Spacenet Satellite Network Services for the Cisco IP VSAT Satellite Network Module

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Table of Contents

1. Overview ................................................................................................................................. 3
2. Introducing VSAT Technology ................................................................................................ 3
   2.1. How VSAT works ............................................................................................................... 4
   2.2. Benefits and limitations of VSAT networking ................................................................. 4
   2.3. Spacenet's VSAT services leadership ............................................................................ 5
3. Applications For the Cisco IP VSAT Module and Spacenet Services ........................................ 5
   3.1. Full-time data/voice services ......................................................................................... 5
   3.2. On-demand services for WAN backup/disaster recovery ............................................. 6
   3.3. Instant and mobile communications (IMICS) ................................................................. 7
4. Spacenet Services for the Cisco VSAT Network Module .......................................................... 7
   4.1. Solution overview – hardware elements ........................................................................ 7
   4.2. Solution overview – service elements .......................................................................... 8
   4.3. Spacenet standard data services ................................................................................... 8
   4.4. Spacenet satellite VoIP service options ...................................................................... 8
   4.5. Spacenet on-demand services ..................................................................................... 9
   4.6. Service coverage map and availability ....................................................................... 10
   4.7. Standard installation ...................................................................................................... 10
   4.8. Common installation problems and pitfalls ................................................................. 11
   4.9. Service technical support and troubleshooting .......................................................... 12
5. VSAT Network Performance and Architecture ...................................................................... 12
   5.1. Basic VSAT network architecture ................................................................................ 12
   5.2. Satellite characteristics and application performance ............................................... 13
   5.3. Security, encryption and VPN compatibility ............................................................... 13
   5.4. Latency and acceleration .............................................................................................. 14
   5.5. VSAT application and architecture considerations .................................................... 14
   5.6. A sample architecture for full-time Internet access ................................................... 16
   5.7. A sample architecture for part-time failover networking ........................................... 17
6. Case Studies In Cisco IP VSAT Module/Cisco Deployment .................................................... 17
   6.1. Leading U.S. energy provider seeking critical WAN backup ....................................... 17
   6.2. Global freight/logistics carrier deploys disaster recovery service ............................ 18
7. Additional Resources and How To Learn More ..................................................................... 18
1. Overview

The Cisco® IP VSAT Satellite WAN Module + Spacenet® Connexstar™ combination provides a complete hardware and connectivity solution for a number of enterprise and government applications including wireless data, voice and video; mission-critical WAN backup and disaster recovery; and instant mobile communications. The solution is composed of a Cisco satellite network module hardware component that is integrated with a Cisco router, and a network services subscription offered by Spacenet.

The Cisco IP VSAT Satellite WAN Module (or “Cisco IP VSAT Module”) solution is well suited to nearly all popular IP applications including Internet access and private network access. Backup/disaster recovery connectivity is available through the VSAT wireless link, with near-instantaneous switchover time. Multicast data delivery for file updates or digital content distribution is easily implemented. VoIP and video are also readily supported with excellent performance. In addition, the IP VSAT Module can further enable a host of combined applications such as secure data, voice, switching, wireless LAN (WLAN) access point service, Content Engine and Land Mobile Radio (LMR) base station usage as part of a Cisco IMICS instant mobile communications solution.

The Cisco IP VSAT Module is a network module compatible with the Cisco 2800-series (except 2801) and 3800-series Integrated Services Routers as well as the Cisco 2600XM-, 2691-, and 3700-series access routers. The Cisco IP VSAT Module incorporates the functionality of a VSAT satellite modem, providing a two-way wireless data connection that can be managed directly from the Cisco router IOS interface. The Cisco IP VSAT Module is a Cisco product that can be purchased from a Cisco partner or other authorized reseller.

Spacenet offers network access services for the Cisco IP VSAT Module, ranging from narrowband to broadband, and from full-time to usage-based/on-demand. Spacenet provides these Connexstar CI™ services in the United States and in select international markets.

Customers interested in the solution will purchase the Cisco IP VSAT Module from their authorized Cisco channel, and will contact Spacenet or an authorized Spacenet reseller for the required SatKit (outdoor antenna and transmitter, etc.) system elements, and choice of installation and service options.

2. Introducing VSAT Technology

While VSAT networks are widely known for their excellent reliability and performance characteristics, there are some important differences between the architecture of VSAT networks and terrestrial wireline networks. Some background on VSAT technology and Spacenet’s VSAT services is useful in developing the understanding required to get the most out of a VSAT network.
2.1. How VSAT works

A Very Small Aperture Terminal (VSAT) is a device (also known as an “earth station”) that is used to send and receive wireless transmissions by satellite. Millions of VSATs are in use around the world, allowing people to send and receive two-way data, voice or video transmissions by bouncing signals off of satellites in orbit.

