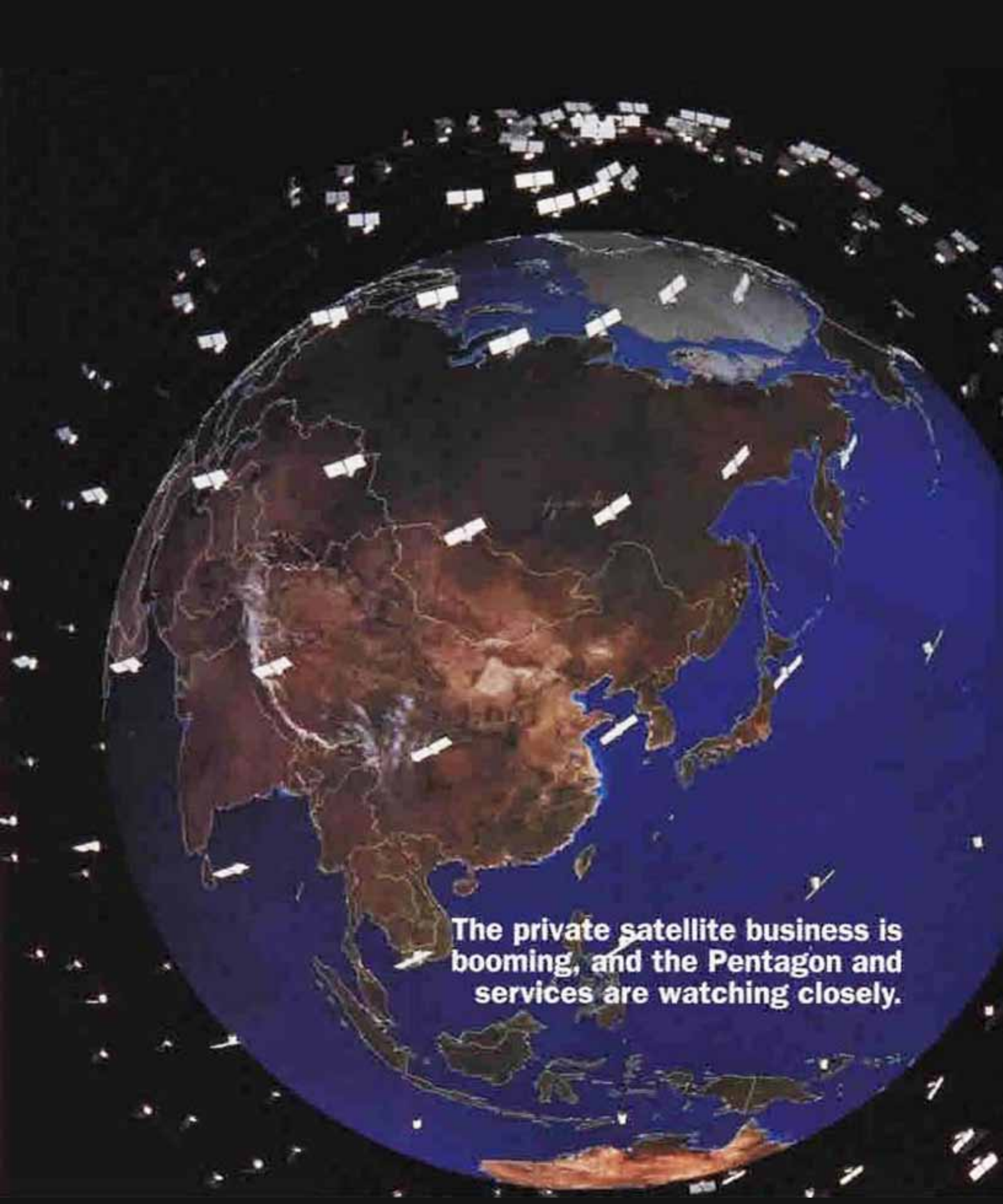
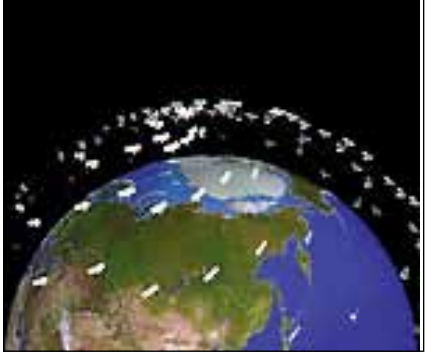


The private satellite business is booming, and the Pentagon and services are watching closely.

Photo courtesy of Teledesic



By Theresa Foley

Commercial Spacefarers

There's no question about it; the satellite industry is in boom times. Twenty percent annual growth rates for the commercial satellite industry have delivered a wide range of new choices to consumers who want mobility and information. First came Global Positioning System for the public, then Direct-To-Home television. Now, consumers will be able to buy a $3,000 Iridium telephone or a $1,000 Orbcomm receiver. Beyond that, new satellite-delivered Internet–multimedia products and services will be available before long.

US Space Command, the Defense Information Systems Agency, and virtually all the services are keeping a close eye on the commercial side of the space business. They believe it carries major implications both for military strategy and for actual use, as military forces plan to piggyback on commercial systems when possible.

Statistics indicate that the trend will continue for the next several years as hundreds more communications satellites are deployed in a variety of orbits for many purposes.

The Satellite Industry Association says that, in 1998, commercial satellite manufacturing revenues will surge to $6.3 billion, nearly double the $3.6 billion stemming from government satellite business. US Space Command analysts say that, from 2000 onward, space infrastructure could contribute $121 billion to the US economy each year.

In September, the Teal Group, a consulting firm based in Fairfax, Va., predicted that 1,017 commercial communications satellites, valued at $50 billion, would be launched in the next 10 years. Teal said that 1998 was a peak period for commercial satellite launches, and another would come in 2002–03 when replacements for first-generation mobile satellites and new broadband multimedia satellites would be launched.

In terms of numbers launched, the largest segment of the industry will be mobile communications satellites—449 in all, or 44 percent of the total, the Teal study found. Broadband multimedia satellites—384 of them, or 38 percent of the total—will be the second largest segment. Increasingly, multiple satellites will be launched

on individual rockets, meaning that the number of launches will not keep pace with the number of satellites.

The Fuel

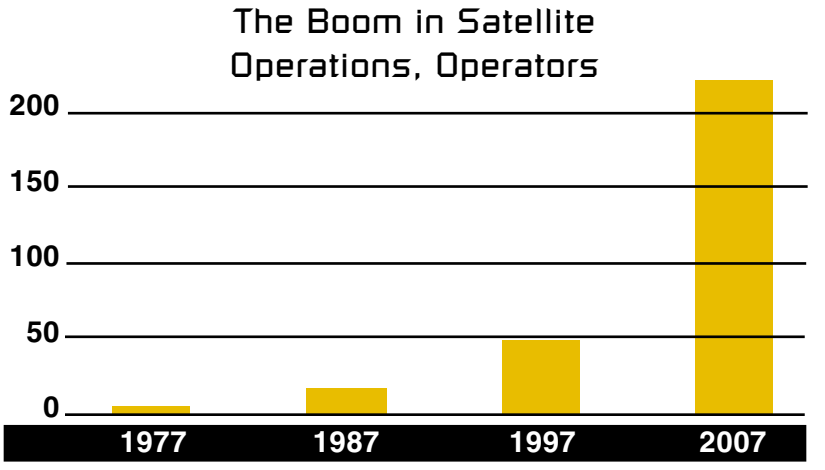
Fueling the boom is the seemingly insatiable demand by consumers for mobile communications, Direct-To-Home satellite TV, and Internet access. Teal analyst Marco Cáceres attributes the growth to a "boom in demand for telecommunications services worldwide and the development of new satellite technologies."

Eric Le Proux, managing director of Euroconsult, a Paris–based group that has studied the satellite industry for many years, cites "the emergence of new geographical markets and the deregulation of the telecom and TV industries" as other factors behind the growth. Euroconsult predicts that, during the period 1998–2007, the number of satellite launches will increase 365 percent over the previous decade. It says the growth can be chalked up to the rise of commercial satellites.

The days when satellites were limited to a narrow role in the $600 billion-a-year telecom business have ended. For their first four decades, communications satellites were used mainly as 22,300-mile-high repeater stations, beaming television or other signals from one point on Earth to broad geographic regions while using relatively simple "bent pipe" transponders. The situation really began to change in the 1980s, with the emergence of proposals for new satellite systems such as the 66-satellite Iridium global mobile telephony constellation.

Iridium and brother systems, such as Globalstar and ICO Global Communications, fly in more complicated Low or Medium Earth Orbits rather than at Geosynchronous Earth Orbit altitude. They orbit in networked constellations, sometimes employing intersatellite links, to provide global instead of regional coverage.

Today, the entire space business is being altered by a fundamental factor: the discovery by satellite builders that the real money lies not in manufacturing a $100 million spacecraft but in providing vital services to telecommunications operators and consumers. As a result, all three major US satellite manufacturers—Hughes Electronics, Loral Space & Communications, and Lockheed Martin—are either in the satellite services business or are working hard to get there. All three plan to be in the global satellite business and no longer limit their market to the US, as was the case only two or three years ago.



As the manufacturers move into operations, they should realize much higher profit margins. On the operating side of the business, the trend is to offer integrated services instead of pure capacity leasing. The result has been a huge expansion in the number of players in the satellite business.

In 1977, five operators earned a total of $300 million in revenues, according to Euroconsult. By 1997, the operating field had grown to 45 with $6.5 billion in revenues. Euroconsult expects satellite service revenues to reach $30 billion–$40 billion by 2007 and forecasts 25 percent of that huge sum coming from new applications such as mobile, broadband, and satellite-delivered radio.

Internet in the Sky

Teledesic, one of the new proposed systems, is a 288-satellite constellation that would operate in the Ka-band region of the radio frequency and provide "Internet-in-the sky" links to schools, factories, homes, and offices. Daniel Kohn, Teledesic marketing director, says, "The killer application for us will be land extension [of terrestrial broadband systems] in the first few years. The customer will be telecom providers."

Teledesic plans to begin operating in 2003. Motorola and Boeing are partnered with Kirkland, Wash.–based Teledesic, which needs at least $9 billion to build its system. The venture was founded with money from telecom billionaires Bill Gates and Craig McCaw and thus is viewed by financial analysts as having a good shot at succeeding.

Following in the footsteps of Teledesic and Iridium are dozens of other projects. These would use satellites for:

- Mobile services, not just to telephones but also to laptop computers and other small devices.
- Internet services to consumers and businesses under a new category called broadband or multimedia satellites.
- Rural telephony, where a satellite dish and pay phone are installed in remote villages in places such as Asia and Latin America, allowing several hundred villagers to share a phone, offering many the opportunity for the first time.

Several factors have converged in the last few years to make these projects more viable.

On the international trade front, an agreement on telecommunications struck in 1997 by the members of the World Trade Organization is gradually opening up markets all over the world to competition and new entrants. As the WTO agreement opens these markets, the new satellite companies have an opportunity to do business in countries that formerly had tightly controlled, monopoly telecommunications services.

On the technology side, Defense Department investment in advanced satellite technologies—in particular, projects such as Milstar—has provided companies like Motorola, TRW, Hughes, and Lockheed Martin experience that is being used in the commercial projects.

On the financial front, the public markets and private investors have pumped roughly $16 billion in the last four years into satellite projects

on the promise of extraordinarily high returns on investment, once the high cost of development has been paid.

Extraordinary Risk

The market is just learning a fact of life long known to government space managers: Along with their ubiquitous nature and "instant infrastructure" advantage over terrestrial alternatives, satellites and rockets carry extraordinarily high risk.

With three highly visible launch failures during the summer and economic crises in several countries, satellite ventures fell out of favor temporarily with investors. The failures in mid-1998 included a PanAmSat Galaxy IV loss in orbit, a Delta III accident in August that blew up PanAmSat's Galaxy X, failure of several of Iridium's 70-plus satellites to operate correctly after launch, and the devastating loss of 12 Globalstar satellites in mid-September on a single Russian–Ukranian Zenit rocket.

Stock values in the satellite sector plummeted after years of strong upward growth. Investment has temporarily dried up, but until late summer, satellite investments had delivered phenomenal returns, thereby luring in even more investment. In 1997, satellite stocks brought shareholders, on average, a 64.8 percent return in the Mobile Satellite Sector and 54 percent in the fixed satellite sector, excluding the Asian satellite companies, which had poor returns due to the economic crises there.

Carol Goldstein, Morgan Stanley executive director, said that 1998 has been "much more volatile" than at any time in the recent past. The mobile satellite stocks were down 6.6 percent for the year by early September and fixed satellite stocks had lost 35 percent of their value since the start of the year.

By the end of July 1998, satellite financings for the year had slowed to a cumulative $6.2 billion, which was far behind the $14.4 billion raised in the first seven months of 1997, according to Stephane Chenard, an analyst with Euroconsult.

Analysts say the satellite industry is poised for sizable expansion, despite the risks and problems encountered this year.

In the mobile satellite category, market leader Iridium was to enter commercial service Nov. 1, followed by Globalstar in late 1999 and ICO in August 2000.

Iridium shapes up to be the gold-plated service, with its charges reaching about $3,000 for the satellite telephone handset and $4.50 to $9 a minute for telephone calls. Globalstar is to be considerably less expensive, with telephones priced under $1,000 and calls at $1.50 a minute, plus a service provider markup.

The market for global MSS is estimated to be 25 million subscribers by 2005, according to Iridium, a venture that claims to be able to break even at 600,000 users. Merrill Lynch estimates that subscribers will reach 32 million by 2007 with revenues of $31.6 billion in the sector.

At least two other firms, Mobile Communications Holdings, Inc., and Constellation Communications, Inc., plan to enter the MSS business but are years behind the three market leaders. In 1998, MCHI and Constellation claim to have begun building their first satellites, but both ventures need to raise considerably more money to complete their development and get into business.

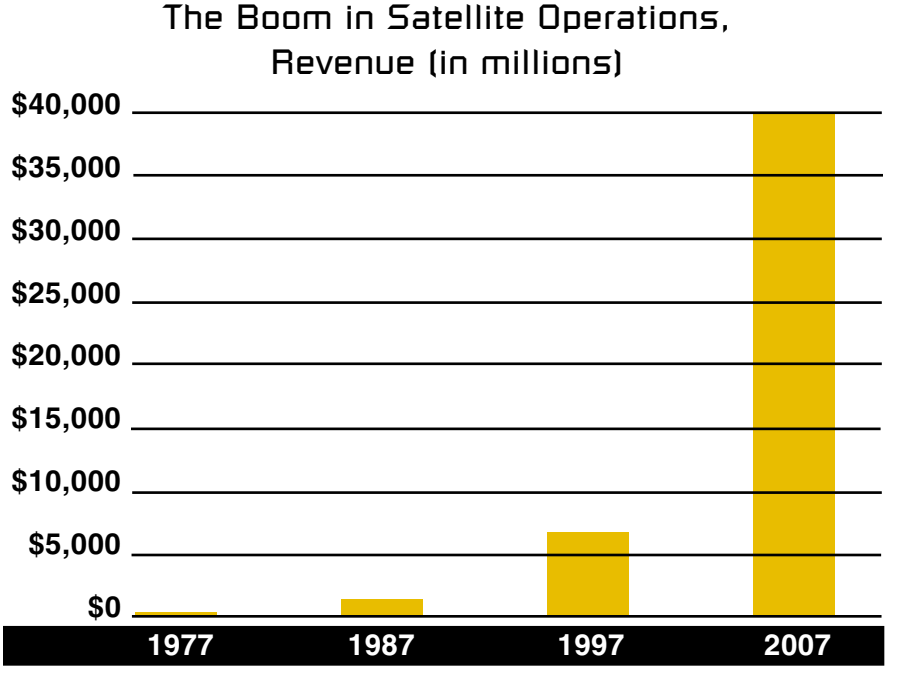
The "little LEO" business also was gearing up this fall for first commercial services with the market leader, Orbcomm, completing its 28-satellite constellation with launches in August and September. For $1,000 or less, Orbcomm offers a communicator device that combines GPS signals with a short data messaging capability, allowing a user to transmit location and a message from anyplace on the planet for a few pennies. Orbcomm CEO Scott L. Webster says small Orbcomm cards, about the size of a matchbook, will be available for $100–$200 within a year.

Military Potential

The miniaturization will enable Orbcomm's communications capability to be embedded in many portable devices for use in industry, by sports enthusiasts, for travelers, and with an obvious appeal to the military. Orbcomm should have the market to itself for about three years before competing systems from Final Analysis, E-Sat, and LEO One can start operations, according to Merrill Lynch. Those three systems are licensed to operate but in the fall were still raising money to build their systems.

The little LEO ventures are relatively inexpensive to deploy, costing several hundred million dollars compared to the billions needed for MSS or broadband.

Direct-To-Home satellite television reaches 9 million US homes currently. Hughes' DirecTV announced its 4 millionth subscriber in September and expects to reach its break-even point in early 1999. Familiar names like DirecTV, EchoStar, and Primestar have demonstrated that satellite television can compete successfully with cable television. Overseas, virtually every large nation has one or more DTH operators, with more introduced each year. Although



analysts have been disappointed in general with the DTH business because subscriber numbers have consistently fallen short of projections, the application will continue to grow and fuel the demand for geostationary satellites. One recent study reports that subscribers will total 55.4 million by 2002, five times the number in 1997.

Rural telephony is emerging as an area where satellites finally are proving their value. Teledensity, or the number of phone lines per 100 persons in a country, is very low in most developing countries, and an estimated 500 million telephone lines are needed around the world in remote towns and villages. In the past, high costs, which could run $20,000–$60,000 for all the equipment needed to install a single telephone connection, kept satellite dishes from use as single or multiple line phone connections. However, in the last two to three years, suppliers such as Hughes Network Systems and Gilat Satellite of Israel, have brought the cost of Very Small Aperture Terminal–based telephone installations down to under $3,000.

In a dozen countries, satellite rural telephony projects have begun operating in the last year or so, demonstrating that, when they share a phone, even villagers in Latin American or African nations can afford enough minutes per month to make them economically justifiable. The calls are costing from a penny to 15 cents a minute, or higher, and sometimes are subsidized, but early evidence is showing that satellite costs for this application can be low enough to work.

Euroconsult says hundreds of thousands or millions of satellite rural telephones could be needed as more countries deregulate, the number of competing carriers multiplies, and technology on the satellite side continues to improve and cost less.

Satellite Radio

Digital Audio Radio Services, yet another new satellite endeavor, uses geostationary satellites. The pioneering venture in this field is WorldSpace, which launched the first of its four satellites Oct. 28 on an Ariane rocket. WorldSpace's AfriStar satellite in early 1999 will introduce satellite radio into Africa, the Middle East, the Mediterranean, and parts of southern Europe. Two other WorldSpace satellites—AsiaStar and AmeriStar—will extend coverage to Asia, Latin America, and the Caribbean later in 1999.

In the US, satellite-delivered radio will become available in 2000 after CD Radio and American Mobile Radio Corp. launch their competing satellite systems. Merrill estimates that nearly 54 million subscribers will use the satellite radio services by 2007, with revenues in the $8.7 billion range.

Much of the projected growth for satellites is based on proposals for a new breed of satellites—broadband, multimedia systems that would deliver high-speed data. The explosive growth of the Internet and an underlying demand for more data services in general are behind some four dozen proposals for new satellite systems that would augment terrestrial transmission methods like fiber optic cables, telephone lines, cable TV networks, and wireless terrestrial systems.

Intelsat, which with 19 satellites currently in geostationary orbit has become one of the world's largest satellite operators, finds that "Internet via satellite is the fastest growing service ever," says Susan Gordon, an Intelsat official.

She added, "Customers say they prefer satellites over terrestrial for the ease of implementation. We think GEOs are the medium of choice for applications like multicasting and caching," two new Internet–service-related techniques of managing and storing web data.

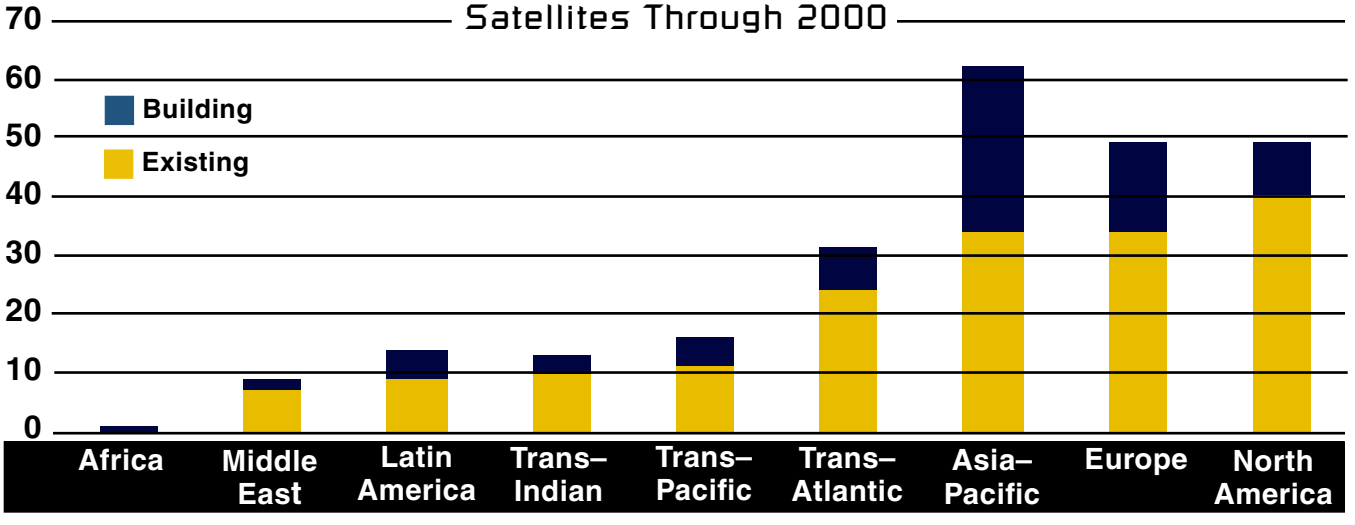
Virtually all the existing satellite operators plan to serve the multimedia market in some fashion, as do new entrants such as Teledesic and SkyBridge, a French–backed project that plans an 80-satellite system to start operating in 2001.

Techno Darwinism

The demand has drawn out at least 42 satellite proposals, representing 1,100 satellites at a cost of $114 billion to build, according to Roger J. Rusch, president of TelAstra, a Palos Verdes, Calif.–based consulting company. Rusch and other analysts say the market likely will support only three to five of the systems, so most of these will remain paper satellites.

The proposals are wide-ranging. They include geostationary and non-geostationary constellations and operating in a variety of bandwidths. Some are licensed, others are not. Some of the systems involve numerous satellites and global coverage, while others are more limited in scope, covering only one region and costing much less to deploy.

Teledesic, SkyBridge, and systems proposed by Hughes, General Electric, and Lockheed Martin are leading the broadband satellite pack.



Most of the projects aim to be up and running in the 2001–03 period. Other companies, like Loral, are testing broadband waters early by offering services over existing satellites and deferring decisions on investing in new dedicated broadband satellites. Loral's CyberStar company is offering corporate networking services over Loral's Skynet satellites.

Rusch warns that the broadband satellite sector has many problems to overcome before operations can start. Rain fade will interfere with the higher frequencies such as Ka- and V-bands, forcing the use of larger dishes and resulting in service outages in some places with a lot of rainfall. The technical challenge of developing small, relatively cheap terminals that can track fast-moving, low satellites for consumer applications could drive equipment costs up and set back the companies with low Earth orbiting systems. The billions of dollars required to build the satellites still must be raised, and investors are not likely to sink money into the broadband satellites until the mobile satellite systems like Iridium prove to be profitable.

Even more-visionary satellite applications are emerging for later in the first decade of the new century. A next-generation mobile phone system requiring dozens more satellites in Low Earth Orbit to follow Iridium is being planned by Motorola under the name Iridium Next, or INX. Motorola has been secretive about the project, for competitive reasons, but is believed to be designing a system that would allow the small handheld phones to perform many more functions than the basic voice, paging, and very slow data transfer of the first-generation Iridium.

Horizons, a geostationary satellite system that would allow laptop computers to connect via satellite from anywhere in the world, is another mobile venture sponsored by Inmarsat, the global maritime satellite organization. But Inmarsat will have to privatize, as it plans to do next April, before it can proceed with the new venture.

High Military Interest

Military interest in the new communications satellite ventures is keen.

Air Force Lt. Col. Edward Alexander, staff assistant for satellite communications systems in the Defense Department's C^3I Systems Office, says DoD is taking advantage of the commercial satellite market on two levels.

"We're reaping a tremendous dividend in new systems that we didn't have to pay a lot of development costs for," he noted. "We used to lead the commercial market in development and engineering, but that has flip-flopped. We are now able to buy satellites off the production line that are much more capable and can be flown much sooner. We're looking at three to four years rather than seven to 10" to develop a satellite.

"In addition we do a fair amount of leasing, and as there are more players in the marketplace, it is driving down rates," he said.

So far, the Defense Department has signed on for only limited use of the new satellites. The Pentagon is buying some 2,000 terminals for the Iridium system and building its own "gateway" ground station to access the system. Orbcomm has orders for 600 terminals for vehicle asset tracking from DoD, with the prospect to grow to 50,000.

"With a $100 million investment for the Iridium gateway, we can use the 66-satellite system" that cost about $5 billion to develop, he says. "For the next big class of commercial satellite—broadband systems like Teledesic and SkyBridge—we are looking at a similar scenario to leverage a system on orbit and just receive services."

Numerous DoD studies have concluded that, in the long run, it is cheaper for the military to own its own satellites than to rely on commercial services, but in the short term, military communications managers are finding that commercial satellites can fulfill immediate requirements within available budgets. Alexander points out that by law, contractors can only make 12 percent profit on a satellite DoD buys, but for commercial transponders, the markup is not regulated and can be 30–50 percent. DoD users who need communications that are nuclear-hardened or with anti-jamming features will have to be carried on Milstar or the Milstar Follow-On system since alternatives, whether they are military or commercial, will not have the costly protection features. For that reason, Alexander said, he sees commercial systems serving as an adjunct to DoD satellites, not as a replacement.

"Due to the declining congressional budgets for defense spending and the explosive growth in information, DoD has had to look at moving a good percentage of its day-to-day communications traffic from military systems to commercial systems," says Mary Ann Elliott. She is president and CEO of Arrowhead Space and Telecommunications of Falls Church, Va., a company that provides domestic and international satellite communications capacity to US military and other users. DoD information managers want to provide digital information, including detailed digital battlefield maps, to all participants in a conflict.

"This requires expansive amounts of bandwidth. They are looking at utilizing the mobile satellite systems, but increasingly, they are looking at Ka-, V- and Q-bands," Elliott says.

Although Elliott believes the military will find using commercial systems more expensive than owning its own, she said DoD and the services are being forced to go commercial because Congress won't allocate funds for new military satellite systems and because the services have been unable to define, fund, and build communications satellites in a timely fashion. As evidence, Elliott cites the $18 billion investment in Milstar, with its limited capacity and low data rate.

Already DoD buys some commercial satellite capacity through brokers like Arrowhead and Comsat, which holds a sizable contract from DISA to provide commercial satellite services. The Defense Department also is considering paying up front for a commercial space segment before it is used so that the commercial operators will consider special requirements like hardening of satellites against radiation or attack.

Elliott says DoD will have to deal with internal conflicts as it uses increasing amounts of commercial satellite services. "The government has to realize it is just another user on a commercial system, and not even a major user," Elliott remarked. ■

Theresa Foley, a freelance writer living in Florida, is a former editor of Space News. *Her most recent article for* Air Force *Magazine, "Corona Comes In From the Cold," appeared in the September 1995 issue.*