Day 4 course

Bandwidth Procurement and Optimizing the Cost Factor

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1- VSAT Networks

Definition

VSAT is a well established acronym for Very Small Aperture Terminal.

VSATs access satellites in geosynchronous orbit to relay data from small remote earth stations (terminals) to other terminals (in mesh configurations) or master earth station "hubs" (in star configurations).

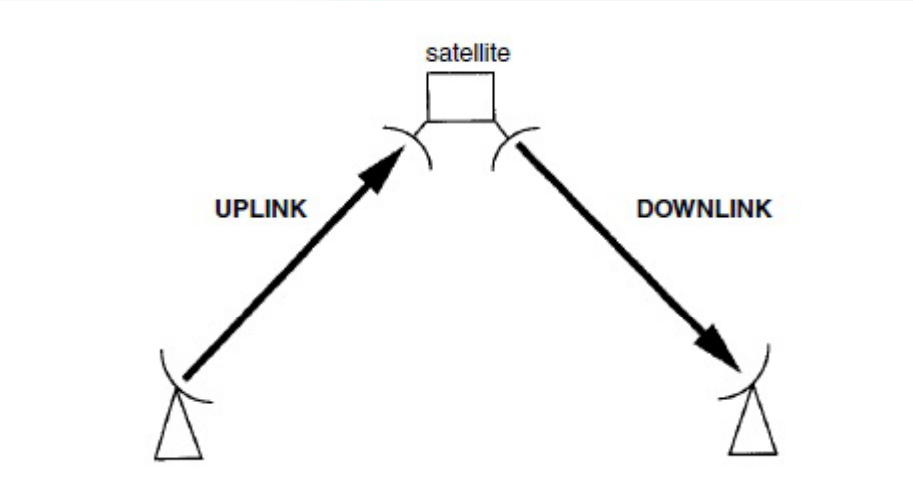
The collection of VSATs communicating together constitutes the VSAT Network.

The largest VSAT network (more than 12,000 sites) was deployed by Spacenet and MCI for the US Postal Service.

1- VSAT Networks

VSATs are connected by radio frequency (RF) links via a satellite, with a so-called *uplink* from the station to the satellite and a so-called *downlink* from the satellite to the station.

The overall link from station to station, sometimes called *hop*, consists of an uplink and a downlink.



1- VSAT Networks

Operation Model

A radio frequency link is a modulated carrier conveying information. Basically the satellite receives the uplinked carriers from the transmitting earth stations within the field of view of its receiving antenna, amplifies those carriers, translates their frequency to a lower band in order to avoid possible output/input interference, and transmits the amplified carriers to the stations located within the field of view of its transmitting antenna.

2- VSAT Networks Topology

Broadcast

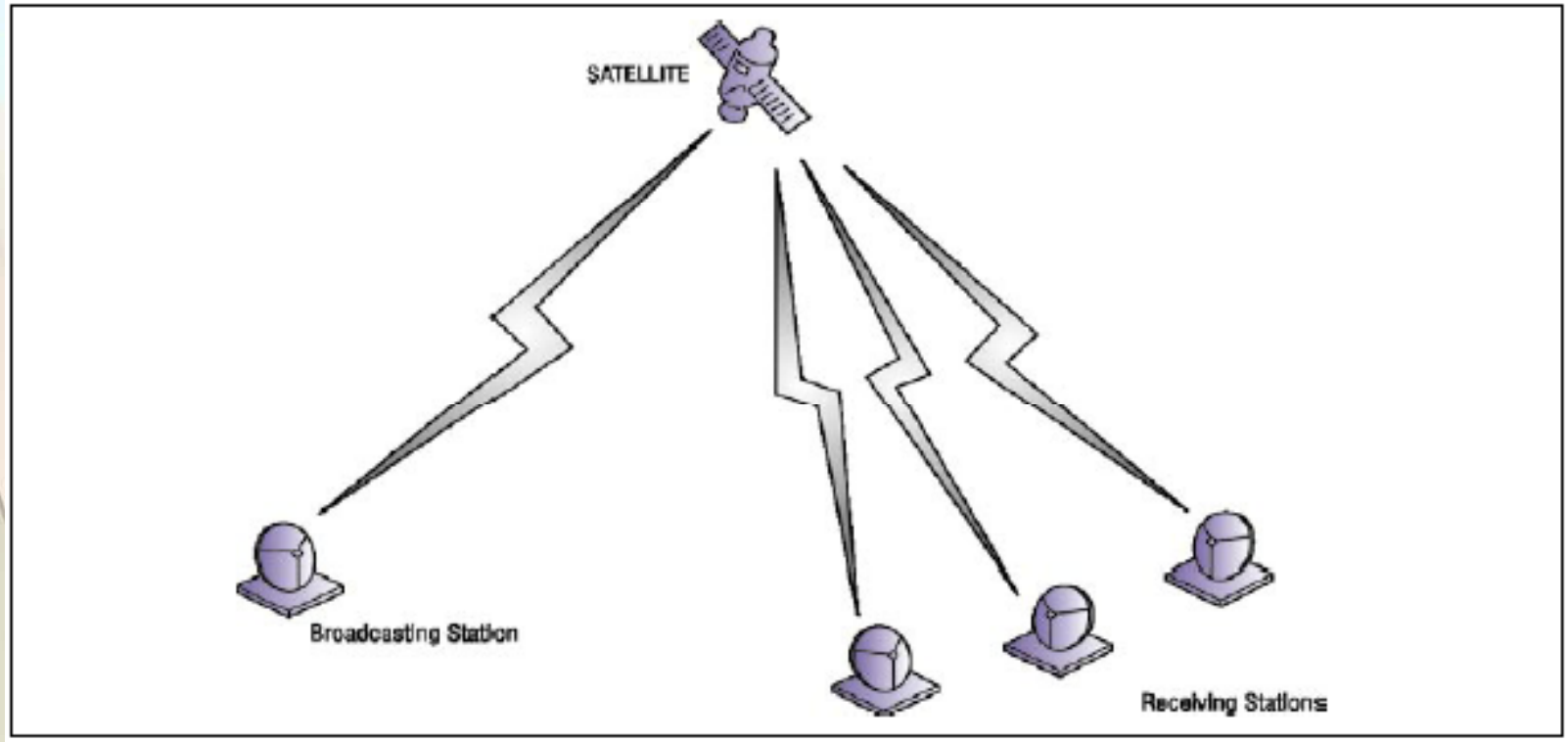
This involves one terminal transmitting the message and several terminals receiving the message and is usually used in broadcasting where you can only receive but not transmit, for example in TV, radio and satellite video systems.

