VSAT TECHNOLOGY

Instructor: Benjamin Akpobaro

RSCE/ICTS/VSAT Technology

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Location: Entebbe, Uganda

Course Outline.

- Introduction
- Transmission Delay
- UN Set Up (As in the MDTS VAN/MCC
- Satellite Transmission Systems
- Practical VSAT Operation

Course objective

- Define VSAT (Very Small Aperture Terminal)
- Explain the basics of satellite communications
- VSAT services in the UN field missions
- VSAT installation and maintenance

Satellite Communications

- What is (VSAT) Very Small Aperture Terminal ?
- Is small telecommunication earth station that receives and transmits real-time date via satellite

- What is Satellite Communications?
- Is an artificial body placed in orbit around the earth on other planet ,satellite facilitates communications as television, radio and telephone transmission etc

- Modern telecommunication services

- It takes two weeks to arrive at proper orbital slot, 22,300 miles

Satellite

Satellite

MODERN SATELLITE

VSAT

Very Small Aperture Terminal

Brief History of Satellite

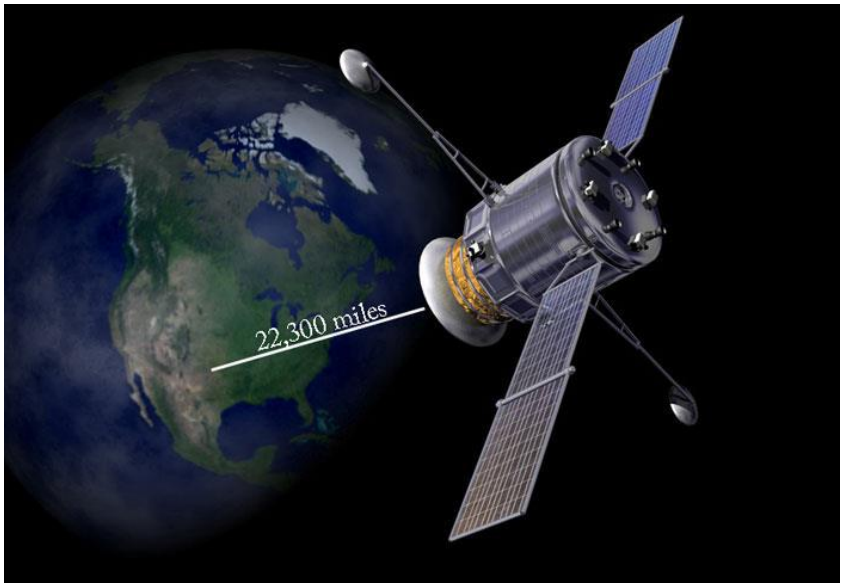
- Satellite communication technology
- Rocketry technology developed during the Second World War

- In 1945 Arthur C. Clarke
- Conceived the idea of geosynchronous satellite located in space to effect long communication

- Transmission of voice, data and video via satellite

Geostationary Earth Orbiting (GEO)

- Types of Orbit
- Geostationary (GEO) “Clarke Belt”

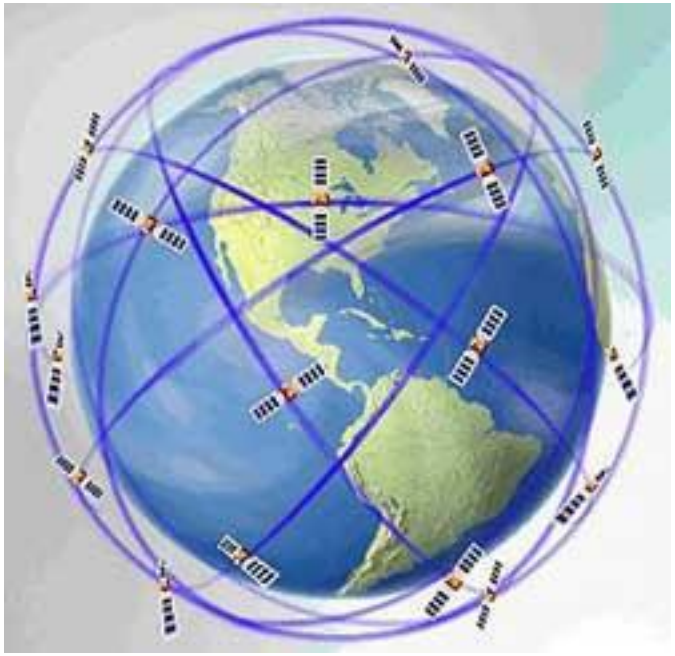


- Also referred as Geosynchronous , the same orbital velocity as the earth

- 24 hour orbit matches Earth rotation , appears stationary

Medium Earth Orbiting (MEO)

- Medium Earth Orbit –Orbit at an altitude, below 22,300 miles and above 930 mile.
- Requirement are less than Low Earth orbiting satellite but more than Geostationary satellite for global coverage
- O3b Constellation is circular on the equator at approx. 4970 miles



O3b Network (MEO)

Low Earth Orbiting (LEO)

