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CURRENT LAUNCH SYSTEMS SESSION

Launch System Development in the Pacific Rim

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ABSTRACT

Several Western Pacific Rim nations are beginning to challenge the domination of the United States, Europe, and the former Soviet Union in the international market for commercial launch services. This paper examines the current development of launch systems in China, Japan, and Australia.

China began commercial launch services with their Long March-3 in April 1990, and is making enhancements to vehicles in this family. Japan is developing the H-2 rocket which will be marketed on a commercial basis. In Australia, British Aerospace Ltd. is leading a team conducting a project definition study for an Australian Launch Vehicle, aimed at launching the new generation of satellites into low Earth orbit.

INTRODUCTION

Access to space is the most basic requirement for doing business in space. Prior to the 1980's, space launches were carried out exclusively by national governments. Today businesses in at least 20 countries worldwide engage in some form of space commerce, including space transportation.[1] The definition of a truly "commercial" launch vehicle is the subject of continuous public debate, and will not be addressed here. This paper discusses the development in the Western Pacific Rim of expendable launch vehicles (ELV) which are (or will be) offered on the commercial market, without regard to the degree of government support which may or may not be provided to the offerer.

COMMERCIAL LAUNCH SYSTEM BACKGROUND

Europe. The Ariane launch vehicle was developed by the European Space Agency (ESA) in order to provide Europe independent access to space. Companies from ten countries worked together on the vehicle, with France contributing the major share (approximately 64 percent), followed by Germany (approximately 21 percent). Under the ESA-Ariane convention of 1981, the French-based company Arianespace was created to produce, market, and operate the Ariane--thus becoming the world's first commercial launch company. Arianespace now dominates the commercial ELV market, having captured more than 50 percent of the world's open commercial launch market, including 25 percent of the U.S. domestic market.[2]

United States. The United States maintained a monopoly in the provision of launch services for the free world prior to the development of the Ariane. A ground rule in the development of the Shuttle in the late 1970's was that ELV's would be phased out (and eventually terminated), and that the Shuttle would be the single transportation system for the Nation. However, after the National Space Policy announced on July 4, 1982, called for continuation of ELV activities until the Shuttle was fully operational, several private firms expressed interest in providing ELV services on a commercial basis. The decision to off-load commercial satellites from the Shuttle after the Challenger accident provided a significant impetus and eventually the government turned over the Titan, Atlas/Centaur, and Delta vehicles to their private sector manufacturers. Additionally, other entrepreneurial companies have started development of small launch vehicles to service both Government and commercial customers.

Commonwealth of Independent State (CIS). Historically the Soviet Union had an extensive array of ELV's and a very active launch program. In 1986 a new space agency, Glavkosmos, was created to be responsible for technical matters concerning the launch of commercial payloads. The space program of the old Soviet Union is now run by the CIS, with Russia accounting for 85 percent of the budget. Vehicles available for commercial launches include the Proton and the Zenit-3, which is the first CIS launcher to be specifically designed as a commercial booster. Additionally, the SS-19 and SS-25 intercontinental ballistic missiles could be converted into commercial launch vehicles. In November 1992 Russia was awarded its first commercial contract with a Western organization when Inmarsat selected a Russian Proton to launch an Inmarsat 3 satellite in 1995.[3]

WESTERN PACIFIC RIM COMMERCIAL LAUNCH VEHICLES

The Western Pacific Rim has been characterized as the "hottest potential sales sector for the commercial space business in the 1990's."[4] While the space policies of each country are different, a common theme is the desire to develop a domestic space industry capability. For example, at least eight countries have developed (or announced the intention to develop) a domestic communication satellite system.[5] For at least three of the countries in the region--China,

Japan and Australia--entrance into the commercial ELV market is a part of their strategy to develop an indigenous space industry.

