance the expectation of many that the government should endeavor to recover as much of the taxpayers' investment in space applications as possible with the equal if not more important need to encourage increased private sector investment in space operations.

I believe that the nation is at an important transition point in the commercial application of space technologies. Crucially, industry and government must find mechanisms which promote government/industry cooperation rather than competition in the internationally competitive marketplace for commercial space applications.

Mr. Chairman, industry should not expect large direct subsidies to encourage commercial space technologies, but, concomitantly, industry should not be forced to compete against government-operated space systems that are effectively subsidized by taxpayer dollars. In this time of very real national budgetary constraints, the government must formulate criteria enabling NASA and other federal agencies to continue to operate space systems critical to the nation's needs, while simultaneously preserving industry opportunities to enter the marketplace and satisfy predominantly commercial needs. I am not suggesting that the government has no right to offer its services to commercial users, but rather that we must find procedures to ensure that the government does not subsidize inefficient space operations and applications, thereby functionally precluding industry from offering more cost-effective alternatives.

I believe that government and industry can develop a consensus on an overall hierarchy of government and private demand for space operations and criteria for meeting those needs. For example, industry should address purely commercial needs by providing services according to market dictates. We should look first to industry to satisfy needs which include both commercial and scientific/research components. If no purely commercial service is forthcoming, the government then should consider a range of responses to ensure that the necessary service is provided. Perhaps the first response should be an effort to jointly develop and/or apply the technology, e.g., NASA's joint endeavor agreements. A second response might be a series of inducements (for example, tax incentives) for industry to provide the needed technology or service. Direct government funding for the technology or service in question should be the last response, and the government should fund such operations only as long as industry is unwilling or unable to supply the service or technology. Furthermore, when the government offers commercial space services, every attempt should be made to recover all associated operating costs. This policy will promote efficiency in government procurement and operation of space systems. Finally, the government may want to continue direct funding of scientific or research and development needs, or policymakers may want to examine the feasibility of offering sufficient inducements to industry to encourage basic research and efficient and innovative R&D.

Mr. Chairman, I offer these suggestions only as a starting point for what I believe is a most important discussion on building industry/government cooperation rather than competition. These suggestions may be facile or unworkable, and I'm certain that others in industry and government will have

useful insights. However, in my judgment it is essential that we incorporate the potential contributions of a new generation of space industries--those willing to take risks to provide commercial space technologies and services--into our evaluations of current and planned space technologies and services. Only by encouraging such space entrepreneurs can our nation truly take full advantage of its investment in space--an investment that has demonstrated new markets and paved the way for a new sector of economic growth to improve the lives of future generations.

Research and Development and Transfer Policy. I often have said that Space Services would not be here today if it were not for the government's substantial long-term investment in space technology research and development. I believe that commercial space applications will fulfill their great economic and social potential only if the U. S. government continues to invest in advanced research and development of new space technologies--particularly long-term, high-risk, high-cost, ground-breaking R&D. I can think of no better recipient of precious taxpayer dollars for this purpose than NASA.

Of course, it is equally important that the products of R&D are effectively transferred, when appropriate, to the private sector for further application and commercial development. The appropriate timing of such transfers is often difficult to determine, but I believe that such transition difficulties are outweighed by the advantages of government R&D, competitive private commercial space activities, and cooperation between the government and the private sector to achieve smoother transitions. NASA already has taken important steps to facilitate the transfer of R&D products to the private sector, and I would encourage even more efforts in this area. Specifically, I believe that NASA should promptly act to transfer expendable launch vehicle operations to the

private sector. Although ELVs can hardly be classified as a "new" space technology, their transfer at this time (under the proper conditions) could generate an important private capability to back up the Shuttle. In the case of new technologies such as advanced solid state sensors for remote sensing applications, NASA should actively solicit industry input at an early stage in the planning process to help identify workable technologies and useful programs. Subsequently, NASA should make every effort to supply research results in a timely fashion to any interested company. Whenever possible, governmentally developed space technologies should be available to any interested party at cost. In those instances where only limited access is possible (for example, use of government launch facilities), it is imperative to avoid monopolies and give equal opportunities to financially and technically responsible small companies, as well as to well-established large corporations. By promoting the entry of new entrepreneurial companies into the space industry, government policy can do much to bring growth, flexibility, and productive innovation to commercial space operations.

