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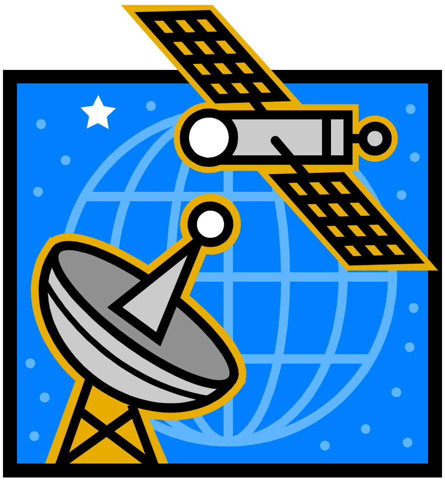
Disaster Relief And Strategic Telecommunications Infrastructure Company

Global Satellite Broadband Data Service

Considerations for selection a VSAT service and hardware platform



Using Satellites for remote Internet and e-mail communications

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VSAT Satellite Service considerations

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Problem

Humanitarian-aid non-governmental organizations (NGOs) working in remote areas, developing nations, and disaster response, all struggle with very poor communications. Field workers who are not connected to all the resources available today cannot operate at maximum efficiency. Historically, staff in remote areas were not able to have effective communications with colleagues, management, and donors. That is no longer the case. Satellite communications can provide cost-effective connectivity to virtually any place on earth, empowering staff to use the wide range of communications and research tools available in the modern connected Internet age. The lack of effective communications need no longer be a barrier to the valuable roles these organizations play.

Solution

The effects of poor communications ripple through all aspects of relief and development work in the field. In some locations, suitable communications infrastructure may not exist at all. For this reason, a satellite system called a VSAT (Very Small Aperture Terminal) may be the only means of providing broadband connection to the Internet. This solution to the communications problem can provide e-mail transmission and synchronization, Web access for research, and telephone access over the Internet VoIP. VSAT systems typically connect to a local area network at the remote site.

Realizing this, NGOs are beginning to apply whatever solution they find. Most are not considering the full range of factors that influence their system performance in selecting a solution. Consequently, many are not receiving the quality of service they expect and need. The technical terminology and needs are often confusing to those not familiar with satellite communications. Many providers define parameters in a number of ways that make it difficult to compare one system with another. To further complicate matters, there is a lot of marketing hype mixed in with the technical information, especially when dealing with the lowest cost systems.

Through our field experience installing many VSAT systems, we have learned what questions a potential customer should ask of their provider, and what answers to accept. In the text that follows, we will discuss many of those considerations. Many of them interact, with the consequences of one choice affecting several other factors and performance areas.

Considerations fall into two broad areas, the service provider and their services, and the hardware platform with its related performance capabilities. Both need to be considered together as a whole. It is of no benefit to choose a good hardware design and then get the service from a poor provider company, or vice versa.

Service Provider
The service provider is defined as a company providing the ongoing data service over the satellite. This can be either a satellite operator directly, or an integrator. A satellite operator usually owns the satellites in their network, and the ground stations called Teleports. A Teleport is the point where the terrestrial network is linked to the satellite portion of the network. An integrator is a company that does not own their own satellites, but makes use of satellites and teleports owned by many different satellite operators. This can be advantageous as they can select from different company's capabilities and coverage options rather than be locked into one operator's satellite fleet.

As you look into satellite service providers, there are several questions that you should seek answers to. These are both operational, related to now the company does business and provides the service and support, and technical, which involves how their network and systems are designed and operated.

Operational issues

1) Coverage area. Does the service provider provide coverage of the area you want to work in? If you wish to provide connectivity to a number of your offices in a region or worldwide, does the provider have coverage in all the areas, or will you need several providers to meet the needs of all your sites?

2) Large satellite fleet for coverage options. Several satellite operators have a large enough fleet to provide good worldwide coverage. Another very valid option would be to use a service integrator that may provide service on different satellite networks, depending on coverage and footprints. This is more of a consideration for the organization planning on supporting a number of geographically diverse locations, and desiring the benefits of working with a single service provider. Another related factor is satellite failure. If a satellite fails, the company with more resources can move service or sometimes even maneuver an in-orbit spare satellite into position to provide ongoing service.

