

Introduction To VSAT Technology

By Greg Heifner ■ *Orbital Data Net, Inc.*

Orbital Data Net specializes in the design and construction of VSAT networks as well as using other more exotic technologies. VSAT stands for “Very Small Aperture Terminal” and refers to receive/transmit terminals installed at dispersed sites connecting to a central hub via satellite using small diameter antenna dishes (.75 to 3.8 meter).

VSAT technology represents a cost effective solution for users seeking an independent communications network connecting a large number of geographically dispersed sites. VSAT networks offer value-added satellite-based services capable of supporting the Internet, LAN, voice/fax communications, video, security, and provide powerful, dependable private and public network

“VSAT technology represents a cost effective solution for users seeking an independent communications network connecting a large number of geographically dispersed sites.”

communications solutions.

Generally, these systems operate in the Ku-band and C-band frequencies, and soon Ka-band. Ku-band based networks are used primarily in Europe and North America and utilize the smaller sizes of VSAT antennas. C-band, used extensively in Asia, Africa and Latin America, require larger antenna sizes. These are quite common in Cyber Cafes throughout the rest of the world.

VSAT networks can be configured to

receive only or transmit and receive. Examples of uses we commonly see for receive only are:

- Stock market & other news broadcasting
- Training or continuing education from a distance
- Distribute financial trends & analyses
- Introduce new products at geographically dispersed locations
- Update market related data, news, and catalog prices
- Distribute video or TV programs (Directv and DISH)
- Distribute music in stores & public areas
- Relay advertising to electronic signs in retail stores.

Examples of uses we see for receive/transmit are:

- Interactive computer transactions
- Internet
- Distance Learning Video Tele-

conferencing

- Database inquiries
- Bank transactions, ATM
- Reservation systems
- Distributed remote process control and telemetry
- VoIP communications
- Airport flight and weather data
- Emergency services
- Electronic fund transfer at Point-of-Sale
- E-mail
- Medical data transfer
- Sales monitoring & stock control
- Surveillance and monitoring.

VSAT networks come in various shapes and sizes ranging from point-to-point, point-to-multipoint, and customized private hubs for thousands of sites. Mesh systems have traditionally been somewhat smaller in size than star systems—5 to 30 sites is a good rule of thumb.

Many of the largest corporations in America utilize VSAT as their primary communications technology to extend their wide area networks. Orbital Data Net has also extended this technology to the National Guard as well as other federal entities interested in a portable technology that can stand up to emergency communications in an instant. The cost of VSAT has been the primary reason that corporations have adopted this technology, but as times change, many business and governmental entities are recognizing the benefit of



Orbital Data Net supplies the Internet connections with several VSAT units for the annual Experimental Aircraft Association “Airventure Show” in Oshkosh, Wisconsin. Using the unit depicted, thousands of the attendees of the 100th year of aviation were able to e-mail home and explore the activities occurring via the Internet during this week.



This graphic shows the basic layout of the types of devices that are commonly interconnected by VSAT. Networks can remain totally private or communicate in common with the Internet cloud.



In answering a call from the National Guard, Orbital produces a custom transportable VSAT capable of being transported in the trunk of a car, or the cargo area of a helicopter. This unit can restore communications to a site hit by a national disaster or terrorist activity within minutes.

using VSAT for “continuity of business operations.” Many agencies are discovering VSAT to be a very reliable means to insure that operations do not cease when there is an interruption in traditional terrestrial services.

When it comes down to cost, making general comparisons between VSAT services and their terrestrial equivalents

is impossible, well almost impossible. Charges for terrestrial services are always distance-dependent, while VSAT connections cost the same whether sites are 1 or 2,000 miles apart. And with most VSAT services, the cost per connection comes down considerably when a customer adds sites. A VSAT provider can offer consistent installa-

tions and a centralized point of contact, something almost impossible to achieve with multiple telcos. VSAT can also be installed in hours rather than days.

One can think of the most common type of VSAT network, the “Star” type architecture, as a giant frame relay network in the sky. This type of VSAT network also manifests that same type of cost savings over a dedicated circuit like a T1. When a user purchases a traditional circuit, they pay for the full bandwidth, whether they use it or not. This does not have to be the case with VSAT. Bandwidth can be pooled and shared amongst VSAT terminals. This can provide an enormous cost savings.

