Satellite Basics

Benefits of Satellite

People need access to enterprise-class, high-speed voice, video and data applications wherever they happen to be. Satellite connectivity has the power to drive communications advances across a broad range of industries and geographies.

Whether it's ship-to-shore maritime communications, Internet access for remote, rural classrooms, or vital data and communications for petroleum operations, satellite applications meet a broad range of needs.

iDirect's communication platform enables any IP application to run reliably and efficiently over satellite. iDirect's advanced technology provides organizations with immediate global reach – making mission critical communications possible in the most challenging and diverse environments.

Communication satellites are used in fixed or mobile wireless communications to receive and transmit radio signals from an orbiting satellite to another terrestrial location. There have been such advances in bandwidth utilization and reliability of communications that satellite service now provides affordable, always-on, high-speed, quality connectivity.

Global Coverage

Today, satellite communication can deliver a terrestrial-grade experience with voice, video, and data that can be accessed anywhere in the world. Ubiquitous coverage can be obtained with a global network of multiple satellites all tying into one central network management system.

Reliability

Satellite networks are dependable, providing constant connectivity even when terrestrial networks fail. With satellite networks, enterprises can maintain business continuity with built-in redundancy and automatic back-up service.

Security

Satellite networks already constitute a private network. By adding encryption technology satellite can provide a more secure connection than terrestrial networks, making it an ideal solution for government, military and enterprise VPN (virtual private network) solutions.

Scalability

The modularity of VSAT systems allows for quick time-to-market and fast upgrades. VSAT remotes can be deployed rapidly and new remote locations are easily added to a network where limited terrestrial infrastructure exists simply by configuring bandwidth to the site and having ground equipment installed.

Fast Deployment

Satellite technology is an ideal solution for quick deployment, immune to the challenges posed by

difficult terrain, remote locations, harsh weather, and terrestrial obstacles. In this rapidly expanding market, satellite allows a service provider to get to market quickly and efficiently and provide immediate connectivity in disaster and emergency relief scenarios.

Cost Savings

Satellite technology can deliver a communications infrastructure to areas where terrestrial alternatives are unavailable, unreliable or simply too expensive. Satellite allows service providers to insure scalability, profitability and maintain low operating expenses, all while overcoming a lack of existing infrastructure.

How Satellite Works

A communications satellite is a satellite located in space for the purposes of telecommunications. There are three altitude classifications for satellite orbits:

LEO – Low Earth Orbit

LEO satellites orbit from 160-2000km above the earth, take approximately 1.5 hrs for a full orbit and only cover a portion of the earth's surface, therefore requiring a network or constellation of satellites to provide global, continual coverage. Due to the proximity to Earth, LEO satellites have a lower latency (latency is the time between the moment a packet is transmitted and the moment it reaches its destination) and require less amplification for transmission.

MEO – Medium Earth Orbit

MEO satellites are located above LEO and below GEO satellites and typically travel in an elliptical orbit over the North and South Pole or in an equatorial orbit. These satellites are traditionally used for GPS navigation systems and are sometimes used by satellite operators for voice and data communications. MEO satellites require a constellation of satellites to provide continuous coverage. Tracking antennas are needed to maintain the link as satellites move in and out of the antenna range.

GEO – Geostationary Orbit

GEO satellites orbit at 35,786 km (22,282 mi) above the equator in the same direction and speed as the earth rotates on its axis. This makes it appear to the earth station as fixed in the sky. The majority of commercial communications satellites operate in this orbit; however, due to the distance from the earth there is a longer latency.

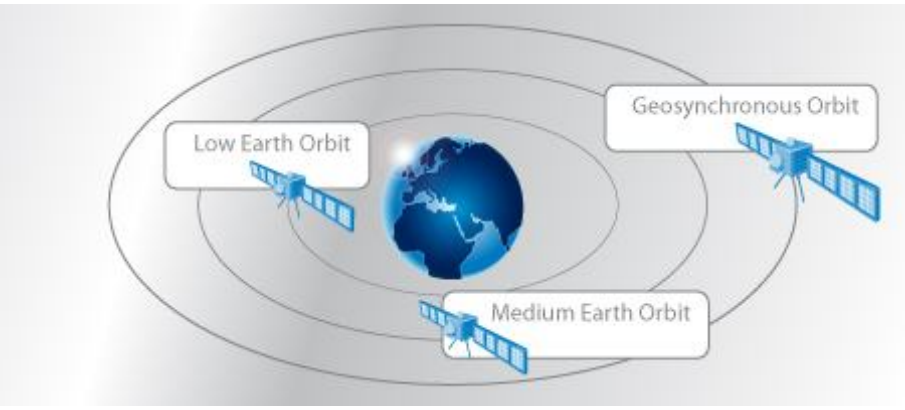

Figure 1. Satellite Orbits

Frequency Bands

There are four radio frequency bands that communication and military satellites operate within:

C band – uplink 5.925-6.425 GHz; downlink 3.7-4.2 GHz
The C band is primarily used for voice and data communications as well as backhauling. Because of its weaker power it requires a larger antenna, usually above 1.8m (6ft). However, due to the lower frequency range, it performs better under adverse weather conditions on the ground.