3) Number of service providers required. Economies of scale on costs and quality of service and support can be obtained through network size. To that end, it may be better to select a service provider that can service all your sites in as large a region as possible. Having to only interface with a single company also reduces staff workload at your headquarters office.

4) Network size economies of scale. Is the network you are buying service on optimized for the best economies of scale that can be passed on to the customer? Many integrators buy bandwidth and equipment in bulk, but do not pass the savings on to the end customer buying in single lot quantities. Another benefit of using a larger service provider or integrator is that the economies of scale extend to supply, support, and training, to name just a few factors..

5) Satellite operator vs. Service integrator. Companies like Intelsat, PanAmSat and New Skies *own and operate* their own fleets of satellites. *Integrators*, on the other hand, are companies that buy bandwidth in bulk from one or more satellite operators. They then operate their own hubs and Teleports. They have the freedom and flexibility to mix and match satellite service depending on which satellite provides the best coverage and price for a given region. Many integrators can also provide equipment sales. In some cases, their prices on equipment and monthly service may be cheaper than buying directly from the satellite companies and manufactures. The greater savings comes from their buying in great volume and passing the prices on to clients.

6) Data security at hub and hub countries. The satellite signals from a geographic region are all connected to the Internet at a Hub device. This is equipment located at a Teleport, or earth station. A single Teleport can feed whatever satellites are in view. The hub is connected to a Network Operation Center (NOC), possibly located halfway around the world, and then onto the Internet. Some providers may use Teleports or a NOC in countries where the security of the data flowing through those hubs may not be very high. One should examine the political and economic factors in the hub locations and possibly rule out certain high-risk countries.

7) Physical security at NOC and Teleport. Likewise, physical security at the NOC and the Teleport should be a consideration. All facilities should be fenced. Access to the networking operational and management areas should be through keyed entry areas, accessible only to authorized personnel.

8) Company size and longevity. How large is the service provider company? Size is no guarantee of stability, but longevity is important in what is a moderately volatile industry. Intelsat became the first service provider in 1964 and has retained the number one spot for four decades by making many wise choices along the way. A very small and new company on the other hand may not have the stability to ensure they will be around in a year, or have too many eggs in too few baskets. Without market and service diversity, they are more subject to the winds of a turbulent industry. On the other hand, a company that is very large and established can become arrogant and unresponsive to individual customer needs.

9) Company financial solidity. Examine the history and financial viability of the service provider. The satellite industry is quite volatile. In an effort to provide low cost services, a number of providers have priced themselves into bankruptcy. The chosen service provider needs a varied and large portfolio of products.

10) Installations, The installation of high performance VAT systems is complex. The better companies recognize this, and require that installers be certified to industry standards. This ensures that the installation will be accomplished in a manner that prevents the VSAT system from suffering interference, or from causing interference to other satellite users. This is a very large problem today. Most service providers charge very high process for remote overseas installations, typically $7,000-$11,000

per site. Does the provider have certified staff in the country or region where the system will be installed, or do they have to travel a long distance at high expense?

11) Regional support. Similarly, does the service provider have local or regional support staff? In the unlikely event of equipment failure, the cost of having to fly a technician in from an overseas office is prohibitively expensive.

12) Support hours of operation. The service provider should have one point of contact for customer service and support. They must be available 24/7/365, and be technically competent. Anyone calling in for support must be treated professionally and quickly. Some providers are not manned over the weekends and at night, and can take several days to respond to a problem. Professional level networks and equipment can actually provide pro-active support by monitoring the health and performance of remote sites, and raising an alert when performance drops, before an actual failure occurs. This can allow technical support to work on a solution and replace faulty components before a system fails and goes off line.

13) Proactive support and monitoring. The performance levels on some services and hardware platforms can be monitored continually by automatic software at the Network Operation Center. This is not monitoring of the content of data transferred, but rather keeping an eye on the remote site hardware to make sure it is performing properly. If the monitoring software notes a failure or even a downward trend over time, it flags that site for attention. In most cases, the NOC can dispatch a technician to investigate locally and even fix the problem before a part fails completely. This capability is commonly found on professional grade equipment and service, and seldom noted on consumer grade services.