Finally, Mr. Chairman, your letter of invitation specifically requested my comments on the NASA/industry partnership to develop commercial space technologies and services. As you no doubt can discern from my testimony, I believe NASA has played and will continue to play an important role in encouraging commercial space ventures. In the future, NASA can provide important technical insights to the lead regulatory agency for licensing private space operations. To promote the development of private markets, NASA must carefully scrutinize each existing and new technology and/or government commercial space service, seeking to minimize competition between domestic industry and the government. To strengthen the underpinnings of private and government space activities, NASA must continue its efforts to

lead the world in advanced space technology research and development--and, subsequently, NASA must disseminate that technology in the widest practicable manner, paying particular attention to the needs of small, entrepreneurial space development corporations.

Thank you, Mr. Chairman, for soliciting my views on this most important topic.

Statement of

Bruce W. Ferguson
Vice President and General Counsel
Orbital Systems Corporation

before the

Subcommittee on Space Science and Applications
Committee on Science and Technology
House of Representatives

May 4, 1983

Mr. Chairman and Members of the Subcommittee:

I am happy to appear before this Committee this morning to present OSC's views on cooperative arrangements for the commercialization of space. OSC currently has agreements with both NASA and Martin Marietta Corporation to develop a high-capacity upper stage for use on NASA's Space Shuttle.

The upper stage, called the Transfer Orbit Stage (TOS), is a large, single stage solid-propellant rocket that is carried up with its payload in the Space Shuttle to low earth orbit. The TOS and its payload are then launched by the Space Shuttle to transport communications satellites and other payloads from the low Earth orbit of the Space Shuttle (approximately 160 miles above the Earth) to higher orbits that the heavy Space Shuttle cannot reach, such as the geosynchronous orbit utilized by most communications satellites (approximately 22,300 miles above the Earth).

The evolution of the commercial satellite market to larger, heavier satellites indicates that an economical high-capacity upper stage such as TOS is well positioned to capitalize on a significant business opportunity. Current launch systems, such as the PAM-D upper stage used on the Space Shuttle, are economical only for smaller satellites. At present, there exists no economical way to launch large satellites of the TOS class (approximately 2,800 to 6,800 pounds) into geosynchronous orbit, other high orbits, or on planetary missions. A sophisticated two-stage rocket, the Inertial Upper Stage, developed by the Air Force primarily for military use on the Space Shuttle, is very expensive, has reliability problems and has a lower payload capability than the TOS. The only publicly announced program to develop an economical launch capability for TOS-class payloads, in fact, is the European Ariane rocket program that competes directly with the Space Shuttle. NASA must provide a similar capability in order to remain competitive with Ariane for commercial payloads.

Recognizing the need for an economical, high-capacity upper stage for use on the Space Shuttle, NASA signed a preliminary agreement with OSC on December 17, 1982 providing for further discussions of OSC's proposal to finance, develop, market and operate the TOS. Based on these discussions, on January 24, 1983 NASA ceased its own efforts to develop a TOS-class

upper stage and on April 18, 1983 NASA signed a final agreement with OSC to develop the TOS. Under the terms of the Agreement, OSC will develop the TOS using private funds at no charge to NASA and NASA will provide technical monitoring out of its Marshall Space Flight Center in Huntsville, Alabama to ensure that the safety requirements of the Space Shuttle are met. NASA also agrees to provide certain interface data on the Space Shuttle and related facilities. No subsidies or purchase guarantees are involved.

