

Agenda

- Day 1 - Basics of Satellite Communications
- Day 2 - Policy and Regulatory Guidelines for Satellite Services (first half / second half)
- Day 3 - Network Planning and Link Budget Analysis
- Day 4 - Vsat Installation and Maintenance
- Day 5 - Vsat Equipment and Bandwidth Procurement

Day 4

INSTAL & MAINTAIN



VSAT Instal & maintenance

- Vsat Installation

- Site survey
- Calculating, measuring and working with CLOS AZEL
- Equipment assembly and configuration parameters
- Grounding and lightening protection
- Using a sprectrum analyser
- Align the antenna to satellite
- Commissioning the service with SP
- User acceptance tests

- Vsat Maintenance

- Preventive maintenance actions
- Troubleshooting and incident resolution
- SLA

Vsat installation (site survey)

Identifies and gathers information (administrative and technical) such as:

- Geografical Local coordinates
- Clear LOS and visibility arc (satellite look angles)
- Flat level surface, no underground obstruction, no interference (radar. wimax, microwave towers, celular towers links)
- IDU, ODU and IFL, optimal or best, location
- Client's responsibility installation (civil works, grounding, ducts)
- Site Installation photos

Vsat installation (site survey example form)

Pedido de Site Survey	
Data: ____/____/____	Direção: _____
Instalador: _____	Utilizador: _____
	Fax: _____
Data objectivo para realização do serviço: ____/____/____	
Rede: _____ NIR: _____ Morada: _____	
Serviço: _____	
Cliente: _____	
Pessoa para contacto: _____ Telefone: _____	
Nome e Longitude do Satellite: _____ Diâmetro da Antena: _____	
Unidade Exterior: _____ Unidade Interior: _____	
<u>Relatório</u>	
Localização da Remota LAT / LONG: _____ N / _____ W	
Energia: Tem UPS ? <input type="checkbox"/> Sim <input type="checkbox"/> Não <input type="checkbox"/> Outro: _____	
Tem Terra ? <input type="checkbox"/> Sim <input type="checkbox"/> Não <input type="checkbox"/> Tem para-raios ? <input type="checkbox"/> Sim <input type="checkbox"/> Não	
Comprimento de Cabos: _____ (m) Tipo de cabo: <input type="checkbox"/> Tipo I <input type="checkbox"/> Tipo III RG: _____	
Localização da Antena: <input type="checkbox"/> Terraço <input type="checkbox"/> Jardim <input type="checkbox"/> Telhado <input type="checkbox"/> Parede <input type="checkbox"/> Torre	
<input type="checkbox"/> Outro: _____	
Altura da Antena ao Solo: _____ (m)	
Tipo de Suporte da Antena: <input type="checkbox"/> NPM <input type="checkbox"/> Universal <input type="checkbox"/> Pedestal <input type="checkbox"/> Parede	
<input type="checkbox"/> Mastro de parede <input type="checkbox"/> P/ torre <input type="checkbox"/> Especial: _____	
Necessidade de Anti-gelo: <input type="checkbox"/> Sim <input type="checkbox"/> Não	
Localização das Unidades Interiores: <input type="checkbox"/> Rack <input type="checkbox"/> Secretária <input type="checkbox"/> Outro: _____	
Sala Climatizada ? <input type="checkbox"/> Sim <input type="checkbox"/> Não	
Cabo em condução do cliente ? <input type="checkbox"/> Sim <input type="checkbox"/> Não	
Trabalhos Adicionais: <input type="checkbox"/> Autorização de condomínio <input type="checkbox"/> Construção de muros	
<input type="checkbox"/> Outros: _____	
Contacto para autorização de acesso a antena (Nome e forma de acesso): _____	
Assinatura do Cliente: _____ Data: ____/____/____	
Assinatura do Instalador: _____ Data: ____/____/____	



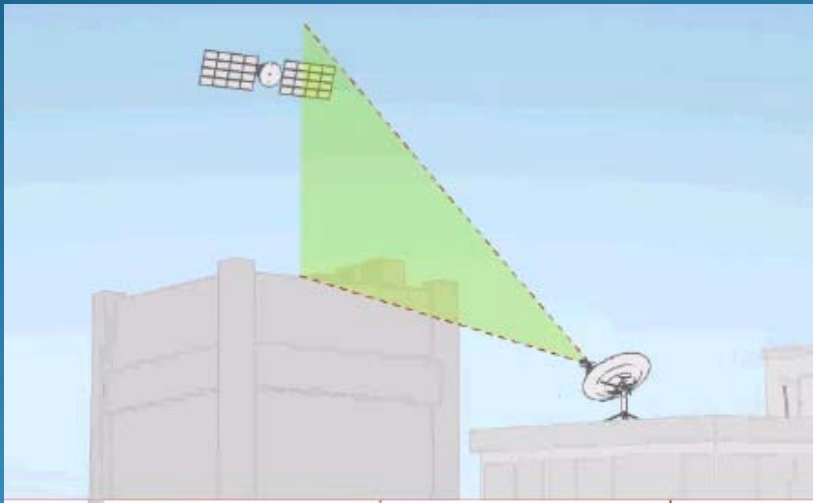
Vsat installation

(installation preparation items)

- Support assembly(npm, soil, post mount)
- Dish assembly
- Calculating pointing parameters
- Pointing dish
- Coaxing cable and cable runs
- Connectors, cabling and waterproof sealing
- Grounding and lightening
- RF equipment installation
- Energy
- IDU installation
- HW / SW testing
- Satellite peacking up
- Commissionning tests

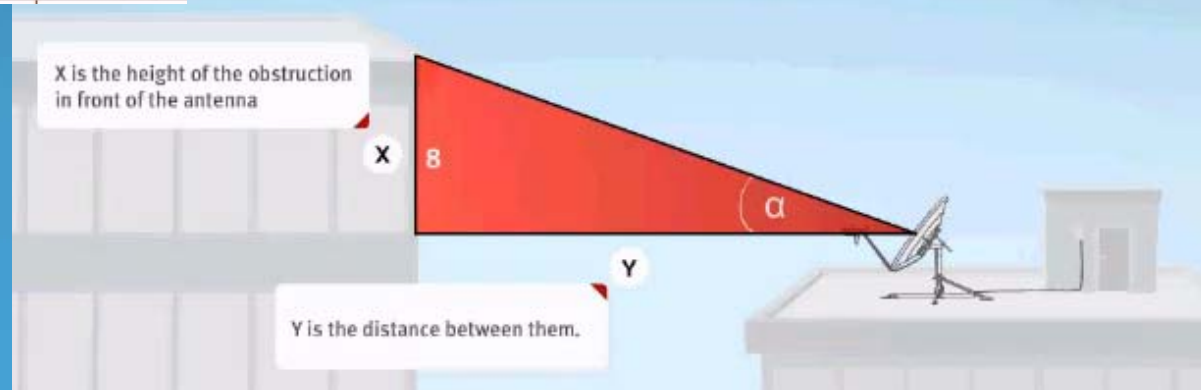
Vsat installation

(calculating clear LOS AZ-EL)



The antenna needs to have a clear LOS to the satellite

$$\alpha = \arctg \frac{x}{y}$$



Vsat installation (equipment assembly tools)



1.
Inclinometer



2.
Compass



3.
Laptop or desktop computer
with Windows 98t and above,
WinZip/WinRar and com port connection



4.
Voltmeter



5.
Basic Tools:
Flat, Cross and Hexen Screwdrivers
Wrench
Wire cutter



6.
Extra Cables:
RG6 cable
Straight and Cross Ethernet Cables
RS232 serial cable

**Optional but highly recommended
additional and spare equipment
to have on site:**

1. Spectrum Analyzer
2. BUC
3. LNB
4. Satellite Router

Vsat installation


(equipment assembly and configuration)

- Assemble and anchor the antenna
- Make sure your antenna is leveled (using a leveler)
- Make sure you have assembled the feed in the correct polarization position
- Confirm correct coordinates
- Use the compass as reference and adjust the antenna left or right horizontally
- Use the inclinometer as reference and adjust the antenna vertically