14) Levels of support. The service provider needs to have a documented support escalation process and procedures on defined timelines. The process needs to allow for the provider to have direct access to the satellite operator and the hardware manufacture technical support staff on a 24/7 basis

15) Responsiveness. The service provider must be very responsive to phone calls or emails. Staff need to return calls or emails within several hours, or alternate contact people should be available.

16) Landing Rights. The service provider must be willing to assist in cases where a government has not yet granted landing rights for the satellite in question. Landing rights are permission from a government to a satellite operator granting them approval to provide service within that country.

Technical considerations

17) Frequency band of service. Satellite service is provided on two frequency bands; C-band and Ku-band. Ku-band requires a smaller dish and is less expensive to install. It is commonly used in where a large number of satellite users are concentrated as the signal only illuminates a small region. C-band can cover whole continents and is available pretty much everywhere. It also works much better in high-rainfall areas.

    a) Ku spot beams for high demand/population regions. Ku band is preferred where practical due to smaller dish size. Smaller 1.2m dishes are cheaper to ship and install. They are less visible in the community, sometimes a good idea for security and safety. However, in some areas, a 1.8m dish is still required due to the satellite signal strength. Ku-band also suffers from rain-fade in high rainfall areas where rain attenuates the signals.

    b) C-band global and hemispherical beams for lower population density and tropical areas. Ku-band service is not as universally available as C-band on a global basis. C-band does cover all regions including low population density regions. C-band is also much less affected by rain fade, making it much more usable in high rainfall areas, especially the tropics. The downside is that C-band usually requires a 1.8 or 2.4m dish, and the equipment costs more to purchase, ship, and install.

18) Proxy caching at hub. Proxy caching at the hub can speed up web access for clients. This becomes less of a requirement if the connection to the Internet at the hub is very fast.

19) Web content filtering at hub. Many users are concerned about the material readily available on the Internet. They are concerned about immorality, violence, and hate content negatively impacting the morals of their users. This is an especially strong factor to the governments in the Middle East. In addition, much of the malware such as adware, spyware, and viruses that infect computers come from these web sites. Even inadvertently opening one of these web sites for a couple of seconds can be long enough for a "drive-by" install of the malware. Once infected, the compromised computer can very quickly generate so much traffic as to cripple the satellite connection from that remote site. In severe cases, the volume of traffic is so high that it can seriously affect other remote sites on the satellite network. In those cases, the satellite operations center will sometimes shut down the offending site to protect the throughput of all the other network remote sites. A web content filter at the satellite hub provides the best solution. This greatly reduces the risk of computers becoming infected from web sites, and reduces the requirement for active filtering to be done at each remote site.

20) Quality of Service control. Internet traffic can be either bursty in nature, such as web surfing or file transfers, or streaming, as with telephone voice calls and audio and video feeds. Bursty modes can tolerate several seconds of delay such as that experienced when a satellite channel is very busy. Non-burst real-time data such as

voice calls cannot tolerate such delays. On voice calls, the result would be very choppy or garbled voices. Quality of Service (QoS) priority can be assigned to certain protocols such as VoIP, giving time critical voice traffic priority over web browsing and FTP downloads. Multiple levels of priority can be assigned to each protocol depending on its importance for the site.

21) Committed Information Rate. In addition, some networks allow for a portion of the assigned bandwidth to be committed to each site. This is called Committed Information Rate (CIR). The most critical traffic, such as VoIP phone calls, are assigned with top QoS priority, and placed in the CIR bandwidth

22) Redundant high speed connections to Internet backbone. The satellite hub sites should have a minimum of two redundant high-speed (DS3) connections to the Internet backbone. Switching from the primary to backup must be invisible to remote client sites.

23) Backup Power at NOC and teleports. Every site that processes the data between the Internet and the remote should have backup power sufficient to operate for at least three days if commercial outside power fails. This is typically met by a large uninterruptible power supply (UPS) and an auto start generator. The Network Operations Center (NOC) and Teleport operators must maintain an adequate fuel supply on site.

24) VoIP support. The service provider must at minimum pass VoIP traffic to the Internet. Individual customers can use either their own gateways or a public gateway. The Service Provider may make a VoIP gateway service available. If so, they need to offer various billing models including prepaid scratch-cards or equivalent.