To provide technical and manufacturing capabilities necessary for success of the TOS program, OSC held discussions with a number of large aerospace companies in late 1982 and early 1983. From these companies, OSC chose Martin Marietta Corporation to act as OSC's prime contractor in developing and manufacturing the TOS. Martin Marietta signed a preliminary agreement with OSC on January 21, 1983 and is now working with OSC under a contract dated as of April 1, 1983. Under the terms of the contract, Martin Marietta's Denver Aerospace Division serves as prime contractor to OSC for the TOS program, performing most of the design, development, testing and producion of the TOS hardware and managing TOS subcontractors. For its part, OSC will have primary responsibility for financing and marketing the TOS. The first TOS is expected to be available for launch by the fall of 1986.

OSC believes that its rapid progress to date in the space commercialization area is without recent parallel. This progress can be attributed to several factors. The most important of these is the business feasibility of the project — the emergence of a well-defined commercial market for the TOS in the next three to five years, combined with relatively low required investment. The business feasibility of the project has enabled OSC to obtain private financing rather than grants or subsidies that take longer to arrange. Another key factor is the acceptability of the project to NASA. The TOS is a new system that will promote the commercial use of the Space Shuttle, allowing NASA to leverage its budget with private funding in the pursuit of its goals. Rather than take existing operations away from NASA or compete with NASA, OSC with the TOS program aligns its interests with those of NASA. OSC's status as a small-business concern underscores the total commitment of OSC and its employees to the success of the TOS program. We have further suspected that, knowing what a demanding project the TOS program is likely to be, NASA also regarded the relative youth and excellent health of the company's founders as an asset.

OSC has received the full support of NASA's top officers in its efforts to establish the TOS program. It is our impression that these individuals, who include James Beggs, General Abrahamson, Messrs. Culbertson, Allnutt and Hosenball, as well as Joe Mahon, Jack Wild and B.C. Lam in the Special Programs Division and Gene Austin in the Marshall Space Flight Center, firmly believe in the desirability of private investment in space and are actively involved in identifying and supporting feasible private initiatives in the space commercialization area. Because of the dominant role that NASA plays in space activity, such support is a vital prerequisite to future progress in space commercialization. OSC has also received cooperation from Martin Marietta Corporation that extends significantly beyond contract requirements and indicates the personal

commitment of Martin Marietta's management, including Norm Augustine, Peter Teets and Richard Farrell, to making a success of our innovative teaming arrangement. The marriage of the entreprenurial energy of a small firm with the technical and production resources of a large aerospace company has been important to the progress of the TOS program and might serve as a precedent in future private endeavors in space.

Space commercialization needs some early success stories. The public -- including the financial community -- is somewhat in awe of the technical and operational complexity of the space program, and correspondingly skeptical of efforts to commercialize space activities. To the extent that NASA and this Committee support projects with a high likelihood of success within a few years, public perception of space commercialization as a new sunrise industry will inevitably increase the number of high-quality projects and available private investment. Cooperative arrangements between NASA and private firms, we have found, are an effective means of demonstrating NASA's support for such projects and should continue to be implemented where practicable.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions.

Charles A. Ordahl
Director of Space Programs
McDonnell Douglas Astronautics
May 4, 1983

Mr. Chairman, Members of the Subcommittee,

I would like to thank you for this opportunity to represent McDonnell Douglas in providing you with information on our past and current space launch vehicle commercialization activities and to share with you some of our views related to the government roles and interfaces in these and future similar space commercial ventures.

McDonnell Douglas has been involved for more than 20 years in providing space launch vehicles and services for NASA and the communications satellite industry first as prime contractor for the Delta launch vehicle and second through our Payload Assist Modules which are upper stages designed to fly on either the Space Shuttle or the Delta.

Over the last ten years we have undertaken several commercial launch vehicle ventures involving the commitment of well over $100 million dollars in development expenditures. In addition, for the last six years, we have been working on a commercial project called "Electrophoresis Operations in Space" involving separation and purification of materials in Space. Mr. Yardley and Mr. Rose discussed details of that project with the Subcommittee in February. These projects have all involved highly interactive activities between industry and government within the structure of agreements between the parties involved.