- LEO satellite are visible for less than an hour during orbit

- LEO is 322-1500 km above the earth

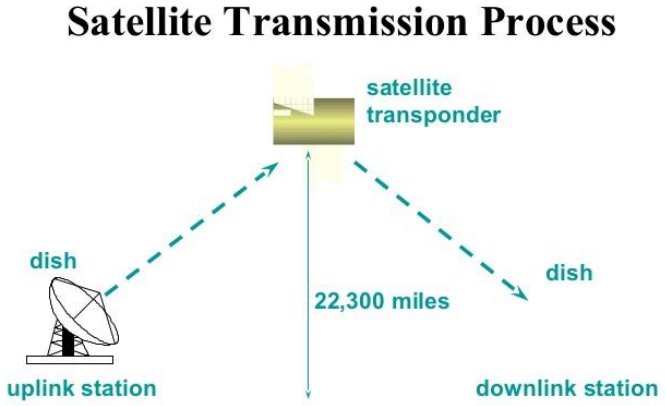
Satellite Link and How It Works

- A satellite modem, satellite antenna and frequency converters
- Data to be transmitted are transferred to a modem from Data terminal equipment
- Similarly, a signal received from a satellite is firstly down converted
- What is satellite transmission?
- The position of GEO satellite is given in degrees of longitude

Satellite Transmission Delay

- Satellite Transmission (latency)

- To transmit and receive a signal entails a delay of approximately a second while electromagnet wave travels to and from satellite. The delay does not affect the accuracy of satellite data transmissions.



Satellite Uplink and Downlink Transmission Frequency

- Transmission from earth station to the satellite is called Uplink and the signal from satellite to the earth is called downlink

- Frequencies available for satellite communication are allocated on international basis by the ITU

L-Band Frequency Receive Range

- L-Band relatively low frequency, L-band is easier to process, less expensive RF equipment

Frequency Band	Uplink Frequency [GHz]	Downlink Frequency [GHz]
C band	5.925-6.425	3.700 - 4.200
Ku band	13.75 - 14.50 / 17.30 - 12.75	10.70 - 12.75
Ka band	29.50 - 30.00	19.70 - 20.20

- C band: C band is the first band used by commercial satellite system
- Ku band: Ku band is not shared by terrestrial microwave systems
- Ka band: Ka band has an available bandwidth of 2500MHz. Higher-power satellite will use this band low cost 2-way communications

Advantages

- High Reliability
- Costs are independent of distance or number of locations
- Wide area of coverage is readily available
- Rapid access to undeveloped areas
- Flexible network configuration

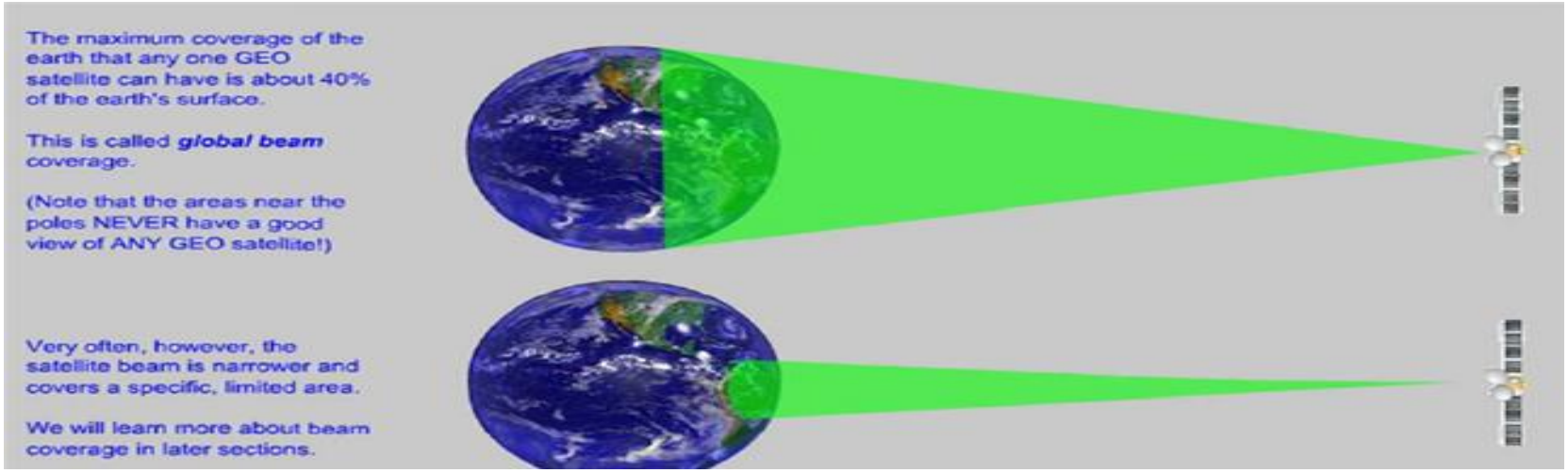
Disadvantages

- Huge initial cost
- Interference and propagation delay
- Congestion of frequencies and orbit

Footprint

- Footprint is the geographic area which satellite downlink antenna directs its signal from which the satellite is visible from the surface of the earth

- Effective Isotropic Radiated Power (EIRP)