Broadcast systems are also used for consumer Internet access; where low-cost receive only satellite dishes7 are combined with the use of dialup telephone or mobile networks for the return path to the Internet. A broadcast network will usually involve several receive systems and one transmitting system.

2- VSAT Networks Topology

Broadcast

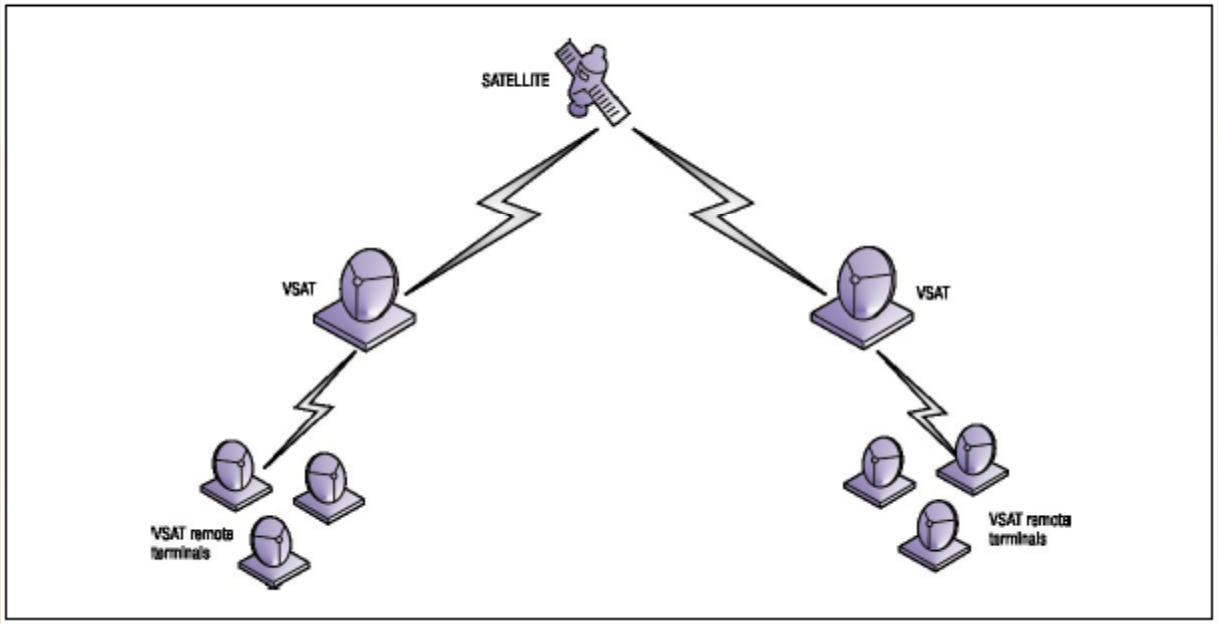
Broadcast systems should not be confused with simplex systems. Simplex systems are two-way systems where transmission occurs in only one direction at a time.



2- VSAT Networks Topology

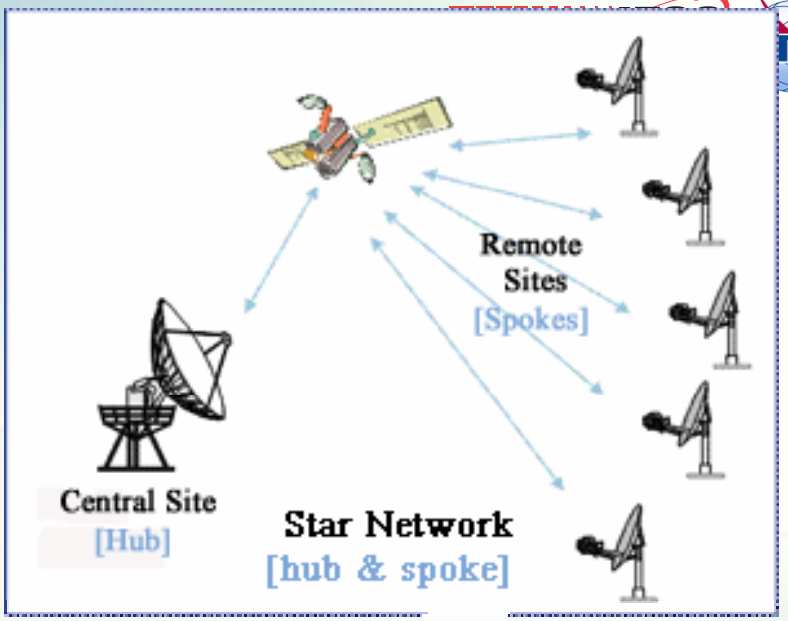
Point to point

This is the simplest topology and involves only two terminals communicating directly with each other over a dedicated channel. Common applications include sending news reports from the field back to a central studio (Satellite News Gathering or SNG), providing telecommunication services to remote areas from a central switch such as extending the telephone connection to a remote town using VSATs and providing large amounts of bandwidth to Internet Service Providers..



2- VSAT Networks Topology

Star Networks Dedicated Satellite Communications



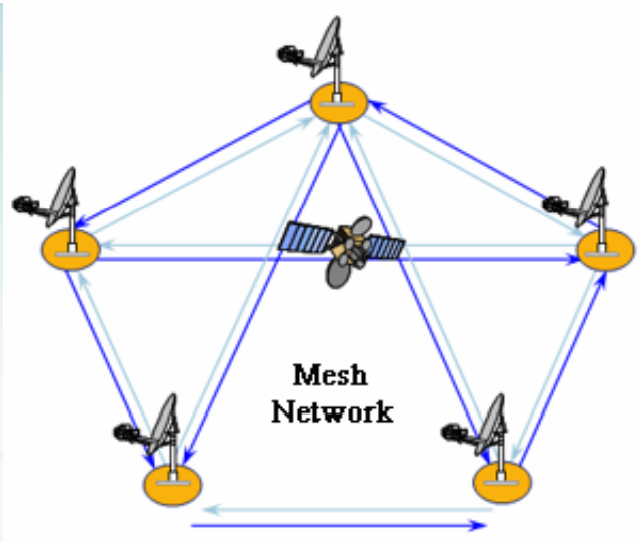
Or Hub and Spoke service is designed so that all signal transmissions to and from an individual VSAT must be routed through a central location or hub.

