Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Special Report:

The Worldwide Growth of Launch Vehicle Technology and Services

2nd Quarter 1997

United States Department of Transpiration • Federal Aviation Administration

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800 Independence Ave. SW Room 331

Washington, D.C. 20591

Special Report

THE WORLDWIDE GROWTH OF LAUNCH VEHICLE TECHNOLOGY AND SERVICES

In the next five years, there will be an unprecedented number of new launch vehicles attempting to gain some portion of the commercial launch market. Some of these are the result of large existing programs like Arianespace's Ariane 5. Others are the first steps of emerging space capable nations like Brazil with its VLS launch vehicle. The launch vehicles involved range from small vehicles, such as Israel's Shavit, to large GEO-capable launchers like Japan's H2A. Many different technologies are being introduced: reusable launch vehicles like the Kistler K-1, new expendable vehicles like India's GSLV, and evolutionary developments of current vehicles like Lockheed Martin's Atlas 2AR.

This report will discuss primarily those vehicles being introduced by the newly emerging space nations. India, Israel, and Brazil are all trying to turn launch vehicle assets into profitable businesses. In this effort, they have found the technological development process less of a problem than the restraints imposed by outside factors like the Missile Technology Control Regime (MTCR). Such restraints have caused the greatest delays in the production of commercial launch vehicles as will be discussed for each case below.

This report will also discuss the changing trends in launch vehicle procurement and their possible effects on missile proliferation as well as on the United State's launch vehicle industry. In particular, the possibility of "Turn Key" launch systems will be considered along with their implications for changes in current launch practices.

INDIA

The most experienced of the new entrants into the commercial space market is India. India was the seventh nation to orbit a payload on an indigenous launch vehicle when it launched Rohini 1B on the Satellite Launch Vehicle (SLV) in 1980. It is currently marketing the Polar Satellite Launch Vehicle (PSLV) for commercial launches, and also plans to market the Geosynchronous Satellite Launch Vehicle (GSLV) once it is proven (it has not yet flown). Indian launch vehicles are marketed by the Antrix Corporation, LTD, a commercial marketing organization created by the Indian Department of Space (DOS). Both the PSLV and GSLV use India's launch facilities at Sriharikota.

The PSLV has been launched three times, including its initial launch in September of 1993. The first flight was a failure but the last two in October of 1994 and March of 1996 were successful. Its last two flights have put the IRS P2 and P3 into LEO orbits. The PSLV is not capable of putting large payloads into a geosynchronous orbit but it has provided a technological basis for the development of the GSLV, which can deliver payloads to GEO.

The GSLV will be able to launch a 2.5 ton payload into a geosynchronous transfer orbit (GTO). Its first flight is expected to take place in the year 2000. The GSLV is designed for the 2095 kg Insat-2-class of geosynchronous satellites but will be able to launch other commercial payloads when testing is complete. The GSLV program has suffered a two-year delay caused by problems importing Russian liquid propellant rocket engine technology.

Originally, India had planned to buy, rather than develop, additional rocket engine technology to augment the PSLV technology for the GSLV. Protests by the United States under the MTCR threw these plans into disorder and resulted in the development of an Indian engine. Russian engines will be imported (without the production technology needed to build them) for use on early GSLV flights, but the final commercial vehicle will be powered by entirely indigenous engines.

ISRAEL

Israel is the eighth and latest member of the space launch club with the launch of the Shavit (which is Hebrew for 'Comet') launch vehicle carrying the Ofeq 1 in 1988. Shavit was designed for the delivery of small (160 kg) payloads into LEO orbits. Israel has successfully launched the Shavit three times between 1988 and 1995 but, as of yet, has made no commercial sales. An upgraded version of the Shavit called NEXT is under development for commercial use.

In joining the commercial launch market, Israel has a particular problem with its launch site at Palmachim Air Force Base north of Tel Aviv. Because Israel is constrained from launching over neighboring countries, its launch facility has severely limited trajectories available for launches. Because of this limitation, Israel has a particular interest in launches from non-Israeli sites.

Israel has sought an exemption from the presidential directive requiring that US payloads launched from the United States also be launched on US vehicles. It has also unsuccessfully proposed the Shavit (in conjunction with United States partners) for NASA's Meteor program in 1990 and for the ultralight launcher competition in 1994. Currently, efforts are being made to get permission to launch the Shavit from Wallops Island, Virginia.

As with India's launch vehicle program, the MTCR has been a major roadblock to the success of the Shavit. Because many believe that the Shavit is developed from the Israeli Jerico 2 ballistic missile, it has been argued that the United States should not support Israeli efforts to market this technology. To do so, it is suggested, would weaken efforts to reduce tensions in the Middle East and would violate the MTCR.

