SATELLITE Markets & Research

March 2011

MarketBriefs

Executive summaries of market trends and opportunities in key market segments and regions worldwide.

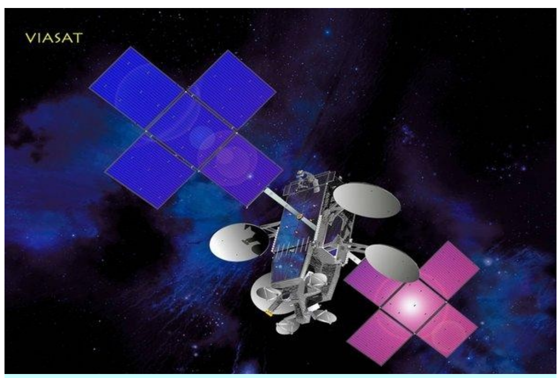
Trends in Satellite Manufacturing

by Bruce Elbert
President, Application Technology Strategy Inc.

Users of communications satellites often ignore the actual hardware in space the makes their applications possible. To help fill this gap, we review some recent trends and developments of the kinds of satellites that operators are launching. This is not intended to encompass all of the systems and services that make up the industry, but rather selects some of the more salient elements that can contribute to industry innovation and future growth.

Orbital Capacity

There are more than 250 geostationary earth orbit (GEO) communications satellites serving the global market for bandwidth and applications. These spacecraft have satisfied demand in commercial use principally for television and broadband interactive services; governments also rely on them to reach remote locations and provide the needed overlay for control and coordination. With the consolidation of satellite operators into four large companies and several mid-size players, the industry has a good financial and business foundation that allows it to replace spacecraft with newer models built mainly in the US and Europe. But, the question arises as to how these replacements will better address the needs of an evolving marketplace.



Scheduled for launch in 2011, the Space Systems Loral-built Viasat-1 will be one of the most powerful satellites in the geostationary arc. (photo: Space Systems Loral)

Configuration Trends

As we all know, a satellite is hardware that performs its mission in accordance with the laws of physics. The math that defines the process of operating the satellite hasn't changed since the launch of the tiny Early Bird GEO satellite in 1965, although many advances have facilitated large vehicles weighing over 5,000 kg and broadcasting 10 kW of RF power. Data throughput has also grown from an aggregate of approximately 1 Gbps for typical area-coverage satellites to as much as 100 Gbps for satellites that exploit multiple spot beams and higher frequency bands. Economics also play a role as they dictate what is feasible from the standpoint of the cost of building/ launching/operating a satellite in relation to the revenue derived there from.

The interplay of economics and physics, along with the limits of available rocket performance and constraints of keeping high powered satellites healthy in orbit, probably restrict basic vehicle growth from this point. This is still subject to further innovations that might allow the power generation systems to deliver more output and innovations in areas such as RF amplifiers and antennas that can increase the actual communications capability of a given satellite. But these are more evolutionary in nature, resulting in incremental improvements over the coming years.

There is the occasional step function that changes a paradigm, such as the development of the 66-satellite Iridium LEO constellation or the construction of ViaSat-1. Both of these caused some others to follow with similar approaches. Still, the basic hardware elements do not change but are only configured differently for service. Motorola and Lockheed Martin constructed Iridium out of a simple satellite design that was not, by itself, particularly innovative. The constellation has operated about twice as long as originally planned, and the next generation of Iridium is now in development at Thales Alenia Space with payload integration to be completed by Orbital Sciences. ViaSat-1, being constructed by Space Systems/Loral, is comparable in size to other GEO satellites but gains its bandwidth mainly by frequency reuse.

Backlog

Satellite manufacturers experience buying cycles due to the relatively long life of the hardware in orbit. There have been substantial peaks and valleys of purchase by the operators, who in turn are working to maintain orbital capacity from decade to decade. For example, the end of the 1990s saw a tremendous build up of purchase and construction, followed by what appeared to be a collapse. In reality, it was a common cycle repeating itself. This is a problem for manufacturers who would like a steady and hopefully increasing flow of satellite construction programs. New construction is principally for replacement satellites (as operators seek to maintain occupancy of orbit slots and the revenues derived there from), but startup ventures appear from time to time. This also includes when an existing operator works to expand their business by launching satellites in new frequency bands or with capabilities to address new markets. There are startling success stories like DIRECTV and HOTBIRD, but equally startling failures like pre-bankruptcy Iridium and Astrolink. Currently, ViaSat has moved to become an operator through construction of ViaSat-1 and acquisition of Wild Blue, and Inmarsat is expanding from their very comfortable base with L-band into a Ka-band system. Satellite manufacturers can benefit from the latter type of business, although they may end up sharing some of the risk of failure if the underlying service business does not develop.