This network configuration is suitable when a large number of VSATs transmit a large number of low bandwidth intensive transactions that are organized at a central location (hub).

Typical applications for Star networks are corporate networks with a Headquarters and remote offices, credit card verification and inventory control.

2- VSAT Networks Topology

Mesh Networks Dedicated Satellite communications



allow several VSATs to communicate with each other via a single relay link through the satellite. The "single hop" nature of this network design leads to a minimal time delay between signal transmission and reception.

Historically, mesh networks have been an expensive application to provide dedicated satellite communications. However, modulation and compression improvements have helped to make this service more cost effective.

Mesh technology is best used for a group of VSATs that need to have real time applications between each site without the latency created by a double satellite hop with communications going through a teleport.

2- VSAT Networks Topology

Hybrid Networks Dedicated Satellite Communications

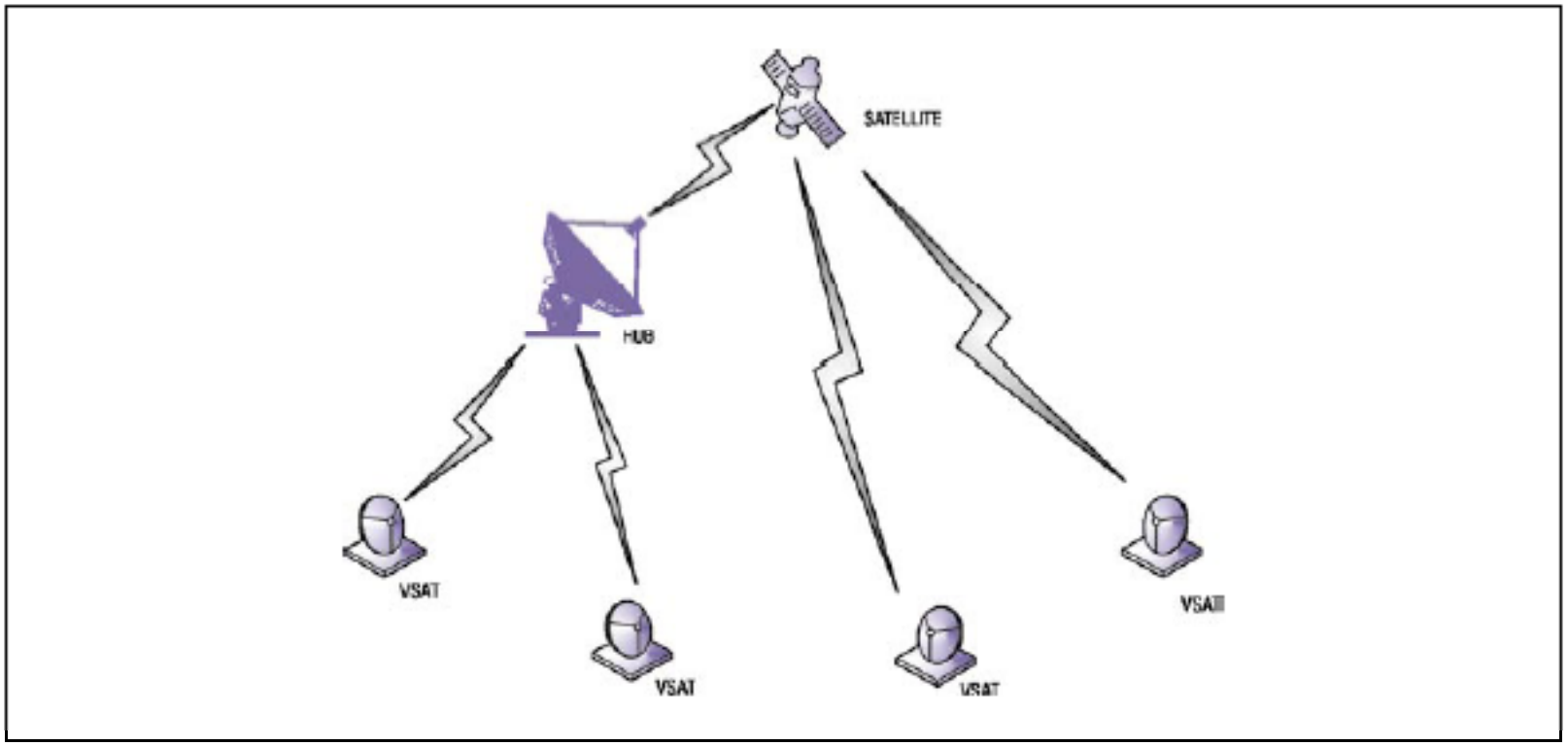
are the result of a combination of mesh and star networks used together to achieve a unique form of dedicated satellite communications to meet the service needs of the subscriber.

In a hybrid situation, some of the sites can be configured as Hubs in a Star network and the remaining sites as a Mesh network. Alternatively, a VSAT may be part of a Star network and part of a Mesh network concurrently.

Each hybrid network application provides an optimal design and solution to effectively provide high speed bandwidth as needed.

2- VSAT Networks Topology

Hybrid Networks Dedicated Satellite Communications



2- VSAT Networks Topology

	Pros	Cons
Broadcast	• Very cost effective if transmitting from one location to many locations simultaneously	• Requires separate return channel e.g. telephone dial up connection for interaction
Point to Point	• Can transfer large amounts of information between two locations • Ideal for real-time communications as no double hops • May be cost effective to establish between two sites since no large Hub costs involved	• Does not use a Hub so requires relatively large and expensive dishes at both sites • Bandwidth can not be easily shared with other sites and so not ideal for sporadic usage.
Star	• Requires relatively smaller low cost antennas at the remote locations • Bandwidth can easily be shared with other remote terminals and so ideal for infrequent "bursty" type traffic	• Not ideal for real-time communications between two locations in the same VSAT network • Requires Hub which is expensive and so only cost effective if servicing many remote locations
Mesh	• Ideal for real-time communications among two or more stations in the same network since no double hops	• Does not use a Hub so require relatively large and expensive dishes at any site
Hybrid	• Shares the pros of both star and mesh networks making it a flexible and adaptable network	• Can be expensive to setup and run

3- Accessing schemes

The primary objective of the VSAT networks is to maximize the use of common satellite and other resources amongst all VSAT sites.