UN Field Mission Satellite Set Up

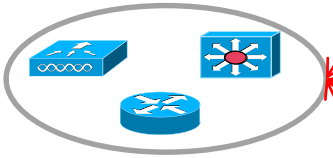
Uplink

Downlink

HUB

CDM 570 Modem Satellite

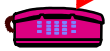
MDTS-VAN TRAILER



VC

Tel

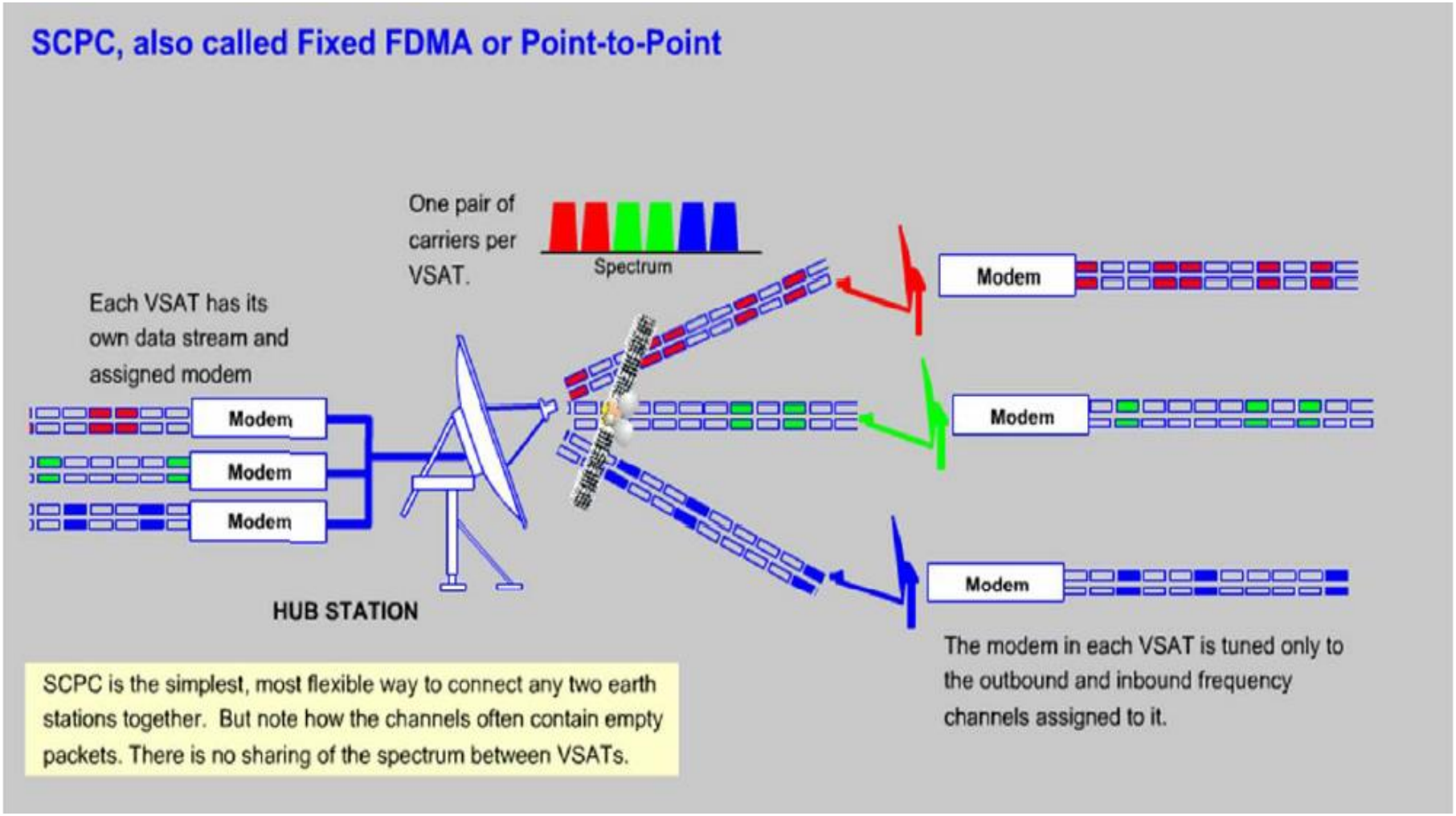
VC



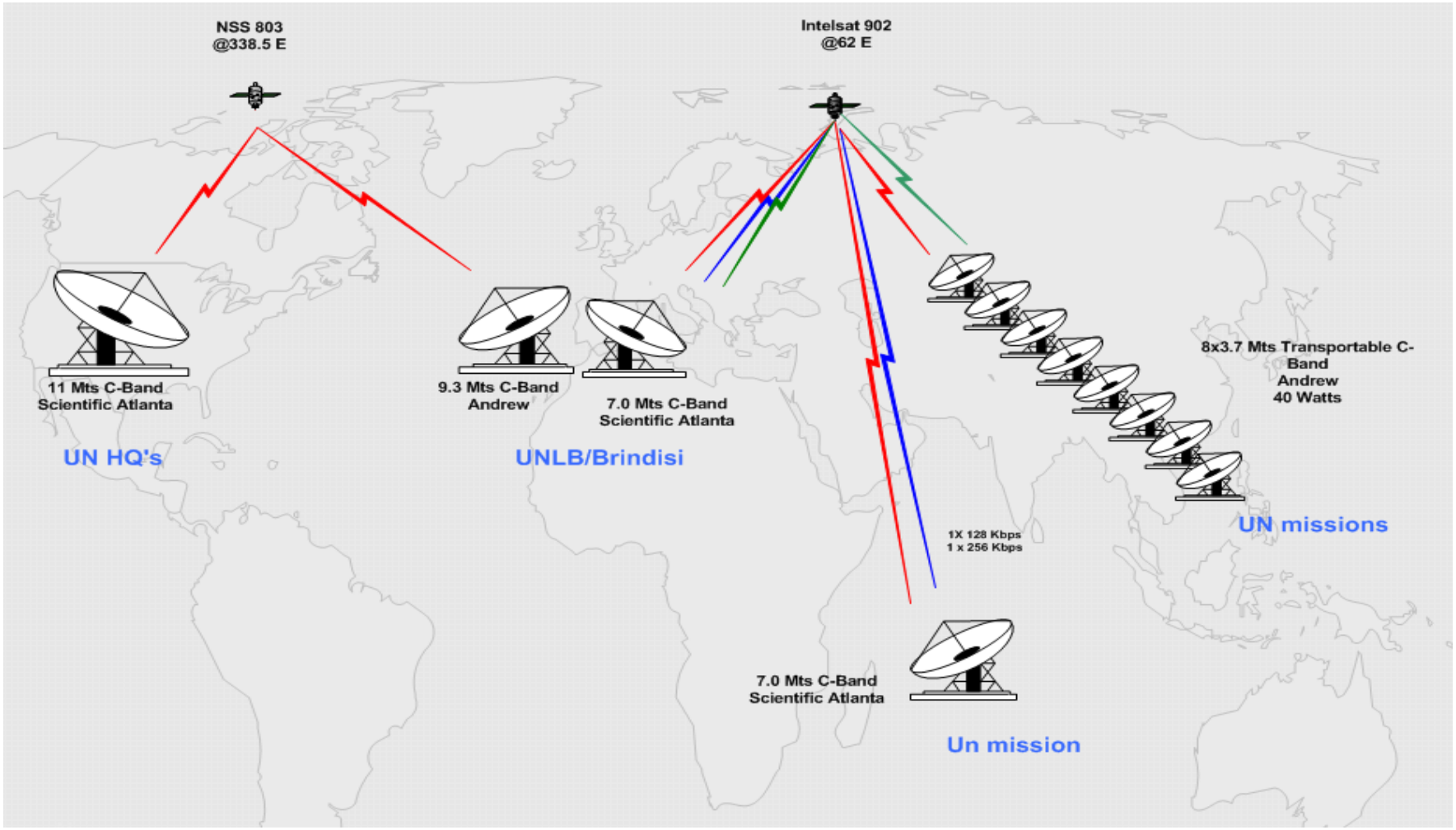
Tel

User

Satellite Transmission Systems



UN Network Example



Network VSAT

- Network VSAT is a satellite transmission system that employs one carrier/outbound from the hub to all remotes sites (TDM)

- The remotes sites inbound (to the central hub) typically use TDMA for the return channel

- Time Division Multiple Access or TDMA is a method used to enable multiple earth stations or VSAT terminals to transmit intermittently on the same frequency, but with the timing of their transmissions so arranged