

1.INTRODUCTION: -

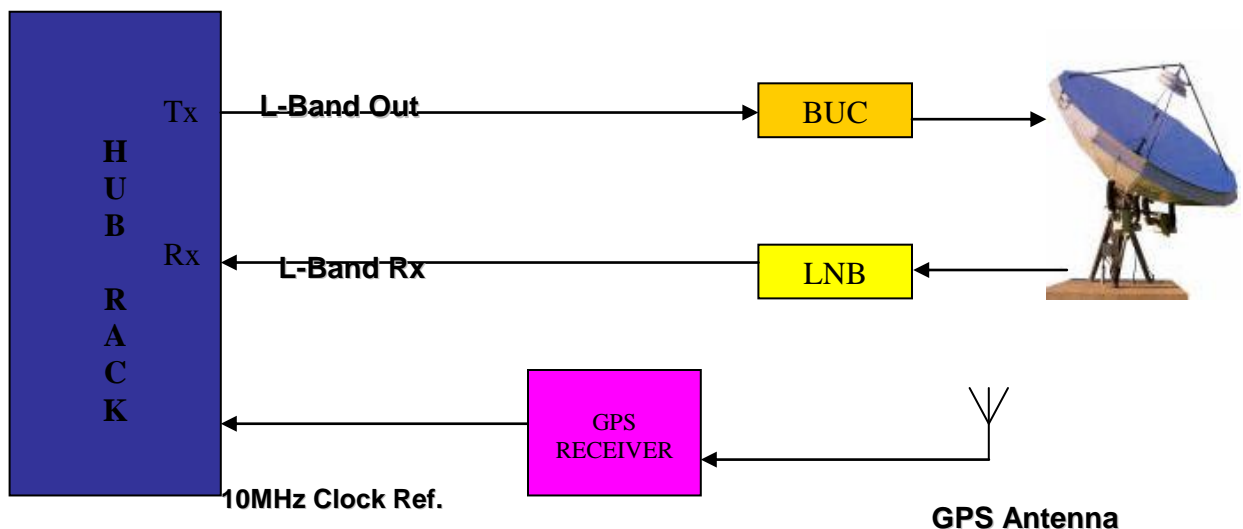
EDUSAT as the name defines is a Satellite completely dedicated for providing education in various fields of society. It may be for providing distance education at different levels, telemedicine application, providing resources to farmers (VRCs) and so on. To utilize the satellite, networks are established that are called as Earth Stations. A network basically comprises of a HUB that acts a central point of resource, 100s/1000s of remotes connected to the HUB and off course the Satellite.

The HUB is a standard two-way broadband satellite communications system for Internet Protocol (IP) over Satellite. It is used for both Transmitting and receiving programs (signal) in the network. The network works in STAR topology and adopts TDM/TDMA technology. The signal transmitted from the HUB is called “TDM or OUTBOUND” signal and it is continuous. The signal transmitted from remotes is called TDMA signals or TDMA bursts. The network operates in either Ku-Band or Extended-C Band. The system application includes Distance Education, Telemedicine, Content distribution, Internet service provider access, Voice-over –IP, Virtual Private Networks, private corporate networks and so on. The HUB is a complete system comprising of both outdoor (ODU) and indoor units (IDU). The ODU comprises of Antenna and Radio Frequency Terminals (RFT) like BUC, LNB. The IDU comprises of the HUB Rack with Base band equipments installed in it and a Network Management System (NMS) computer. An Inter Facility Cable (IFL) provides the link between the ODU and the IDU.

4.THE HUB SYSTEM: -

The Hub system is an interconnection of Outdoor units (ODUs) and Indoor units (IDUs). The Outdoor units comprise of the Antenna, Block Up Converter (BUC), Low Noise Block (LNB) and the Inter Facility Cable (IFL) connecting the BUC and LNB to the Indoor unit. The Indoor unit is basically a RACK incorporated with many devices that are interconnected. The devices mounted in the RACK are discussed in detail in the following section.

Fig2.0 shows the System Block diagram of the HUB.



5. CIRCUIT PATH IN THE HUB SYSTEM: -

The circuit path in the HUB system is broadly classified into 2 Chains. One is the transmit chain and the other is the receive chain. As shown in Fig3.0

The transmit chain consists of the following equipments: -

1. IP Encapsulator (IPE).
2. Timing & Distribution Unit (TDU).
3. 70 to L Converter.
4. Modulator.

The receive chain consists of: -

1. 1:16 L-Band Splitter.
2. Gateway Channel Units (GCU).
3. 70 to L Converter.

