SMALL PAYLOAD OPPORTUNITIES ABOARD SOVIET LAUNCH VEHICLES

William B. Wirin*
Executive Vice President and Chief Operating Officer
The Space Commerce Corporation
and
Yuri Solomonov
Vice President Technopribor

The Space Commerce Corporation of the U.S. and Technopribor of the Soviet Union have agreed to develop jointly and market a new commercial mobile launch vehicle derived from Soviet SS-20 medium-range missile technology.

The Soviets have indicated they could produce 300 launchers within a five-year period following a go-ahead decision. The launcher could be employed for commercial payloads or scientific research, including materials processing experiments.

President Gorbachev reiterated in his speech at Stanford University on June 4, 1990 the commitment of the Soviet Union to convert military armaments to peaceful commercial purposes. He recognized the requirement to develop international legal safeguards against potential military use evolving from converted armaments. The Arms Control and Disarmament Agency is likewise concerned with the START vehicle and these issues will need to be resolved.

In addition to the development of a small relocatable launch vehicle there are opportunities to have accommodation payloads placed aboard other Soviet launch vehicles. In November, 1989 Energetics Satellite Corporation placed an order for $54M. Their SAT/TRAC satellites will be placed into geosynchronous orbit by Proton launchers.

---

*Juris Doctor; Life Member, International Institute of Space Law; Member, American Institute of Aeronautics and Astronautics, Senior Member; American Bar Association.

THE START LAUNCHER

The Space Commerce Corporation and Technopribor of the Soviet Union signed an agreement in Moscow on October 11, 1989. The Memorandum of Understanding established the working relationship between The Space Commerce Corporation and Technopribor to develop and market a new small launcher to be named START.

Technopribor is a newly formed organization that controls the SS-20 military production complex. The joint project would allow the Soviet Union to transition its SS-20 production facilities and work force into commercial activities. It will utilize technology, systems and manufacturing complexes that are not required to be destroyed under the Intermediate-Range Nuclear forces (INF) treaty.

Labeled the "Conversion One Project" by the Soviets, START could become the first step in the practical implementation of a long-term process. Soviet leader, Mikhail Gorbachev, has directed the transformation of the nation's military-industrial complex into commercial activities.

START will be a newly designed vehicle. It will not incorporate parts of existing SS-20 missiles which have been destroyed under the INF treaty. However, former SS-20 production facilities in the Soviet Union will be used to build the new launchers. Components developed for the SS-20 may also be utilized. The SS-20's guidance system may be upgraded and reprogrammed, for example, into an orbital guidance system.

The faring size will be approximately 1800cm by 1300cm narrowing to 800cm. The three-stage, solid fuel launcher will be capable of carrying, for example, a 350 kg payload into a 400 km orbit at 30 degrees inclination. According to preliminary specifications, START will weigh 40-45 metric tons and will have an overall length of 20 meters, making it slightly larger than the two-stage, 16.49 meter SS-20.

As with the SS-20, the START booster will be mounted on a mobile transporter/launcher vehicle, enabling it to be launched from a variety of sites without special launching pads. The significance is that the launch vehicle can be brought to the satellite and not vice versa as is the current practice. It would also enable launches from locations that currently do not have established launch complexes. Being able to "relocate" the launching site enables the mission planner to achieve a particular orbit giving due consideration to safety and cost.

MARKET ANALYSIS

Estimated costs will be $10,000-16,000 per payload lb., or $4-5 million per launch. START would compete for low Earth orbit commercial payloads with the other small launch vehicles.

To determine the commercial profitability of the START launcher, SCC conducted a market analysis including an extensive survey of prospective experimenters and research organizations.

Our census of experimenters identified 332 separate payloads that, if funded, could be ready to fly in the 1990s. About 20% of these are payloads from foreign organizations, primarily in Canada and Europe. About 30% are payloads sponsored by various U.S. domestic and military programs. The remaining 50% are sponsored by U.S. civilian government agencies or private resources.