that the bursts do not overlay when they arrive at the satellite but arrive in sequence and thus are all successfully received by the teleport hub modem burst demodulator.

Network VSAT

- Point-to-Multipoint network are used to connect a central location to multiple location

- The hub will output a continuous carrier that is received by all of the remote sites and received the individual carriers from each remote sites on individual demodulators

ADMINISTRATION

- Due to the high demand of the satellite communications , all new link's are requested through UNHQ NY.

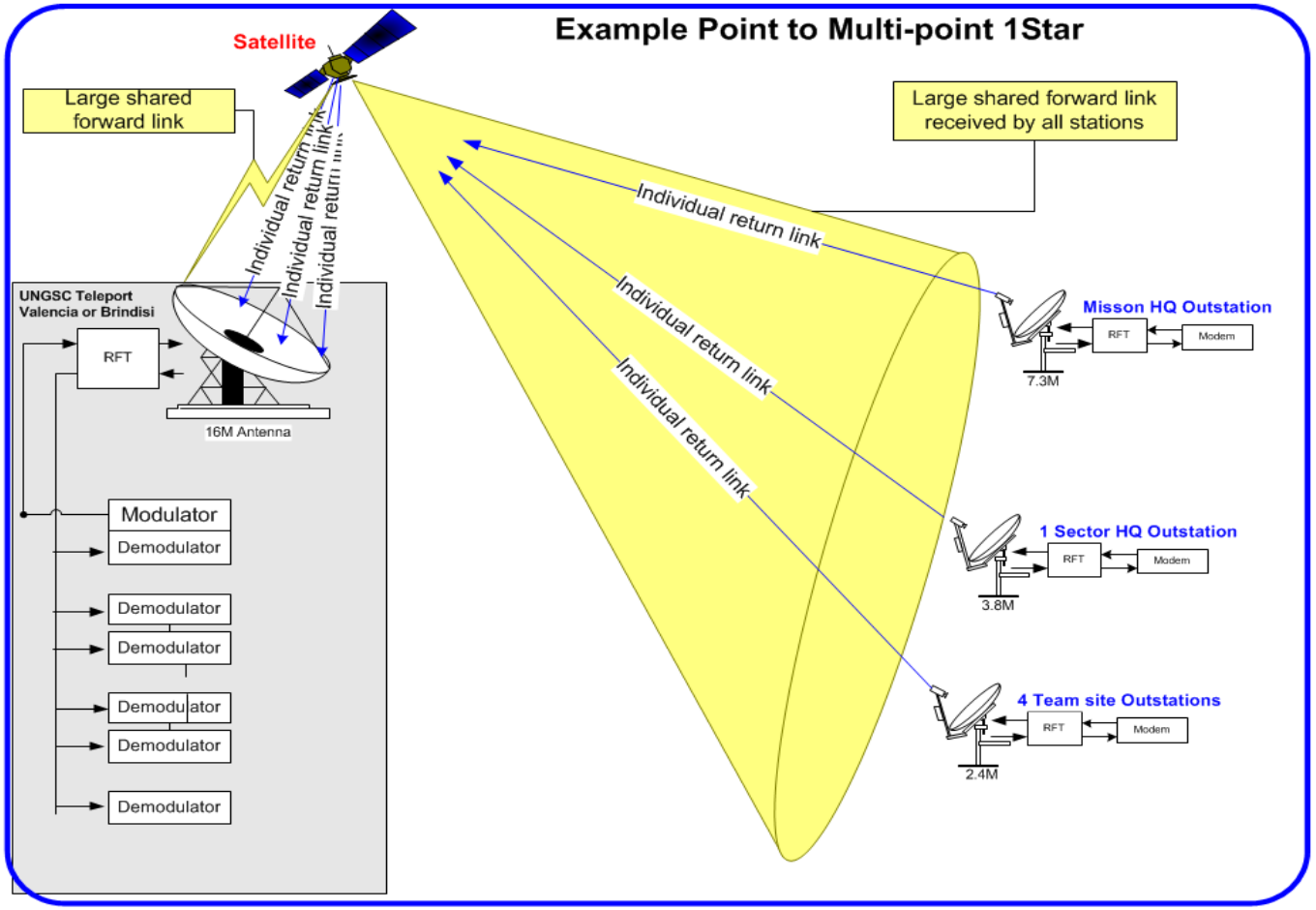
- All contact details are outlined in the Satellite Engineering Support Unit UNLB , which will be give the allocation for the new link after NY and Mission authorization.