Service Trends

The primary role of a satellite is to provide a radio relay in space and thereby connect or deliver information to many locations across a wide coverage area. How you use this resource is only a question of the need for such communication, the kinds of user terminals to be employed, and the business model within which the satellite performs its function. GEO operators like Intelsat and Inmarsat traditionally focused on the aforementioned primary role and left the issues of service and user access to their respective customers for satellite bandwidth. DIRECTV and Iridium did much to change this model as these companies addressed the space segment, the ground segment, and service to the end user (although both companies engaged partners where markets were local in nature). Intelsat, the leading bandwidth provider in the Fixed Satellite Services (FSS) segment, has developed an extensive terrestrial network using fiber between teleports. This is an effective adjunct that makes it easy for many customers to get up on the right satellite, and provide for contingencies that arise from time to time.

With all forms of video still representing the lion's share of usage and revenue of GEO satellites, the interactive broadband segment is showing encouraging signs. Remote access to the Internet has a strong following in North America and less so in Western Europe. But it is in the emerging and developing world where this type of service is expanding rapidly. This is difficult to track because of market fragmentation due the proliferation of service providers who purchase their equipment from leading manufacturers and satellite capacity from the operators. Many of these service providers are private or part of a much bigger organization, so usage and revenues are not publically available. The fact that FSS satellites serve nearly the entire globe makes it relatively easy for broadband Internet service to be put up and address a small but lucrative market. There are notable exceptions like HughesNet and Wild-Blue in North America and the newly-launched Ka-Sat in Europe. It would not be surprising to see a reduction in the fragmentation that has prevented satellite broadband from being a global force.

TerreStar-1 pictured here, has an 18-meter antenna reflector, is the largest commercial satellite ever launched to date. (photo: Space Systems/ Loral)

The mobile satellite service (MSS) sector is still dominated by Inmarsat and regional operator Thuraya, both of which employ GEO multibeam satellites, and Iridium, the surviving big low earth orbit (LEO) system. It was the belief back in the 1990s that MSS would become a personal communications service through handsets that were "pocket sized". However, the limitations of the service and awkward size of the handsets were not accepted by a broad market. Today, most of the growth in MSS usage is for government applications and commercial uses for what is termed "machine-to-machine" communications.

The Digital Audio Radio Satellite (DARS) application segment was pioneered by WorldSpace and introduced within the US by operators XM and Sirius. The latter two companies merged and their service has achieved wide acceptance by the US driving public. SiriusXM is broadcast by geosynchronous satellites (XM's are GEO and Sirius employs a combination of satellites in the Tundra highly inclined orbit along with GEO). Receiving antennas are simple in design and the actual receivers low in cost. Satellite signals are augmented by a terrestrial broadcast infrastructure within urban areas because any blockage will interrupt line-of-sight propagation from space.

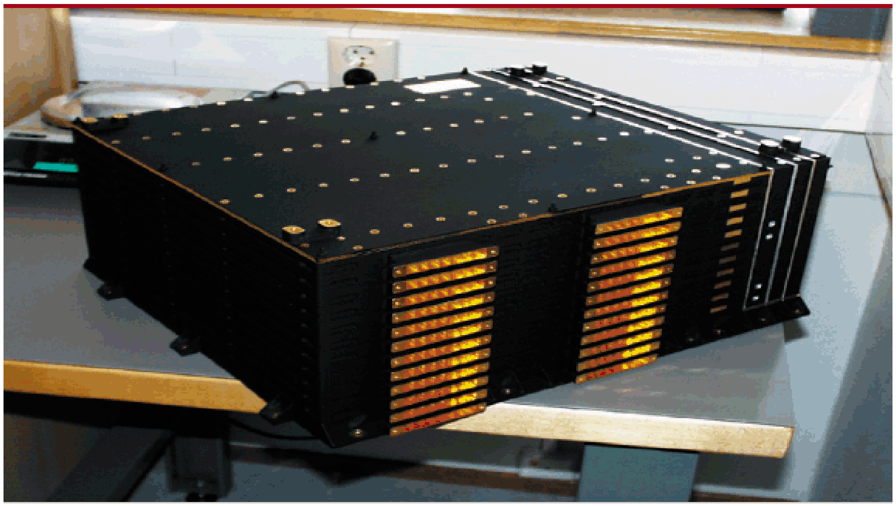
The establishment of DARS has encouraged MSS operators in the US to pursue what is called Ancillary Terrestrial Component (ATC), an amalgam of two-way MSS service and a wireless terrestrial system of cellular-type towers. ICO and TerreStar have both launched S-band satellites to initiate the space portion, and LightSquared (formerly SkyTerra) recently launched their new L-band satellite. The ATC mission looks good in principle as it allows a user to employ wireless base stations where available and efficiently transfer to the satellite in remote, open areas. TerreStar has demonstrated an attractive smartphone device called the Genius™ that would have many familiar features; however operators have not yet completed a functional satellite and terrestrial wireless network that works together as a coordinated system.