The methods by which these networks optimize the use of satellite capacity, and spectrum utilization in a flexible and cost-effective manner are referred to as satellite access schemes.

Each of the above topologies is associated with an appropriate satellite access scheme. Good network efficiency depends very much on the multiple accessing schemes.

There are many different access techniques tailored to match customer applications.

3- Accessing schemes

SCPC

Dedicated satellite communications via SCPC networks are an integral part of large business, ISP, and enterprise network operations worldwide. This is because advanced reliability, security, and flexibility enable **SCPC** (single channel per carrier) satellite service to provide vital, private communications links over VSATnetworks in a variety of operating configurations.

The effectiveness of dedicated satellite communications networks enable them to serve as a primary communications tool or as a secure backup connection.

This ensures a real-time link between data and operations centers even in the most remote regions of the world.

3- Accessing schemes

SCPC

SCPC satellite backbone connectivity provides constant dedicated communications to deliver one way, full duplex or asymetrical service in point to point, point to multi-point, star, mesh, or hybrid network configurations.

In these designs, an SCPC network can deliver high bandwidth to easily support the most demanding service applications, such as, video-conferencing, voice communications, and data transmission. Dedicated bandwidth connectivity is offered on SCPC, iSCPC, DVB and DVP-S2 platforms.

3- Accessing schemes

SCPC

Important Satellite SCPC features

- Supports true multimedia capabilities - voice,video,data
- Replacement of terrestrial circuits
- Backup circuits for redundancy or diversity
- Remote access where high-speed terrestrial connectivity isn't available

Potential SCPC applications

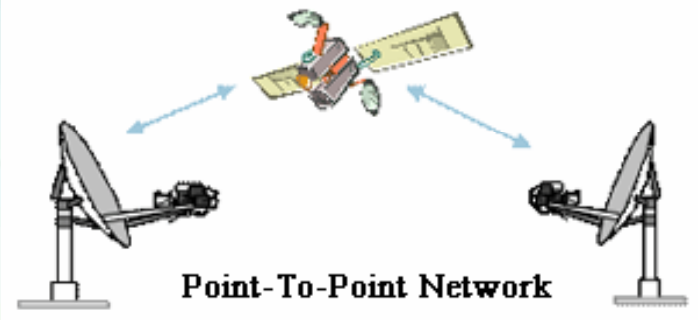
- High-speed access to IP networks
- Replacement of terrestrial circuits
- Credit authorizations and inventory management
- Corporate operations and account management
- WAN connectivity

3- Accessing schemes

SCPC

Point-To-Point Dedicated

Satellite Communications



provide a direct link between two sites that are located on the same satellite footprint.

Depending upon the satellite and provider, some links can deliver high bandwidth speeds of up to 155Mbps which is comparable to a terrestrial leased line connection.

3- Accessing schemes

SCPC

These networks easily support voice, video, and data transmissions utilizing a standard data/voice multiplexer, an SCPC satellite modem, and a VSAT terminal at each site. This is a very simple approach for point-to-point networks as communications are only between the two sites. Similarly, **Point-To-MultiPoint** satellite connectivity is a network configuration composed of multiple Point-To-Point SCPC connections.

There is no connectivity to the teleport which requires the satellite signal to make a double hop. More important, the quality of real time applications is not affected.

There are no costs associated with the usage of a teleport or backhaul which makes this a less expensive solution!

3- Accessing schemes

TDMA

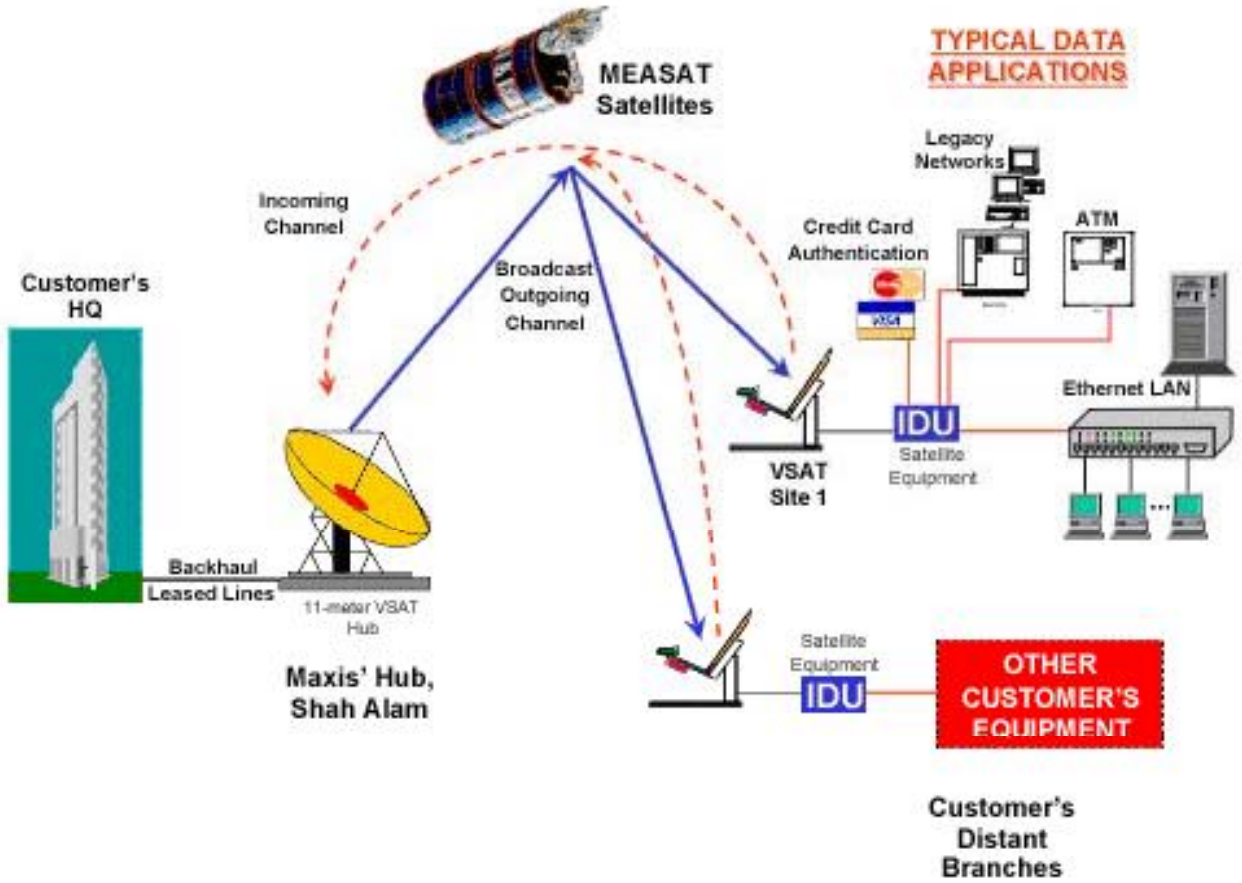
With TDMA networks, numerous remote sites communicate with one central hub – a design that is similar to packet-switched networks.