Satellite Outdoor Equipment

Block Up Converter (BUC)

Low Noise Block (LNB)

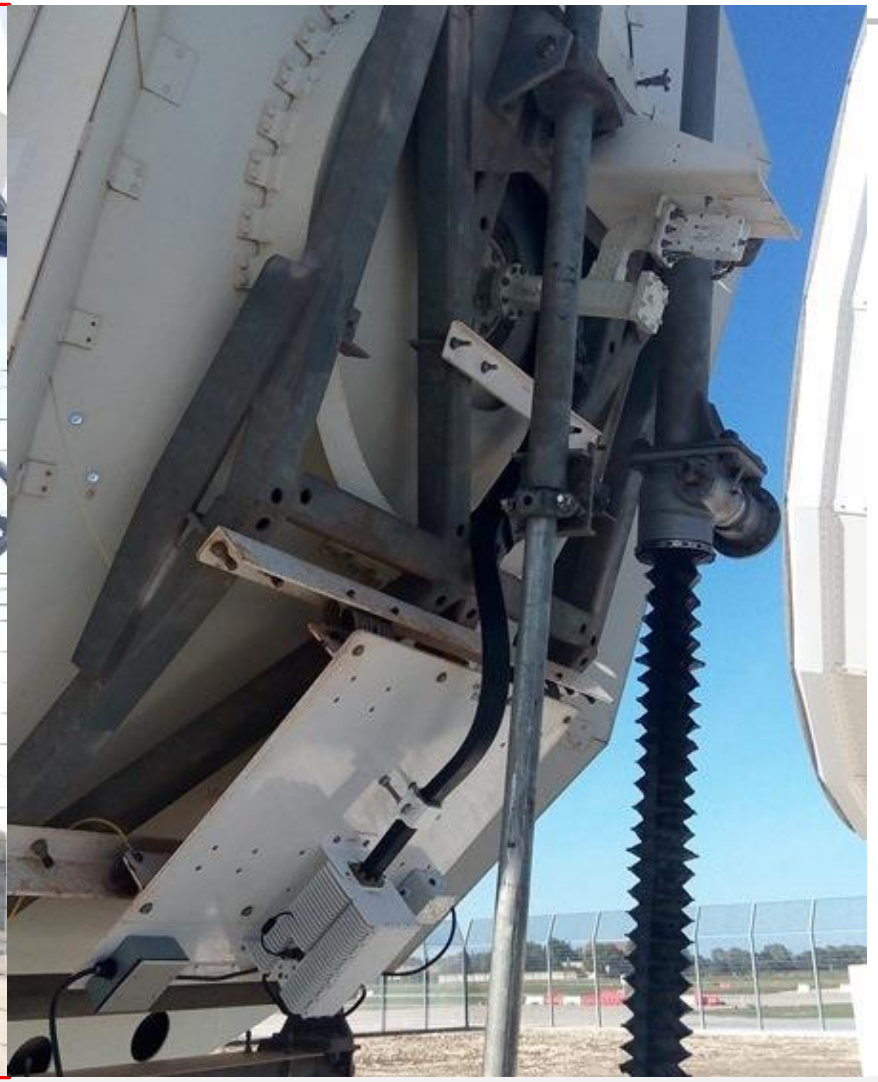
UN Field Mission 1Star Vsat Network Set Up



