Multi-Billion Dollar Space Industry

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SPACE HAS become a multi-billion dollar industry that is growing rapidly; one where people are making real money. It is an exciting time — the era of the commercial development of space is here to stay, Malcolm Curie, Chairman Emeritus and former CEO, Hughes Aircraft Company (USA), recently wrote.

There is dramatic growth and opportunity in the global space industry. Undoubtedly, this industry has become the backbone of global information highway. Also, it provides new resources to help farmers increase the yields from their crops.

Satellites in low Earth-orbit (LEO), sun-synchronous orbit (SSO), and geo-synchronous orbit (GEO), orbit around Earth at the respective altitudes of 200 to 300 km, 700 to 1000 km, and about 36000 km. They usually have abilities to

- generate information observing remotely Earth's surface and atmosphere, probing the infinite space around, and/or processing the data communicated from Earth, and
- transmit with or without processing the received information together with any available generated-information.

Satellites can also

- facilitate, for various industrial ventures of the future, many special processes and experiments —most of them impossible on Earth — in the infinite space, having "perfectly clean room" environment, complete vacuum, almost zero gravity ("microgravity"), extremely low temperature (-269^{o} C), and uninterrupted infinite supply of solar power.

The activities of space industry can be viewed as civil or military. While governments sponsor military activities, in civil activities governments as well as private sectors have interests. The activities of space industry can be grouped under four sectors:

- infrastructure,
- telecommunications,
- remote sensing, and
- other activities.

Infrastructure

Under the infrastructure sector, the activities involved are design and construction of satellites and their launch vehicles, ground station, and sensors. Globally, private industries play a significant role in the activities of this sector. Even in countries where the entire infrastructure sector is owned by governments, as in India, invariably private industries enjoy significant revenues through outsourcing policies.

The dominant ground station industry includes launch facility, satellite tracking, and satellite data processing. The design, construction, and operation of launch vehicles — launch vehicles and launch facilities — are owned or very carefully controlled by governments in view of the sensitive military applications involved.

In 1996, as per the study led by the accounting firm KPMG Peat Marwick, global revenues from the infrastructure sector exceeded $46 billion, forming 61% of $77 billion for the total space industry. In 2000, this is projected to be $59 billion forming, however, only 49% of the $121 billion space-industry. This $59 billion includes 25% for satellite industry, 10% for launch vehicles, 46% for ground station, and 19% for R&D.

Telecommunications

The activities under satellite telecommunications sector primarily depend on the satellite's ability to transmit with or without processing the received information. And, the activities under remote-sensing sector principally rely on the ability to generate information, observing remotely Earth's surface and atmosphere from a vantagepoint in space. But the information received by the end user under the latter sector must have had some contributions from the former. For example, missile warning or weather forecasting primarily depends on remote sensing but telecommunications makes the information available to the end user. Reasoning this many countries, including India, have developed their cost optimized multi-purpose satellites, which have

abilities for telecommunications as well as remote sensing.

Most of the activities in the telecommunications sector have civil as well as military applications. Important examples are:

- television broadcasting and cable networking, very small aperture terminal (VSAT) transmission services, multimedia services (Internet, tele-conferencing, distance learning, telemedicine, etc.), international telephony services, and wireless local loop services under fixed satellites services from GEO;
- worldwide personal communications (cellular phones) and mobile data terminals under mobile satellite services from LEO and SSO; and
- direct-to-home television broadcasting (C band with 3 meter antennas as well as Ku band with 1 meter antennas) and satellite-based digital radio broadcast under direct-to-home services from GEO.

After the infrastructure sector, the satellite telecommunications sector forms the second major one with a very high annual growth rate of about 20%. Without question, the most powerful force in space commercialization has been the telecommunications industry.

In 2000, satellite telecommunications sector is projected to have a share of 38% of the space industry revenue of $121 billion. Commercial applications in the satellite telecommunications being the major revenue sources, private industries have become the dominant players in this sector. This trend is expected to grow to greater extent in view of deregulation and privatization of telecommunications in many countries.