Remote sites in a TDMA network compete with one another for access to the central hub, restricting the maximum band.

In a TDMA network, all VSATs share satellite resource on a time-slot basis. Remote VSATs use TDMA channels or inroutes for communicating with the hub. There could be several inroutes associated with one outroute. Several VSATs share one inroute hence sharing the bandwidth. Typical inroutes operate at 64 or 128 Kbit/s. Generally systems with star topology use a TDMA transmission technique. Critical to all TDMA schemes is the function of clock synchronization what is performed by the TDMA hub or master earth station.

3- Accessing schemes

TDMA



Typical SkyNet (TDM/TDMA) configuration supporting various interactive data applications

3- Accessing schemes

FDMA

It is the oldest and still one of the most common methods for channel allocation. In this scheme, the available satellite channel bandwidth is broken into frequency bands for different earth stations. This means that guard bands are needed to provide separation between the bands. Also, the earth stations must be carefully power-controlled to prevent the microwave power spilling into the bands for the other channels. Here, all VSATs share the satellite resource on the frequency domain only. Typically implemented in a mesh or single satellite hop topology, FDMA has the following variants:

- **PAMA (Pre-Assigned Multiple Access)**
- **DAMA (Demand Assigned Multiple Access)**
- **CDMA (Code Multiple Access)**

3- Accessing schemes

PAMA

It implies that the VSATs are pre-allocated a designated frequency. Equivalent of the terrestrial leased line solutions, PAMA solutions use the satellite resources constantly. Consequently, there is no call-up delay what makes them most suited for interactive data applications or high traffic volumes. As such, PAMA connects high data traffic sites within an organization.

SCPC (Single Channel Per Carrier) refers to the usage of a single satellite carrier for carrying a single channel of user traffic. The frequency is allocated on a pre-assigned basis in case of SCPC VSAT which is also synonymously known as PAMA VSAT.

3- Accessing schemes

DAMA

The network uses a pool of satellite channels, which are available for use by any station in that network. On demand, a pair of available channels is assigned so that a call can be established. Once the call is completed, the channels are returned to the pool for an assignment to another call. Since the satellite resource is used only in pro-portion to the active circuits and their holding times, this is ideally suited for voice traffic and data traffic in batch mode.

DAMA offers point-to-point voice, fax, and data requirements and supports video-conferencing.

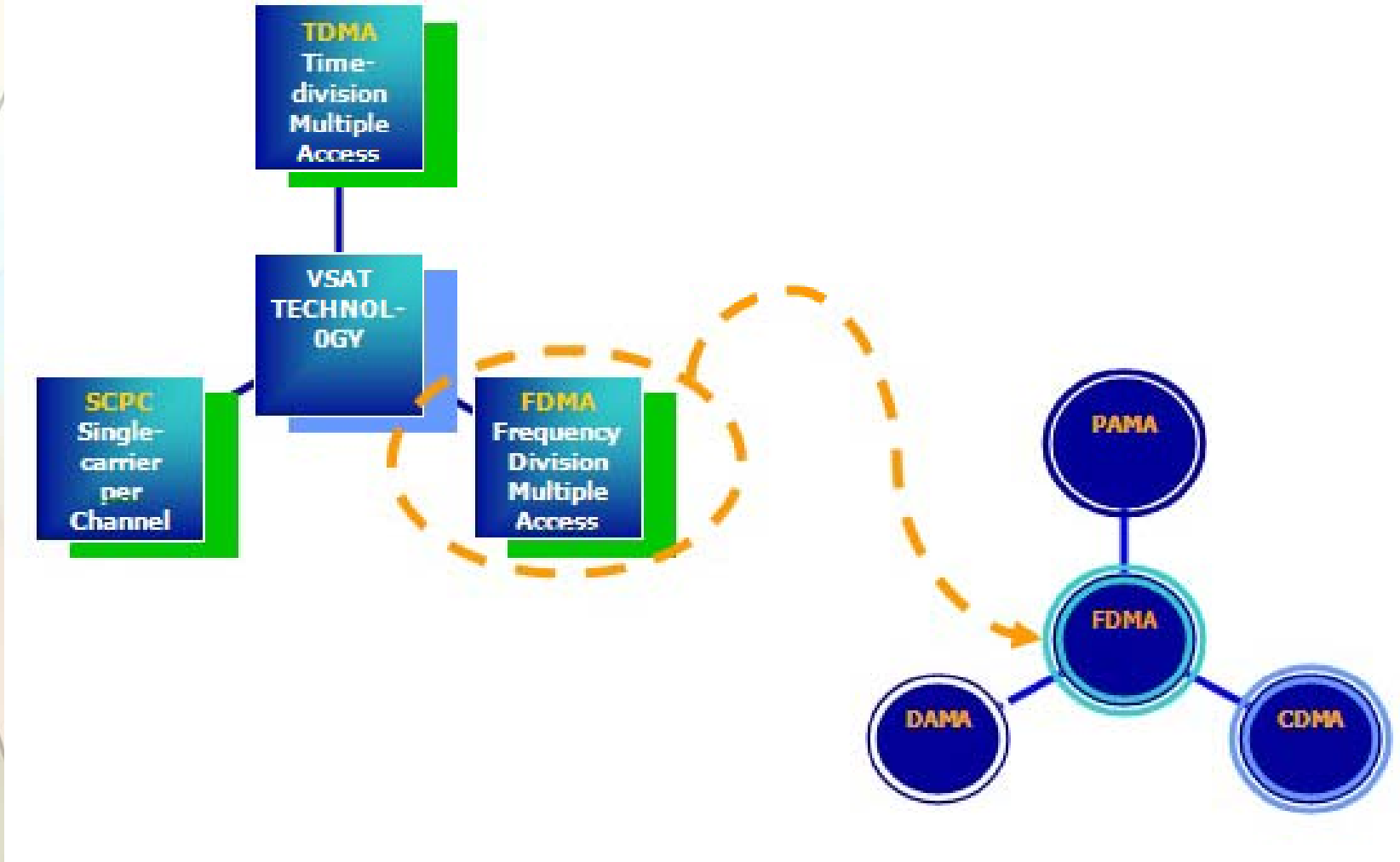
DAMA systems allow the number of channels at any time be less than the number of potential users. Satellite connections are established and dropped only when traffic demands them.