Some of these payloads are planned as fully integrated spacecraft that would require only launch services. Most, however, are just an experimental apparatus that must rely on support subsystems supplied by the launch service or some third party. It may be necessary to design and supply a standard spacecraft buss structure including power and other subsystems in order to sell START launches to these potential customers.

Many of the experiments included in our customer survey will require multiple flights to complete their research work. Including these reflight requirements, the payloads that we have identified total about 600 "flight needs" during the 1990s. However, because several experiments typically share a single spacecraft bus, this assessment of "flight needs" does not translate to a specific number of launches.

U.S. domestic payloads users were surveyed in more detail because they represent the majority of all small commercial payloads which could be launched into outer space by the START vehicle during the 1990s. A sample of these U.S. domestic payloads surveyed indicates that the two scientific research areas with the largest number of identified experiments are:

1. basic physics and astronomy (sponsorship shared by the U.S. military and civilian (NASA) space programs); and

2. microgravity/materials processing basic research (primarily supported in the U.S. by the Center for the Commercial Development of Space).

Figure 1 shows the results of a survey of potential START customers by broad scientific areas for U.S. domestic payloads. It is important to note that the communications segment represents only identified applications for technology which is already been demonstrated to work. Research programs supporting the communications area, such as atmosphere effects on signal propagation, are counted as physic experiments.

WHO PAYS FOR THE LAUNCH

Considering hardware development costs for U.S. domestic users only, which we estimate to be about 80% of the entire START

commercial market during the 1990s, approximately 60% of these payloads are built entirely or partially by U.S. civilian government agencies. The U.S. Department of Defense sponsors another 35% of these payloads. Thus, hardware development funded exclusively by private capital make up less than 5% of the number of experiments surveyed. However, private funding also participates in cosponsoring an additional 5% of the payloads with the civilian government program (NASA). Thus, private capital appears to be involved in building only about 10% of the payloads SCC has identified in this study.

Figure 2 shows the breakdown of this funding for U.S. domestic payloads. These statistics reflect the number of payloads, and hence the number of launches that could be anticipated on the START launch vehicle. They do not reflect the dollar investment by any of the sponsors. This becomes especially important when "in-kind" support and facility sharing arrangements by industry and government are taken into account. This type of sharing arrangement is not included in our analysis. It is clear, therefore, that the vast majority of all U.S. domestic payloads are built using government funds. Therefore, in order to be commercially successful, the START project must be able to launch U.S. domestic payloads. SCC reached this conclusion and as a result, expanded the scope of the international marketing study to include an analysis of the U.S. legal and regulatory regime controlling:

1. the use of the START launch vehicle in the United States for U.S. domestic payloads; and

2. the use of the START launch vehicle from launch sites outside the United States with payloads, or payloads containing U.S. components.

HOW MANY ACTUAL FLIGHTS

Although the SCC survey found over 300 potential payloads for the START launch vehicle, our assessment indicates that, at current price levels, only 15% - 20% of these can be expected to reach active flight ready status, given current program plans and funding support. This estimate is partially confirmed by survey responses that 59 payloads (18%) are now manifested. These small payloads can be carried both on expendable launch vehicles, and as secondary payloads on the Space Shuttle.

It is important to remember that as a salesman must make many contacts to sell to a few customers, so also do ideas for experiments in space become a smaller number of actual launches which could be accomplished by START.

ACCOMMODATION PAYLOADS

The potential START launcher is only one method of getting your small satellite into space. The Energetics Satellite

Corporation of Englewood, Colorado signed a contract with SCC in November, 1989. The SAT/TRAC satellites will be part of the SAT/TRAC Geolocation system. The technology, although novel in concept and application, utilizes predominately "off-the-shelf" components to generate position information and relay the data to users. The system's major components consist of a simple relay type satellite, a ground-based computer processing and data distribution center and numerous end user transponders. Transponders attached to or carried by any vehicle, object or individual can be located within 50 feet.