Satellite networks send and receive data via high-frequency radio waves relayed off a satellite in orbit, providing a single continent-wide wireless last-mile solution. VSAT networks are designed in a hub-and-spoke fashion, with customer locations connecting directly over the air to a central “hub” facility. At the central hub facility, a large dish/antenna (often 30 feet or more in diameter) and hub server equipment receive and transmit to the remote sites, and route information to and from the Internet or private networks.

VSAT networks can be used for Internet access, or they can be connected from the hub facility directly to a corporate data center or application service provider such as a credit card authorization provider (see Figure 1). VSAT networks may have anywhere from one to tens of thousands of remote VSATs communicating with a single hub.

The "very small" component of the VSAT acronym refers to the size of the VSAT “antenna” or “dish” - typically about 2 to 4 feet (0.55-1.2 meters) in diameter - that is mounted on a roof, attached to a wall or placed on the ground. Attached to the dish are a Low-Noise Block converter (LNB), which receives satellite signals; and the transmitter, which sends signals. Together, the dish, LNB and transmitter make up the VSAT outdoor unit (ODU), one of the two components of a VSAT earth station.

The second component of VSAT earth station is the indoor unit (IDU). The indoor unit may be a small desktop box, or it may be (as in this case) a network module integrated with a Cisco ISR router. The Cisco® IP VSAT Satellite WAN Network Module is a complete VSAT IDU system developed by Cisco to provide VSAT network connectivity just as any other network module might provide a T1/E1 interface or FDDI/HSSI interface.

The IDU contains receiver and transmitter electronics and an interface to communicate with the user’s other networking equipment - LANs, servers, PCs, TVs, kiosks, etc. The indoor unit is connected to the outdoor unit with a pair of coaxial cables (one to send data and another to receive it).

2.2. Benefits and limitations of VSAT networking

VSAT is generally a very cost-effective medium for narrowband or broadband data communications, and has particularly strong advantages in ubiquity (VSAT is available at any location with a view of the southern sky) and multicast support (sending the same data to tens or thousands of locations at once). VSAT connections experience about a half-second of latency in a round trip (from the time to reach the satellite and return), although this does not adversely affect most applications.

One key advantage of VSAT connections is that service availability is not limited by the reach of terrestrial telephone or cable infrastructure. A VSAT earth station can be placed anywhere - as long as it has an unobstructed view of the satellite. VSATs are capable of sending and receiving all sorts of video, data and audio content at the same high speed regardless of their distance from terrestrial switching offices and infrastructure.

This also serves to make VSAT an ideal choice for WAN backup and disaster recovery. Because VSAT completely avoids the local area wireline infrastructure, it is effectively able to avoid even large-scale local outages or disasters.
VSAT may not be the best choice in situations involving latency-sensitive applications. Even at the speed of light, it takes about 1/4 second to make the trip to the satellite and back. This latency has no effect on the vast majority of business applications, but certain "chatty" applications like NTLM authentication or CIFS file sharing may not run adequately over satellite. Other applications, such as Citrix, can be tuned and optimized to provide excellent performance over satellite. If you have questions about whether key applications would work well with satellite, contact Spacenet for a consultation.

Similarly, certain encryption technologies are not compatible out-of-the-box with VSAT acceleration technologies. Although Spacenet has solutions for many of these technologies (VPN, SSL, etc.), they do require special setup, and are not guaranteed to be compatible with all vendor implementations.

2.3. **Spacenet's VSAT services leadership**

Spacenet Inc., based in McLean, Virginia, was founded in 1981 to provide data networking and voice services via VSAT (two-way satellite communications). Today, Spacenet is a leading provider of VSAT and hybrid terrestrial managed networks to enterprise and government users.

Spacenet is trusted by many of the world’s largest enterprise and government networks to deliver mission-critical network services, management and implementation services. Spacenet manages more than 50,000 enterprise and government customer sites with its Connexstar broadband services, and nearly 30,000 residential and small office customers with its StarBand™ VSAT Internet access service. Spacenet operates three master “hub” facilities in the United States – in McLean, Virginia; Chicago, Illinois; and Marietta, Georgia.

Spacenet is a services subsidiary of Gilat® Satellite Networks, Ltd. Gilat has a nearly 20-year history of VSAT technology development leadership and is a Cisco Technology Development Partner. Gilat has more than 550,000 VSAT terminals installed worldwide in 85 countries, and its SkyEdge™ VSAT platform is the industry standard for scalability, reliability and multi-service performance. Gilat is publicly traded on the NASDAQ market under the ticker symbol GILT.

3. Applications For the Cisco IP VSAT Module and Spacenet Services

3.1. **Full-time data/voice services**

The Cisco IP VSAT Module and Spacenet's Connexstar CI services can be used as a primary or overlay full-time narrowband or broadband connection that supports a wide range of applications. Enterprise and government customers utilize full-time Spacenet Connexstar data/voice VSAT services in support of mission-critical services including Internet/intranet access, retail applications (Point of Sale, credit authorization), digital content delivery, back-office applications and more.