3- Accessing schemes

CDMA

Under this, a central network monitoring system allocates a unique code to each of the VSATs enabling multiple VSATs to transmit simultaneously and share a common frequency band. The data signal is combined with a high bit rate code signal which is independent of the data. Reception at the end of the link is accomplished by mixing the incoming composite data/code signal with a locally generated and correctly synchronized replica of the code. Since this network requires that the central network management system co-ordinates code management and clock synchronization of all remote VSATs, star topology is, by default, the best one. Although this is best applicable for very large networks with low data requirements, there are practical restrictions in the use of spread spectrum. It is employed mainly for interference rejection or for security reasons in military systems.

3- Accessing schemes



4- Some common technical considerations

There are a whole host of technical considerations you will need to make when buying a VSAT. Most of them involve making trade offs among the technical characteristics that give you what you want and what you can afford.

The common considerations you may be forced to make are:

- Whether to use inclined orbit satellites
- Whether to use C or Ku band
- Whether to use shared or dedicated bandwidth.

4- Some common technical considerations

Use of Inclined Orbit Satellite

The price of bandwidth on inclined orbit satellites is usually much lower since these satellites are nearing their end of life. The downside is that it requires a dish with tracking capabilities that can be very expensive. The high capital costs associated with the expensive antenna can be offset by lower operating costs but only if you are purchasing large amounts of bandwidth.

You should therefore make sure that you carefully consider both your capital and operating costs over the period you intend to operate the VSAT. Of course, remember to ascertain the exact remaining life of the satellite, when making this consideration. If you decide to opt for inclined orbit capacity, caution is advised as the service can be down for a while in the event that you are running mission critical applications.

4- Some common technical considerations

C Band vs. Ku Band

One of the big decisions you are likely to encounter when buying a VSAT is whether to use C band or Ku band. In order to enable you to arrive at an informed decision, we have briefly presented the advantages and disadvantages of each band.

4- Some common technical considerations

C Band vs. Ku Band

Advantages of using C band

o C band is less affected by rain. If you happen to live in a high rain-fall area such as the tropics and your VSAT applications are “mission critical”, in other words, you want your system available all the time, you can opt for C band over Ku band. However, this does not exclude the use of Ku band systems in the tropics especially for home TV and Internet access since these are not mission critical applications and the consumers can live with a few hours of intermittent service.

4- Some common technical considerations

C Band vs. Ku Band

Advantages of using C band

C band systems have been around longer than Ku band systems and thus rely on proven technology. However, Ku band systems seem to be overtaking C band systems as the preferred technology in the home consumer business in the last few years. Note that Ku band dishes are more likely to be smaller and therefore cheaper for any given application, because of Ku band's higher frequencies. You should also bear in mind that Ku band bandwidth prices are higher than C band prices and therefore any savings on capital costs could be offset by higher operating costs.

4- Some common technical considerations

C Band vs. Ku Band

Advantages of using C band

C band satellite beams have large foot prints with the global beam covering almost a third of the earth's surface. If you are looking for single satellite hop operation (e.g. for real time applications such as telephony or videoconferencing) to connect locations far apart from one another, you may be forced to choose the wider coverage C band beams. However, the latest satellites launched have large Ku band beams covering entire continents. You should also note that two beams on the satellites can be connected through a method called "cross strapping" thus allowing two or more locations covered by two separate beams to be connected in a single hop.

4- Some common technical considerations

C Band vs. Ku Band

Disadvantages of using C band

- C band requires the use of larger dishes which can be quite cumbersome to install and are more expensive to acquire and transport.
- C band systems share the same frequency bands as allocated to terrestrial microwave systems. As such care must be taken when positioning C band antennas in areas where terrestrial microwave systems exist (for example TV or radio stations). For this reason, C band satellite transponder power is deliberately limited during the satellite's design and manufacture according to sharing criteria laid down by the ITU, leading to a requirement for larger dishes on the ground.

4- Some common technical considerations

C Band vs. Ku Band

Advantages of using Ku band

- Ku band systems require smaller dishes because of their higher satellite transponder power and higher frequencies, which translates into smaller, cheaper antennas on the ground and therefore lower start up and transport costs.

o The smaller Ku Band dishes can be easily installed on almost any surface- the ground, roofs or bolted to the side of buildings. This is an important consideration for areas with limited space.

4- Some common technical considerations

C Band vs. Ku Band

Disadvantages of using Ku band

- Ku band systems are more affected by rainfall because of their higher operating frequencies and as such are usually considered unsuitable for mission critical applications in the tropics, unless specific measures are taken to provide for the added rain attenuation, for example by using larger dishes. This drawback has also been slightly offset by the higher power satellites being manufactured today. As noted above, Ku band systems are gaining popularity even in the tropics for home use where users can survive a few hours of intermittent service a month.

4- Some common technical considerations

C Band vs. Ku Band

Disadvantages of using Ku band

o Ku band satellite systems usually have smaller beams covering a small surface of the earth. Therefore if you intend to cover two locations a large distance apart, within a single hop or with a broadcast system, you may need to consider C band systems.

o Ku band bandwidth is more expensive that C band bandwidth. As noted above, the savings in capital cost you gain using Ku band's smaller antennas may be negated by the higher operating costs imposed by high bandwidth prices.

4- Some common technical considerations

C Band vs. Ku Band

Advantages of using Ka band

o Ka band dishes can be much smaller than Ku band dishes because of the even higher Ka band frequencies and higher satellite power. The smaller dishes translate to lower start up costs for equipment.