Our first such commercial project, undertaken in 1973, was a performance upgrade of the Delta called the 3914, which increased the Delta payload capability to 2000 lbs into the geosynchronous transfer orbit. At that time, NASA policy was that no further government funds would be used to improve the performance of expendable launch vehicles in view of the Nation's commitment to develop the Space Shuttle. However, the emerging domestic communications satellite industry was very interested in the cost effectiveness of the additional Delta launch capability and this thereby set the stage for our first commercial space venture. RCA became the first customer and agreements were structured between RCA, McDonnell Douglas and NASA to operate the projects as follows:

- McDonnell Douglas agreed to design and develop the uprated vehicle at their own risk on commercial funds but with profit limitations.
- McDonnell Douglas agreed to recover its investment through a specified "not to exceed" customer charge for each commercial launch; however, there would be no "investment charge" for U.S. Government use of the vehicle.
- NASA agreed to contract for production and launch services of the improved vehicle as an integral part of the on-going Delta Program and would provide technical monitoring.
- RCA agreed to contract with NASA for three vehicles and launch services and with McDonnell Douglas for three User development amortization payments.

The first launch was successful in 1975 and as of May 4, 1983 there have been 23 launches of which seven have been U.S. government missions with the remainder being commercial and foreign customers.

Our second commercial venture in this field was the Payload Assist Module (PAM-D) undertaken in 1976. PAM-D is an upper stage vehicle for Delta class satellites designed to assist launch vehicle customers in planning launches in the era of transition between expendable launch vehicles and the Space Shuttle. The PAM is basically a part of the payload cargo element and as such it may be used either as a third stage on the Delta or as an upper stage on Shuttle to carry the satellite into the geosynchronous transfer orbit. This provides the customer with the flexibility to plan a launch on Delta or Shuttle and a relatively easy means to shift between the two if conditions should so warrant. Again, McDonnell Douglas began this development after reaching an agreement with NASA on how the program would be performed. The primary features of this agreement were as follows:

- McDonnell Douglas agreed to develop the system completely on commercial funds on a schedule compatible with the Shuttle operational requirements.
- McDonnell Douglas agreed to sell PAM commercially at a specified "not-to-exceed" ceiling price along with a fixed escalation for inflationary factors in addition to profit limitations.
- NASA agreed not to fund or formally solicit the development of competitive or alternate systems.
- NASA agreed to provide suitable building facilities at KSC for PAM processing activities with reimbursement as a part of the Shuttle launch service contract with each customer using PAM.
- NASA agreed to provide interface data and technically monitor the project.

The first commercial PAM contract was signed between Hughes and McDonnell Douglas in 1978. The first flight was successful for Satellite Business Systems on Delta in November 1980. The first two flights on Shuttle were successfully completed in November 1982. To date, McDonnell Douglas has contracted 29 PAM-D missions of which all 10 have been successfully flown. Sales of PAM are of course highly interlocked with the availability and pricing of Shuttle and Delta for commercial launches. To date, this has been generally favorable although several potential missions were lost to Ariane in the 1984-1985 timer period because NASA was not able to offer STS launches at the time these contracts were decided and Delta prices were not competitive. Subsequently, STS launch space is available in those years.

In 1977 McDonnell Douglas signed a similar agreement to develop a larger PAM for Shuttle launch only called "PAM-A." This version has comparable payload capability to the Atlas Centaur ELV. After a competition with another aerospace firm, NASA awarded McDonnell Douglas a Firm Fixed Price Contract for 6 PAM-A launches which has subsequently been increased to 8. There are, however, no currently assigned missions for PAM-A and no commercial sales have been achieved.

In 1982 customers began requesting additional performance from the PAM-D system, but short of the more expensive PAM-A capability. As a result McDonnell Douglas decided to commercially undertake a growth version called "PAM-DII," which includes a new motor and raises the payload capability to approximately 4100 lbs into the geosynchronous transfer orbit. PAM-DII retains a vertical Shuttle bay installation in order to optimize the overall space transportation price and will

be available for launches in 1985. Our initial commercial contract for PAM-DII was authorized in August 1983 with an order from the GTE Satellite Corp. At present we are negotiating a formal agreement for NASA's technical monitoring of the PAM-DII Program.