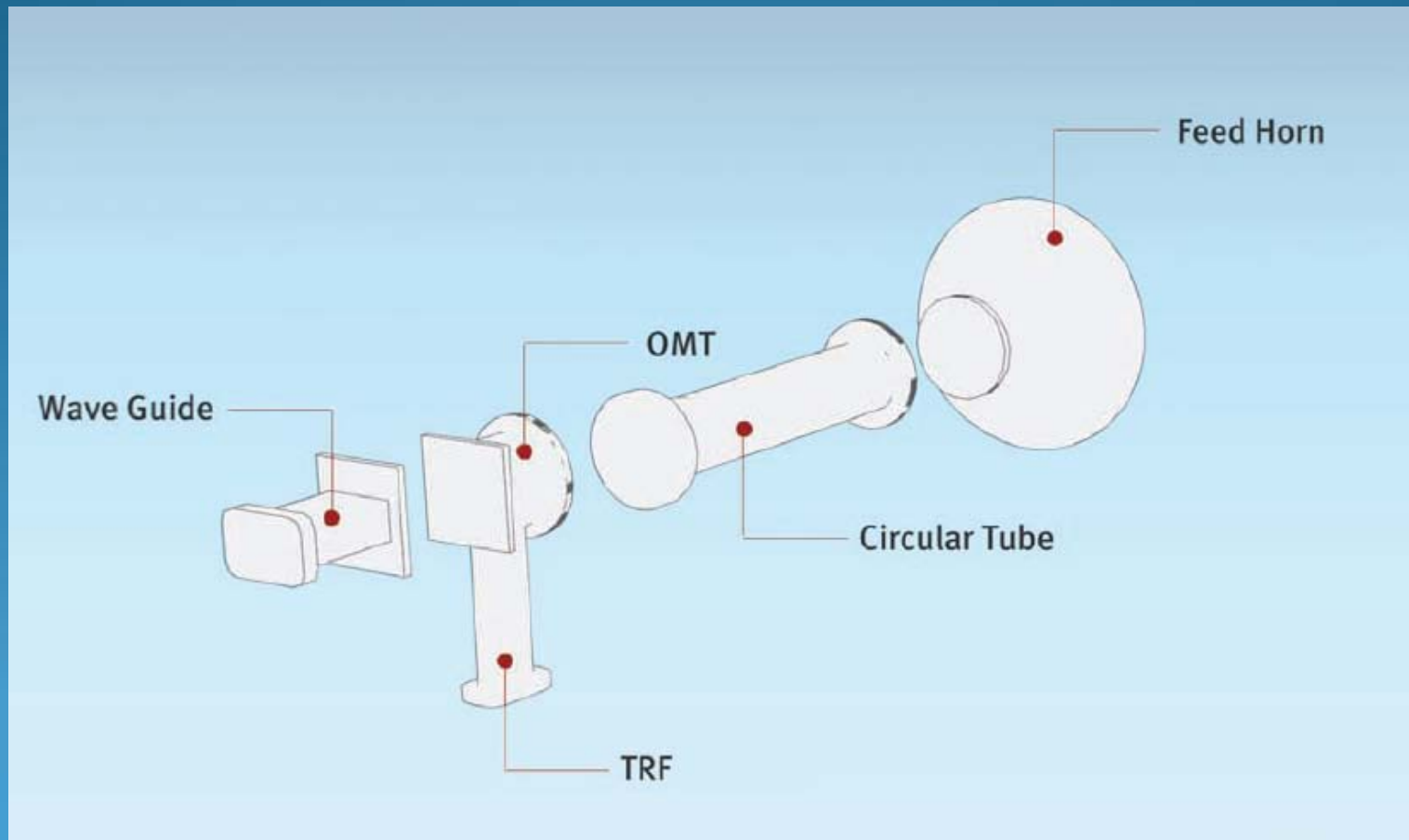
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Vsat installation

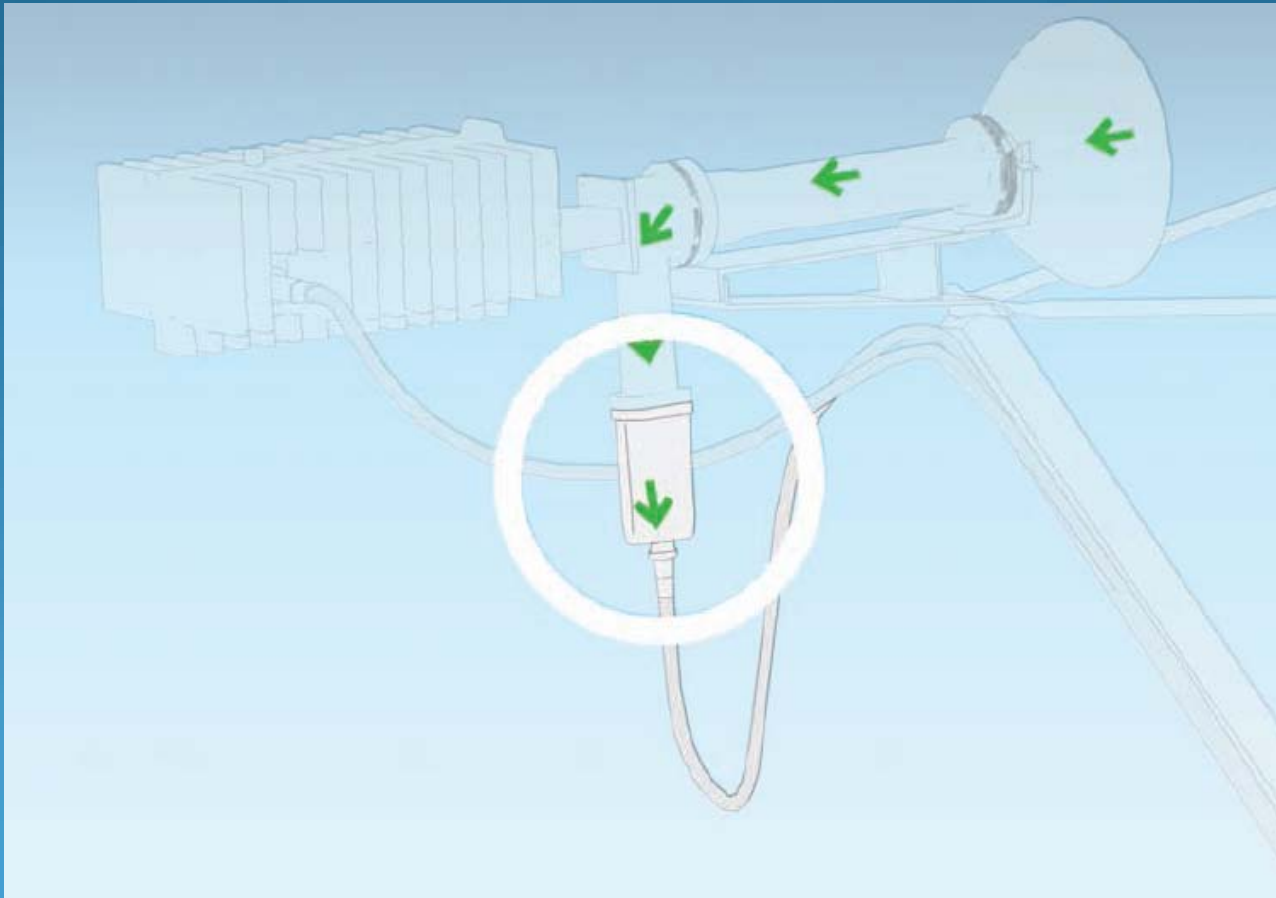
(equipment assembly and configuration)

- Grounding and lightening
- Install the RF equipment (feed, LNB and BUC) 
- Find the correct satellite with the spectrum analyser
(or alternately with the vendor sw)