The equipments are mounted in the RACK and are interconnected using the wires that are pre routed in the RACK. A Network Management System PC is connected to the Router that acts as the graphical representation of the SUN SERVER for configuring and monitoring it. Individual equipments will be explained in details in the next coming section.

6. THE HUB MODULES: -

The HUB system's Outdoor unit comprises **of the Antenna, BUC, LNB, GPS antenna and the IFL** cable. The BUC and LNB are mounted on the Antenna. The IFL cable connects the BUC and LNB to the 70 to L Converter.

The above diagram is the basic block level representation of the HUB system. One of the IFL cables from the Tx port of IDU mounted in the RACK is connected to the BUC on the antenna; the other is connected from the LNB on the antenna to the receiving port of the IDU. A separate GPS antenna is installed and is connected to the GPS Receiver on the RACK to provide stable 10MHz-reference clock to other IDUs mounted on the RACK. Indoor Units comprise of series of equipments used for modulation, demodulation, providing reference clock, monitoring and controlling the entire system. A separate Network Management System Computer is used at the HUB to configure, monitor and control the entire HUB operation. A 10KVA UPS is used as a backup for HUB RACK against power failures.

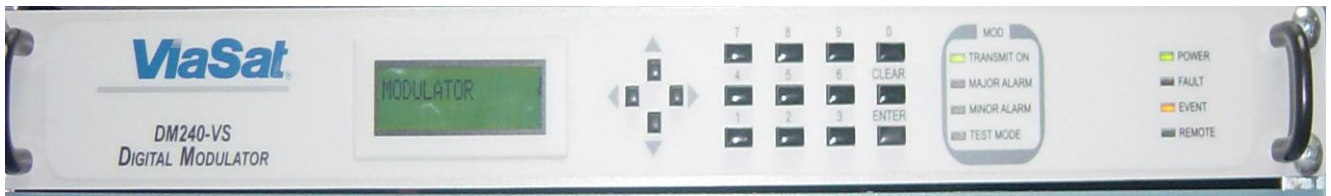
1. GPS RECEIVER



The GPS Receiver provides stable 10MHz reference signal to the MODULATOR, TDU and 1:16 SPLITTER. The GPS Antenna signal is given to 'GPS ANTENNA' port of the GPS receiver. 3 frequency ports of the GPS Receiver is connected to MODULATOR's External ref. port, TDU's 10MHz port and 1:16 SPLITTER's 10MHz ref.port respectively. In the GPS Receiver the 'power', 'Time valid' and 'Tracking Satellite LED' should be always green.

SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	GPS Antenna	N-Type	GPS Receiver	GPS ANTENNA
2	GPS Receiver	FREQ1	Modulator	ExT. Ref.
3	GPS Receiver	FREQ2	TDU	10MHz
4	GPS Receiver	FREQ3	1:16 Splitter	10MHZ Ref.

2. DIGITAL MODULATOR



The Digital Modulator receives the aggregate traffic from the Transmission link, modulates it to 70MHz Intermediate frequency and sends it to the RF chain. The Modulator is connected to the GPS Receiver, TDU and the 70 to L Converter. Ensure the 'Transmit ON' LED is ON.

The important parameters to be checked in the Modulator are: -

Menu 1) MODULATOR

70 MHz (± 18 MHz)

Carrier - ON

Inner FEC Rate - 2/3

Data Rate - This will automatically change according to Symbol Rate value

Spectrum - Normal

Power - -15.0 dBm

Modulation - QPSK

Symb Rate - 02000000 sps

Menu 2) INTERFACE

➤ **REF FREQ SRC** - External

➤ **External Reference** - 10MHz

Menu 3) TEST

- **Carrier Type** - Normal
- **Test Pattern** - None

SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	Modulator	IF out	70-L Converter	IF out
2	Modulator	ASI in	TDU	10MHz Ref.
3	Modulator	Ext. Ref.	GPS Receiver	Freq1