The contract provides prices for launching up to eight satellites on the Proton launch vehicle. The reason for the low price of $54M for the entire constellation is because they will be accommodation launches. The 480 pound satellites will be put into geosynchronous orbit in pairs. They will "piggy back" on one of the ten to twelve Proton launches the U.S.S.R. utilizes each year to boost its own communications satellites into GEO. The cost to the Soviet Union is nominal. The only cost in reality is the integration and mating of the satellite to the rocket. Preliminary quotes from the insurance industry are 12% for the Proton vs. 16-18% for other large launchers.

Another alternative for satellite owners is to place several satellites on a launch vehicle such as the Cyclone to go into low Earth orbit. For instance, it can place 4000 kg into a 200 km by 70 degree inclination. The faring size of the Cyclone is 2300cm by 5900cm. It can be launched for $15M, depending upon the services required by the customer. As of April 1, 1989 there have been 73 successful launches out of 75 attempted.

POLICY ISSUES

SCC has already discussed and will continue to discuss the legal ramifications of the project with the U.S. State Department, Arms Control and Disarmament Agency, On-Site Inspection Agency and other interested government agencies. For the project to move forward, the possible conflicts with the Intermediate-Range Nuclear Forces (INF) Treaty will have to be resolved.

Soviet officials noted that the conversion process would require the development of administrative and legal tools and safeguards to ensure against possible military use both actual and perceived. The Soviets have indicated that START facilities would be open to inspection.

Technopribor will provide Space Commerce Corporation with a detailed technical description of the START mobile launch vehicle complex within 90 days of a decision to proceed. Each launch complex consists of a launch vehicle, a launcher container, transporter and support equipment. Design work on the launcher will be completed in six to nine eighteen months after starting.

When decision is made to proceed with the project, flight testing of the launcher would begin approximately one year. Ten test launches are tentatively planned to be conducted in the Soviet Union as well as other sites around the globe. We would like to conduct some of the test launches from Canada, Australia and Brazil. We will also seek Department of Transportation approval to conduct a test launch in the U.S.

As this paper is being written, the new space launch policy of the Bush Administration has not been released by the National Space Council. However, the preliminary indication is that the application to the Department of State by United Technologies Corporation to work with the Cape York Space Agency and the Soviets in Australia will be approved.

This is the first break in the U.S. policy against permitting American satellites to utilize Soviet launchers. The policy issue appears to be two aspects of technology transfer. The initial concern was that the Soviets might learn valuable secrets from being near a satellite built in the U.S. (The Administration apparently believes the PRC is not as capable of discovering these secrets.)

The corollary concern of the government is the possibility of the proliferation of launch technology to nations that currently do not possess such information. If these are, in fact, the concerns of the Bush Administration and not merely protection of the U.S. launch industry, the START launcher could be utilized countries possessing launch technology.

In the past the primary impediment to using Soviet launch vehicles has been the U.S. policy preventing export of satellites manufactured in the U.S. The vehicle for implementing this policy has been the International Traffic in Arms Regulations. The ITAR defines all satellites as munitions. This subjects them to the scrutiny of war materials whose export is governed by the Arms Control Act.

The applicability of these rules to an export application for a satellite with open technology has not been tested. If the design of a satellite has been published in open literature and the information is available to the public (except for applicable copyright protection), the technology transfer argument would fade away like the grin on the Cheshire cat.

CONCLUSION

In this time of changing policies the satellite builder and operator should keep the options open, both in design criteria and desired launch service provider. The one thing certain about U.S. government policy is that it will change. The adroit space operator will be prepared to seize opportunities as they arise.