Key strengths of Spacenet VSAT satellite networks include:

- **Available nearly anywhere** - Rather than relying on the presence of telephone/cable infrastructure for the "last mile," VSAT networks use wireless links to satellites in geosynchronous orbit over the equator. Therefore, they can get broadband access from essentially anywhere that there is a view of the Southern sky - from cities to mountaintops.

- **Business-grade service with SLAs** - Spacenet's Connexstar services deliver uptime (guaranteed with SLAs) and throughput similar to SDSL or Frame Relay circuits, for prices competitive with SDSL and much less than Frame Relay.

- **Unbeatable multicast support** - Need to get the same data to tens, hundreds or thousands of locations simultaneously without straining your network? The DVB outbound of Spacenet's services
is native-multicast medium, making it the perfect solution for distributing data, files, video and more with electronic delivery receipts and immediate distribution.

• **Service on the go** - Spacenet offers portable VSAT solutions that can be mounted on vehicles or deployed rapidly in fixed locations, then packed up when you move on. Retailers or other businesses with location turnover can take their VSAT service from one location and have it installed at another when needed.

• **Uniform service levels** - Unlike DSL (where the speeds/services available are based on infrastructure and distance from your telco Central Office), VSAT offers the ability to deliver the exact same speed/service level to every single one of your locations – even internationally.

• **Centralized network management** - Because of the hub-and-spoke architecture of VSAT networks, Spacenet can control the entire network from one of its redundant earth station locations. This means that we can provide firewalling, virus scanning, intrusion detection, network management and more for an entire customer network in a completely centralized fashion.

• **Amazing scalability** - Spacenet VSAT networks scale easily from a single site to more than 10,000 locations.

3.2. **On-demand services for WAN backup/disaster recovery**

Business continuity and disaster recovery planning is increasingly seen as an essential requirement for enterprise and government networks. The ability to maintain data and voice connectivity in the face of emergencies, natural disasters or terrorist attacks must be part of every network manager’s planning. Having a network backup capability ensures communication support for business continuity efforts and also reduces the cost of lost revenue, loss of employee productivity and loss of critical infrastructures during a network outage.

Since the recent Gulf Coast disaster in September 2005, there is especially high visibility of the importance of planning for not just transitory outages from accidents or network problems but also for long-term outages. In the aftermath of Hurricane Katrina, Spacenet's satellite services helped major oil companies, retailers and logistics companies quickly replace damaged terrestrial communications networks and resume critical operations and supply-chain communications. VSAT served as an ideal disaster recovery solution since it can be deployed virtually anywhere, does not depend on the local phone infrastructure, can be installed on parked vehicles or docked ships, and can provide support for Internet, voice and commercial transaction data.

There is a history of outages in terrestrial networks, including large-scale frame relay network outages in the late ’90s and disruptions related to accidents like the July 2001 Baltimore train tunnel fire. Having a physically diverse network path, which does not rely on a terrestrial solution, is critical for avoiding days or even months of downtime due to repairs to the terrestrial network.

The Cisco IP VSAT Module with Spacenet services provides a unique solution for mission-critical disaster recovery/backup networking and other on demand applications, integrated directly with a customer’s existing Cisco router equipment. Leveraging the industry’s most advanced satellite technology, it delivers available-anywhere broadband capabilities that can be used for failover connectivity, digital content delivery, IP telephony, Internet/VPN access and more.
3.3. *Instant and mobile communications (IMICS)*

The Cisco IP VSAT Module also forms a critical part of the Cisco IMICS system for instant and mobile communications. IMICS provides an all-in-one solution for local wired and wireless connectivity that utilizes the Cisco IP VSAT Module as the backhaul to the public Internet or private corporate/agency network.

IMICS can be used as a rapidly deployable communications base for any temporary site (construction site, energy facility, public event, etc.) IMICS can also be a critical component of disaster recovery preparedness for state and local governments or public safety agencies, and can provide enterprises with the ability to stay connected during disasters or other extended network outages.

IMICS benefits for Emergency Response Communications:
- On-demand secure voice communications for first responders and other agencies
- Secure dispatch of information back and forth from the affected site to command and control
- Coordination between various agencies active at the disaster site
- Broadband connection to the Internet for accessing critical information
- Enables setting up of temporary ATMs and Point of Sale locations during a disaster
- IMICS can be integrated in a mobile van
- Create a Mesh Wireless Hot Spot any place, any time
- Easy integration with Cisco PWLAN solution for commercialization

Other benefits of the Cisco IMICS solution include:
- Plug-and-play operation in under 10 minutes
- VSAT technology is tried and tested
- Satellite coverage is available everywhere
- Based on rich Cisco ISR feature set (the “Swiss Army knife” of the networking world)
- Weighs less than 200 pounds including an auto-acquiring VSAT antenna
- Integrated Wireless Access Point and LMR Gateway functionality
- All services built on top of IP - interoperable and scalable
- Autonomous unit, independent power and connectivity

For more information on the IMICS solution, contact your Cisco or authorized partner representative.