BRAZIL

Brazil has yet to launch an indigenous launch vehicle but it plans to do so soon and become the ninth country to have its own launch vehicle capability. Current plans are to launch the first Veiculo Lancador de Satelites (VLS) launch vehicle sometime this year. It will carry the Brazilian SCD satellite into a LEO orbit. Like the Shavit, VLS is intended to put small payloads (in the 200 kg range) into LEO orbits. Also, like the Shavit, it is intended to become a commercial money maker for its builders.

The original timetable for the VLS called for a first launch in 1992 but Brazil's access to the necessary technology was limited by the MTCR. Because of this, the VLS had to be redesigned, a process which added five years to its development time. Four development flights are planned. If they are

successful, the VLS will be offered on the international commercial launch market.

	Initial Launch Date	Orbit Type	Payload Weight
India			
PSLV	1993	LEO GTO	2200 lbs 990 lbs
GSLV	2000	LEO GTO	11000 lbs 5500 lbs
Israel			
Shavit	1988	LEO	350 lbs
Brazil			
VLS	1997	LEO	440 lbs

TURN-KEY LAUNCH SYSTEMS

Beyond these new sources for commercial launchers, it is also becoming possible to buy "Turn-key" launch systems that will enable instant access to space. Both the Israeli Shavit and the Russian START launch vehicle have been offered to third parties for their own use. As previously mentioned, the Shavit has already been offered to teams of US companies for a number of NASA contracts as well as the more recent Wallops Island proposal.

In the case of START, Russia's STC Complex has already signed a "turn-key launch services package"[1] agreement with SpacePort Canada. Under the terms of this agreement, START vehicles would be launched from Churchill, Manitoba, on the shore of the Hudson Bay in Canada. Just as the launch of Shavit vehicles from Wallops Island would greatly increase their possible trajectories, the launch of START vehicles from SpacePort Canada would also open new orbital possibilities to users of the START vehicles.

MIXED NATIONALITY LAUNCHES

Another important development is the growing possibility of commercial launches of vehicles from sites in other countries. In recent years, proposals have been made for the launch of Russian Proton rockets from Cape Canaveral Air Station (CCAS) in Florida, Alcantara in Brazil, and from a proposed Australian Spaceport. There have also been proposals that the United States Delta or Ukrainian Cyclone launch vehicles use the ELA-2 Ariane 4 facilities at the Guinea Space Center (Kourou) once all Arianespace payloads have been shifted to Ariane 5 vehicles. There have even been suggestions that the X-33's commercial follow-on , the Lockheed Martin Venture Star, might be launched from outside of the United States in some cases.

In addition to the possibility of mixed nationality launches from fixed sites there are also site-free launch vehicles. Two of these vehicles are the Sea Launch Zenit, which is launched from a mobile ocean platform, and the OSC Pegasus which is launched from an aircraft. Neither of these launch vehicles call for ground based infrastructure as do pad-launched rockets. These mobile launch sites also allow one nation's launch vehicles to be launched from another country's "soil," but on a one-at-a-time basis. The upcoming Minisat 01 launch

[1] "Spaceport Deal Signed" in *Space News*, October 14-20, 1996, page 1

from Spain is an example of the flexibility of such vehicles.

Financial Implications of Mixed Nationality Launches

All of these suggestions raise a variety of important issues about the nature of the commercial launch business. As has been reported in Space News[2], Orbital Sciences Corporation (OSC) has gone on record against the Israeli use of United States launch sites because they are funded through US taxes, not just user fees.[3] OSC feels that foreign developed launch vehicles would have an advantage over domestic US vehicles if they were allowed to launch from United States launch sites.

At the same time that United States launch vehicle builders are concerned about foreign competition, commercial spaceports have taken a different view. Groups concerned with the Florida Spaceport have pushed for both Shavit and Proton launches from Florida in the hopes of raising the number of launches from Florida sites. The United States-based commercial spaceports are seeking launch opportunities, regardless of the origin of the launch vehicle. These trends are indicative of a maturing launch market but it is not clear at this point where they will lead.

Vehicle	Country of Origin	Suggested Launch Site
Cyclone	Ukraine	Guinea Space Center (Kourou)
Delta	United States	Guinea Space Center (Kourou)
Proton	Russia	CCAS, Florida; Alcantara, Brazil; Australia
Shavit	Israel	Wallops Island, VA; CCAS, Florida
START	Russia	SpacePort Canada, Manitoba, Canada

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2 Warren Ferster, "Israel Spurs Policy Debate With Bid for U.S. Launches," in *Space News*, February 17-23, 1997, page 1

3 Current United States law calls for commercial users to pay only the marginal cost of using United States launch ranges. The rest of the expense of maintaining these sites is borne by the tax payer and ultimately, in part, by commercial entities like OSC. Foreign users would not bear these additional expenses.