X band – uplink 7.9- 8.4 GHz, downlink 7.25 – 7.75 GHz
The X band is used mainly for military communications and Wideband Global SATCOM (WGS) systems. With relatively few satellites in orbit in this band, there is a wider separation between adjacent satellites, making it ideal for Comms-on-the Move (COTM) applications. This band is less susceptible to rain fade than the Ku Band due to the lower frequency range, resulting in a higher performance level under adverse weather conditions.

Ku band– uplink 14 GHz; downlink 10.9-12.75 GHz
Ku band is used typically for consumer direct-to-home access, distance learning applications, retail and enterprise connectivity. The antenna sizes, ranging from 0.9m -1.2m (~3ft), are much smaller than C band because the higher frequency means that higher gain can be achieved with small antenna sizes than C-band. Networks in this band are more susceptible to rain fade, especially in tropical areas.

Ka band – uplink 26.5-40GHz; downlink 18-20 GHZ
The Ka band is primarily used for two-way consumer broadband and military networks. Ka band dishes can be much smaller and typically range from 60cm-1.2m (2' to 4') in diameter. Transmission power is much greater compared to the C, X or Ku band beams. Due to the higher frequencies of this band, it can be more vulnerable to signal quality problems caused by rain fade.

VSAT Network

Network Equipment

A network typically consists of a larger earth station, commonly referred to as a teleport, with hub equipment at one end and a Very Small Aperture Terminal (VSAT) antenna with remote equipment at the other end. The network equipment can be divided into two sets of equipment connected by a pair of cables: the Outdoor Unit (ODU) and the Indoor Unit (IDU).

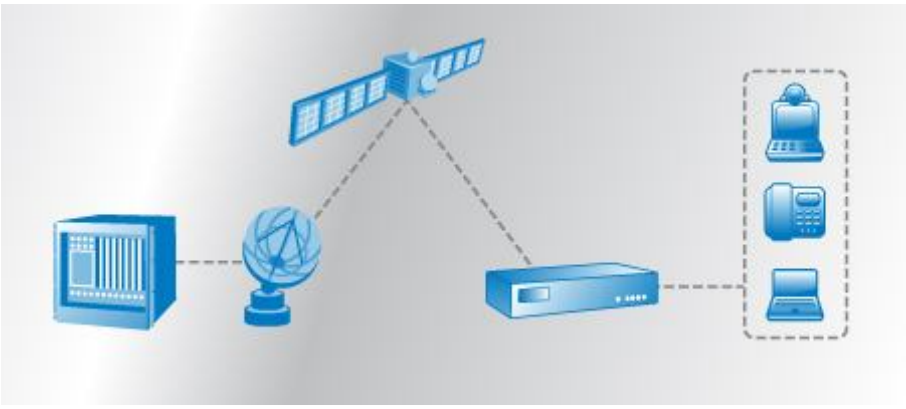

Figure 2. Network Equipment

ODU

An ODU is the equipment located outside of a building and includes the satellite antenna or dish, a low noise block converter (LNB), and a block-up-converter (BUC). The LNB converter amplifies the received signal and down converts the satellite signal to the L band (950 MHz to 1550 MHz), while the BUC amplifies the uplink transmission when the antenna is transmitting.

IDU

The IDU equipment at the teleport usually consists of a rack-mounted hub system and networking equipment connected to terrestrial networks, like the PSTN or Internet backbone. There is also a device that converts between satellite and IP protocols for local LAN applications such as PCs, voice calls and video conferencing.

At the remote location, a router connects to a small VSAT antenna receiving the IP transmission from the hub over the satellite and converts it into real applications like Internet, VoIP and data.

Topologies

Network topologies define how remote locations connect to each other and to the hub. The link over the satellite from the hub to the remote is called the outbound or downlink transmission, whereas the link from the remote to the hub is referred to as inbound or uplink. Satellite networks are primarily configured in one of these topologies:

Star (hub & spoke) Networks

In a star network topology the hub connects to the remote, where all communications are passed back through the hub. Virtually an unlimited number of remotes can be connected to the hub in this topology. Smaller, lower powered BUCs can be used at the remote end since they are only connecting back to the larger hub antenna.

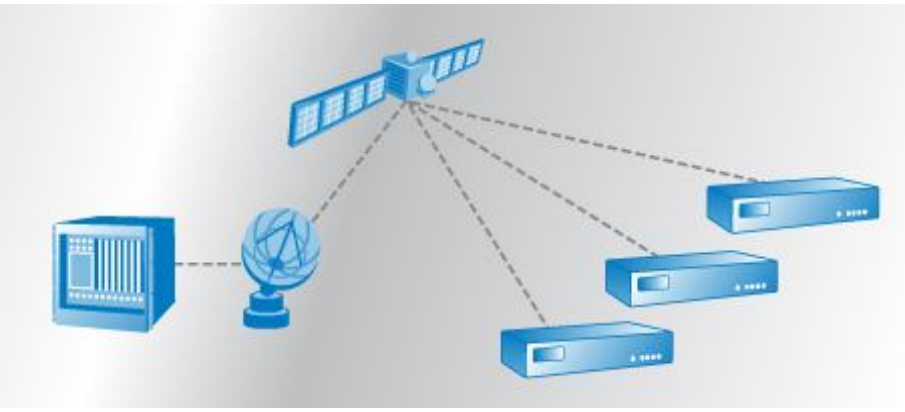

Figure 3. Star Topology

Mesh Networks

A mesh network topology allows one remote VSAT location to communicate with another remote location without routing through the hub. This type of connection minimizes delay and often is used for very high quality voice and video conferencing applications.