25) Ability to rapidly change bandwidth allocation. The service provider should be able to increase bandwidth allocation quickly and readily without charging a fee for changes.

26) Integrated webcasting IP delivery capability for distance education. The service provider should be able to provide webcasting (delivery of data to many sites) for distance education and conferencing. This could be live web casting or a service where data is pushed out to remote sites and cached locally for later use.

27) Mail relay. The service provider needs to provide a mail relay server for pop3/smtp users to send out mail. Mail servers increasingly do not permit mail to be sent from sites they cannot verify, which is frequently the case with VSAT systems.

Bandwidth Issues

28) SCPC vs. Shared. Data traversing between the Teleport and Remote is relayed by a satellite in geostationary orbit. Each satellite has many transponders. A transponder is

a repeater capable of relaying many signals at once. Each transponder is capable of relaying a tremendous amount of bandwidth, typically on the order of 25-50 Mbps. That is far more than an average remote site will need. Leasing an entire transponder will cost $100,000-$150,000 per month. Consequently the service providers divide up the transponder into many different carriers with a variety of bandwidths available.

a) SCPC. But even the bandwidth for a relatively small channel can cost$3,000-$5,000.month. That is because you are paying for the channel whether you are transferring data or not. This service is called "Single Channel Per carrier" (SCPC). The higher cost is validated if the remote site needs to always have all its bandwidth available and ready to use at ant time.

b) Shared bandwidth. Most Internet traffic is burst in nature. Most sites do not need the full amount of bandwidth at all times. A very cost effective way to reduce the bandwidth requirement is to share slices of time on the carrier. Each remote site may need lots of bandwidth, but only for a very short time. The rest of the idle time, other sites can be using the channel. This is a Time Division Multiple Access (TDMA, or shared, service. If ten sites share a carrier, then the oversubscription ratio is 10:1, and each site pays approximately 1/10 the cost of the equivalent SCPC circuit.

29) Oversubscription ratio. How well a TDMA shared service works depends a great deal on how many remote sites are on a given carrier. Top level corporate or Internet café users should have no less than 4:1 oversubscription. Medium offices do very well at 10:1, and small offices are fine at 20:1 service. Home users with just a single PC might do fine at 30:1. But beware of unscrupulous service providers with very low cost service aimed at consumer services that run at 50:1 or even 80:1 oversubscription. This level of service will very often be so slow as to be unusable for Internet and especially for VoIP calls. The situation is even worse if the remote sites, instead of having a single PC, have 10 or 20 or more computers in an Internet Café at the site.

30) Burstable CIR service. A shared TDMA carrier works well for bursty Internet web browsing activity, but does not do well with VoIP phone and other real-time voice traffic. This needs to have some guaranteed bandwidth, like SCPC, to work well and deliver reliable voice call capability. A portion of the shared bandwidth should be committed to each site. This is called Committed Information Rate (CIR). An SCPC channel is all CIR. Most sites just need a small portion. This type of service is a shared Burstable CIR service, and reflects the best value and performance for most users.

31) Jitter. This is a measure of how even the latency is over the satellite (how long the signal takes to get from one side to the other). It is imperative that the latency remain fairly constant if the VoIP voice quality is to be any good at all. Networks with wildly varying latencies, typically encountered on lower grade best effort systems, can all

but kill VoIP voice traffic. This is very commonly encountered on best-effort and excessively over-subscribed services.

32) Best-effort or guaranteed performance. Most of the low priced services available are "best effort" services. There is no guarantee of throughput or performance. At the end of the day, even if the channel becomes so congested as to be unusable for hours every day, the service provider can simply say "that is the best the network can do". Very often the data rates advertised are theoretical maximum data rates, not typical throughput. One differentiator between consumer grade best effort systems and professional grade services and equipment is that the latter operates under a Service Level Agreement that guarantees performance and reliability.

33) Service Level Agreement with guarantees of network availability, latency, and packet loss. The SLA defines a minimum performance level, and may take the following basic requirements and remedies. The SLA is provided by the service provider. Remedies for not meeting the stipulated service levels shall take the form of credit for extra service. Typical SLA parameters are:
   i. The network will be available to the customer an average of 99.7% of the time per calendar month, except for standard service events, and for events outside the carriers control or at the remote site.
   ii. Packet loss will not exceed 2% during a calendar month.
   iii. Latency shall not exceed 750 mS for a single satellite hop.
   iv. Jitter. Jitter must be held below 10% in order to maintain good VOIP connections.
   v. Committed information rate (CIR) speeds shall be met at all times.