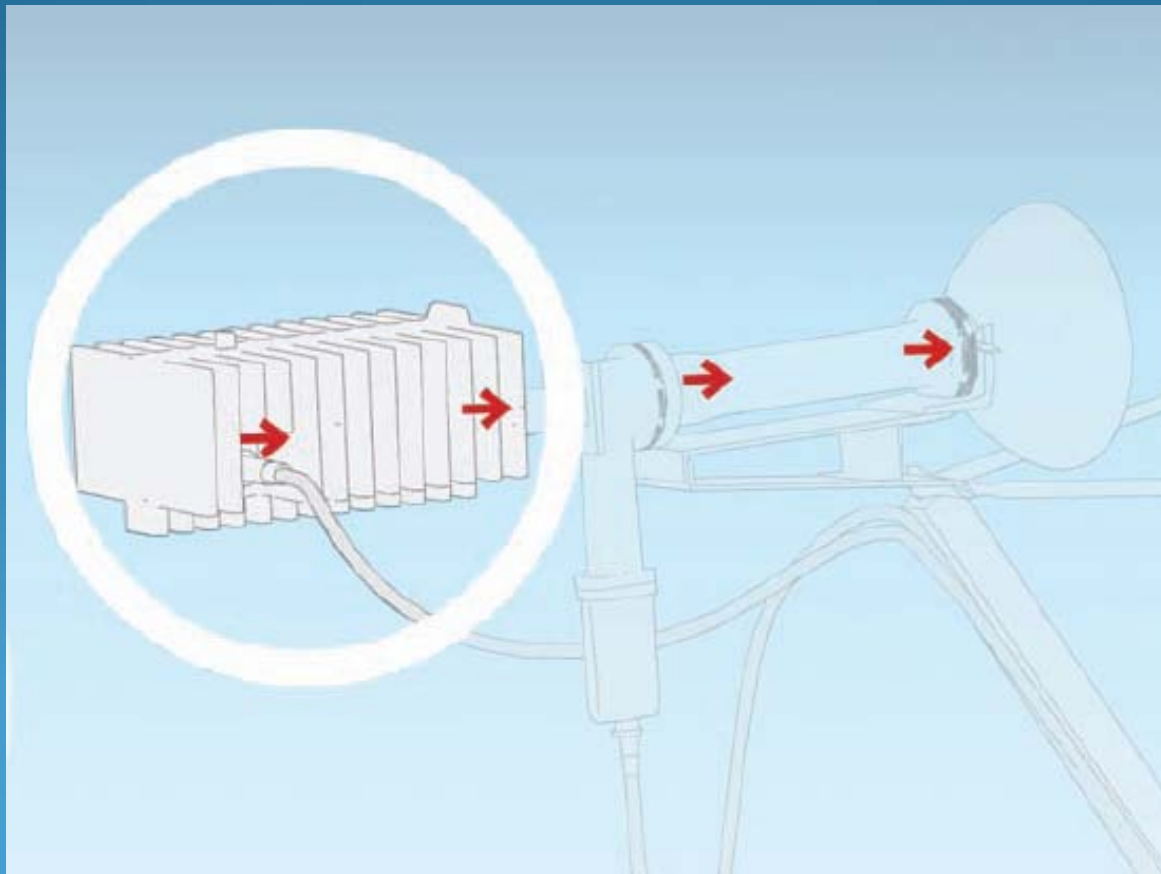
Vsat installation (RF Equipment feed)



Vsat installation (LNB & Equipment feed)



Vsat installation (BUC & Equipment feed)



Vsat installation

(grounding, lightening, ESD & EMI protection)

- The grounding shall be assured through the connection of dish (where all the other components are connected) to the earth potential, whatever would be with copper plates or rods
- Mainly for top building or roof installations (but not only) the lightning protection shall be used. For this cases a lightening arrestor shall be installed.
- Special care shall be taken on the ESD when manipulating electronics (BUC, LNB, Modems) and EMI when in proximity of interference sources

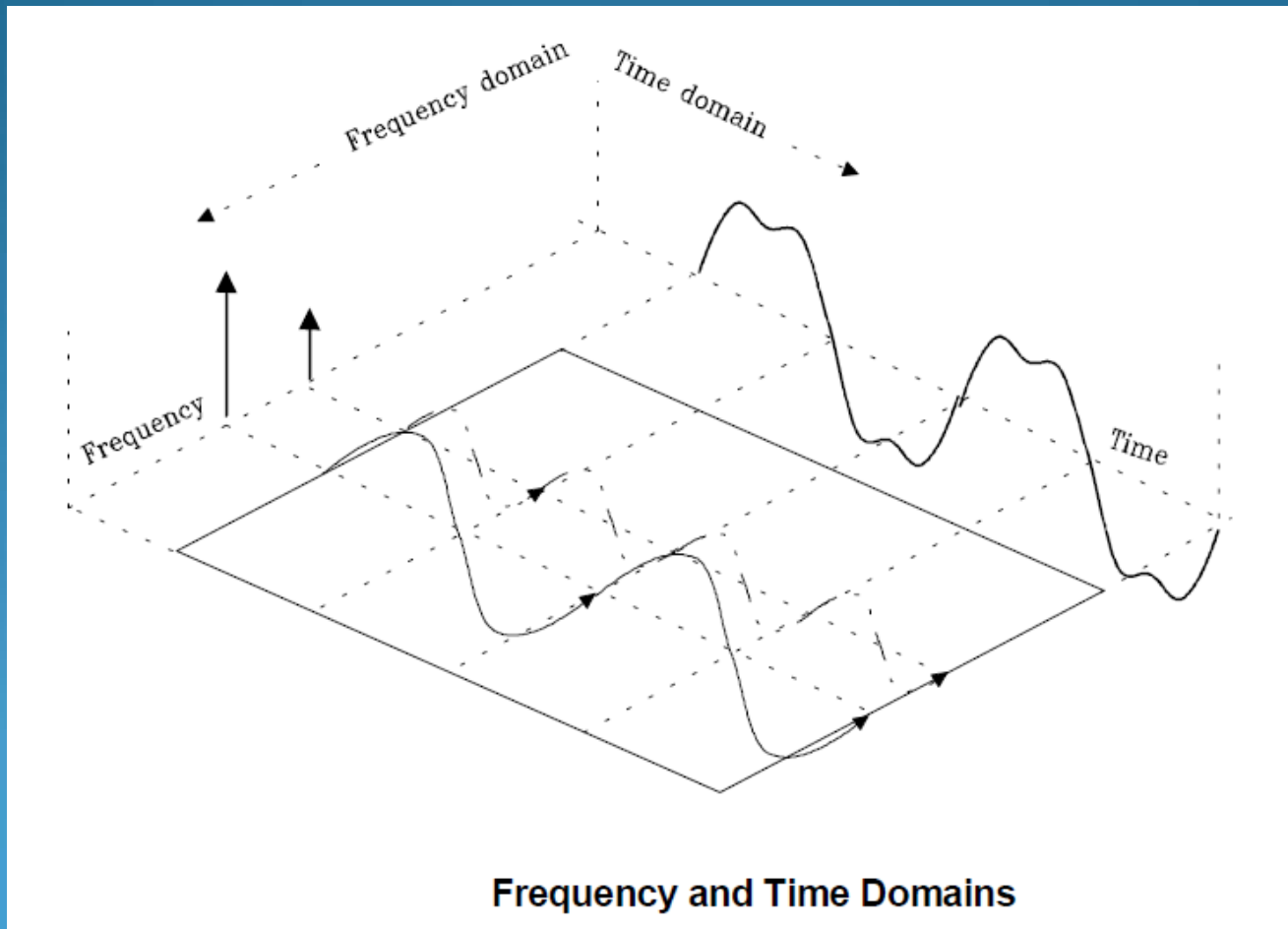


Vsat installation (Spectrum analyser)