Trailer Upgrade to L Band IF

Before

After



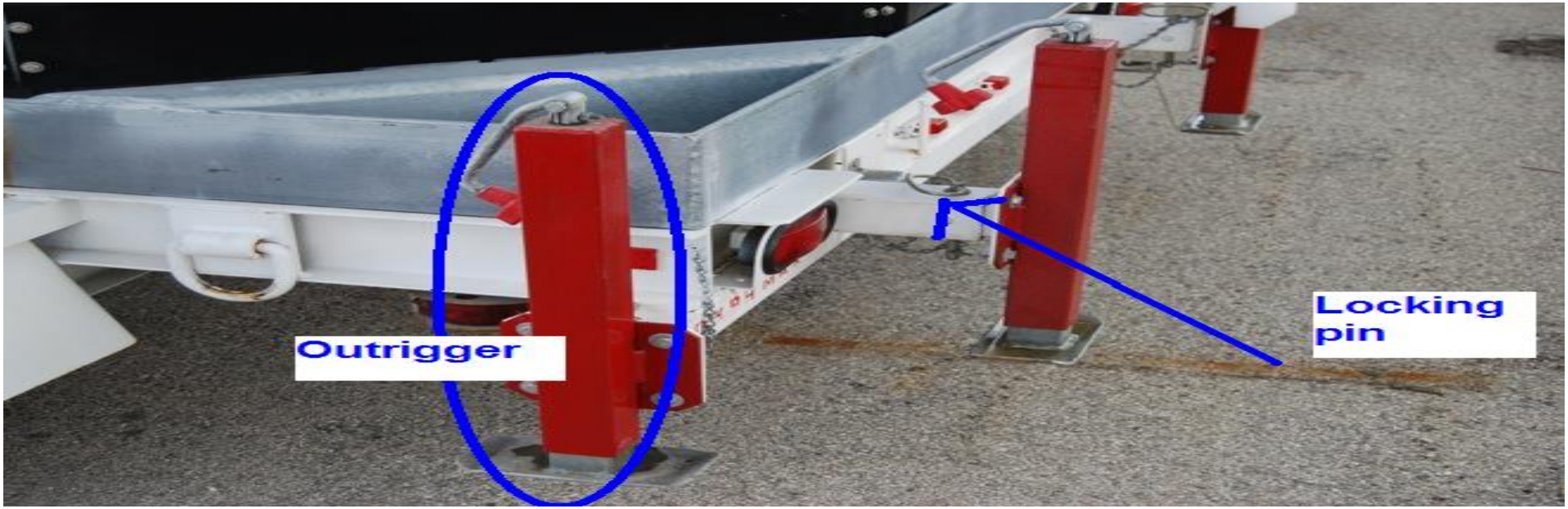
Practical VSAT Operations

Purpose Of Site Survey

- Ensure that the chosen site has clear line of sight toward to the satellite without any obstruction
- Select the best placement for the antenna
- Determine and document the path and length of the cable to run
- Discover and document any special problem that may affect the installation

TES-3900 Terminal System Set Up

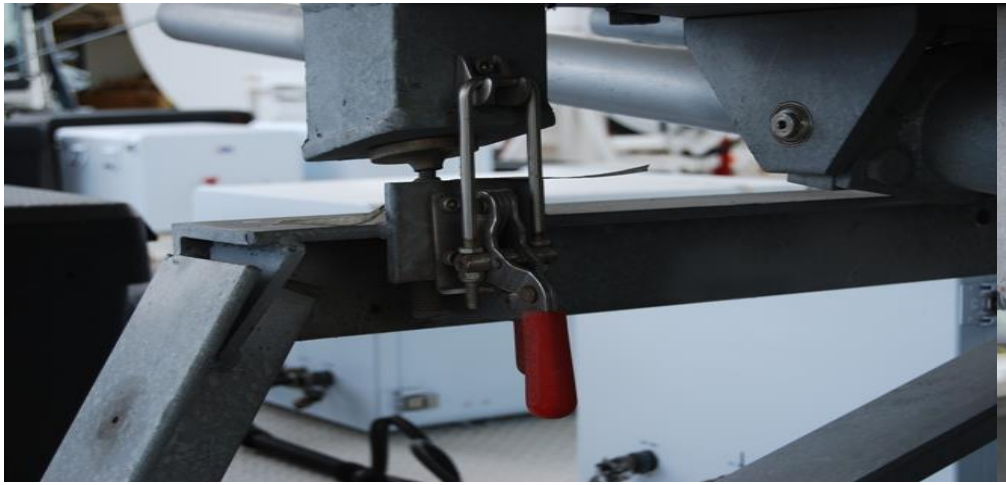
- Release outrigger at four corners of the trailer by removing locking pins, and reinsert it into the closest applicable height adjustment holes to lock in place



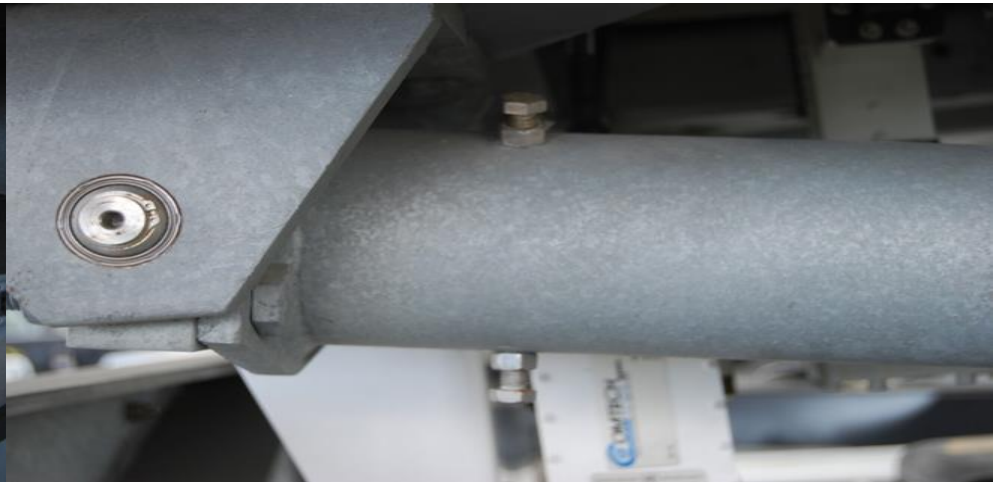
TES-3900 Terminal System Set Up

- Adjust the four jack screw to obtain a perfect flat position on the horizon using the spirit bubble putting the bubble into the middle of the cross line

- Release both elevation safety clamps, strut locking screws and the 4 reflector hold-down assemblies and then raise the dish assembly between 15 to 20 degrees