In general we consider these commercial launch vehicle ventures to be successful although financial returns have been more difficult to achieve than originally planned primarily due to schedule delays and increased complexity of the projects. Both the 3914 and PAM Programs have experienced investment/development costs substantially in excess of initial estimates which were the basis of ceiling prices in the agreements and as a result investment return has taken far longer than planned. As a lesson learned, the most unwieldy part of the PAM Agreement has been the ceiling price limitation set in 1976 which had inadequate provisions for timely adjustment to recognize increases in system complexity, technical direction, and schedule delay impacts associated with the developing Shuttle system and requirements. In the future we will have technical working agreements with NASA while allowing the price to be governed by the substantial competitive environment that is developing in the communications industry, thereby obviating any further need for government price controls.

Overall our relations with NASA have been excellent in working toward our objectives since these projects have been so closely interrelated with NASA's Delta and Shuttle Programs. Some learning on both sides has been experienced on the PAM-D Program in determining the extent of NASA's technical direction since no government investment was involved. Although the cost burden has remained completely on McDonnell Douglas, each technical issue arising to date has been ultimately resolved.

In our commercial projects we have been careful not to compete with NASA but rather to be compatible with and companion to their efforts. This was a prime objective of our PAM-D agreement. We are fully willing to compete with any other commercial firm but not directly with NASA. In general, where other business factors are favorable, commercialization can be encouraged through agreement by the government not to compete with industry in selected areas. We believe this is especially significant in space launch services where the government has such a dominant position.

Space commercialization can also be encouraged by the government through favorable and stable allocation and pricing of government facilities and resources. Decisions by the government in these areas will be a substantial and increasing factor as the size and scope of space commercialization projects expand. In fact, in some cases it may well be a deciding factor in whether or not a commercial project is undertaken. So far in this area we have experienced excellent cooperation from NASA for the commercial ventures that I have discussed.

In summary, we at McDonnell Douglas consider these commercial ventures to be successful thus far and look forward to continued cooperation with the government in improving our interactive relations and in expanding our efforts in areas of mutual benefit thereby improving our Nation's overall space capabilities.

This concludes my prepared remarks.

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McDonnell Douglas Astronautics
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Subcommittee on Space Science and Applications
Committee on Science and Technology
House of Representatives

May 4, 1983

Mr. Chairman and Members of the Subcommittee:

I am happy to appear before this Committee this morning to present OSC's views on cooperative arrangements for the commercialization of space. OSC currently has agreements with both NASA and Martin Marietta Corporation to develop a high-capacity upper stage for use on NASA's Space Shuttle.

The upper stage, called the Transfer Orbit Stage (TOS), is a large, single stage solid-propellant rocket that is carried up with its payload in the Space Shuttle to low earth orbit. The TOS and its payload are then launched by the Space Shuttle to transport communications satellites and other payloads from the low Earth orbit of the Space Shuttle (approximately 160 miles above the Earth) to higher orbits that the heavy Space Shuttle cannot reach, such as the geosynchronous orbit utilized by most communications satellites (approximately 22,300 miles above the Earth).

The evolution of the commercial satellite market to larger, heavier satellites indicates that an economical high-capacity upper stage such as TOS is well positioned to capitalize on a significant business opportunity. Current launch systems, such as the PAM-D upper stage used on the Space Shuttle, are economical only for smaller satellites. At present, there exists no economical way to launch large satellites of the TOS class (approximately 2,800 to 6,800 pounds) into geosynchronous orbit, other high orbits, or on planetary missions. A sophisticated two-stage rocket, the Inertial Upper Stage, developed by the Air Force primarily for military use on the Space Shuttle, is very expensive, has reliability problems and has a lower payload capability than the TOS. The only publicly announced program to develop an economical launch capability for TOS-class payloads, in fact, is the European Ariane rocket program that competes directly with the Space Shuttle. NASA must provide a similar capability in order to remain competitive with Ariane for commercial payloads.