34) Data rate definition. Different service providers define their bandwidth of the services in different ways. When comparing one service to another, be sure to convert values to the same parameters. Information rate and Transmission Rate are the most frequently quoted, and in one way or another represent the maximum theoretical throughput of the channel. They do not address typical throughput. At least request in writing what typical throughput will be. The best way to measure and have bandwidth quoted is by IP throughput. This is a much more realistic measurable of the performance of a channel.

35) Non-preemptable service. The service bandwidth can be either preemptable or non-preemptable. This becomes a factor if the satellite transponders all become full, or inoperative. In those cases, a satellite operator or service provider may have to move some or all the users to a new satellite. Priority is given to customers with non-preemptable service. In case of a partial failure, non-preemptable customers will be often be allowed to stay on the existing satellite service. This is very important as, in the case of a satellite failure, it may mean having to repoint all the satellite systems that pointed at the former satellite. The more remote an area, the greater the difficulty in accomplishing this, and the greater the inconvenience to the user of days or weeks without service. This runs counter to the central theme of reliable service..

Hardware equipment platform

It is essential to consider the hardware platform in conjunction with the service provider. Furthermore, it is imperative to ensure the provider is using the platform in a manner consistent with good reliable performance. The service provided can only be as good as the hardware platform selected. Conversely, the platform is only as good as the provider and how they deploy and configure the platform.

Non-technical considerations

36) Manufacturer size and longevity. The equipment manufacturers need to be moderately large and well established with a long enough history to offer some expectation of future longevity. This is true of the modem, outdoor units, and antenna manufacturers.

37) Company financial solidity. The chosen suppliers should be financially stable and not undergoing financial reorganization or bankruptcy. One should be reasonably assured of future longevity.

38) Equipment customer support. The modem manufacturer's support staff should be available 24/7/365. Anyone calling in for support must be treated professionally and quickly. The support staff must be very responsive to phone calls or emails. Staff need to return calls or emails within several hours, or alternate contact people should be available. Ask if the manufacturer has a published technical support escalation process. End users or field installers and technicians will seldom need to contact the manufacturer directly, but it is imperative that the service provider have direct access 24/7 to the manufacture tech support staff as the last level of escalation on technical issues.

39) Age of equipment design. The platform chosen needs to be relatively recent in design, and not an earlier design approaching obsolescence.

40) Upgradability. The hardware platform needs to be upgradeable in the future as new firmware is released. Firmware updates should be automatically uploaded to remote terminals.

Technical considerations

41) Bandwidth efficiency. The most expensive component of a VSAT system is the recurring monthly satellite bandwidth cost. The modem platform selected should optimize the use of that bandwidth. TCP/IP throughput should be at least 1 kbps/MHz of transponder bandwidth. Different modem technologies can vary by more than 30%, so this is a very significant consideration.

42) Carrier Spacing. Overall bandwidth efficiency on the satellite transponder is also affected by guard bands. Each signal on the satellite tends to bleed over to the adjacent channel. To avoid interference, satellite operators leave a “guard band” in between adjacent channels. Some modems and modulation methods generate signals with steeper drop-offs on the edge of the signal than others. The more contained the actual signal is, the steeper the drop off on each side. This results in a smaller required guard band. This directly translates into less actual spectrum used on the satellite, and therefore a reduced cost. Most modems require a guard band of 20% of the channel width on each side. Ultimately, the user pays for that extra 40% of bandwidth. Some modems require as little as 10% guard band on each side, a savings of 20% overall on the bandwidth and thus the cost of service.

43) Non-contiguous bandwidth. Traditional satellite modems require a contiguous section of the satellite transponder spectrum. As multiple carriers come and go over time, the satellite transponder spectrum can become fragmented. Some modems can use small left-over slivers of bandwidth cumulatively. These small “leftovers” of bandwidth are often available at discounted prices to the service provider, who can pass the savings on to customers.