4. **Spacenet Services for the Cisco VSAT Network Module**

4.1. *Solution overview – hardware elements*

The Cisco IP VSAT Module is a Cisco network module compatible with the Cisco 2800-series (except 2801) and 3800-series Integrated Services Routers as well as the Cisco 2600XM-, 2691-, and 3700-series access routers. The Cisco IP VSAT Module incorporates the functionality of a VSAT modem, allowing the VSAT to be configured and managed from the familiar Cisco IOS interface. This enables the unit to be used for advanced services such as automatic network failover or application routing without additional third-party equipment or software.

The Cisco IP VSAT Module is interoperable with the industry’s most advanced VSAT technology platform, the Gilat SkyEdge. The SkyEdge VSAT system's features include high bandwidth capabilities, strong security (with capabilities for Cisco VPN compatibility), fine-grained QoS controls, and TCP + HTTP acceleration for optimum performance. The SkyEdge is the most widely deployed and field-tested among the new generation of VSAT systems, used at thousands of locations in countries around the world.
In addition to the Cisco IP VSAT Module itself, a working solution also requires additional hardware elements that are collectively called a “SatKit.” The SatKit includes the VSAT antenna, transmitter and required cabling. The SatKit is provided by Spacenet and is purchased separately from the VSAT Network Module (contact Spacenet or a Spacenet authorized channel partner for pricing).

4.2. Solution overview – service elements
Spacenet offers a range of services called Connexstar CI™ to provide network connectivity for the Cisco IP VSAT Module. Currently, Spacenet is the only provider of network services for the Cisco IP VSAT Module in the United States. Spacenet can also deliver services in selected markets internationally through its Spacenet Global Services alliance (contact Spacenet for more details).

The Connexstar CI network service for each Cisco IP VSAT Module unit ordered has a minimum service term of 36 months from the date of installation. After the minimum service term has been satisfied, the service will be automatically continued at the same rates unless and until either the customer or Spacenet terminates the service by providing at least 60 days prior written notice.

4.3. Spacenet standard data services
Spacenet's Connexstar CI full-time data services offer an always-on connection at bandwidth levels ranging from narrowband to 1 Mbps upstream/2 Mbps downstream. These services provide a flat-rate, always-on connection for private network data or Internet access.

<table>
<thead>
<tr>
<th>Max upload speed</th>
<th>Max download speed (standard)</th>
<th>Max download speed (Plus package)</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 kbps</td>
<td>64 kbps</td>
<td>1 Mbps</td>
</tr>
<tr>
<td>128 kbps</td>
<td>128 kbps</td>
<td>1 Mbps</td>
</tr>
<tr>
<td>256 kbps</td>
<td>256 kbps</td>
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<tr>
<td>768 kbps</td>
<td>768 kbps</td>
<td>1.5 Mbps</td>
</tr>
<tr>
<td>1 Mbps</td>
<td>1 Mbps</td>
<td>2 Mbps</td>
</tr>
</tbody>
</table>

4.4. Spacenet satellite VoIP service options
In addition to standard data services, Spacenet also offers Voice over IP (VoIP) satellite solutions. These services must be ordered separately from a customer's data service; the standard data packages are not designed to be used with VoIP traffic.

Spacenet's VoIP services are based on the advanced technology of the Cisco IP VSAT Module and its ability to provide prioritization for real-time traffic, delivering a superior-quality VoIP user experience. Spacenet's VoIP satellite services support a wide variety of industry standard protocols and codecs, including SIP, H.323, G.723 and G.729.

Spacenet VoIP services can be delivered as “transport only” or “complete” solutions:

- **Transport only**: This provides the requisite satellite bandwidth for high-quality voice service and will connect a phone at a customer’s remote location to a customer’s PBX or PSTN interface (collocated with Spacenet or via a dedicated backhaul). These services are intended
for customers who will provide their own call termination and phone numbers, and are priced by the number of lines available for simultaneous use.

- **Complete solution:** This service provides an end-to-end VoIP solution including a local phone number, full PSTN access, local/long distance inbound/outbound call termination and E911 service. Optional services include voice mail; call forwarding; speed dial; and inbound toll-free numbers. These services are priced by the number of phone numbers/lines (customers with a local PBX or other phone system may multiplex lines and pay only for simultaneous connections).

Standard options are available from one phone line/number up to a maximum of 12 phone lines/numbers per Cisco IP VSAT Module. For more information about specific aspects of the VoIP services, please contact a Spacenet or authorized Spacenet channel partner representative.