The major suppliers of VSAT domestically are Direcway, ViaSat and Spacenet as well as some others. Our relationship is primarily with Spacenet, Inc. that uses the Gilat technology from Israel. We work with several other VSAT manufacturers and we will cover them as this series of articles goes on and explore their varied differences.

Most VSAT networks like Direcway and Spacenet’s are STAR based, TDM/TDMA VSAT network works using a hub station, usually six meters or more in size and small VSAT antennas (between .75 meters and 2.4 meters). All the channels are shared and the remote terminals are always listening online, offering fast response times. Consequently, TDM/TDMA systems are comparable with terrestrial X.25 or frame relay connections. The exception to this strategy is that they are employed by Gilat through Spacenet. They use FTDMA technology that greatly reduces bottlenecks in the transmission side of the network and also provides an additional layer of security, as the signal is frequency hopping every few fractions of a second. This network design is very efficient and supplies literally tens of thousands of well-known customers served by Spacenet in the commercial markets and Starband (which also uses similar technology from Gilat) in the residential markets.

Mesh networks which use capacity on a demand assigned multiple



It is really very simple. The main satellite hub (earth station) transmits a channel divided into time slots (TDM) which is received by all the VSAT's, or at a group of VSAT sites. Each VSAT contends for time slots on a shared (TDMA) inbound channel. If they collide in a slot, they retransmit after a delay, with the exception of the FDMA network Gilat uses, then the inbound channel is rapidly switched across available channels to keep the network and latency down to a minimum. So, there are two main conduits to a satellite, a TDM outbound channel from the hub to the VSAT and a TDMA (or FDMA in the case of Gilat) inbound channel/s from the VSAT to the hub.

access (DAMA) basis take a different approach. The master control station merely acts as a controller and facilitator rather than a hub through which traffic passes as in a star network. However, these connections take a little time to set-up and thus, mesh/DAMA systems are often equated to a terrestrial dial-up connection. There are also mesh systems that use a TDMA access scheme where all of the terminals in a network receive and transmit to the same channel, selecting different time slots because each terminal is aware of what the others have reserved. In the past, this type of system has been costly and therefore reserved for large-scale trunking applications. But more recently, costs have come down considerably and now can be cost competitive with SCPC/DAMA systems for thin route applications as well.

Point-to-point SCPC (single channel per carrier) links are the satellite equivalent of a terrestrial leased line connection. They are usually set-up on a permanent, 24-hour basis and are thus more costly in satellite capacity and less efficient if not used all the time. However, they do support high bandwidths

(typically from 5 Mbps inbound to 11 Mbps outbound) and can easily be used to carry data, voice and even video traffic.

All other systems are usually a variation on one of the themes described above, either in a star, mesh or hybrid (star and mesh) configuration. Soon Ka-band systems will be available. While these are primarily aimed at low cost residential services, there will be commercial uses for them as well. They work in a similar fashion to existing VSAT networks. Generally, the VSAT equipment they use is lower in cost and the antenna size is smaller.

At Orbital Data we have exhaustively tested hundreds of application over VSAT for numerous agencies and corporations. Much of this testing has

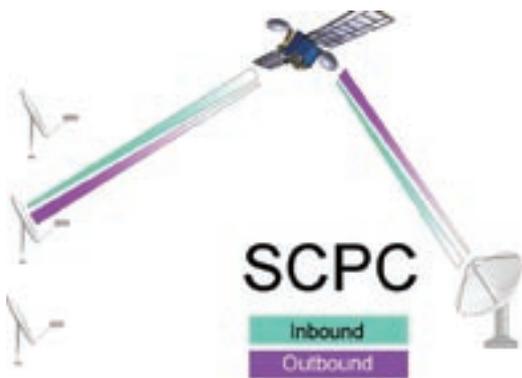
been through our long relationship with Spacenet, Inc. As resellers of their commercial Connexstar™ offering, we have gotten to work with their VSAT product in a lot of different scenarios. As a result we have learned the following; VSAT has few weaknesses with the exception of latency. We will discuss this later in depth, but the essence is that it takes an average of 200ms (2/10th of a second) for the satellite signal to cover the 50,000 miles round trip to and from the satellite. Now, everything introduces latency, even in terrestrial networks it is common to see up to 100ms latency as packets migrate their way through the Internet. In the case of VSAT, it is important to design the network in a way that reduces the number of satellite transactions needed to fill a web page, for instance. Many networks such as Spacenet's have taken these issues into account and have