44) Forward Error Correction. All VSAT modems use Forward Error Correction (FEC) for transmitting data. FEC is a means of improving the Bit-Error Rate (BER) on both directions of the satellite link. Older modems and the current DVB-RCS (Direct Video Broadcast-Return Channel by Satellite) standard use the older Reed Solomon Viterbi (RSV) form of FEC. This method is very inefficient when compared to modem Turbo Codes (TC) or Turbo Product Codes (TPC). This inefficiency results in higher bandwidth and power required for the same BER as TC or TPC.

45) Shared bandwidth service. Satellite bandwidth is also shared by multiple remotes on a single carrier .This is workable as TCP/IP data flow is bursty by nature, and statistically, all sites seldom transfer data at the same instant. The total bandwidth is made available to the remote that requires it. The modem chosen must support shared mode operation. If unmanaged and oversubscribed, the shared model can become very slow at times. With proper management and a good business model, it is the preferred mode of operation.

46) Committed Information Rate. Some remote sites may want full bandwidth with no sharing and therefore no slowdowns in service. CIR service costs a lot more. The selected hardware platform must support CIR mode or SCPC (Single Channel Per carrier) mode. VoIP calls should always be carried within CIR bandwidth to ensure good quality and usability.

47) Shared service with CIR foundation. Some modem hardware platforms and service models are designed around shared service, but with a guaranteed minimum committed information rate. This is the best mode of operation in that it ensures that no one site gets all the bandwidth, but that all sites get their minimum paid for

bandwidth, and excess capacity not being used by other sites is available for "bursting" to the maximum carrier speed.

48) Bandwidth on demand - Rapid Allocation. The modem platform needs to reallocate Burstable bandwidth very rapidly. Some hardware platforms assign burstable bandwidth to a requesting site for 10 or 20 seconds, even though they may just need it for a few seconds. Other remotes that request some bandwidth they are entitled to cannot get access to the previously allocated bandwidth until the other remote releases it. The more rapidly a system assesses and reallocates bandwidth, the more efficient the network is and the better the user experience. Some hardware platforms can reallocate at up to 8 times per second.

49) Application QoS for VOIP and other protocols. The modem should be able to assign Quality of Service priority to time sensitive applications such as VoIP and email. This will ensure high quality voice calls and data throughput and reliable email transport.

50) Queue determined bandwidth allocation. QoS should also prioritize bandwidth allocation based on the queue of data at remote sites. The site that has more data queued should be able to receive a greater portion of the shared bandwidth in order to reduce its queue more quickly.

51) TCP Acceleration (Pure IP over Air) in both directions. This is extremely important for effective web browsing. The verification process within the TCP/IP protocol works poorly over the high latency of satellite connections. The problem is specifically with the TCP protocol. TCP satellite acceleration involves removing the TCP data from the TCP/IP frame, replacing it with a protocol designed for satellite latency path. The TCP header is added at the other side of the satellite link. This process drastically increases data throughput over a satellite link. This can be accomplished with TCP accelerators at both ends of the link to obtain speed enhancements at both ends. These products typically cost $20,000 at the hub and $4,500 or more per remote. A lower cost option is to use one way acceleration of only the outbound data, but this approach requires the use of TCP acceleration software on every client PC at the remote site. The ideal modem should incorporate bi-directional TCP acceleration within the modem.

52) TCP Session Initiation Acceleration. When a new web page is opened, each and every element opens in a new session. TCP sessions use slow start up for each session. This is especially troublesome when opening a web page that has multiple links for content or many elements. Each one of these items has to do a connection/acknowledgement process sequentially. A modem platform that can bypass the need for end-end acknowledgements over the satellite link can greatly speed up this process.

53) VPN support. The modem platform and service provider need to pass all VPN traffic. Some VPN protocols work better than others over high-latency paths as found on satellite links. TCP packets embedded inside VPN data cannot be compressed as

described in (51) and (52) above because the VPN TCP headers are hidden inside the VPN frame. This will make VPN traffic run at uncompressed speeds. The solution is to use VPN accelerators specifically designed for VSAT applications. Some modem manufactures offer products specifically optimized to work on a satellite path using their modem technology, allowing the benefit of the TCP compression to be regained even over VPN circuits. It is highly recommended that the modem/accelerator package be considered if a significant amount of VPN traffic is anticipated.