3. IP ENCAPSULATOR (IPE)

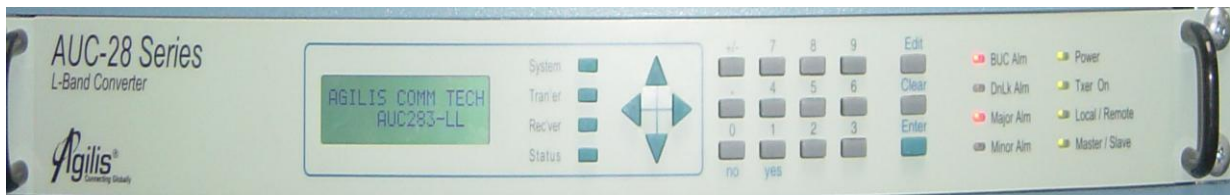
CAUTION: Do not insert or Remove Flash Card while system is Operating

The IPE receives outbound IP packets, inserts them into MPEG2-TS packets after performing Multi Protocol Encapsulation (MPE), and creates an outbound IP over Digital Video Broadcast (DVB) stream. The output of the IPE is provided to the DVB ASI input of the TDU.

The IP Address for IPE is: - LAN1 is 192.168.150.8
 LAN2 is 192.168.152.8

SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	IPE	LAN1	ROUTER	Any
2	IPE	LAN2	ROUTER	Any
3	IPE	ASI OUT	TDU	ASI IN

4. 70 - L BAND CONVERTER



The 70-L Band Converter is used to convert the 70MHz (IF) to L-Band signal. The equipment operates in both transmit and receive paths. Important parameters to be checked are: -

Txer LED should be **ON**.

Txmtr Menu-

- Tx freq should be 1229MHz.
- BUC DC should be ON.
- 10 MHz should be Internal.

SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	70-L Conv.	L-Band Out	BUC (Through IFL cable)	IF IN
2	70-L Conv.	L-Band In	LNB (Through IFL cable)	N-Type
3	70-L Conv.	IF In	MODULATOR	IF OUT
4	70-L Conv.	Aux L-Band Out	1:16 Splitter	L-band in

5. ROUTER



The Router is the interface between the Customer traffic that comes into the Hub and the traffic that goes out of the HUB i.e. it acts as the gateway interface between customer networks and the LinkStar Network The router serves multiple functions. The router has a connection to the outbound link via the IP Encapsulator (IPE). In the inbound the GCUs are connected to the Router. The SUN SERVER is connected to the Router which is the main unit of the HUB System. The NMS PC is also connected to the Router. The Linkstar network is connected to the 192.168.150.XX series and the Customer traffic is connected to the 172.31.XX.XX series (Ge 0/0 port). The following table gives the IP addresses for various equipments in the RACK that are connected to the Router.

SL.No	DEVICE	IP ADDRESS
1	ROUTER	192.168.150.51
2	NMS PC	192.168.150.7
3	SUN SERVER	192.168.150.1
4	GCU1	192.168.150.11
5	GCU2	192.168.150.12
6	IPE LAN1	192.168.150.8
7	IPE LAN2	192.168.152.8

GE 0/0 PORT: 172.31.10.13 is the port on the Router that is connected to the Customer LAN.

6. TDU (Timing & Distribution Unit)

The TDU receives the output of the IPE and multiplexes it with the PCR (program clock reference) into the outbound DVB stream. The ITDU is connected to the GCUs to synchronize the TDMA frames with the NCR. Each TDU can support up to 15 GCUs.