### 4.5. Spacenet on-demand services

Spacenet's Connexstar CI On-Demand service provides a low monthly base cost with usage-based billing (either by time used or packets sent) – ideal for backup services. These on-demand options can be used with Connexstar CI data services, VoIP services or both.

Connexstar CI On-Demand can be deployed almost anywhere and does not depend on local phone infrastructure, making it an ideal solution for organizations seeking 100 percent network uptime. Other benefits of Connexstar CI On-Demand backup solutions include physically diverse network path to terrestrial alternatives, easily and quickly deployable, seamlessly integrated with primary networks, scaleable and flexible service options.

- Customer configures Cisco IP VSAT Module as failover networking path
- Optional IPSec Internet backhaul/private line set up to route data from the Spacenet hub
- When satellite service interruption occurs, the VSAT automatically switches over to the failover connection after pre-specified time period
- After terrestrial connectivity is restored, the connection automatically switches back to the primary network

Spacenet's On-Demand services for backup/disaster recovery are available in all of the same speeds as Connexstar CI Data Services. Each package includes a set amount of usage, with additional usage on a per 8-hour increment basis. Spacenet monitors the traffic usage per VSAT and records it in 3-hour usage units (e.g. a VSAT that was active for 30 minutes will be recorded as 1 usage unit; a VSAT that was active for 3 hours and 15 minutes will be recorded as 2 usage units).

<table>
<thead>
<tr>
<th>Package</th>
<th>Usage Included per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI On-Demand 1</td>
<td>1 day</td>
</tr>
<tr>
<td>CI On-Demand 2</td>
<td>5 days</td>
</tr>
<tr>
<td>CI On-Demand 3</td>
<td>10 days</td>
</tr>
<tr>
<td>CI On-Demand 4</td>
<td>15 days</td>
</tr>
</tbody>
</table>

### 4.6. Service coverage map and availability

VSAT service coverage areas for Spacenet include the vast majority of the contiguous United States, southern Canada and the Caribbean. Coverage of sites in Alaska and Hawaii is planned for availability in mid/late 2006. Shown below is an approximate map of current service availability:
The satellite antenna/dish size and transmitter power recommended for a service may vary and are typically a function of the customer’s location and chosen service package. Locations in extreme north or south of the satellite coverage area require larger dishes in order to achieve acceptable signal strength for business-grade availability. Customers in areas with heavy rainfall or other inclement weather may also need a larger dish to ensure uptime.

4.7. Standard installation

Installation of the Cisco IP VSAT Module is typically provided by the customer or the customer’s authorized contractors; SatKit installation is typically provided by Spacenet or one of its authorized Connexstar Channel Partners. Installation of the VSAT SatKit typically involves the deployment of a fixed satellite ODU (antenna and transmitter) on the customer’s roof or other outdoor mounting location. The installation location must have an unobstructed view of the satellite being used for the service, and must be safely and legally accessible by the installation technician.

For a complete installation, both the IP VSAT Module installer and the SatKit installer must be present at the same time in order to fully verify that the service is operational. Customers seeking to do their own service installations may undergo a Spacenet installation certification program in order to conduct self-installations.

Standard SatKit installations will include the following:

- Conducting a site survey (coincident with the VSAT installation) to determine the most suitable location and mount-type for the VSAT antenna.
• Assembly and installation of either a Non-Penetrating Roof Mount (NPRM) or a wall mount at the antenna location.
• Assembly and installation of a .75m - 1.8m antenna, and mounting of the Out-Door Unit (ODU) and Low Noise Block (LNB) on the antenna feed assembly.
• Provision and weather sealing of one building penetration to accommodate Intra-Facility Link (IFL) cable entry into the building.
• Installation of up to 300 feet (2 runs of 150’ each) of RG-11 PVC jacketed coaxial IFL cable with connectors.
• Commissioning of the VSAT using Spacenet’s VSAT Automated Commissioning System (VACS).
• Conducting an agreed-upon acceptance test to verify satellite connectivity.
• Removing and disposing of all trash and debris related to the VSAT installation.

Standard Spacenet SatKit installations do not include installation or configuration of the Cisco IP VSAT Module or the customer router.

**4.8. Common installation problems and pitfalls**

Problematic installations are often encountered in cases involving the following:

- Shopping malls or other leased spaces with common roof areas (see below)
- Locations with tall trees or buildings blocking much of the southern sky
- Heavily slanted roofs or other situations where a flat roof mount is not possible

If you are aware that your installation location may involve one or more of these factors, please contact Spacenet in advance for further discussion or a potential site survey.