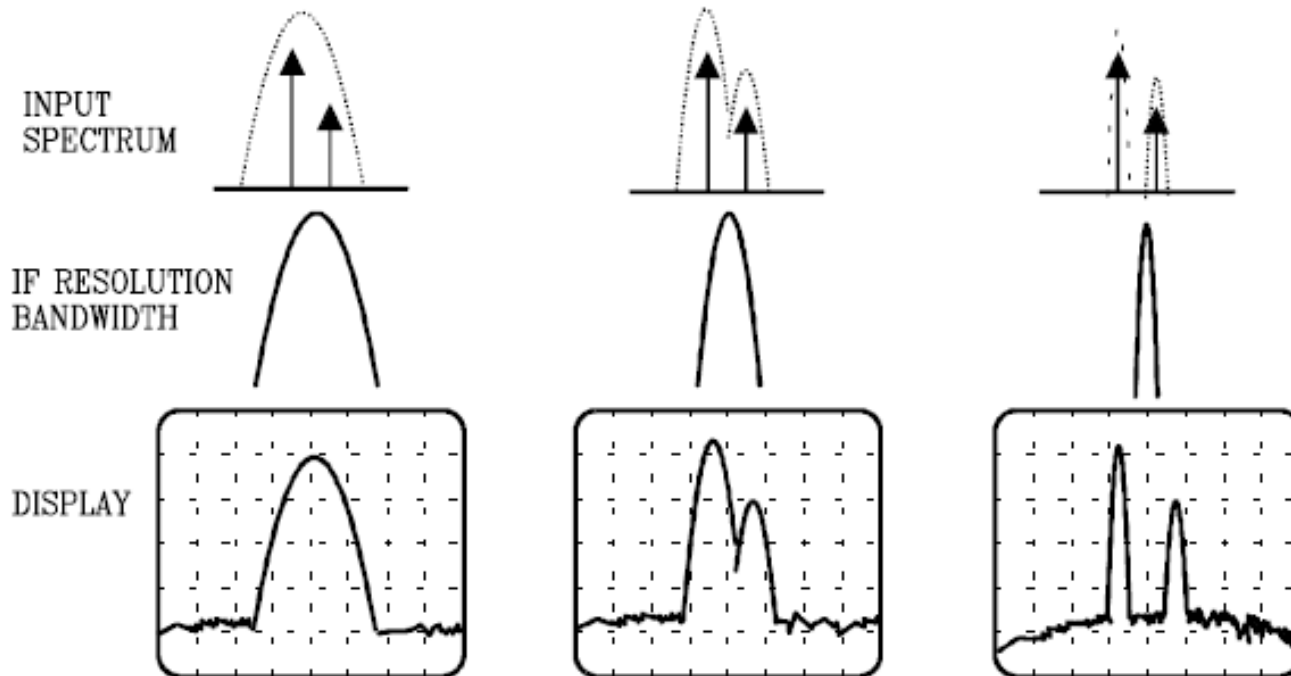
- The standard method for observing electric signals is to use an oscilloscope. The horizontal axis of a CRT oscilloscope increases by a unit of time. Oscilloscopes are sometimes referred to as time-domain instruments. Observation in time domain is useful to obtain signal timings and phases.
- But the performance of certain elements such as amplifiers, oscillators, mixers, modulators, filters, and others require the analysis of other characteristics (frequency response, harmonic distortion, intrinsic noise) and meaningful information is not attained until their frequency responses are obtained. Instruments that display levels of an electric signal as a function of the respective frequencies are called frequency domain instruments, called spectrum analyzer



Vsat installation (Spectrum analyser)



Vsat installation (Spectrum analyser)



Vsat installation (Spectrum analyser)

- Being basically one receiver with scanning capacity, they integrate one filter of variable tuning (mixer) to convert the input signal into several IF's depending on the components within the original signal, and showing them according to resolution band filters used, in a way that makes it possible to visualize them.
- According to the RF band we wish to check, we shall use specific types of spectrum analyser e.g. DC-8GHz, 10Hz-6,2GHz or 9GHz-20GHz



Vsat installation

(Align antenna using a spectrum analyser)

- Pre-set the polarization, through the axial rotation of feed-horn
- Set the elevation angle got from the “pathfinder” with as much accuracy as possible
- Find the downlink carrier details (the pre-recorded satellite spectrum view will be very helpful)
- The downlink frequency carrier in hertz will be located next to the RX_freq. This value needs to be converted to an L-Band range.
- Next to the RX_bitrate you will find a value in bits that you can convert to the span required on the spectrum analyzer.

Vsat installation

(Align antenna using a spectrum analyser)

- Connect the LNB to the splitter input using a 75 ohm RG6 coaxial cable.
- Connect the splitter DC pass-through out to the satellite modem, and the DC blocking out to the spectrum analyzer.
- Adjust the spectrum analyzer to the beacon frequency of the satellite - or to a pre-recorded downlink carrier - where the Center frequency will be the calculated RX_Freq and the span will be the calculated RX_bitrate just in units of Mhz instead of Mbps.

Vsat installation

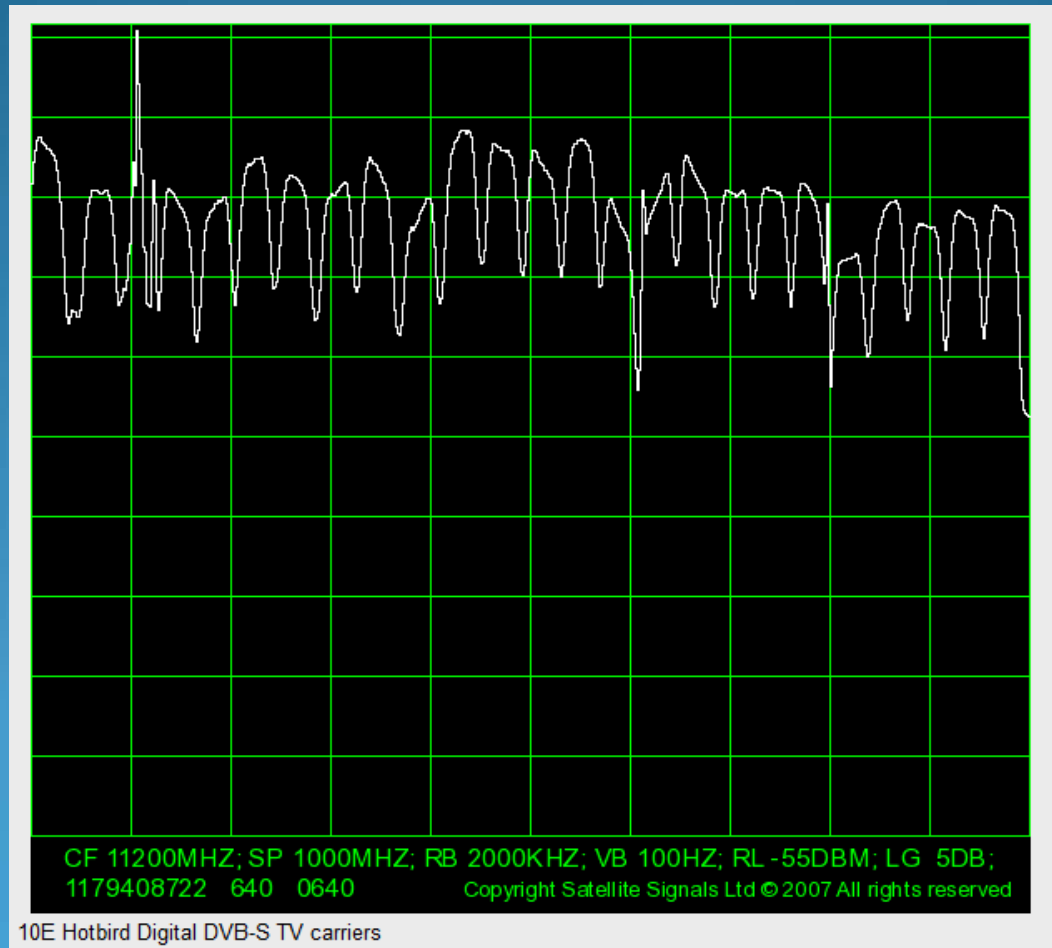
(Align antenna using a spectrum analyser)

- Adjust the elevation to the correct value, according to the site location and antenna offset.
- Sweep the sky in the expected azimuth area until you acquire the satellite signal. If the signal is not acquired, decrease or increase the elevation angle by slightly adjusting the regulation strut, and repeat the azimuth sweep until the signal is acquired.
- Adjust the feed horn slightly and monitor the size of the carrier on the spectrum to complete the maximization of the gain. To determine the best pol. setting, rotate the feed element until you acquire the strongest signal level.