54) Web compressions. Web traffic can be very slow if a lot of detailed graphics are sent over the VST link. One solution is to use web compression to compress the images and other compressible data through lossy compression prior to transmission out to the remote sites. Some modem platforms include this capability, resulting in a further level of speed increase for web browsing. The uncompressed images are available by just clicking on the transmitted image.

55) Integrated webcasting IP delivery capability. The hub and remote platform should be able to support multicasting, the broadcasting of IP data from the hub to many sites. This is useful for distance education and conferencing,

56) Built in Router/NAT/DHCP/DNS caching. This is a trap that is easy to fall into. The VSAT system is just one link in the connectivity chain. Additional functions are needed at the remote site to build an efficient and workable communications tool. The VSAT system provides basic connectivity to the Internet. The local connection is output on an Ethernet connector. To provide service to a LAN, further networking functionality is needed locally. This includes a Router providing NAT, DHCP, and network security from the satellite WAN. Further functionality should include DNS caching and TCP acceleration. Combined, these items can easily cost more than $6,000. Some modems provide all this functionality within the modem, reducing system complexity, size, and power requirements.

57) Built-in Web Caching. In order to reduce the volume of traffic on the satellite link, a local web cache at the remote VSAT site can be used to cache frequently requested information. Although this can be provided by an external PC, some modems incorporate this function as an optional hard drive directly in the modem. This reduces complexity, cost, power, and maintenance requirements.

58) Built-in 3DES satellite link encryption. The satellite link is much more stable than a wired or wireless LAN. Remote sites may want improved data security, and the modem platform should be able to encrypt the satellite data path. This encryption should be industry standard, preferably 3DES, and add less than 1% overhead to the data.

59) Automatic uplink Power Control. Rainfall affects satellite performance on both the downlink and uplink of the satellite path. Uplink power is set quite tightly to be just enough to get a reliable signal to the satellite without overloading it. Rainfall will attenuate the signal, and in the case of a heavy rainstorm, the uplink signal may drop

below the receiver threshold on the satellite, breaking the connection. The hub in some hardware platforms continuously monitors the signal strength received from remote sites. When a drop is sensed from rain fade, the hub remotely commands the remote site to increase transmit power to maintain the connection. More advanced modems go even further by varying the Forward Error Correction coding under extreme signal degradation. This means that the satellite link will stay at full speed as long as possible under degrading conditions such as a building rainstorm. When the rain gets extreme, rather than just dropping the link completely, the coding is changed and the link gets progressively slower but does not stop completely.

60) Remote Modem Disabling. Should the satellite equipment be stolen, or a site evacuated, it may be desirable to disable the VSAT modem temporarily (stun) or permanently (kill) the modem. A system so disabled can only be reactivated by the network operator or factory. This would prevent the system being used for whatever purposes by unauthorized or undesirable users. This is an option in some modems.

61) Possible equipment choices. Remote modem equipment falls into several levels largely determined by the target market. The delineations are not solid, with crossover of one product into the adjacent markets.

   a) The consumer market is aimed at IP connectivity to users with 1 or 2 PCs on the LAN. Their connectivity is seldom mission-critical and they can accept slowdowns and stoppages on the network. In order to deliver a very low monthly cost, service providers massively oversubscribe the space segment, to as high as 80:1. Terminal cost is also very low. They are classed as "best effort" systems and have no service level agreement (SLA) guarantees. Typical platforms include Hughes DirecWay, Gilat 360E, and ViaSat Surfbeam.

   b) The SOHO (small office home office) market requires more reliable connectivity with less slowdown and no stoppage of data. These networks typically support 2-10 PCs on the LAN, and also rely largely on a shared bandwidth model. These systems may support a single VOIP phone line as well, with minimal packet loss or jitter. Oversubscription is much lower, typically in the 10:1 to 30:1 range. They may or may not be a true best effort system, and many of the lower cost services have no SLA. CIR service is sometimes an option, but is outside the normal network. Common platforms include the ViaSat Linkstar and Gilat Skyedge.

   c) The SME (Small-Medium Enterprise) market is for commercial users with larger networks (10-100 PCs) on the LAN, or who require faster throughput, or both. They can also support 1-8 VOIP lines based on satellite bandwidth with very high call quality. These networks almost always have an SLA in place with remedies enforced for underperformance. The industry standard oversubscription for shared SME service is 8:1. The network can also incorporate sites with CIR and SCPC. Typical hardware is the iDirect iNFINITI Series 3000 and 5000 modems.

d) The large corporate user market relies heavily on high-bandwidth SCPC CIR services. They can support 50-500 PCs and 20-100 VOIP calls. Remote terminals include the Gilat commercial series, Comtech/EFData products, ND Satcom, and the iDirect Series 7000 modems.