The People's Republic China. China began space activities in 1957 by entering into an agreement with the Soviet Union to acquire strategic missile technology. On April 24, 1970, China successfully launched its first satellite on the Long March-1, a three-stage vehicle with a low Earth orbit (LEO) capability of 300 kilograms. Development of the Long March ensued and the family now includes vehicles with a wide variety of capabilities.[6]

China's first commercial communications satellite launch, AsiaSat-1, was accomplished with the Long March-3 in April 1990.[7] Long March-3 is a three-stage vehicle with two conventional first stages and a restartable cryogenic (liquid hydrogen/oxygen) third stage. It has the capability of placing a 1400-kilogram payload into geostationary transfer orbit (GTO). An enhanced version of the Long March-3, the Long March-3A, is currently under development. The Long March-3A has an upgraded cryogenic third stage and a GTO capability of 2,500 kilograms.[8]

The newest entrant in the Long March family is the Long March-2E. It is a two-stage vehicle with four strap-on liquid propellant boosters attached to the first stage. The Long March-2E has a GTO capability of 3,000 kilograms.[9] Two Long March-2E's were selected for Australia's Optus-B1 and Optus-B2 national communications satellites. On March 22, 1992, the first attempt at launching the Optus-B1 failed when the launch vehicle went into automatic shutdown.[10] The satellite was subsequently successfully launched on August 14. An unsuccessful attempt was made to launch the Optus-B2 on December 21, 1992. As of early 1993 it has not been determined if the failure was caused by the launch vehicle or the satellite.[11]

Intelsat announced in 1992 that it would purchase the first commercial launch of the Long March-2E/HO, tentatively set for late 1995 or early 1996.[12] The Long March-2E/HO (or Long March-3B) is based on the Long March-2E with a liquid hydrogen/liquid oxygen upper stage to provide 4,800-kilogram GTO capability.[13]

Long March vehicles are designed and manufactured by the Beijing Wan Yuan Industry Corporation, which is part of the Chinese Ministry of Aerospace. The China Great Wall Industry Corporation, also a part of the Ministry of Aerospace, is the marketing and contractual company for the vehicles. Launches take place at the Xichang Satellite Launch Center in Sichuan province and tracking and command are exercised at the Xian Satellite Control Center in Xian.

Japan. Japan began orbit-capable ELV development by purchasing U.S. Delta ELV technology, which it agreed not to use or transfer commercially. The first Japanese orbit-capable ELV's, the N-1 and N-2, were based on this technology. The H-1 was an evolutionary development of the N-family, with a new cryogenic second stage resulting in a geostationary satellite launch capability of 550 kilograms. Because of the licensing constraints these rockets were not offered on the commercial market.[14]

The H-2 rocket, the first vehicle to be based on all-Japanese technology and marketed on a commercial basis, is currently under development by the National Space Development Agency of Japan (NASDA). The H-2 has two cryogenic stages and two solid rocket boosters, resulting in a geostationary satellite launch capability of 2,000 kilograms. The H-2's core engine, the LE-7, has experienced a series of failures during ground testing. The most recent problem occurred in June, 1992, when the engine caught fire during a test, damaging the engine and the test stand. A redesign of most of the engine may be necessary. Problems with the LE-7 have delayed the scheduled first launch of the H-2 from 1992 to February 1993, and now until sometime in 1994.[15]

The H-2 rocket is the responsibility of the Rocket Systems Corp. Rocket Systems was formed in July 1990 by 77 large Japanese corporations, led by Mitsubishi Heavy Industries.

Australia. Australian involvement in space activities started in the 1940's when British Menace Rockets were tested at the Woomera testing ground, in the South Australian desert. By the 1960's Woomera had become the largest rocket launching base outside of the United States and the Soviet Union.[16] Launch activity reached a high point in 1967 when Australia's first satellite the WRESAT-1 was placed into orbit from Woomera. After this milestone Australian space industry began to decline, possibly due to a small country's inability to compete in a multibillion dollar business, and Britain's joining ESA and therefore severing its partnership with Australia. Nevertheless, Australia has remained one of the largest users of space technology due to its size, sparse population, and geographic location.

Australia's space policy since 1986 is to encourage greater involvement by Australian industry in space research and development, and the development of commercially-viable activities based on space technologies. Australia plans to enter the launch services arena with commercial launch facilities providing access to polar, geostationary and 28-degree orbits before the end of this decade.[17]

An Expert Panel was formed in 1991 to assess the performance of Australia's government-funded space program. Part of the Panel's review and recommendations involved two initiatives which would enter Australia into the commercial launch services market: a commercial spaceport and a new ELV, the Australian Launch Vehicle. A description of these projects and the Panel's recommendations concerning them follows.[18]