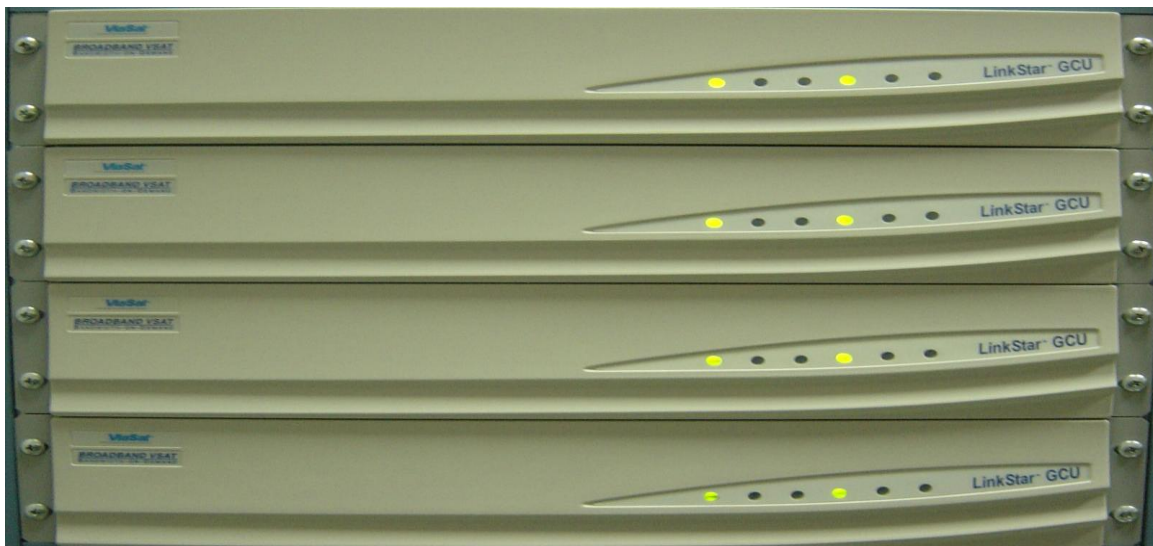
SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	TDU	ASI IN	IPE	ASI OUT
2	TDU	ASI OUT	MODULATOR	ASI IN
3	TDU	10MHz Ref.	GPS Receiver	FREQ2
4	TDU	1 TO 14	GCUs	any

7. GCU (Gateway Channel Unit)

At the Hub, a pool of DVB-RCS – *Gateway Channel Units (GCUs) or demodulators* are used to *receive* multiple carriers from the remote RCSTs. The GCU is compact with an L-band IF interface. The GCU includes an MF TDMA demodulator, a frame synchronizer card, and a terrestrial 10-Base-T traffic interface. Each GCU receives a single MFTDMA carrier assigned by the Regional NCC.

The LinkStar GCU modem can be configured to demodulate different symbol rates:

- 156.25 ksp/s • 312.5 ksp/s • 625 ksp/s • 1.25 Msp/s • 2.5 Msp/s



SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	GCU1	Rx IN	1:16 SPLITTER	Any of O/P ports.
2	GCU2	Rx IN	1:16 SPLITTER	Any of O/P ports
3	GCU1	10/100 Base T	ROUTER	Any
4	GCU2	10/100 Base T	ROUTER	Any
5	GCU1	TDU ports	TDU	Any
6	GCU2	TDU ports	TDU	Any

8. 1:16 L-Band Splitter

The 1:16 Splitter is used in the receive chain. It receives the L-band signal from the LNB through the 70-L converter. It has 16 output ports with similar interfaces from where the GCUs are connected.



SL.No.	FROM		TO	
	DEVICE	PORT	DEVICE	PORT
1	1:16 SPLITTER	L-Band IN	70-L Conv.	Aux L-Band Out
2	1:16 SPLITTER	10MHz	GPS Receiver	FREQ
3	1:16 SPLITTER	Any o/p port	GCU1	Any of O/P ports.
4	1:16 SPLITTER	Any o/p port	GCU2	Any of O/P ports.

9. SUN SERVER

The SUN SERVER is the heart of the entire HUB system. It contains all the required software, Database, configuration files for the network to function. The SUN SERVER is graphically accessed using the NMS computer. The server has 3 processes to be checked for its functionality. They are: - 1. NCC (network control center)
2. RNCC (Regional NCC)
3. TCPPEP