4- Some common technical considerations

C Band vs. Ku Band

Disadvantages of using Ka band

o The higher frequencies of Ka band are significantly more vulnerable to signal quality problems caused by rainfall and therefore Ka band VSATs are usually unsuitable for mission critical or high availability systems in the tropical and sub-tropical regions without the provision of measures to combat adverse weather conditions.

o Also, Ka-band systems will almost always require tracking antennas.

o Ka band bandwidth is more expensive than C band or Ku band bandwidth.

o Ka band is currently unavailable over Africa.

4- Some common technical considerations

C Band vs. Ku Band

Summary

	C Band	Ku Band	Ka Band
Advantages	Less affected by rain Proven technology Wider coverage	Smaller dishes Easy installation	Smaller dishes than Ku Band
Disadvantages	Larger dishes Interferences with terrestrials microwaves frequencies	Affected by rain Smaller beam More expensive than C Band	Affected by rain Require tracking antennas More expensive bandwith Unavailable over Africa

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

It is critical for you to decide whether you will accept shared or dedicated bandwidth. Shared bandwidth refers to bandwidth that is shared with other customers of your service provider.

Dedicated bandwidth is “committed” solely to you. Shared bandwidth is obviously cheaper than dedicated bandwidth because you are also sharing the cost of the bandwidth among other users.

Unfortunately, some service providers pass off shared bandwidth as dedicated bandwidth and charge you rates equivalent to those for dedicated bandwidth.

You therefore have to be clear what you are buying.

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

Shared bandwidth is desirable when you will not be using all the bandwidth all the time. If your primary applications will be email and web surfing and you do not have many users e.g. a community telecenter, then shared bandwidth may well work for you.

However, if you have a large volume of users accessing the system throughout the day or if you intend to run real time applications such as telephony or videoconferencing, then you will need dedicated bandwidth.

There are three key metrics you will need to consider when purchasing shared bandwidth:

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

The contention ratio

Contention is a term that comes from terrestrial internet systems such as Digital Subscriber Link (DSL) and refers to sharing. The contention ratio is the number of users sharing the bandwidth.

Obviously the more users sharing the bandwidth, the less bandwidth you get if they are all online.

For instance if you are sharing bandwidth with a capacity of 1 Mbps among 20 customers (contention ratio of 20:1), then your maximum connection speed when all the customers are using the bandwidth is 50 kbps, equivalent to a dial up modem connection.

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

The contention ratio

If, however, the contention ratio is 50:1 or 50 customers sharing the connection, then your maximum speed when all customers are using the system is 20 kbps.

As you can imagine, how much of the 1 Mbps promised by the service provider you actually get depends on the contention ratio. Contention is also called “over booking” or “over selling” capacity.

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

Committed Information Rate (CIR)

Even with shared bandwidth capacity, your service provider may guarantee you certain minimum capacity at all times. This guaranteed capacity is the CIR.

In our example above using a contention ratio of 20:1, this CIR would be 50 kbps, even though you are quoted a bandwidth capacity of 1 Mbps.

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

Bursting capacity

Bursting refers to the ability of a VSAT system to utilize capacity above and beyond its normal allocation. Bursting is only possible when you purchase shared bandwidth.

If your service provider has implemented bursting, a portion or all of the shared bandwidth capacity will be pooled. For instance, several portions of 1 Mbps may be pooled together.

When other customers are not using their capacity, you may be able to "burst" or use more than your allocated capacity.

4- Some common technical considerations

Shared vs. Dedicated Bandwidth

Bursting capacity

Note that bursting also only occurs when there is 'free' or available capacity in the pool. The amount of additional or burst capacity to which any VSAT station sharing the pool is entitle to is limited to a set maximum, usually less than the total pool capacity to ensure that there is always capacity available for other VSAT stations.

In summary, when purchasing shared capacity, you should ask your service provider to specify the contention ratio, your CIR and how much bursting capacity you can get.

5- Selecting a partner provider

The acquisition process involves either competitive or non competitive selection of your VSAT equipment and service provider(s). Under competitive selection, two and usually more service providers are asked to submit proposals or “bids”. The selection is based on the best offer, arrived at by comparing all the proposals received using a pre-determined evaluation scheme.

Under non-competitive selection, only a single service provider is invited to submit a proposal, and no other service providers are considered. Non-competitive selection is also referred to as single sourcing or direct contracting.

As you can imagine competition is healthy in order to obtain the best solution that matches your business requirements at the best price and in the most efficient way.

4- Selecting a partner provider

Therefore, a competitive approach is strongly recommended except in very extreme situations that can and should be clearly justifiable on economic and efficiency grounds.

Non competitive acquisition or single sourcing should only be considered:

- In an emergency, for example if a VSAT is required to establish communication capabilities following a natural disaster and expediency is the over-riding factor.
- If there is only a single authorized or licensed supplier in your country or region.
- If you want to ensure compatibility and integration with existing equipment or systems.
- If you are extending an existing contract based on prior good performance and for continuity purposes.

4- Selecting a partner provider

In case of competitive selection when you have analyzed your requirements and completed your vendor search, you are ready to start the vendor selection process.

You can then proceed by the following ways :

- Request For Proposal (RFP)
- Request For Quotation (RFQ)

A well written *Request for Proposal* (RFP) or *Request for Quotation* (RFQ) is the key for selecting the best vendor at the best value for your company. Writing a RFP or RFQ is not difficult if you understand the objectives and function of the document.

4- Selecting a partner provider

RFP

A **request for proposal** (**RFP**) is an early stage in a procurement process, issuing an invitation for suppliers, often through a bidding process, to submit a proposal on a specific commodity or service. The RFP process brings structure to the procurement decision and allows the risks and benefits to be identified clearly upfront.

The RFP may dictate to varying degrees the exact structure and format of the supplier's response. The creativity and innovation that suppliers choose to build into their proposals may be used to judge supplier proposals against each other, at the risk of failing to capture consistent information between bidders and thus hampering the decision making process. Effective RFPs typically reflect the strategy and short/long-term business objectives, providing detailed insight upon which suppliers will be able to offer a matching perspective.[2]

4- Selecting a partner provider

RFQ

A **request for quotation (RFQ)** is used when discussions with bidders are not required (mainly when the specifications of a product or service are already known) and when price is the main or only factor in selecting the successful bidder.