Commercial Spaceport. Woomera, at approximately 30 degrees south of the Equator, is not the best geographic location for launching commercial communications satellites efficiently. A launch site at the Cape York Peninsula at the northern-most point of eastern Australia (approximately 12 degrees south of the Equator) would provide a significant geographical improvement. A consortium led by the Cape York Space Agency Pty. Ltd. (incorporated in 1987) began development of a commercial spaceport concept. An initial feasibility study which included launching the Ukrainian-built Zenit launch vehicle from

Cape York was funded by the Australian Space Office. The Cape York Space Agency found itself in financial difficulties during 1990-1991 which culminated in the appointment of a liquidator in October, 1991.[19]

The Australian Industry Development Corporation, funded by the Australian Space Office, performed an independent assessment of the spaceport concept. This assessment, which was released in November 1991, confirmed the project's viability and projected a sufficiently high rate of return.[20] While several companies have expressed strong interest in the project, as of late 1992 none have been able to raise sufficient private funding. The recommendation of the Expert Panel relating to the Cape York Spaceport was that no additional government funds be budgeted for the effort if private monies for the spaceport were not forthcoming by the end of 1992.[21]

The Australian Launch Vehicle. While Cape York offers a significant geographic advantage over Woomera, Woomera has the advantage of being an existing asset. A proposed new Australian-built ELV for launching 500 to 1,000-kilogram payloads from a refurbished Woomera into low earth polar orbit is being studied. A consortium led by British Aerospace Ltd. and including Auspace and Hawker de Havilland is conducting preliminary feasibility studies of the Australian Launch Vehicle (also called the "Southern Launch Vehicle").

The Australian Launch Vehicle concept is a light, low cost commercial rocket. The nominal payload performance goals are mass in the 750-kilogram class and a 480 kilometer circular polar orbit. The baseline vehicle configuration consists of three solid propellant boost stages and a small liquid post boost stage to assure accurate orbit insertion.[22] Two prototype launch vehicles are planned, with the first to be launched in late 1994.

The target market for the Australian Launch Vehicle is the emerging lightsat market. While the demand for medium and large communications satellites launches has leveled off at about 14 per year, the demand for small launch vehicle services is expected to grow significantly.[23] This will be especially true if small satellite systems such as IRIDIUM are successful. Sensors of all types in space are very cost sensitive: if low Earth orbiting spacecraft do become cheap enough, market expansion will take place into areas such as bushfire monitoring, fish detection, etc.

The Expert Panel considered the Australian Launch Vehicle but could not make an assessment of its validity due to the early stage of the proposal's development. The Panel recognized the potential value to Australia of such a commercial vehicle, but also noted that similar projects elsewhere in the world have required government financial support in the establishment stage. The Panel's recommendation was that as soon as the proposal has been adequately developed that it be subjected to a comprehensive study and evaluation.[24]

SUMMARY AND CONCLUSIONS

The growth, both current and potential, of the Western Pacific Rim as a customer for and supplier of space services is widely recognized. Despite the fact that space services are generally available in abundance from suppliers elsewhere in the world, several reasons for indigenous development in the area are apparent. From the strictly entrepreneurial viewpoint, development provides the opportunity for profit. From the governments' viewpoint, development may provide the potential for additional benefits. Although the extent to which national governments do or do not support these development efforts was not used to define "commercial" in this paper, the justifications for whatever support is provided (be it direct, indirect, anchor tenancy, etc.) involve both national prestige and recognition of the benefits resulting from the stimulus to overall national high technology industry.

Most current commercial space systems developed outside of the Western Pacific Rim were designed primarily to meet their own national requirements. The nations of Western Pacific Rim are generating alternative requirements resulting from their unique geographic and population distribution characteristics. Examples of these requirements include--but are certainly not limited to--bushfire detection, education, and medical consultancy.

Commercial launch vehicles are being developed in the Western Pacific Rim for every class of payload. The success of these vehicles will be measured both technically and, because they are commercial, financially. Not only can the launch vehicles described in this paper present significant competition to the commercial launch industry in the rest of the world, but also to themselves. As is true elsewhere, development of indigenous launch capabilities strictly for national programs can impact the success of the new entrants to the market. Even when new systems are not offered commercially, they remove (at least initially) some of the demand from the market. On the other hand, competition from land-based systems (i.e., fiber optics and microwave) is less significant in the Western Pacific Rim due to the distributed nature of the population and general geography.

ENDNOTES

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