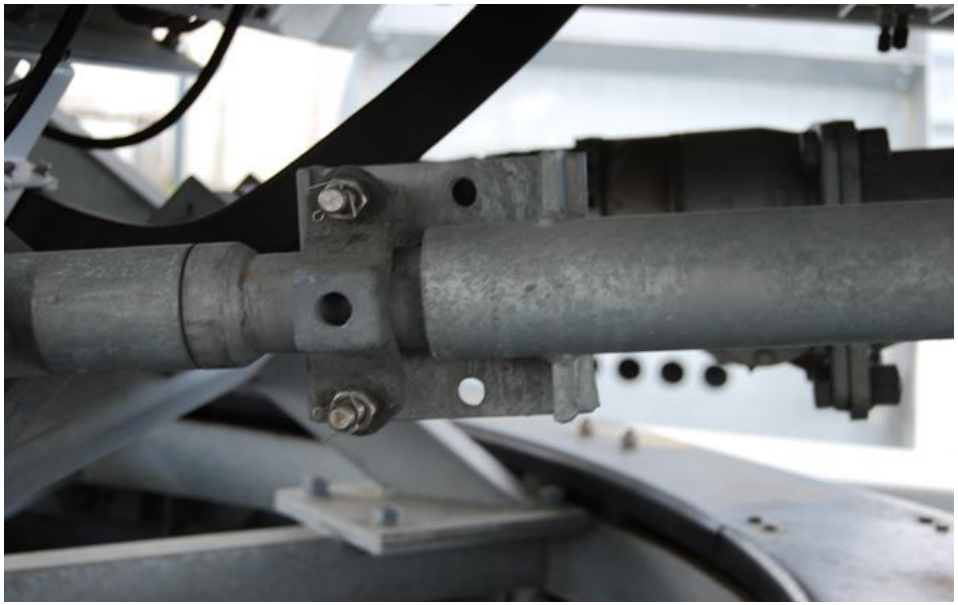


Elevation safety clamps



Locking screws

TES-3900 Terminal System Set Up



Locking screws

Reflector hold-down assemblies

TES-3900 Terminal System Set Up

- Slowly swing the reflector sides out into their operating position and lock in place with the two lower 1/4-turn fasteners on each side as the picture. Lower the reflector and lock up the remaining ¼-turn fasteners

TES-3900 Terminal System Set Up

- Remove hand knobs from strut stow clamps. Deploy struts into positions and install hand knobs

TES-3900 Terminal System Set Up

- Remove sub reflector from stow position

TES-3900 Terminal System Set Up

- Support sub reflector bracket on struts. Be sure to match the arrow on the sub reflector with the arrow on the strut

TES-3900 Terminal System Set Up

- Install the hand wheel on the elevation jack to set up the elevation and use the same to adjust the azimuth in order to locate the signal

VSAT Installation

- Site Survey
- Obtaining construction permits and transport equipment to Client site
- Assembly and installation ,Erecting and pointing of antenna
- Installation of IF ,M & C cables and installation of indoor equipment
- Proper grounding of all equipment and connect client equipment to the VSAT
- Preform end-to-end and Commissioning tests

Angles Measurements

- **Elevation**: Is the angle between the beam pointing direction, directly towards the satellite, it is the up-down angle
- **Azimuth**: Rotation of the whole antenna around a vertical axis. It is the side to side angle
- **View**: Look through elevation angle to find the best spot for your dish
- Point and alignment satellite dish
- **Inclinometer**: used to measure the angle of elevation to the satellite
- **Azimuth**: Measured by using compass

Satellite Look Angles

- **Address: Entebbe Uganda**
  Latitude: 0.0512°
  Longitude: 32.4637°

- **Satellite: 64.2E INTELSAT 906 (IS-906)**
  Elevation: 53.0°
  Azimuth (true): 90.1°

Satellite Look Angles 64.2E Intelsat 906 (IS 906)

Address: Mogadishu, Somalia

Latitude: 2.0469°

Longitude: 45.3182°

Satellite: 64.2E INTELSAT 26 (IS-26) | INTELSAT 906 (IS-906)

Elevation: 67.7°

Azimuth (true): 96.0°

Azimuth (magn.): 96.2°

Procedure to Point an Antenna

- Know the orbital position of the satellite and the geographic location of the antenna
- Calculate the azimuth and elevation for the specific satellite for your specific location
- Read the compass at ground level .Stay away from motors and large steel constructions

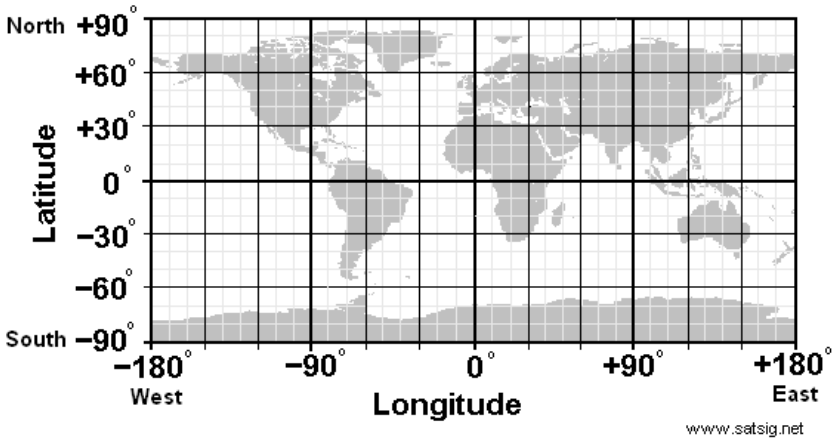
Viewing of Satellite Signal On Spectrum Analyzer

- Turn on spectrum analyzer wait for few minutes
- Set the center frequency to 66.1127 MHz: **Press FREQUENCY, Center Frequency , 66.1127 MHz.**
- Set the frequency span ,**Press SPAN, 5 MHz**