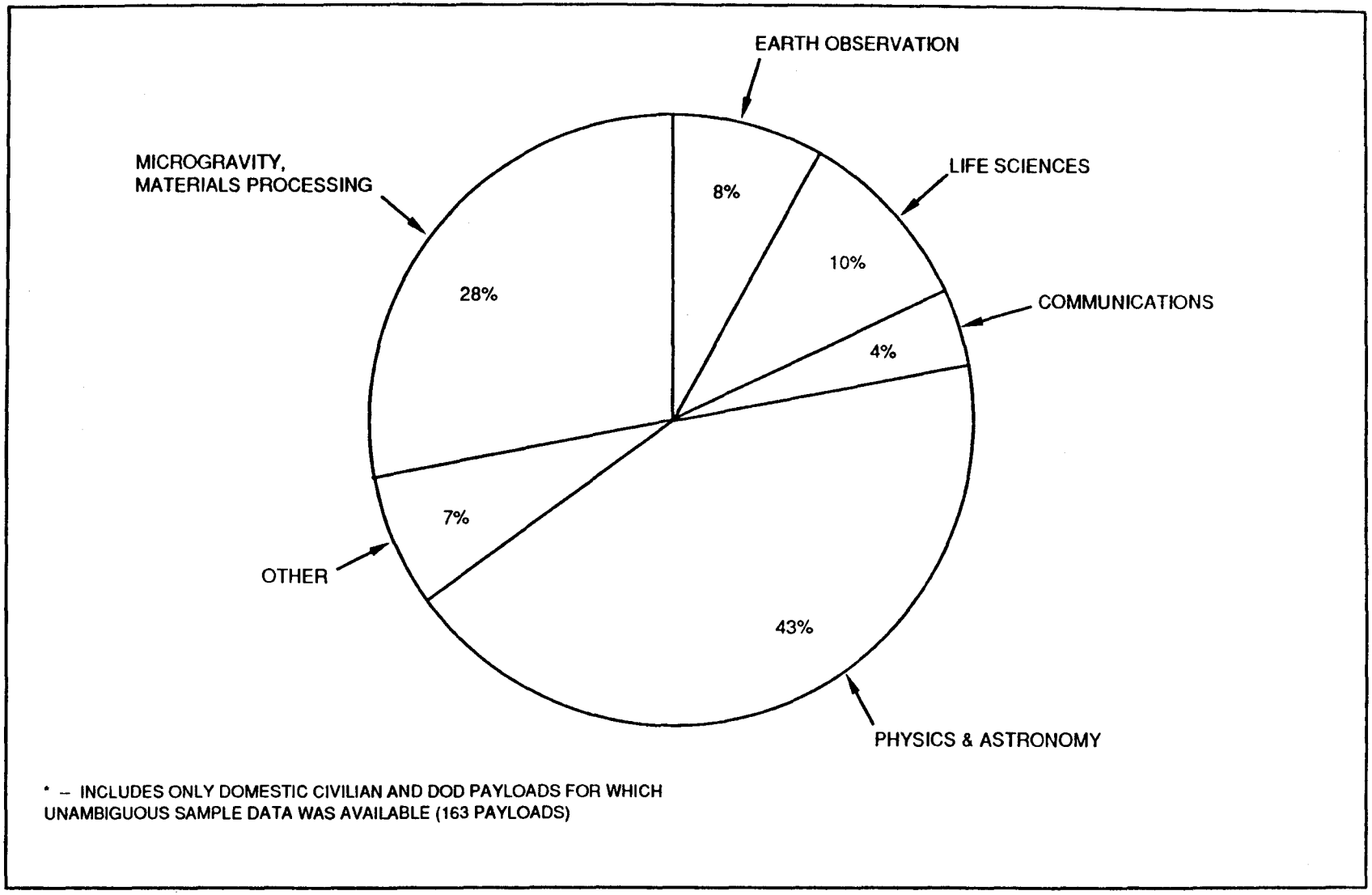

FIGURE 1 Survey Results by Discipline Area