If a customer does not own the facility/space where the VSAT will be installed, “roof rights” (the right to install new equipment and make the necessary cable runs, etc.) may be an issue. If you do not have “roof rights” for your facility, you must contact Spacenet ahead of time so that access and installation rights can be obtained in advance. This is often the case in shopping malls, subleased spaces or other tenanted locations. If you are not sure whether you have appropriate permissions for a dish to be installed, please contact Spacenet 30 days before the planned installation date. Procedure for ordering installations at these sites is:

1) When submitting the installation order, Spacenet's customer must include local mall management office contact information.

2) Spacenet must have the appropriate legal approvals arranged by the customer before they can do the install.

3) The customer must provide either 1.) a letter of authorization from the property's local management office, indicating approval to install a satellite antenna on the roof (this usually includes some contingencies for final approval), or 2.) a copy of tenant lease or addendum, indicating tenant is approved to install a satellite antenna on the roof. Note: it is best that the authorization letter or lease addendum come from the local property management office, not the corporate office, in order to ensure that the local office is aware of the pending VSAT install.

Installation orders for stores on property not owned by Spacenet's customer will be placed in a “hold” status until the Spacenet Installation Project Manager receives one of the above items. One the authorization to proceed is received, the installer will contact the location’s property management office to gain final approval for the installation.
Most property management offices will require Spacenet meet certain criteria prior to installing the antenna (usually these are contingencies listed in the letter of authorization). The most common are:

1. Provide proof of insurance – this is typically provided by the Spacenet installer
2. Provide a drawing/specification of the antenna to be installed – this can be sent to property management by the Spacenet Installation Project Manager
3. Have the mall-contracted roofer install the point of entry
4. Provide a detailed installation plan

Items 3 and 4 will require site surveys to be conducted by the Spacenet Installer at a cost to the customer per contract.

   a. Should a survey be required, a request is sent to the customer and the install order is placed back on hold pending survey results / bid approval.
   b. If no survey is required (or once the survey is completed and any out of scope bids are approved) the installer puts together anything else necessary for final property management approval.
   c. Once property management approves the install, installer calls the store POC to schedule the date of install.

While Spacenet makes every effort to ensure that its standard professional-grade satellite equipment installation is sufficient for the vast majority of customer deployments, there may be cases in which special installation efforts (also known as “out of scope” installs) are required. In these cases, the installer will consult with the customer before undertaking any installation activities that require additional charges.

4.9. Service technical support and troubleshooting

Spacenet provides technical support and troubleshooting services related to the satellite link connection and the SatKit dish/cabling. Spacenet does not provide technical support for issues related to the Cisco IP VSAT Module itself, the Cisco router or any router configuration/setup issues (these should be addressed by the customer’s Cisco reseller or Cisco SMARTnet subscription.)

If an issue is experienced with the satellite connection, the customer should first verify that the router is configured correctly and the IP VSAT Module hardware is properly working. If after a basic set of troubleshooting steps the problem is believed to be in the in the satellite connection or outdoor hardware, the customer should open up a web trouble ticket with Spacenet or call Spacenet’s technical support center.

Spacenet will work with the customer to either identify or repair the problem, or if the problem does not exist with the satellite service or onsite location to isolate the problem to the Cisco IP VSAT Module or router. Customers may elect to subscribe to a regular on-site maintenance plan with a variety of service response level or may choose a time and materials based maintenance plan.

5. VSAT Network Performance and Architecture

5.1. Basic VSAT network architecture

VSAT networks are designed in a hub-and-spoke fashion, with customer locations connecting directly over the air to a central “hub” facility. The equipment at a customer site is a VSAT receiver/router (similar to a DSL or cable modem), attached to a small dish mounted on top of or outside the building. At the central hub facility, a large dish and sophisticated hub RF components receive and transmit to the remote sites, and route information to and from the Internet or private networks via leased line links.
VSAT networks can be used for Internet access, or they can be connected from the hub facility directly to a corporate data center or application provider such as a credit card authorization provider. VSAT networks may have anywhere from one to tens of thousands of remote VSATs communicating with a single hub.

5.2. Satellite characteristics and application performance

Due to the necessary transmission overhead in a satellite connection and the way that packets are optimized for satellite links, “real-world” application throughput of a satellite connection is typically less than the full rated throughput. Application performance will not necessarily be the same over satellite and wireline/terrestrial circuits of the same size.

The true throughput of an application is determined in large part by the application’s network traffic characteristics. Satellite transmission protocols use fixed timeslots/packet sizes and work best with small volumes of large data packets that can be effectively grouped. Applications that use large amounts of small packets that cannot be grouped together tend to leave more wasted space in the transmission and therefore have greater “overhead.” This overhead may range from 10 percent to as much as 33 percent. Therefore, when estimating the size of satellite connections required to support customer applications, it is important that some allowance is made for bandwidth overhead.

5.3. Security, encryption and VPN compatibility

VSAT networks are widely considered to function as secure, private layer-two networks. Most enterprise VSAT network customers do not apply additional encryption technologies to their networks; however, if this is a requirement for a customer network, certain issues are important to keep in mind.