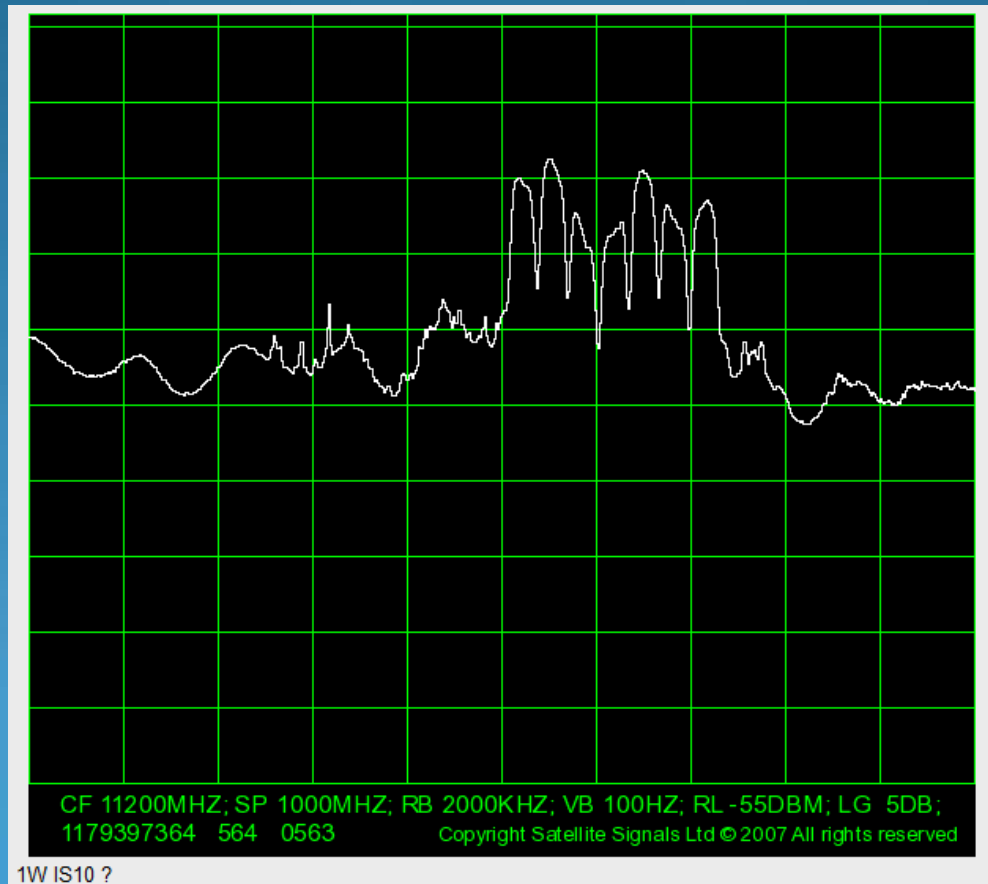
Vsat installation

Pre recorded SS views 1/3



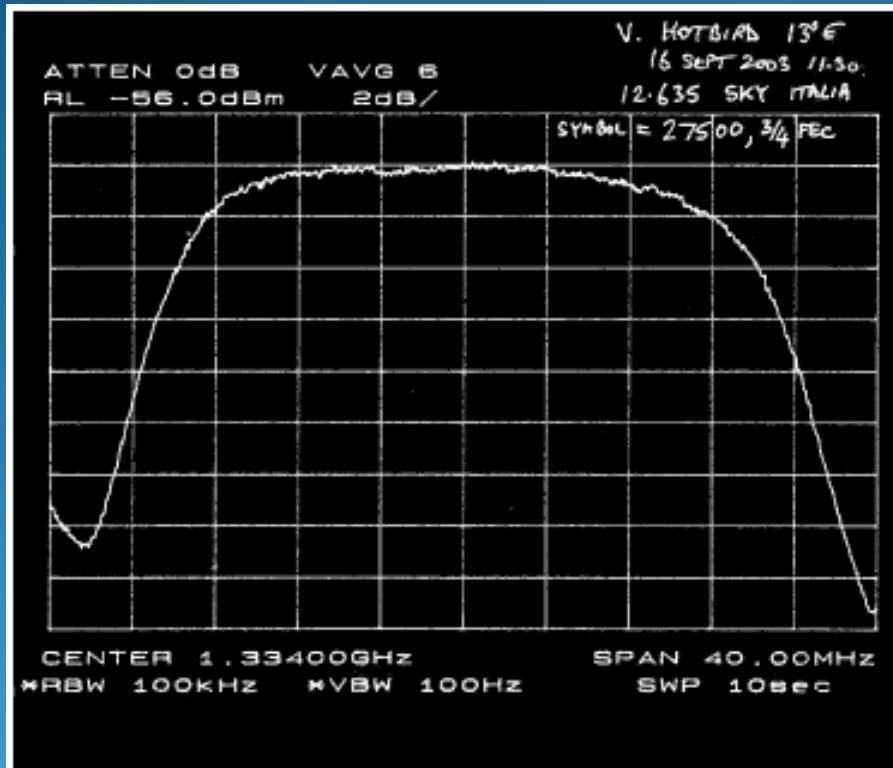
Vsat installation

Pre recorded SS views 2/3



Vsat installation

Pre recorded SS views 3/3



Spectrum plot of a DVB-S carrier

Symbol Rate= 27500 ksym/s

Bandwidth

-3 dB 26.4 MHz,
-3.8 dB 27.5 MHz,
-4 dB 27.93 MHz,
-6 dB 30.27 MHz,
-12 dB 34.53 MHz.

Ref data: South East UK, 1.8m west, az=12.8cm, Skyrelay RF head,
LO=11.3 GHz, Hotbird 13E, SKY ITALIA, 12.635 GHz

Vsat installation

(commissioning service with SP)

- Depending on the services that have been awarded to Services Provider, e.g data, voice, voice plus data etc , the commissioning tests aim to verify if functionalities are according to its design (contracted) objectives,.
- It is common to have some vendor software for this, and therefore it is only necessary install it, and follow the testing procedures.
- Just to name some the basic tests, will include the following:



Vsat installation

(commissioning service with SSP)

- Antenna alignment
 - Look angle
 - Coarse pointing
 - Using the pointing parameters received from the SO or the Hub try to point the antenna.
 - Once pointed check the E_b / N_0 of the outbound at the remote and confirm with the hub, the value achieved (this a first indication, because as we know the beamwidth of hub is narrower than vsat)
 - Next remote feeds a CW (clean carrier) - if there is space segment dedicated to that - and the Hub check the value which has been previously determined.



Vsat installation

(commissioning service with SSP)

- Coarse pointing (continuation)
 - Hub must check C / N and the crosspol - if it has that possibility – testing 2 inbound (SA configuration with span 0 and slow sweep).
 - The hub shall test the 1 dB compression point, if EIRP adjustment is possible
- Fine pointing
 - Try to improving the C / N measured at the hub, and checking the Eb / N0 on the remote, adjusting first in AZ and after in EL (EL is worse that AZ to loose pointing) , and after maximum achieved, try to disappoint the antenna manual and check again

Vsat installation

(commissioning service with ssp)

- Power off / power on test
- Modem reset test (inbound direction)
- Indoor equipment setting & statistics
 - Equipment details
 - Modem parameters
 - Ethernet statistics (through ping and trace)
 - Satcom statistics (through ping and trace)

Vsat installation

(user acceptance tests)

- Commonly designated as “user acceptance and quality check” tests
- Aim to verify if applications are running according to specifications, and verify the compliance of the basic contract conditions to be verified for the provisional (or final acceptance) tests and the release of down payments.
- Used also in the framework of the “warranty period” where the timegap (contractually agreed) from provisional acceptance to the final acceptance, is used to recheck all the system.
- These tests are witnessed by the customer , and results will be summarized in a “punch” list, being signed both by the customer and tester.