designed in features that streamline and accelerate web browsing as well as FTP transfers of data. These are the situations where most people "feel" the latency and the clever technology Spacenet used does make browsing the Internet a faster and enjoyable experience. But some types of applications such as Citrix or even Microsoft "drag and drop" do not respond well over VSAT because of latency they were not designed to handle. These types of applications were designed for very low latency on local area networks and don't like VSAT at all. We accommodate this by pointing out, for instance, that FTP file transfers are as effective as "drag and drop" and are greatly accelerated over VSAT. We call these "Direct Access" channels at Spacenet and they are used for FTP file transfers, PCanywhere and now, Voice Over IP type applications. Using this DA technology, greatly enhanced speeds are available through the same architecture by opening up space on the satellite to accommodate an unimpeded flow of data.

But for some applications, we simply steer clear. Some Citrix applications can be modified or replaced with others that have been designed to properly work with this technology. Another area where VSAT does not fit well is



The SCPC mesh/DAMA system works differently. This time a VSAT uses a TDMA CSC (command, signaling and control) channel to request the hub to set up a link from the requesting VSAT and another VSAT. The hub then informs the called VSAT of the request and allocates two channels to serve as a bi-directional link between the two VSAT sites. After the data has been exchanged, the call is finished and the channels are returned to the pool for the next request. Much like a dial up network.



Point-to-point SCPC (single channel per carrier) links are the satellite equivalent of a terrestrial leased line connection. They are usually set-up on a permanent, 24 hour basis and are thus more costly in satellite capacity and less efficient if not used all the time. However, they do support high bandwidths (typically from 5 Mbps uplink to 11 Mbps on downlink) and can easily be used to carry data, voice and even video traffic.

video interactive gaming. For obvious reasons, a delay in this realm can make you a very poor competitor. As all of our customers are commercial, this has not been an issue for us. But, for apartment complex tenants, it may be. We however feel these are small prices to pay for the cost effectiveness and homogenous availability VSAT offers.

Hotel operators and apartment complex owners can use VSAT to provide services both for their own network needs as well as to provide e-mail and Internet access to their customers. As competition increases in this arena, we are seeing property owners looking into alternatives to the high prices demanded by terrestrial suppliers. One note of caution is that while VSAT on-site equipment may look similar (for example the Spacenet commercial VSAT units look just like the Starband residential product), they are not. The satellite hub is where the majority of the magic takes place. In the case of Spacenet, their product is designed for commercial uses only, unlike the Starband service that is primarily designed for residential users, but is also offered to commercial users. There is a major difference in how these networks are managed and the subscription ratios that are adhered to. This will usually manifest itself in a couple of areas. Speeds during busy times are always impacted more severely in a

residential VSAT network as the hub operators are usually allowing more users for the bandwidth available. Also, most residential VSAT networks do not allow a commercial VSAT operator to attach a direct connection between the VSAT satellite hub and their own network operations center. These IPsec backhauls or dedicated circuits will allow a company to use VSAT as extensions to their private wide area network. This can be important for financial transactions as well as any number of corporate applications that respond well to the reduced latency and the enhanced management capabilities that a direct connection to

the hub provides.

In the following months, we will cover specific VSAT manufacturers and explore their differences and clients they serve. ■

About the Author

Greg Heifner is one of the early pioneers of satellite communications, he was instrumental in the technology that our industry uses, as well as helping to develop the relationships our industry has with video programmers. He is an "unabashed nerd" and had devoted his life to technology in its various forms. He is now the founder and CEO of Orbital Data Net, Inc., which provides broadband and video solutions to the military, state governments, educators and business' nationwide. He may be reached at 573-445-8101 or greg@orbitaldata.net.



Birds-Eye Network Services

Check us out at:
www.birds-eye.net
 Or contact us:
info@birds-eye.net
 651-398-4679

A strategic choice for custom software solutions,
 we specialize in providing economical
 monitoring/reporting/diagnostic solutions,
 integrating new and legacy video and billing systems,
 interfacing with all types of hardware,
 and automating testing and broadband operations.
 No project too big or too small.

Birds-Eye Network Services - For a *Birds-Eye View* of your network or service