IPSec/VPN traffic: Spacenet’s transparent TCP acceleration technology is used to overcome the inherent satellite latency and is crucial in most cases to allow TCP/IP applications to work properly. When IPSec is configured on the router, packets arriving to the IP VSAT Module are encrypted and thus TCP acceleration cannot be applied. Therefore, it is recommended not to use IPSec over the satellite services.
Security & encryption options: As mentioned above, enabling IPSec/VPN over the satellite link is not recommended since it will disable TCP Acceleration. To overcome this limitation Spacenet recommends that customers consider an application layer encryption technology such as SSL based VPN. SSL-VPN does not encrypt the TCP header and thus allows the IP VSAT Module to perform TCP Acceleration while preserving the encrypted payload. For an in-depth discussion of this topic, see Spacenet’s encryption and security white paper available from www.spacenet.com/cisco.

5.4. Latency and acceleration

Because VSAT connections bounce signals off a satellite in geosynchronous orbit 22,300 miles above Earth’s equator, some latency is inherent in the connection due to the speed of light. As measured by ping times, round-trip latencies are typically 600-700 ms, but can range higher depending on network “distance,” congestion or other applications running.

Spacenet VSAT networks use a variety of advanced techniques to mitigate the effects of the latency inherent in satellite networks. These technologies and their parameters should be kept in mind when architecting VSAT networks.

TCP Acceleration: Spacenet dramatically improves IP network performance through intelligently accelerating TCP acknowledgement messages and increasing data throughput. The standard Connexstar services include a transparent TCP acceleration technology. The maximum number of active TCP sessions per site depends of the service level per the following table. If additional TCP sessions are required, customer will need to upgrade to the next available service level.

<table>
<thead>
<tr>
<th>Service</th>
<th>TCP Connections</th>
<th>Service</th>
<th>TCP Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI-128</td>
<td>32</td>
<td>CI-128 Plus</td>
<td>64</td>
</tr>
<tr>
<td>CI-256</td>
<td>64</td>
<td>CI-256 Plus</td>
<td>96</td>
</tr>
<tr>
<td>CI-384</td>
<td>96</td>
<td>CI-384 Plus</td>
<td>128</td>
</tr>
<tr>
<td>CI-512</td>
<td>128</td>
<td>CI-512 Plus</td>
<td>160</td>
</tr>
<tr>
<td>CI-768</td>
<td>160</td>
<td>CI-768 Plus</td>
<td>192</td>
</tr>
<tr>
<td>CI-1024</td>
<td>192</td>
<td>CI-1024 Plus</td>
<td>256</td>
</tr>
</tbody>
</table>

HTTP Acceleration: Spacenet’s Connexstar CI services include a transparent HTTP acceleration technology for web browsing. No software or special configuration is required at the customer’s PCs. HTTP acceleration is implemented for Internet access, and customers with IPSec/VPN or terrestrial backhauls that need to accelerate Intranet sites will be required to provide DNS Forwarding information.

5.5. VSAT application and architecture considerations

The Cisco IP VSAT Module solution is well suited to nearly all popular IP applications including Internet access and private network access. Backup/disaster recovery connectivity is available through the VSAT wireless link, with near-instantaneous switchover time. Multicast data delivery for file updates or digital content distribution is easily implemented. VoIP and video are also readily supported with excellent performance. When combined with a Cisco Integrated Services Router, the IP VSAT Module can further enable a host of combined applications such as secure data, voice, switching, wireless LAN (WLAN) access point service, Content Engine and Land Mobile Radio (LMR) base station usage.

Due to the physics of satellite communications, approximately ½ second of latency is present in each satellite round-trip for data packets. On-board transparent acceleration of TCP and HTTP provides a high-quality user experience for most applications. However, certain applications that require constant exchange of large datasets or break the acceleration through IPSec encryption or tunneling require special considerations to achieve optimal performance. Consult your Cisco or Spacenet representative for more information on these applications.
Firewall protection: Spacenet's firewall protection brings all data through our master hub facility firewalls before sending it through to the corporate remote sites or the public Internet. The default firewall profile blocks all incoming traffic from the Internet to each VSAT. Customers can choose to open up to 20 ports/IP address combinations or request to open all traffic to their VSATs.

IPSec/VPN and encryption: See section 5.3 above.

GRE tunnels: Similarly to IPSec/VPN, GRE implementation warps the TCP/IP packets with a GRE/IP header and thus masks the ability of the IP VSAT Module to perform TCP accelerations. Therefore, it is recommended not to use GRE encapsulation over the satellite services.

Routing protocols: Activating routing protocols will be required in most cases only when customers have an IPSec/VPN or terrestrial backhaul that connects to the customer’s private/Intranet network. Spacenet recommends that customers use Spacenet’s satellite-optimized RIP implementation to reduce the amount of routing keep-alive traffic over the satellite link and improve performance. Other routing protocols (such as OSPF) can be enabled using GRE tunnels.