Vsat installation

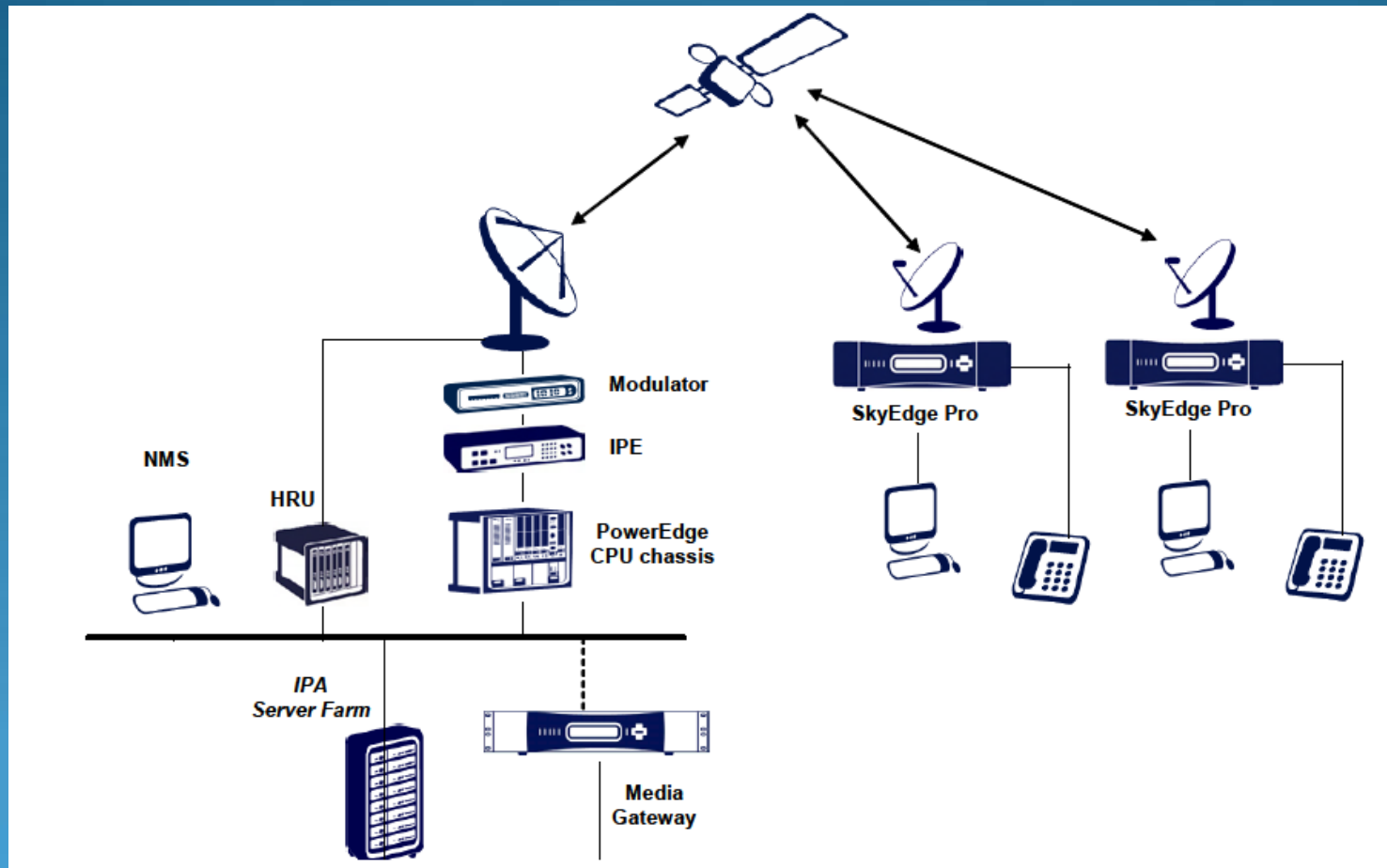
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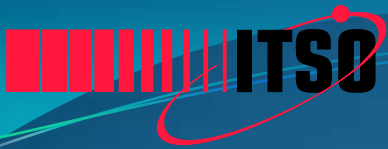
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Vsat installation

(example of user acceptance tests topology)





Vsat installation

(example of user acceptance tests with voice)

- Hub verification of remote power failure and recovery
- Hub to vsat and vsat to hub, communications test
 - ping test
 - ftp test
 - http acceleration
 - bypass card functionality
- Telephony
 - general
 - vsat to vsat call
 - vsat to hub call
 - hub to vsat call
- NMS configuration backup and restore

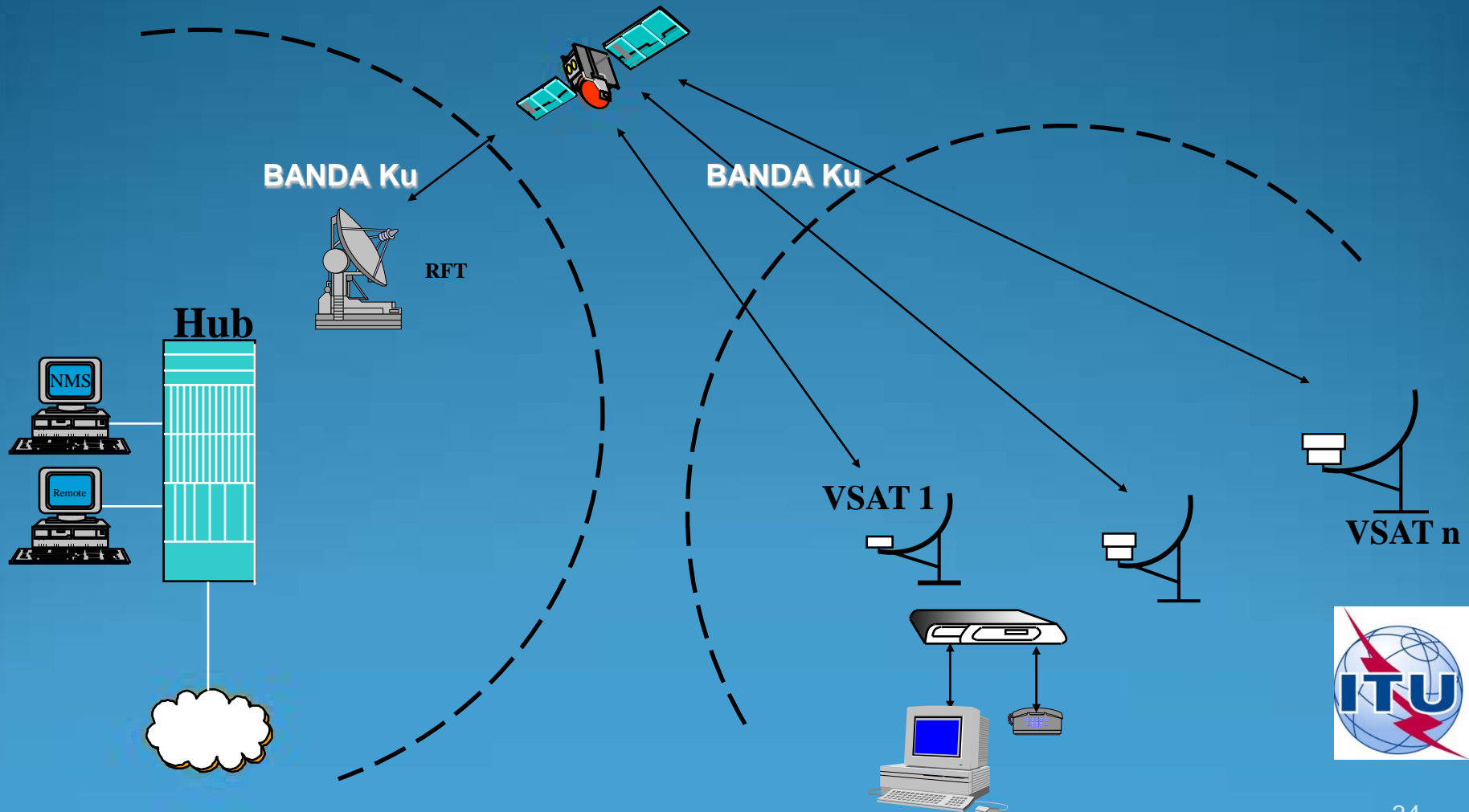


Vsat maintenance (preventive maintenance)

- The documents list, delivered with the installation of a Vsat system, does includes, besides, installation manuals, system manuals, wiring diagrams and so on, in summary the named “maintenance plans and procedures” referring both to the preventive and to the corrective actions (incident resolution).
- According to a predetermined plan and taking into account the extension of useful life of equipment, the verification of operating conditions, continuously, leads to the named “controlled maintenance” which gives the best cost effective solution for maintenance.