VOIP

Voice Over IP (VOIP) phone call capability is increasingly in demand. The satellite hardware platform chosen should be able to support 1-4 simultaneous calls, depending on the needs at the remote sites.

62) Choose a network and equipment that adds minimum delay. The latency of the satellite link adds fixed delay of typically 560mS. Additional fixed but typically minimal delay is added by the satellite transponder. More delay is caused by the VSAT hub and client remote equipment. The satellite network topology and equipment should be selected that adds the minimum additional latency to the end-end path.

63) Jitter. VOIP relies on a constant stream of data being transmitted sequentially. Packets transmitted at equal intervals may arrive at the destination with irregular delay and out of sequence. This is called jitter, and must be managed and controlled to ensure good VOIP voice quality. This can be accomplished by sending the data in short transport frames and distributing them evenly in the overall data stream, by dynamically allocating bandwidth several times per second, by fragmentation so that large data packets don't get in front of small voice packets, and by managing the queue depth. The modem platform and service should be chosen that transfer the VoIP calls under CIR dedicated bandwidth.

64) Packet Loss. VOIP traffic is UDP/IP is not retransmitted like TCP/IP and is lost if an error occurs. Very low Bit Error rates (BER) are required for high quality voice calls.

65) Bidirectional QoS and Traffic Prioritization. Satellite networks are subject to congestion, especially those using shared bandwidth. This can lead to delayed, dropped, or out of sequence packets. Bidirectional Quality of Service (QoS) ensures delivery of VOIP traffic on congested networks.

66) Compression. The dominant industry standard for VOIP calls is the G.729 codec, requiring a minimum of 8 kbps of bandwidth. When IP/UDP/RTP headers are added, the actual bandwidth required is 16-18 kbps. Modems that compress the RTP drop the bandwidth requirement to 10kps.

67) Bandwidth for VOIP calls. G-729 codecs require 16-18kpbs per call uncompressed, and 12kbps if compressed. G.723 will require about 10-12k once compressed as well. Incidentally, video conferencing at 30 fps requires about 384 kbps of CIR in both direction for excellent quality.

68) Internal corporate networks. Corporate users may prefer to run the VOIP link directly to their main office. A gateway at that location will tie the remote site into the PBX at the main office. The remote site telephones will function as extensions on the main office PBX. This could be accomplished through either a small PBX at the remote site, or with direct single line phones. Calls into and out of the internal network and the Public Switched Telephone Network (PSTN) are handled like any other call on the phone system.

69) Public gateway. VOIP calls can be routed to a public service for interfacing to the PSTN. The gateway services can be run by private companies or may be part of a service offered by the satellite service provider. Calls can be made in and out between the PSTN and satellite remote sites.

70) Billing options. If an external service provider is used for VoIP, they should offer a number of options for billing. This may include postpaid billing, prepaid accounts, and prepaid scratch cards.

Summary

Admittedly the above 70 factors to consider when choosing a satellite service and provider can seem overwhelming. It is a complex field, with a lot of variations that can positively and negatively affect what you get for the expense. Hopefully this white paper will clarify some of the considerations so that planers and users can be fully aware of what questions need to be examined.

DRASTIC have considered every factor in this list in the design of the DRASIC VSAT network. Additional factors were also considered that pertain to the entire network. DRASTIC selected the iDirect hardware platform for its technical superiority, flexibility, scalability, quality, and support. The global service provider chosen to manage and control the entire network was selected at the end of a nine-month process. The service provider meets all the requirements defined in this document. The chosen service provider and hardware manufacturer have assisted in the design and implementation of the overall network to optimize it for use in remote and austere locations.