Multicast service: The ability to rapidly deliver large volumes of data or other digital content to a large population of remote locations via multicast distribution is a unique advantage of VSAT technology. Spacenet can provision multicast bandwidth in 100 kbps increments for a set fee per month. This service requires collocation of the multicast content server with Spacenet, or an IPSec/other terrestrial backhaul connection to Spacenet from the content distribution point.

Content hosting: Web hosting or other content serving applications are not supported in the standard Connexstar services. Specific bandwidth intensive applications such as video conferencing and video surveillance are not included in the basic services either, but can be supported through a custom service. Please contact your sales representative for additional information. Spacenet cannot guarantee the functionality and/or performance of non-industry standard and/or proprietary applications.

IP addressing: Standard Connexstar CI data services include two public IP addresses (255.255.255.252 or /30 subnet) assigned by Spacenet – one should be configured and assigned to the VSAT network module and one should be configured for the router satellite interface. Customers can assign any private IP addresses on the router LAN interface(s) as long as Network Address Translation (NAT) is being configured in the router to map the private IP addresses to Spacenet’s assigned Public IP address. Customers can purchase an upgrade to a public subnet of 5 IP addresses (255.255.255.248 or /29 subnet) or an upgrade to a public subnet of 13 IP addresses (255.255.255.240 or /28 subnet) for an additional fee per month. Routing of private IP addresses is possible but requires a purchase of an IPSec/VPN or terrestrial backhaul service in addition to the VSAT service.
5.6. A sample architecture for full-time Internet access

In the diagram above, Spacenet provides a public /30 IP subnet to the satellite network segment, assigning a public IP address to both the VSAT network module and the router satellite interface. Network Address Translation (NAT) is implemented on the Ethernet interface of the router, so that multiple clients can be connected and use the Connexstar service.
5.7. A sample architecture for part-time failover networking

In the diagram above, Spacenet provides a private /30 IP subnet to the satellite network segment, assigning a private IP address to both the VSAT network module and the router satellite interface. RIP is forwarded from the WAN1 interface of the router over the terrestrial network to the terrestrial core router located at Spacenet’s teleport or the customer’s data center. Arrival of RIP at the terrestrial core router tells it that the link is active and to route all traffic to the remote site over WAN1 (DSL or Frame Relay). OSPF is configured on the terrestrial core router (as the “low cost route”) and the hub core router (as the “high cost route”). If RIP is no longer received by the terrestrial core router, OSPF will route all traffic to the remote site over WAN2 (VSAT). Hot Swap Routing Protocol (HSRP) implemented on the remote site router will switch from WAN1 to WAN2 if terrestrial connectivity is lost.

6. Case Studies In Cisco IP VSAT Module/Cisco Deployment

6.1. Leading U.S. energy provider seeking critical WAN backup
A leading energy company in North America was seeking a network backup solution for its oil refinery locations. It chose the Cisco IP VSAT Module with Spacenet’s satellite services for its network backup solution. With this solution, the leading oil refiner company is prepared to recover immediately from disasters and continue business operations by communicating over satellite and can also use it for high performance concurrent applications such as data, voice and security while reducing operating costs.
This leading company operates around the clock delivering millions of barrels of oil per day. Uninterrupted communications and operations are crucial for its business. In the event of an emergency or disaster, the Cisco VSAT module provides sophisticated failover and traffic prioritization capabilities. This solution enables the company to preserve its traffic transport of the most essential applications and continue vital business functions.

6.2. Global freight/logistics carrier deploys disaster recovery service

During the aftermath of Hurricane Katrina in 2005, a leading transportation and logistics company found that its United States terrestrial communications infrastructure was vulnerable to extended outages. This company’s IT infrastructure required 100% uptime to support its delivery of millions of packages per day.

The company deployed Spacenet’s Connexstar services and the Cisco IP VSAT Module to restore vital communication networks in the Gulf Region. Spacenet’s back-up satellite services provide a diverse network path that is scaleable for the leading package carrier’s business needs and seamlessly integrated with its primary networks. In the case of a disaster that seriously affects the local terrestrial network infrastructure, satellite services can continue to operate or be restored quickly with a dish repoint – often days or even weeks before the wireline network is back in service.

7. Additional Resources and How To Learn More

Spacenet maintains a website dedicated to providing customers and partners with information about Connexstar CI services for the Cisco IP VSAT Module. These include presentations and white papers on security, application optimization and VSAT technology essentials. A wealth of additional resources are available at www.spacenet.com/cisco.

Cisco also provides a wide variety of learning resources on the IP VSAT Module product, including detailed documentation on installation and configuration of the VSAT Network Module. These can be found at Cisco’s website www.cisco.com.