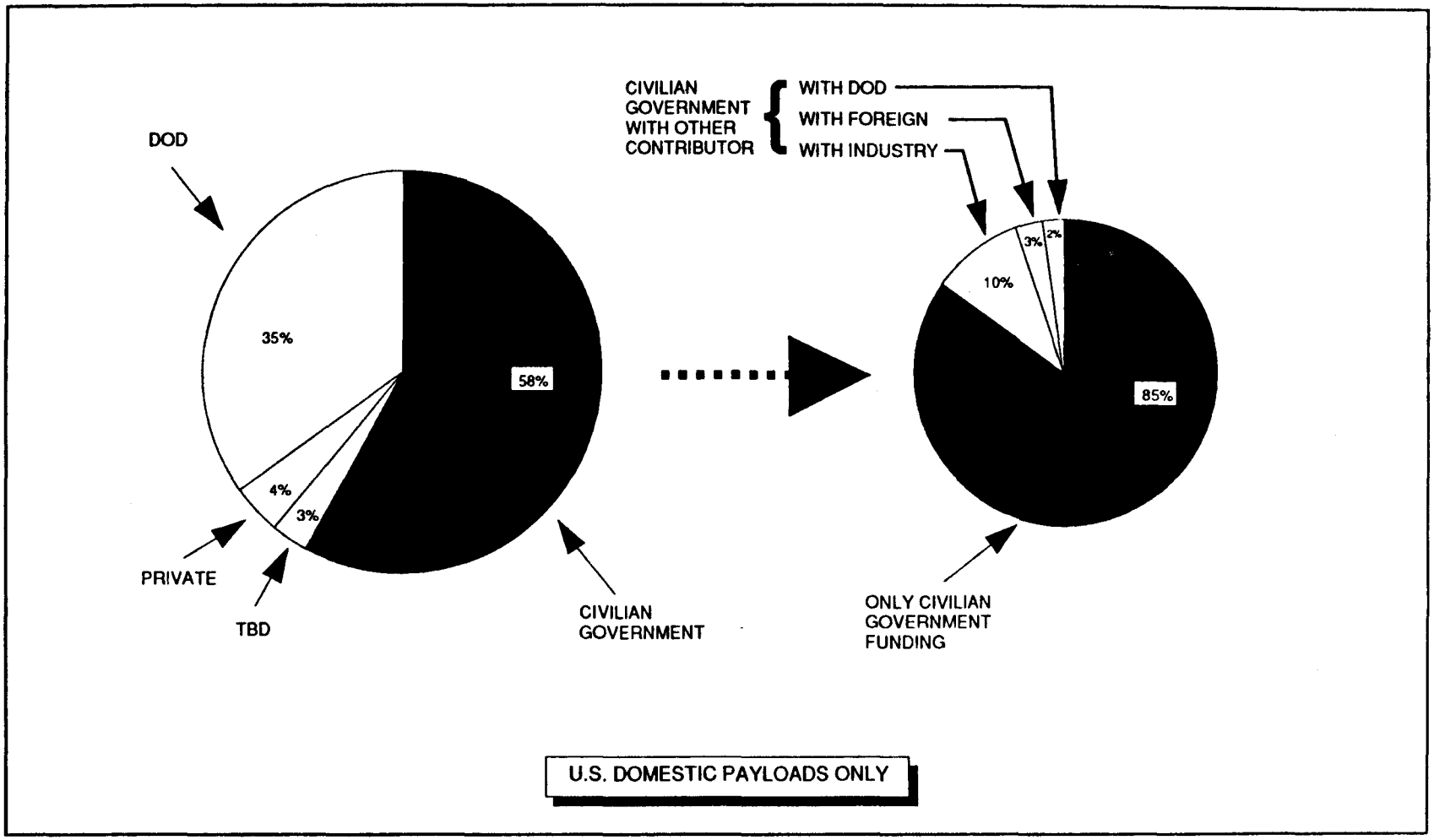

FIGURE 2: Who Pays to Develop Hardware