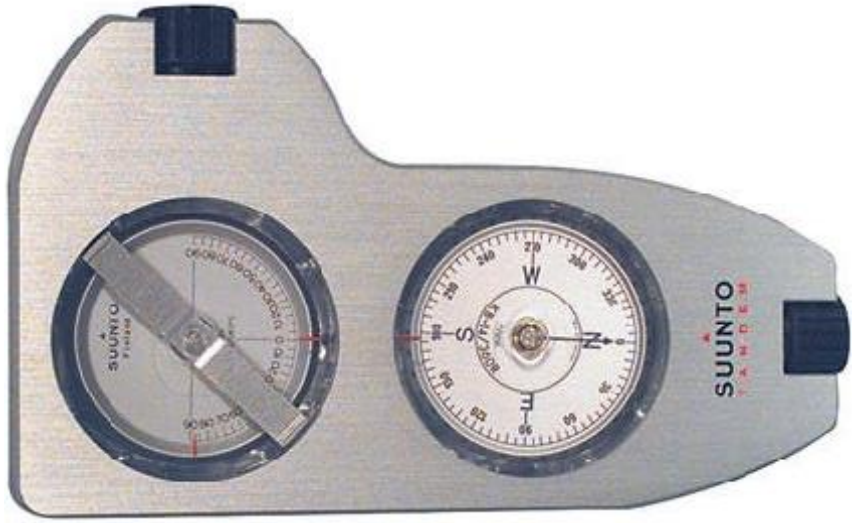
Viewing of Satellite Signal On Spectrum Analyzer

- Set the reference level to 5 dB: **Press AMPLITUDE Scale Div 5, dBm**
- Press **BW/Avg**, **Res BW**, then 30 KHz.)
- Press BW/Avg , 10.0 KHz and VBW , 10.0 KHz
- Set the sweep to 1 to 5 second: **Press SWEEP, 2 SEC**.

Satellite Dish Pointing Tools



Latitude , Longitude



Inclinometer/Compass

Satellite Modem cdm-570

Spectrum Analyzer

DATUM Modem Satellite Configuration

DATUM MODEM M7L CONFIGURATION			
UNIT- IP Control			
DHCP	IP Address	Network Mask	Gateway
DISABLE			
DNS 1	DNS 2		
MODULATOR-BUC			
Buc LO	10 MHz Ref	Xmt Spectrum	Power
4900.00 MHz	Enable	Non-Inverted	If BUC 20W: enable
			If BUC 50W: Disable (External AC)
DEMODULATOR-LNB			
LNB LO	10 MHz Ref	Rcv Spectrum	Power
5150.00 MHz	Enable	Inverted	+13V or +18V enable

Frequency Configuration	
MODULATOR-IF	
Frequency (MHZ)	1174.2091
IF BUC Xmt Frequency (MHz)	6074.2091
Spectrum	Normal
Filter-Roll-off	0.30
Level (dBm)	from -35.00 dBm to +5.00 Transmit output power level
BUC Xmt Level (dBW)	Transmit output power level display based on the BUC Xmt Gain parameter setting
Output	Transmit carrier Enable
Modulation	8PSK
AUPC Mode	Disable
Mute	Automatic
Impedance (Ohm)	75
MODULATOR-Data	
Bit Rate (Kbps)	128 kbps
Symbol Rate (Kbps)	Modulator Symbol Rate -The max and min are determined by settings and options
Rate Entry Mode	Bit Rate
Send Interface	E7 Express Interface
FEC Mode	LDPC
FEC Option	LDPC FEC encoder block size: 4k Block
FEC Code Rate	3/4
Scrambler	V.35 self-synchronizing scramblers respectively in all modes.
Demodulator-IF	
Frequency (MHZ)	1300.7169
LNB Rcv Frequency (MHz)	3849.2831
Sweep Range (KHz)	± 30 kHz is common for standard demodulators.
Sweep Mode	Fast
Sweep Time (sec)	0.0
Modulation	8PSK
Spectrum	Normal
Filter Roll-Off	0.30
AUPC Mode	Disable
Impedance (Ohm)	75
Demodulator--Data	
Bit Rate (Kbps)	128kbps
Symbol Rate (Kbps)	Modulator Symbol Rate -The max and min are determined by settings and options
Rate Entry Mode	Bit Rate
Send Interface	E7 Express Interface
FEC Mode	LDPC
FEC Option	LDPC FEC encoder block size: 4k Block
FEC Code Rate	3/4
Scrambler	V.35 and Intelsat self-synchronizing scramblers respectively in all modes.
Interface- I/O	
Port 1 Mode	Data I/O
Port 1 Connection	Automatic
Port 1 VLAN ID (0-4094)	Disabled
From Port 2 Mode to Port 5 Mode	Disabled
Interface-Send	
WAN Mode/ WAN Protocol	Remote Bridge PTP/ M7 HDLC
Interface-Rcv	
WAN Mode/ WAN Protocol	Remote Bridge PTP/ M7 HDLC
Interface-QOS	
QOS Mode	WRED
Interface-MCC	
Mode	Full Access
Protocol	M7 Binary Packet
Send Rate Limit (kbps)	64
Send Address	1
Rcv Address	1

DATUM Satellite Modem M7 LT

Datum M7LT Front Panel View

DATUM M7LT Rear Panel

Datum M7LT Rear Panel AC Prime Power Input

Datum M7LT Rear Panel DC Prime Power Input

VSAT Maintenance

- Inspect the total appearance of the equipment, including satellite dish feed horn and LNA
- Inspect ground connections
- Inspect power equipment facilities
- Inspect the IF equipment and terminal equipment including indoor
- Inspect cables and connectors
- Inspect areas exposed to the weather to insure they are adequately waterproofed
- Evaluate antenna overall performance