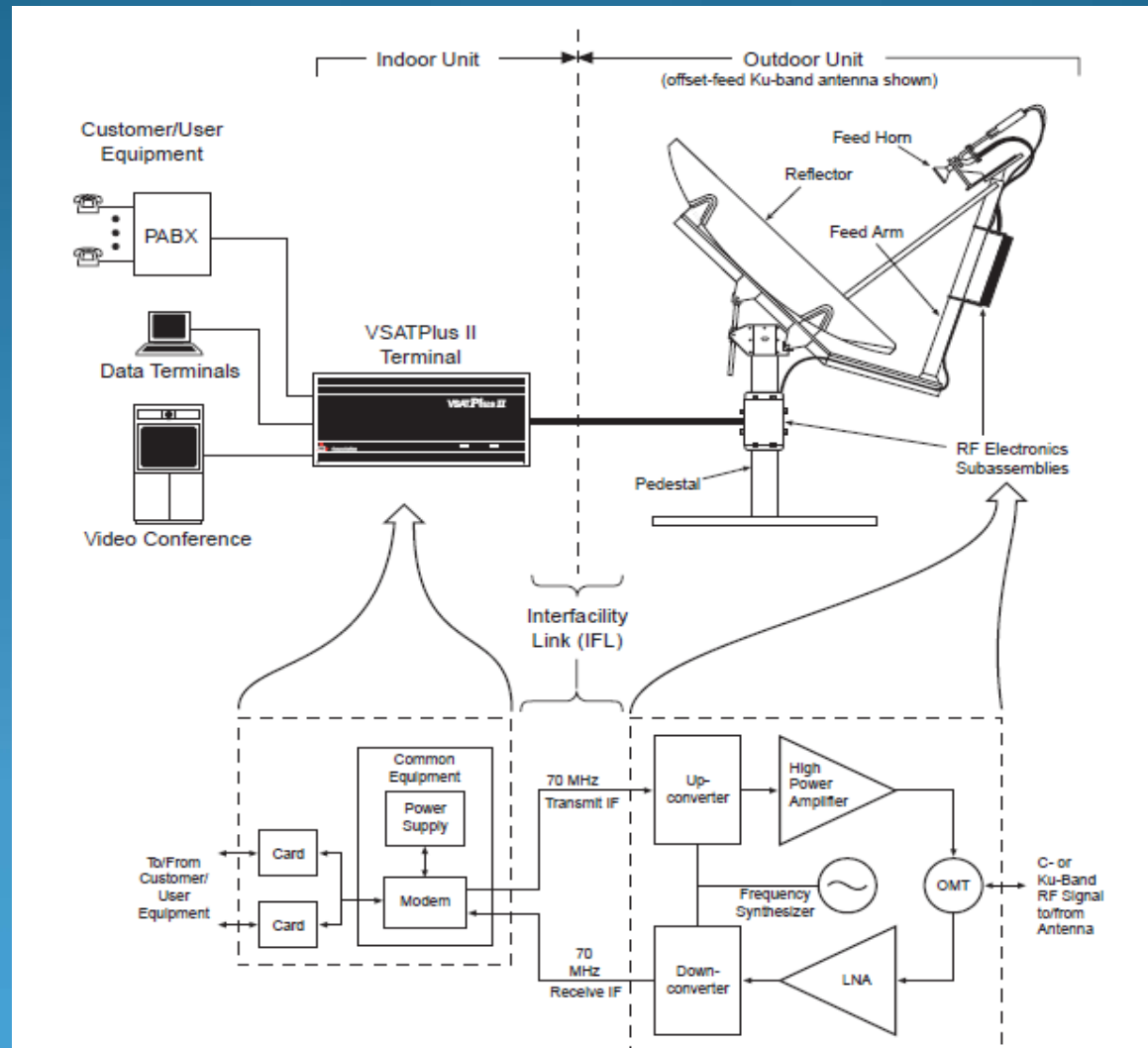
Vsat maintenance (Global network view)



Vsat maintenance (hub - maintenance plan)

Sistem	Equipament	Model	Maintenance schedule
Antenna	ACU	Electrospace 93C23F	Monthly
	Beacon Receiver	Electrospace	Monthly
Transmission	<i>Modulator (9)</i>	<i>Radyne DMD 4500 4000</i>	Weekly
	<i>Modulator (8)</i>	<i>EFDATA SDM 8000</i>	Weekly
	U/C (4)	ETS 6000	Weekly
	U/C (2)	ETS 6207	Weekly
	TWT (3)	CPI VARIAN VJW2740	Monthly
	KPA (3)	VARIAN KPA 2725G	Monthly
	<i>Switch Modulator</i>	<i>EFDATA SMS – 658 A</i>	Quarterly
	<i>Switch Modulator (2)</i>	<i>RADYNE RCU780</i>	Quarterly
	Switch U/C	ETS 6000	Quarterly
	Switch Branching	MITEC M254	Quarterly
	Switch HPAs	CPI VARIAN	Mensual
Reception	LNA (3)	MAXTECH	Weekly
	D/C (4)	ETS 4000	Weekly
	<i>Demodulator (9)</i>	<i>Radyne DMD 4500 4000</i>	Weekly
	<i>Demodulator (4)</i>	<i>EF-Data SDM 8000</i>	Weekly

Vsat maintenance (remote units layout)



Vsat maintenance (remote units layout)

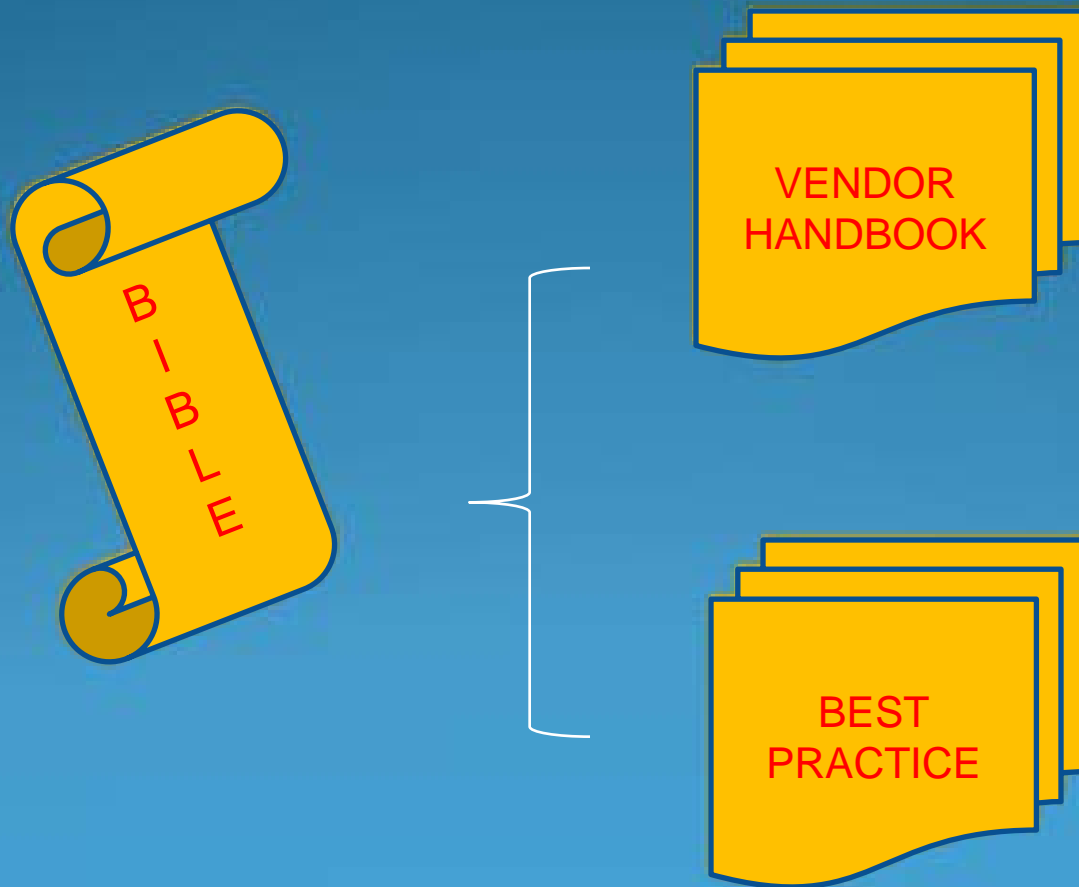
- The maintenance actions will occur in the IDU, ODU or IFL.
- Statistically ODU, is more prone to environmental elements
- ODU
 - Antenna unalignement
 - Cable and connectors inspection
 - BUC and LNB / LNC assembly (especially the fan and opening for air circulation) , whatever may be the cause for energy failure, overheat conditions (specially in high temperature regions)
- IFL
 - Connectors and cable, in case of direct exposure to sun (UV) or rodents action (in case of ducts use)
- IDU
 - Energy problems
 - Modems configuration
 - Cables and connectors

Vsat maintenance

(vsat - maintenance plan)

Sistem	Equipament	Vendor_Model	Maintenance schedule
Antenna	Dish and support	Gilat and local	Monthly
	Offset arm	Gilat	Monthly
ODU (Tx/Rx)	BUC	CODAN	Monthly
	LNB / LNC	MAXTEC	Monthly
	<i>Cables and connector</i>		Each visit
IDU	<i>Modulator</i>	<i>COMTECH</i>	Weekly
	<i>Modulator</i>	<i>COMTECH</i>	Weekly
	<i>Switch Modulator</i>	<i>EFDATA</i>	Quarterly
IFL	<i>Cables and connector</i>		Each visit

Vsat maintenance (troubleshooting & incident resolution)



Vsat maintenance

(troubleshooting & incident resolution)



HW swap on site
SW reset / update

Spares list

Power supply
Fan
RF connectors
LAN connectors
BUC / LNB,C
SSPA

Reconfiguration

Factory config
Local config
Remote config

Vsat maintenance

(troubleshooting & incident resolution)



Rx chain

1. Check LNB and feed horn
2. Coaxial connection is tight?
3. Check coaxial connector is clean and corrosion free→ substitute
4. Check the feed is secure to the LNB
5. Check “O” ring installed between LNB and the feed horn flange
6. Check the outside cover of coax cable is without breaks or sharp bends pinch point or flattened sections of the cable
7. Check the power to feed LNB
8. Check the signal at the end of the cable before the modem with a Spectrum analyser
9. Check the frequency sweeper range under the modem parameters

Vsat maintenance

(troubleshooting & incident resolution)



Tx chain

1. Does the BUC matches the antenna and the satellite router being used?
2. Are the input and output freq ranges are correct?
3. Does the DC power level matches the vendors spec at the modem output and at the cable end on antenna?
4. The coaxial connection is tight and connector sealed?
5. The directions of the feed waveguide and OMT are oriented correctly?
6. The BUC is secured to the feed using the screws?
7. The O ring is installed between the BUC and the feed flange?
8. The BUC is properly grounded with protection against lightening and ESD damage , and does the BUC power LED is green?
9. The outside cover of the coaxial cable is without breaks, bends no pinch point or flattened sections of the cable ?
10. Change the BUC (check if the local freq oscillator is same)



Vsat maintenance

(troubleshooting & incident resolution)



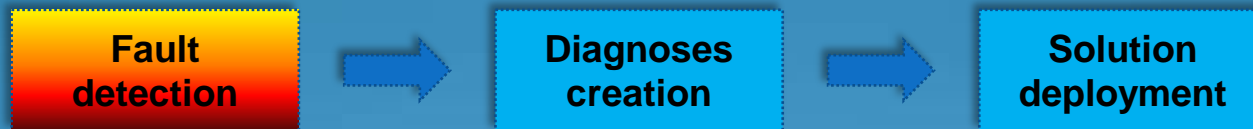
Signal Degradation

1. Was there a change of site or antenna?
2. Was there a change or failure of equipment?
3. Are Tx, Rx, and LAN cables are connected to the satellite router?
4. Rx LED on?
5. Tx LED on?
6. NTW LED on?
7. BUC Power LED on?
8. LNB PWR LED on?

Vsat maintenance

(troubleshooting & incident resolution)

Today the main part of the troubleshooting process is manual, but some projects have been presented and deployed to automate it. As a general overview the following layout is been presented

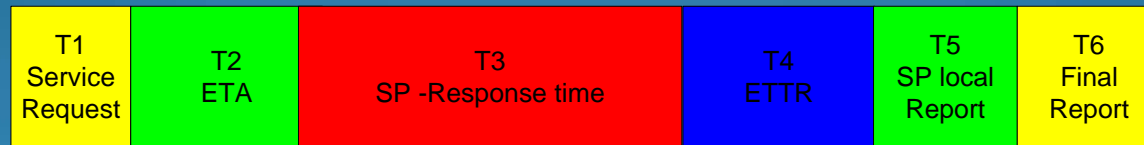


Automatic



Manual

Vsat maintenance (ETA / ETTR control)



SP – Global response time

SP – Repair time

Vsat maintenance (slm - service level management)

- What is?
- Is the position in the company that tries to reduce or minimize (eliminate is impossible) several years of damage caused by badly managed equipment (and or services) whatever responsibility is the vendor's (supplier), services' provider, or the internal management staff.
- SLA's are the road chart of SLM, or in other words the underpinning process of effective and efficient work

Vsat maintenance (plan to implement sla)

- Create a service catalogue
 - The menu the service provides (not a wish list)
 - The catalogue doesn't need to be complex
- Establish service level requirements
 - Collected during meetings
- Plan the SLA structure
- Negotiate and agree SLA
 - SLA must balance between individual people want and what the business actually needs and is willing to pay for.

Vsat maintenance (Service measurements & KPI)

- Number of breached SLA
- Number of escalations
- Number of 1st level escalations and xrd escalations
- Number of incidents per service
- Downtime per incident and global
- Number of incidents cleared within SLA
- Number of incidents cleared outside SLA and up to x minutes, y minutes

Vsat maintenance (sla - guaranteed parameters)

Guaranteed QoS , parameters to:

SUPPLIER SIDE

KPI definition – limits, steps tolerances

Credit algorithm in failure situation

SLA parameters definition and metrics

Occurrences reporting (type, availability, periodicity)

General conditions to SLA application

Vsat maintenance (sla - guaranteed parameters)

SUPPLIER SIDE

- KPI definitions, limits, steps, toerances
- Credit algorithm in failure situation
- SLA parameters definiitons and metrics
- Ocurrances reporting (type, availability and periodicity)
- General conditions to SLA application

Vsat maintenance (sla - guaranteed parameters)

CLIENTS SIDE

- Site downtime is minimized
- Compliance with technical and environmental requirements
- Establishment of schedule operation time (site by site)
- Acceptance of maintenance windows
- Bonus value for better KPI performance
- General conditions to SLA application