With this topology, larger antennas are required and more power is needed to transmit, thereby increasing cost.

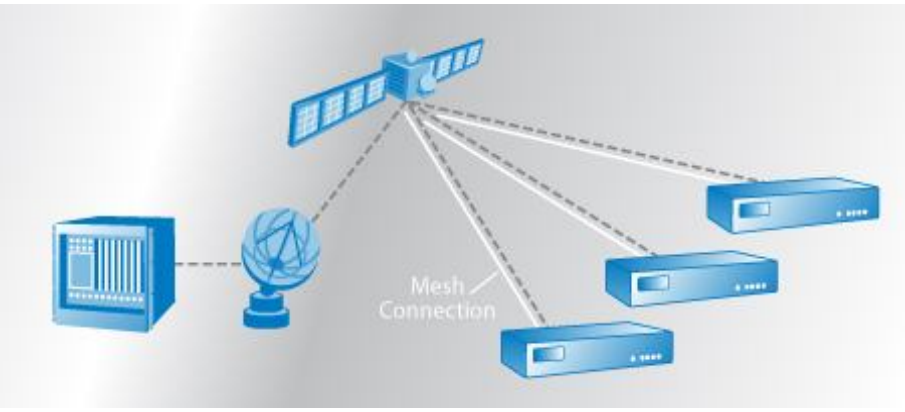

Figure 4. Mesh Topology

Hybrid Networks

A hybrid topology is a mix of star and mesh networking solutions. This topology allows the hub to send information to the remotes, with the remotes then able to communicate with other VSAT locations.

Point to Point Connectivity

Contrary to the networking topologies, a point-to-point topology involves a dedicated connection between two antennas. This topology is a direct pipeline with a set bandwidth capacity regardless of usage and is typically designed with Single Carrier per Channel (SCPC) technology.

Value Chain

Equipment Vendors

Equipment vendors are generally distinguished between pure antenna manufacturers and satellite equipment manufacturers that produce indoor or outdoor ground equipment including antennas, LNBs, BUCs, hubs, routers, software and network management systems.

Satellite Operators

Satellite operators are responsible for the planning and cost of the construction and launch of satellite into space. They own and manage a constellation of satellites and determine coverage and geographic areas. Satellite operators lease this bandwidth to service providers, government entities, television broadcasters, enterprises and sometimes direct to the end consumer.

Service Providers/ Network Operators

Service providers, sometimes known as network operators, are telecommunication companies or specialized satellite service companies who sell a full service package to the end customer. They lease capacity from satellite operators, purchase and operate the network equipment and the antenna, and are responsible for the installation and maintenance of the network.

Customers

Customers are the enterprises, organizations and consumers who use satellite communication services. Governments or large corporate customers may operate as their own service provider by managing the equipment directly and leasing bandwidth from satellite operators. Individuals and smaller enterprises typically work with service providers who manage the equipment and connections.

Applications

Always-on, high-speed connectivity is needed for a variety of applications. Whether broadcasting radio to consumers or multi-casting data for enterprise networks, satellite can support all of a user's networking requirements, including:

- VoIP
- Email
- Internet
- Video
- Data
- VPN
- Broadcasting

Satellite can provide the right solution for a number of applications, whether extending the edge of the terrestrial networks to remote places or as a stand-alone solution, such as:

- Enterprise Connectivity
- Retail Transactions
- Internet Connections (ISPs)
- Video/TV Direct to Home
- Maritime
- Cellular Backhaul
- Military Defense
- Energy & Utilities
- Oil & Gas
- Business Continuity
- Disaster Recovery/Emergency Relief
- Education & Training
- Aeronautical Connectivity

About VT iDirect

VT iDirect, Inc. (iDirect), a subsidiary of VT Systems, is transforming the way the world gets and stays connected. The company's satellite-based IP communications technology enables constant connectivity for voice, video and data applications in diverse and challenging environments. These include extending private networks to remote offices; supporting mobile connectivity across land, sea and air; providing rural telephony and Internet broadband; and maintaining communications in the wake of disasters and network failures. The iDirect Intelligent Platform™ integrates advanced technology into iDirect's portfolio of hubs, routers and network management software to address the growing complexity of deploying and managing global IP networks. With more than 13 years of global satellite communications experience, iDirect serves customers in 50 countries through a diverse network of channel partners, including some of the largest satellite providers, operators and carriers in the world and seven of the World Teleport Association's Global Top Ten. Headquartered in Herndon, Virginia, iDirect has offices in Europe, Asia, Middle East, Africa and Latin America. Please visit www.idirect.net.

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