Recognizing the need for an economical, high-capacity upper stage for use on the Space Shuttle, NASA signed a preliminary agreement with OSC on December 17, 1982 providing for further discussions of OSC's proposal to finance, develop, market and operate the TOS. Based on these discussions, on January 24, 1983 NASA ceased its own efforts to develop a TOS-class

upper stage and on April 18, 1983 NASA signed a final agreement with OSC to develop the TOS. Under the terms of the Agreement, OSC will develop the TOS using private funds at no charge to NASA and NASA will provide technical monitoring out of its Marshall Space Flight Center in Huntsville, Alabama to ensure that the safety requirements of the Space Shuttle are met. NASA also agrees to provide certain interface data on the Space Shuttle and related facilities. No subsidies or purchase guarantees are involved.

To provide technical and manufacturing capabilities necessary for success of the TOS program, OSC held discussions with a number of large aerospace companies in late 1982 and early 1983. From these companies, OSC chose Martin Marietta Corporation to act as OSC's prime contractor in developing and manufacturing the TOS. Martin Marietta signed a preliminary agreement with OSC on January 21, 1983 and is now working with OSC under a contract dated as of April 1, 1983. Under the terms of the contract, Martin Marietta's Denver Aerospace Division serves as prime contractor to OSC for the TOS program, performing most of the design, development, testing and producion of the TOS hardware and managing TOS subcontractors. For its part, OSC will have primary responsibility for financing and marketing the TOS. The first TOS is expected to be available for launch by the fall of 1986.

OSC believes that its rapid progress to date in the space commercialization area is without recent parallel. This progress can be attributed to several factors. The most important of these is the business feasibility of the project -- the emergence of a well-defined commercial market for the TOS in the next three to five years, combined with relatively low required investment. The business feasibility of the project has enabled OSC to obtain private financing rather than grants or subsidies that take longer to arrange. Another key factor is the acceptability of the project to NASA. The TOS is a new system that will promote the commercial use of the Space Shuttle, allowing NASA to leverage its budget with private funding in the pursuit of its goals. Rather than take existing operations away from NASA or compete with NASA, OSC with the TOS program aligns its interests with those of NASA. OSC's status as a small-business concern underscores the total commitment of OSC and its employees to the success of the TOS program. We have further suspected that, knowing what a demanding project the TOS program is likely to be, NASA also regarded the relative youth and excellent health of the company's founders as an asset.

OSC has received the full support of NASA's top officers in its efforts to establish the TOS program. It is our impression that these individuals, who include James Beggs, General Abrahamson, Messrs. Culbertson, Allnutt and Hosenball, as well as Joe Mahon, Jack Wild and B.C. Lam in the Special Programs Division and Gene Austin in the Marshall Space Flight Center, firmly believe in the desirability of private investment in space and are actively involved in identifying and supporting feasible private initiatives in the space commercialization area. Because of the dominant role that NASA plays in space activity, such support is a vital prerequisite to future progress in space commercialization. OSC has also received cooperation from Martin Marietta Corporation that extends significantly beyond contract requirements and indicates the personal

commitment of Martin Marietta's management, including Norm Augustine, Peter Teets and Richard Farrell, to making a success of our innovative teaming arrangement. The marriage of the entreprenurial energy of a small firm with the technical and production resources of a large aerospace company has been important to the progress of the TOS program and might serve as a precedent in future private endeavors in space.

Space commercialization needs some early success stories. The public -- including the financial community -- is somewhat in awe of the technical and operational complexity of the space program, and correspondingly skeptical of efforts to commercialize space activities. To the extent that NASA and this Committee support projects with a high likelihood of success within a few years, public perception of space commercialization as a new sunrise industry will inevitably increase the number of high-quality projects and available private investment. Cooperative arrangements between NASA and private firms, we have found, are an effective means of demonstrating NASA's support for such projects and should continue to be implemented where practicable.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions.