An Introduction to VSAT Services and Service Providers in the U.S.

Summary

Very small aperture terminal services started in the 1980s. Over 500,000 systems are now in operation worldwide. Understand the technology and the services before implementing your VSAT network.

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Technology Basics

While business satellite services have been around for many years and are based on mature, well-established technologies, residential (consumer) satellite services emerged more recently and now offer viable alternatives for two-way data service, Internet access and home TV service. The standards and technologies used in satellite systems continue to improve today, with the result being more reliable and more cost-effective solutions for both business and residential customers. The satellite services industries for consumer and business markets continue to enjoy healthy annual growth figures, and this trend is expected to continue for the near future, although growth in very small aperture terminal (VSAT) services is at a slower pace. The balance of this report will examine the use of VSAT technology and services for enterprise business applications, primarily in the United States market.

The first satellite (SPUTNIK) was launched in 1957. In the early 1980s, a small company began developing a new satellite transmission system — the digital phase shift keying (PSK) Ku-band VSAT. Envisioned was a low-cost low-to-medium-speed data communications enterprise network that could link thousands of locations. The original network grew from about 150 digital VSATs in 1986 to over 150,000 VSATs worldwide by 1996. These time division multiplexing/time division multiple access (TDM/TDMA) VSAT networks are now manufactured by leading companies around the world (and include some networks using other technologies, such as frequency hopping TDMA [FTDMA]), with estimates of over 500,000 systems in operation around the globe. VSAT networks today are used for voice, data and video (as well as IP) services by a large variety of industries.

A VSAT system consists of a satellite transponder, a central hub or master earth station, and the remote VSAT units. An overview of each of these components follows.

Satellite Transponders

Located within the satellite itself, the transponder (or repeater) performs the following functions:

- Signal reception — receives signal uplinked by a VSAT or hub
- Frequency translation — where the frequency of the received (uploaded) signal is translated to a different frequency, known as the download (transmitted) frequency (to ensure that there is no positive feedback and to avoid interference)
- Amplification — where the transponder also amplifies the downloaded (transmitted) signal

A typical satellite has multiple transponders operating in one or more frequency bands (such as C band, Extended C band, Ku band and Ka band), with each transponder typically having a bandwidth of 40MHz.

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Uplink GHz (Earth Station to Satellite)</th>
<th>Downlink GHz (Satellite to Earth Station)</th>
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<tbody>
<tr>
<td>C Band</td>
<td>5.925 to 6.425</td>
<td>3.700 to 4.200</td>
</tr>
<tr>
<td>Extended C Band</td>
<td>6.725 to 7.025</td>
<td>4.500 to 4.800</td>
</tr>
<tr>
<td>Ku Band</td>
<td>14.000 to 14.500</td>
<td>11.700 to 12.200</td>
</tr>
<tr>
<td>Ka Band</td>
<td>27.500 to 31.000</td>
<td>17.700 to 21.200</td>
</tr>
</tbody>
</table>

Source: Gartner

Because the Ku band uses higher frequencies, it can also support smaller antenna sizes (in comparison to C and Extended C bands); however, it is also more susceptible to rain outages. The Ka band will
provide wider bandwidth service (over 10 Kbps to 100 Kbps) and wide-bandwidth service (at about 1.5 Mbps to 155 Mbps) for VSAT networks. The Ka band systems will also support the use of even smaller antennas (ranging from about 45 centimeters to 60 centimeters in diameter); however, the Ka band can then be even more susceptible to rain outages than the Ku band. As a result, these systems may continue to use Ku-band-size antenna (dishes). By comparison, the C band and Ku band, by definition, are restricted to using antennas that are less than or equal to 7.8 meters or 3.8 meters in diameter, respectively. Realistically though, most VSAT antennas used today range from about 0.75 meters to less than 1.0 meters in diameter, with larger (1.2 meter) antennas required in some high average rainfall areas. The basic concepts to keep in mind here are the following:

- The higher the frequency band used, the higher the bandwidth (transmission speeds) supported.
- The higher the frequency band used, the smaller the antenna required.
- The smaller the antenna, the lower the power requirements for the transmitter.
- Smaller antennas using less power generally result in lower costs.
- Smaller antennas may also be more susceptible to rain outages.

Central Hub or Master Earth Station

One or the other handles the monitor and control functions in a VSAT network and (in some applications) the communications with the VSAT terminals in the network.

The functionality of the central hub or earth station (typically with an antenna measuring six meters to 11 meters in diameter) is dependent on the type of VSAT network deployed. In a star topology, the central (hub) earth station controls, monitors and communicates with the VSATs in the network (typically a large number), and all of the VSATs communicate with the central hub only. In a mesh topology, the hub station performs the monitoring and control functions for the VSAT network. The VSATs communicate directly with any other VSAT in the network without going through the hub. Mesh topology networks are well-suited for telephony applications and for networks requiring point-to-point high-speed links. Many VSAT networks also use a hybrid topology, employing a combination of both the star and mesh topologies. Typical applications for a VSAT network would be in the retail and hospitality industries, which use VSAT for high-speed credit authorization, point-of-sale polling and back-office Internet/intranet access.

Remote VSAT Units

Each remote VSAT unit is comprised of two basic modules: an outdoor unit and an indoor unit.

The outdoor unit consists of an antenna and Radio Frequency Transceiver (RFT). The antennas in general use today are typically about 0.75 meters to 1.2 meters in diameter, although larger antennas (measuring 1.8 meters to 2.4 meters) are also in use. The RFT handles down-converting, for amplification and down-conversion of the received signals, along with up-converting and high-powered amplification for up-converting and amplifying the signals being transmitted. The up/down-converters also convert frequencies between intermediate frequency (usually intermediate frequency level 70MHz) and radio frequency. For example, using Extended C Band, the down-converter receives signals at 4.5GHz to 4.8GHz, and then the up-converter converts it to 6.725GHz to 7.025GHz.

The indoor unit functions as a modem and also interfaces with the end-user equipment, which could include stand-alone PCs, local-area networks (LANs), telephones, private branch exchange (PBX) telephone switching systems or point-of-sale equipment/devices. Typically, the indoor units also have built-in routing capabilities. The indoor unit also contains the frequency demodulator used to encode the
signal set. The indoor unit typically connects to the outdoor unit via a low-loss coaxial cable, which is usually no longer than about 300 feet.

**Operating Requirements**

One of the main requirements for a VSAT network is a satellite service provider with an operational network of in-orbit satellites. These satellites can be initially defined by their orbital position (in distance from the earth) as being low earth orbit (LEO), middle earth orbit (MEO) or geosynchronous earth orbit (GEO).

<table>
<thead>
<tr>
<th>Table 2: LEO, MEO or GEO</th>
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<tbody>
<tr>
<td><strong>Type</strong></td>
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<tr>
<td>Distance from the Earth</td>
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<tr>
<td>Time on Line of Sight</td>
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<tr>
<td>Typical Round-Trip Signal Delay</td>
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<tr>
<td>Number of Satellites Needed for Worldwide Coverage</td>
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<tr>
<td>Benefits</td>
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<tr>
<td>Drawbacks</td>
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**Technology Analysis**

Long viewed as a technology geared toward low-speed data transmission, used to connect large numbers of disparate, remote sites (or to connect sites in remote geographic locations), satellite technology has reemerged as a multifaceted transmission medium capable of handling high-bandwidth applications, including voice, data and video. Satellite technology is also now universally viewed as a viable alternative to terrestrial technologies, such as private line, frame relay and other services, as well as a means for providing disaster recovery and transmission network backup. VSAT networks can be quickly deployed; are capable of serving remote areas, in addition to sites in densely populated areas supporting low to high bandwidth applications; and are cost-competitive with terrestrial services (especially when compared over a multiyear period).
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Business Use

Some typical applications of VSAT network services include credit authorization terminals, inventory control systems, centralized data collection systems, point-of-sale terminals, reservation systems, distance learning, videoconferencing, disaster recovery, data transmission, voice services, TV broadcasting, Internet access, shipboard communications, global positioning systems, telemedicine and many more. As the technology continues to improve (resulting in higher bandwidths and lower costs), the number of applicable business uses will continue to grow.

Benefits and Risks

Some of the major benefits of VSAT networks are the relatively quick deployment time and their ability to provide services to remote locations (where terrestrial services are not so readily available). They are also an ideal distribution medium for point-to-multipoint applications, such as for the distribution of broadcasting content.

Some of the major risks with satellite services are the higher startup costs per location and the potential for more downtime (as compared to terrestrial networks). Keep in mind, however, that terrestrial (landline) networks are also prone to service disruptions and downtime as well, while some VSAT customers may experience very little satellite network downtime. In terms of space segment, there is also the risk of both in-orbit failures, as well as launch failures. Launch failures, however, do not generally impact VSAT customers, since VSAT customers are sold network capacity on satellites already in orbit. To mitigate the risks, however, costs for VSAT services can be highly competitive with terrestrial services (especially if total costs are compared over a multiyear period). Satellite service providers are providing service-level agreements that typically guarantee uptimes of around 99.9 percent (almost comparable to terrestrial networks and certainly adequate to suit a large variety of user needs).

Standards

There are a variety of standards that affect satellite services, and there are numerous standards and regulatory bodies involved in this area. Consider that most satellite service providers offer their services on a multicountry basis, and many offer their services on a regional or global basis. The result is the involvement of numerous country, regional and international regulatory bodies, in addition to the standards bodies that cover both the satellite services and the terrestrial applications for which the satellite services are being used, and various space agencies.

A partial list of some of the major standards and regulatory bodies and space agencies involved in satellite communications includes:

- Satellite Earth Stations and Systems (SES)
- European Telecommunications Standards Institute (ETSI)
- Telecommunications Industry Association (TIA)
- International Telecommunication Union (ITU)
- Satellite Alliance USA
- Global VSAT Forum
- Society of Satellite Professionals International (SSPI)
- Satellite Broadcasting and Communications Association (SBCA)
Price vs. Performance

In comparing VSAT network services to competing terrestrial network services offerings, VSAT often comes out with a higher startup cost by comparison, because the enterprise user has to purchase (or lease) the VSAT equipment for each site in the network, plus pay the monthly fees associated with the service offering. However, if the total costs are compared over a longer (multiyear) period, then the VSAT offerings can be quite competitive. The potential enterprise business user should also keep in mind that the cost of VSAT equipment has been falling over the past several years as technology improvements come to market. In the 1980s to early 1990s, first-generation C band VSAT equipment for data applications cost around $10,000 to $20,000 per site. From the early 1990s to late 1990s, second-generation C/Ku band VSAT equipment for voice and data applications cost around $5,000 to $10,000 per site. From the late 1990s to the present, third-generation C/Ku/Ka band VSAT equipment for multimedia applications has dropped in cost to under $2,000 per site. And while the technology has improved, the applications increased and the costs have come down, the performance (in terms of bandwidths supported) has increased. As a result, VSAT network services have become very attractive alternatives to competing terrestrial service offerings for certain types of enterprise, government and other vertical markets.

Selection Guidelines

When considering the implementation of a VSAT network, the enterprise business user should take the following points into mind:

- Applications to be handled over the network
- Bandwidth requirements
- Number of sites in the network
- Geographic area of coverage required
- Acceptable level of service/downtime
- Time frame to implement network
- Interaction required between remote sites and central location (or from remote site to remote site)

Having developed a clear understanding of the total network requirements, the user can now contact vendors of both VSAT and terrestrial networks to get comparable quotes. To realistically compare the vendor offerings, the user should get quotes that cover a multiyear period of operation. Beyond that, the user should also do a thorough vendor due-diligence study to ensure that each vendor is capable of providing a long-term business relationship, a high level of service and support, and guaranteed quality-of-service levels, including arrangements by the vendors to provide backup service in the event of a (terrestrial or satellite) network failure.
The leaders in the VSAT network services area include companies such as Hughes Network Systems (Direcway), Gilat Satellite Networks (Spacenet), SES-Americom, ViaSat and a number of others. While it is difficult to cover all of the vendors and all of their service offerings within the scope of this report, a brief overview of the main service offerings of these four vendors follows.

**Hughes Network Systems (www.hns.com)**

Hughes Network Systems (a subsidiary of Hughes Electronic Corporation — www.hughes.com) is a leading provider of satellite services, satellite networks and user equipment. Its headquarters are in Germantown, Maryland, and services are provided throughout the U.S. (and globally) under the Direcway brand. In 2004, Hughes expects to launch its new Spaceway services that will support higher-speed services and operate in the Ka band. Also, keep in mind that (in December 2003) GM (the owner of Hughes Electronics) sold off the Hughes Electronics unit to News Corporation. It is not known if News Corporation has any plans to change the focus of the Hughes Network Systems group.

The Direcway service offerings include Internet access (to provide an always-on Internet connection for an enterprise’s main and remote sites), private IP network (to connect an enterprise’s remote sites to the corporate LAN), multicast delivery (to support the transmission of large files to multiple sites simultaneously), multicast streaming (to transmit live streaming media to multiple sites simultaneously), satellite backup service, hosted applications (such as in-store music and messaging/advertising services, along with support for e-payment processing), Wi-Fi or Wireless Fidelity access (for wireless Internet service providers to provide Internet access via satellite from Wi-Fi hot spots), broadcasting services (for satellite music and TV) and many more. Additionally, Hughes offers a number of business solutions for various vertical markets, such as automotive, education, e-learning, financial services, healthcare, petroleum/convenience stores, restaurants, retail and teleworkers.

The Hughes product offerings include VSAT terminals and DirecPC (Internet access) terminals, for both the outdoor antenna (dish) and indoor units.

**Gilat Satellite Networks/Spacenet (www.gilat.com)**

Gilat is also a leading provider of satellite services worldwide, providing consumer and enterprise business (VSAT) services, along with fixed-location satellite telephony and Internet access services. Like Hughes, Gilat provides both the services and the equipment. Gilat’s Spacenet subsidiary (acquired from GE Americom in 1998), headquartered in McLean, Virginia, provides two-way broadband satellite services throughout North America, while other divisions of the company handle consumer services in North America, along with satellite services around the world.

The service offerings of Gilat/Spacenet include Skystar Advantage (an IP VSAT service supporting speeds up to 8 Mbps outbound from hub to VSAT and up to 153 Kbps inbound from VSAT to hub), Skystar 360E (enterprise VSAT service supporting speeds from 2 Mbps to 52.5 Mbps outbound and 0.5 Mbps inbound, along with multicasting applications), DialAw@y IP VSAT (service delivers up to six telephone lines plus always-on Internet access to remote locations), Faraway VSAT (offers multichannel voice and high-speed data for use in remote locations) and SkyBlaster 360 VSAT (marketed in the U.S. by the StarBand Communications, supports outbound speeds of 2 Mbps to 52.5 Mbps and inbound speeds of 153 Kbps for Internet access, along with support for unicasting, multicasting and interactive content delivery applications).

**SES-Americom (www.ses-americom.com)**
SES-Americom (a subsidiary of SES Global, with a fleet of over 40 spacecraft) is headquartered in Princeton, New Jersey, and serves North America, Central America and the Caribbean via 13 satellites dedicated to those areas. SES also serves Latin America (via an equity interest in NahuelSat), Europe (via Sirius 2) and parts of Asia and provides transoceanic connectivity. Formerly a leading provider of satellite services for the broadcast and government markets, SES is now also providing services to the enterprise business market.

Services offered to enterprise customers include Internet access, end-to-end network services (analog or digital service with data rates from 9.6 Kbps to over 60 Mbps for private data networks, videoconferencing) and disaster recovery services (with data rates from 56 Kbps to 50 Mbps utilizing shared network, private network or on-demand service solutions).

**ViaSat (www.viasat.com)**

ViaSat is also a leading provider of satellite services, satellite networks and user equipment. Its headquarters are in Carlsbad, California, and services are provided throughout the U.S. While ViaSat does not have its own fleet of satellites, the company does contract for time and bandwidth using the facilities of other satellite service providers (such as Loral, PanAmSat, SES and others). ViaSat operates shared hubs in Atlanta and Carlsbad through which users can connect their VSAT networks, and ViaSat maintains a network operations center (NOC) to monitor, control and manage satellite networks for its customers. The NOC can provide on-demand or 7x24 service for customers and offers full-service capabilities with a variety of built-in security and redundancy factors to ensure full support.

ViaSat’s products include systems for network access or communications infrastructure, supporting virtually any combination of voice, data and multimedia applications, including IP over satellite services and applications (particularly Voice over IP services), and supporting operations in the C, Ku and Ka bands. ViaSat systems can support inbound speeds up to 1.5 Mbps and outbound speeds up to 60 Mbps.

**Technology Alternatives**

The primary alternative to VSAT satellite services are the host of wireline terrestrial services, including private line, frame relay, virtual private network and high-speed Ethernet. Depending on the situation, VSAT may be better, wireline/terrestrial services may be better or a hybrid approach using both technologies may be appropriate. The other possibility is to use terrestrial/wireline services as the primary network topology and to use VSAT services for backup or disaster recovery. The alternative approach might also prove to be ideal in some circumstances — that is to use VSAT services as the primary network and to use wireline/terrestrial services for backup or disaster recovery purposes. See the Selection Guidelines section, and follow those for whatever approach is chosen. And in all cases, it is advisable to get quotes from multiple vendors before contracting for services from any of them.

**Recommended Gartner Research**

VSATs Still Have a Solid Enterprise Role, DF-20-2410

Alternate Wireless Technologies: Client Survey, QA-20-7578

Next-Generation Satellite Technology to Become Viable Market, TELC-WW-DP-0564

**Insight**

In the final analysis, VSAT network services offer a viable and competitively priced alternative to the more traditional wireline terrestrial service offerings. Satellite technology continues to improve, resulting in higher bandwidths, support for additional applications and lower costs. And satellite services continue to show good annualized growth rates, despite the weak economy, boding well for the future of this
technology. Enterprise business users just need to be certain to thoroughly identify their needs and expectations prior to contracting for a VSAT network and ensure that they have contracts in place that will guarantee both.