There is yet another important application that represents a coordinate use of satellite communications in conjunction with cellular and other wireless terrestrial services. Termed "cellular backhaul", it links remote base stations with a switching center in a major city. This application currently employs C- and Ku-band FSS satellite capacity in every region of the world. Growth of cellular backhaul around the world has caused satellite operators to view this as a very significant market segment in coming years.

Needs to be Filled

The Satellite Industry Association (SIA) and the World Teleport Association (WTA) along with other satellite industry groups continue to express optimism for our current and future prospects. There is now wider acceptance of satellite communications than ever before. For example, many IT organizations that once shunned satellite for its inherent propagation delay and bandwidth cost are now embracing it as a reliable means of reaching users in remote places or traveling in various modes of transportation. The ability of satellite links to provide medium and high data rate services is well recognized and the simplicity of the satellite network itself tends to simplify the job of the IT manager as well.

Boeing introduced the 702MP spacecraft in 2009 to meet the needs of customers seeking satellites in the middle-level power ranges. Its flexible design supports payloads that range in power from six to 12 kilowatts.
(image of Intelsat's IS-22 satellite courtesy of Boeing)



Inmarsat 4 Digital Transparent Processor (DTP) performs on-board digital processing of the signal without demodulation and decoding. It is implemented between pre- and post-processors, assuring RF-to-baseband and baseband-to-RF conversions.
(photo courtesy of Alcatel Alenia Space)

Satellite ground equipment is also more affordable in relation to the overall cost of service and no longer requires extensive technical training for the end user (service providers, however, still need a solid understanding of how this technology works and can be brought into use). Link capabilities are also improved with ground technology innovations like DVB-S2 and carrier-in-carrier transmission.

The technology that goes into the satellite is not much different today and innovation comes mainly in terms of the architecture employed in space and on the ground. Satellites only differ in terms of the quantity of components used to create the communications payload and spacecraft bus. The efficiency of converting solar energy indo DC power has experienced a steady rise due to better solar cells, and larger solar panels are introduced to grow the overall power level. Also, digital processing is now far beyond what we carried as recently as 2000. The first major innovation was the on-board processor, brought to operational status by Boeing in Spaceway and Thuraya. These satellites, unlike Iridium and GlobalStar, create their cellular beam patterns using digital beam forming. As a result, the beam patterns can be changed to match traffic needs. The same adaptability will be provided using ground-based beam forming on TerreStar and LightSquared.

Satellites are also available in various physical sizes to better match the need of the satellite operator. Orbital Sciences builds spacecraft to serve the under 6 kW market where as few as 24 transponders are appropriate. Larger quantities of transponders, with greater power as well, can be accommodated onboard medium to large satellites built by Space Systems/Loral, Boeing, Lockheed Martin, EADS Astrium and Thales Alenia Space. On the upper end of the spectrum, a satellite operator can purchase and subsequently launch a GEO satellite with over 20 kW of DC power at end of life and with a reflector antenna up to 20 meters in diameter.

New space hardware located at good orbital positions is very much a valuable resource, in terms of power and bandwidth available. These are the strong suits of the leaders: Intelsat, SES, Eutelsat and Inmarsat. ViaSat claims that its satellite can deliver 130 Gbps, which is impressive on its face. Likewise, large reflectors on spacecraft like TerreStar give the operator the means to deliver medium data rates to a multitude of customers using as little as 25 MHz of aggregate spectrum. Neither of these capabilities would have been possible in 2000. At the same time, Intelsat and Inmarsat demonstrate how incremental improvements in space hardware help grow what are already the highest operator revenues in the world. So we see that these satellite hardware advances help drive the leaders and the overall industry forward.

Bruce Elbert has over 30 years of experience in satellite communications and is the President of Application Technology Strategy, Inc., which assists satellite operators, network providers and users in the public and private sectors. He is an author and educator in these fields, having produced seven titles and conducted technical and business training around the world. During 25 years with Hughes Electronics, he directed major technical projects and led business activities in the U.S. and overseas. He is the author of The Satellite Communication Applications Handbook, second edition (Artech House, 2004). Website: http://www.applicationstrategy.com/ Email: bruce@applicationstrategy.com

Contributing to this article was **Michelle Elbert**, Director of Marketing for Satellite Markets and Research and concurrently a consultant with Application Technology Strategy, Inc. She has extensive experience in the satellite and IT industries and has an M.B.A. from Concordia University. She can be reached at: michelle@satellitemarkets.com