An RFQ may also be used as a step prior to going to a full-blown RFP to determine general price ranges. In this scenario, products, services or suppliers may be selected from the RFQ results to bring in to further research in order to write a more fully fleshed out RFP.

4- Selecting a partner provider

RFQ and RFP Content

The RFP or RFQ should contain the following sections. Keep in mind, that each document will be different depending upon the type of company and product you are searching for. Tailor each section for your individual needs.

- **Submission Details**
- **Introduction and Executive Summary**
- **Business Overview & Background**
- **Detailed Specifications**
- **Terms and Conditions**
- **Selection Criteria**

4- Selecting a partner provider

RFQ and RFP Content

It is usual to request for the following specific information to be included in the Bid:

- The overall VSAT network and service design, including outbound, inbound channel system and VSAT stations.
- Satellite used with detailed coverage zones (transmit and receive).
- Detailed link budgets.
- Description of the hub/teleport, with location, staff, organization, interconnection toterrestrial networks (e.g. internet backbone, ISDN), and extra provided services

4- Selecting a partner provider

RFQ and RFP Content

For end-to-end service, you should, in addition to the above information, also request for:

- A confirmation of the space segment provider, that the space segment offered by the Bidder is available.
- A confirmation of the teleport provider, that the teleport service is available.
- A confirmation of the VSAT station hardware supplier, that the VSAT systems offered by the Bidder are available.

5- Partner provider factors to be considered

Before buying VSATs, an enterprise has to consider many factors.

Though cost has remained the main discussion point for enterprises, the importance of factors like feasibility, bandwidth capacity and reliability should not be underestimated.

5- Partner provider factors to be considered

Feasibility

A feasibility check is a must before going the VSAT way. Connectivity options should be taken into account before making decisions because while in some areas a limited range or even single connectivity is feasible, in others multiple connectivity options might be available.

VSAT may be the most suitable connectivity option for remote rural villages with no terrestrial telecommunications network. Urban areas though may have a good fiber or other terrestrial telecommunications network.

5- Partner provider factors to be considered

Bandwidth Capacity

Bandwidth capacity of a particular technology is one of the most important factors in selecting the connectivity option. You should determine the bandwidth capacity depending on the applications you run or intend to run in the future.

For example, high capacity applications such as videoconferencing may preclude the use of low capacity options such as dial-up Internet connections. It is important to keep future requirements in mind, otherwise, you may find yourself having to buy a new system when your bandwidth needs increase.

5- Partner provider factors to be considered

Reliability

Reliability consists of multiple factors such as latency, availability, mean time between failure (MTBF) and mean time to restore (MTR). For example, for real-time or VPN applications under certain conditions, VSATs as well as some other technologies have high latency, making them unsuitable to deploy.

Cost

Cost has always remained the decisive factor in selecting from connectivity options that fulfill the other criteria outlined above. One should consider both initial investment as well as recurring costs throughout the useful life of the technology selected.

5- Partner provider factors to be considered

Frequency Band

Selecting frequency band is also an important factor that can play an important role in taking a decision. It should be decided which frequency band is most suitable. Alternatively, you can ask your service provider to decide the band for you after specifying your preferred service availability level year around or in the worst month. The latter is the recommended approach to take.

Beam Coverage

If you are installing VSATs in more than one location, you should specify the beam coverage required. If all VSATs in the network use the same beam, sharing central hub facilities is an option. Use of a single beam is necessary to avoid double hops, if opting for a mesh network. Additionally, you should ask the service provider to provide you with footprints or contour maps of the satellite they intend to use.

5- Partner provider factors to be considered

Dedicated vs Shared Bandwidth

Depending on your business requirements you should decide the bandwidth type dedicated, shared, or burstable. Your choice of bandwidth type also has a bearing on what access scheme you choose, as some access schemes only support shared bandwidth approaches.

Access Technologies

Access technologies should be specified based on your business and functional requirements. Different access schemes have different maximum information throughput rates, which also have a bearing on scalability and future growth. Alternatively, you can ask your service provider to propose alternative schemes if they can justify them on technical, efficiency, and economic grounds. This is especially important for the inbound route.

5- Partner provider factors to be considered

Topology

Users should select the topology depending on the applications they intend to run. Real-time applications such as telephony or videoconferencing may require a mesh topology, whereas simple Internet access for Web browsing and email is most economically served by a star network.

Access schemes and topologies are the major cost drives for VSATs as they influence the size and capacities of the remote equipment, efficiency of bandwidth usage, and the type of hub infrastructure required. You should ask the provider for a detailed technical and economical justification for their proposed access scheme and topology.

5- Partner provider factors to be considered

A Comparison of Common Connectivity Options

Connection method	Capacity (maximum)	Feasibility	Start up costs	Average running costs/per kbps ($)	Reliability	Capacity Scalability
Dial-up connection	56 kbps	**Medium**—anywhere with landline coverage	Low (<$50)	$12.9	Low to medium	Very low (<64 kbps)
Leased wireline	■ ISDN—128 kbps ■ DSL—1.5 Mbps	**Low**—depends on country's telecom infrastructure	Medium (<$2,000)	$2.87	Medium	—
Terrestrial Wireless	■ Wi-Fi 802.11 a and g-54 Mbps ■ Wi-Fi 802.11 b- 11 Mbps ■ WIMax- 75 Mbps	**Low to medium**—depends on the country's telecom infrastructure, although can be set up relatively cheaply	Low to Medium ($50-$2,000)	$6.77	Medium to High	High (<100 Mbps)
Mobile/ Cellular	■ Basic GSM—9.6 kbps ■ GSM-HSCSD—38.4 kbps ■ GPRS—171 kbps ■ EDGE—384 kbps ■ UMTS—2 Mbps	**Medium**—anywhere within cellular coverage	Low (<$50)	$12.9	Low	Low (<2 Mbps)
Fiber	Unlimited (in theory)	**Low**—depends on the country's telecom infrastructure	Medium (<$2,000)	$4.14	High to Very High	Very High (>1 Gbps)
Satellite	■ VSAT—100-155 Mbps (when loaded transponder downlink) ■ Mobile satellite—64 kbps (eg Immarsat, Worldspace)	**Very High**—anywhere on the earth	High to Very High (>$2,000)	$7.3	High to Very High	High (<155 Mbps)

End of Day 4 course

Bandwidth Procurement and Optimizing the Cost Factor