Recently there has been an interesting development in the sectors of information technology and telecommunications. The development is towards the convergence of information technology and telecommunications in the direction of the commercial growth for advanced "infocom" products and services

Personal computers (PCs) and associated software comprise a major chunk in the information-technology industry. In recent years, computers — the one-time office and laboratory gadgets — have entered homes essentially through the communications facilities, namely, Internet and E-mail services. Now the most powerful software-companies, telecom giants, and investment leaders, such as Microsoft, AT&T, and Deutsche Bank respectively, are attempting through mergers and acquisitions a seamless mix of PC, telephone, television, and Internet in one "box" and exploit fully homes' infocom market.

Pocket telephones (or better known as satphones), providing additionally data, fax, and paging services, have become the reality in November 1998 with the help of the $3.4 billion Iridium project. Investors to this project are spread all over the world — India's Iridium India Telecom Private Limited is one among the total 17.

In the project Iridium, totally 79 satellites were launched within 12½ months, using three different launch vehicles through 17 flights — 10 by the US, 4 by China, and 3 by Russia. Seven failed in orbit, but 66 are only required for full system coverage, providing 6 spares in the orbits. The inter-linked 66-satellite Iridium constellation in six near polar orbital planes (SSOs) enables the coverage of all areas of Earth simultaneously.

Advances in wireless technology is now moving towards connecting anyone, anywhere, anytime not only by voice but also by "Internet in the Sky" through portable PCs, providing all types of information including voice messages, web sites, E-mail, and news.

Remote Sensing

Remote sensing is mainly used in navigation, imaging intelligence, surveillance, and meteorology. Apart from military applications such as missile warning, satellite tracking, anti-satellite weapons, and geodesy, the civil-application areas are oil and gas exploration, forestry, environmental modeling, agriculture, mining, transportation, disaster relief and monitoring, civil planning, and tax mapping.

From the remote sensing sector, two new commercial services have emerged in recent years: Geographical Information System (GIS) and Global Positioning System (GPS). GIS analysts take data from multiple sources — satellite imagery, digitized maps, census-bureau data, resident incomes, zoning regulations — and combine them to present an overall picture of the situation that they are investigating. GIS has applications in market analyses, disaster management planning, civil planning, etc. Many mayoral offices have opted to use GIS for improving their cities' administrations.

GPS combines navigation and surveillance. It has applications in marine and aviation position and navigation services, vehicle location and tracking, mapping, and surveying.

In recent years, automobile companies, such as Ford, and car rental services, for instance Singapore's Comfort Transport, are using the GIS-GPS convergence to keep track of expensive-model vehicles and direction assistance.

Ironically, notwithstanding the excellent utilities that remote sensing satellites can offer in civil

applications, national security issues for many countries have started to loom because of the dramatic growth in commercial remote sensing. Many private sector companies now own very high resolution imaging satellites. One-meter resolution is already available with these companies while a few years back this kind of resolution was available only with military intelligence. Under the "open space" policy, it may not be difficult for any interested party in getting a high-resolution image of any part of Earth's surface.

Remote sensing is an emerging field and is expected to grow at an annual rate of 16% and have a market share of about 10% in 2000.

Other Activities

Professional, financial, and insurance support services to space industry, coming under this fourth sector, are estimated to have about 2% share of the total space market. The other activities also include material processing in the space environment, astrophysics, R&D, waste disposal, space power stations, and tourism and human activities.

A very significant item in material processing is the microgravity processing, having applications in the manufacture of pure crystals for use in drug development, defect free structural materials, and better semiconductors. The disposal of toxic waste and radioactive material in space is a very touchy issue and it requires an elaborate international regulation and agreement.

Manufacture of materials, mining, waste disposal, solar power stations, and tourism and human activities can become economically viable in the space only when the satellite launch-cost per kg can be reduced by more than one order of magnitude from the present average value of $12000 per kg for a LEO. With the current vigorous attempts all over the world, this "cheap access to space" is expected to fructify before 2010.

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