List of Major equipments of Uplink –down Link station

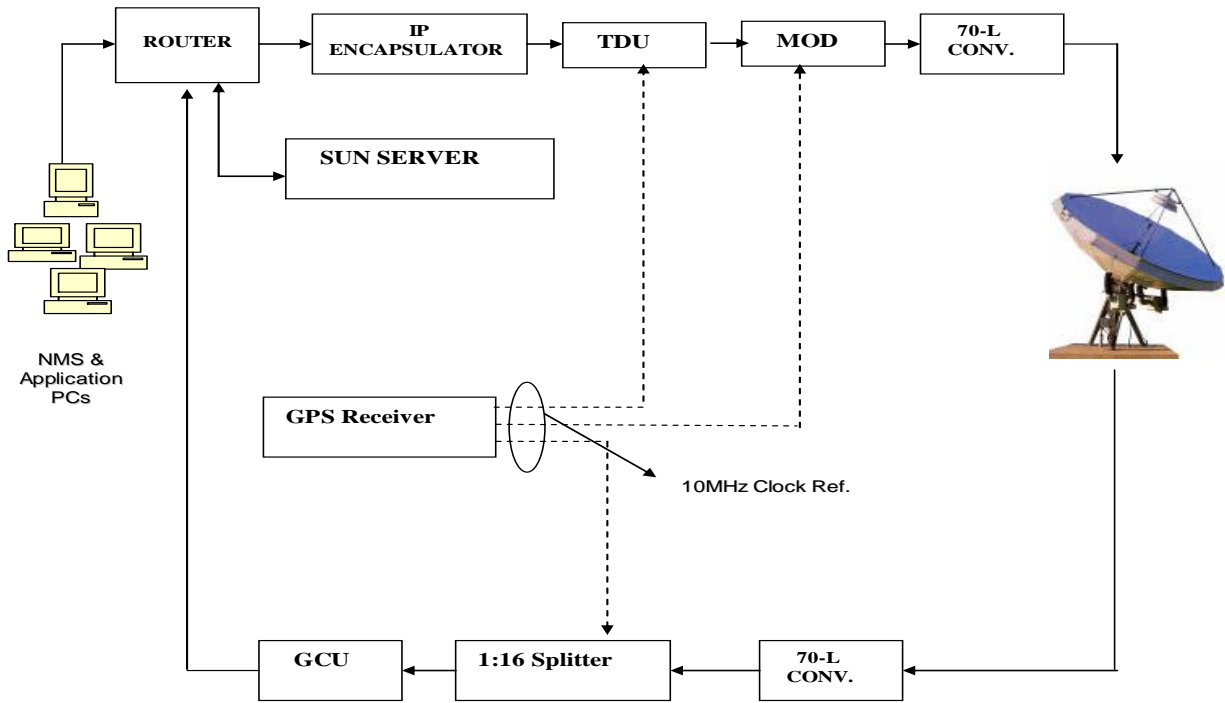
S.No	Item Description	Make & Model
1	6.3 Mt Antenna & Feed System	Comsat
2	Antenna Controller	Comsat
3	High Power amplifier 400 W TWTA	CPI VZC 6964 AA
4	Synthesize up converter	Radyne Comstream SFC 6400 A
5	DVB Modulator	Radyne DM 240-VS
6	MPEG 2 Encoder	Scopus E1000
7	Audi Video Processor distribution amplifier	Leith, FR 683AV
8	IRD	Scopus 2600
9	Down Converter Extended C-Band to L band	ALSOV BDC – C/L
10	Extended C- band LNA	Paradise datacom , RF 3000-45-60-B4
11	Transmit Reject Filter (TRF)	Comsat
12	1:2 power divider	Mini Circuit ZN 2PD2-50-S
13	AVR 10KVA	Automatic Electronics EMS- 12
14	Dummy Load with W/G switch	Sector Microwave & MCS
15	19” standard rack for mounting	Arraycom
Test & Monitoring equipments		
16	Spectrum analyzer	Agilant – E-4408B
17	TV Monitor 21” Colour Trinitron	Sony
18	Waveform Monitor	Tektronix 1731
19	RF power meter cum frequency counter	Agilant, 53147A & 8481A
20	Pattern Generator & Audio generator	Tektronix TSG-131A
21	Accessories	

A	Monitoring panel for earth station	Arraycom
B	Required power distribution and interfacing cables, connectors, patch panel	
C	RF accessories like adaptor, attenuators fixed and variable, RF cable small length, extra flexible WG, etc.	
D	Field accessories like millimeter	
E	Software backup wherever necessary	
22	Router	CISCO 2800
23	IP Encapsulator (SMR)	SMR -25
24	Time Stamp Unit (TDU)	Viasat
26	NMS software & haedware (SUN Server)	SUN System
27	In route Demodulator with 04 Gateway Channel Unit (GCU)	Link star/ Viasat
28	10KVA on line UPS with 4 Hr back up	Series 4110/ E&C Aqua Power.
29	1.8 Mt C- band Antenna with NP mount & Earthling Kit	BEL
30	Ext-C- Band 2 W BUC with PLL LNB	Viasat
31	Link star Return Channel Terminal (RCST)	Viasat / Linkstar
32	Multimedia PC	DELL
33	Server	HP
34	DSL Modem	Multitech

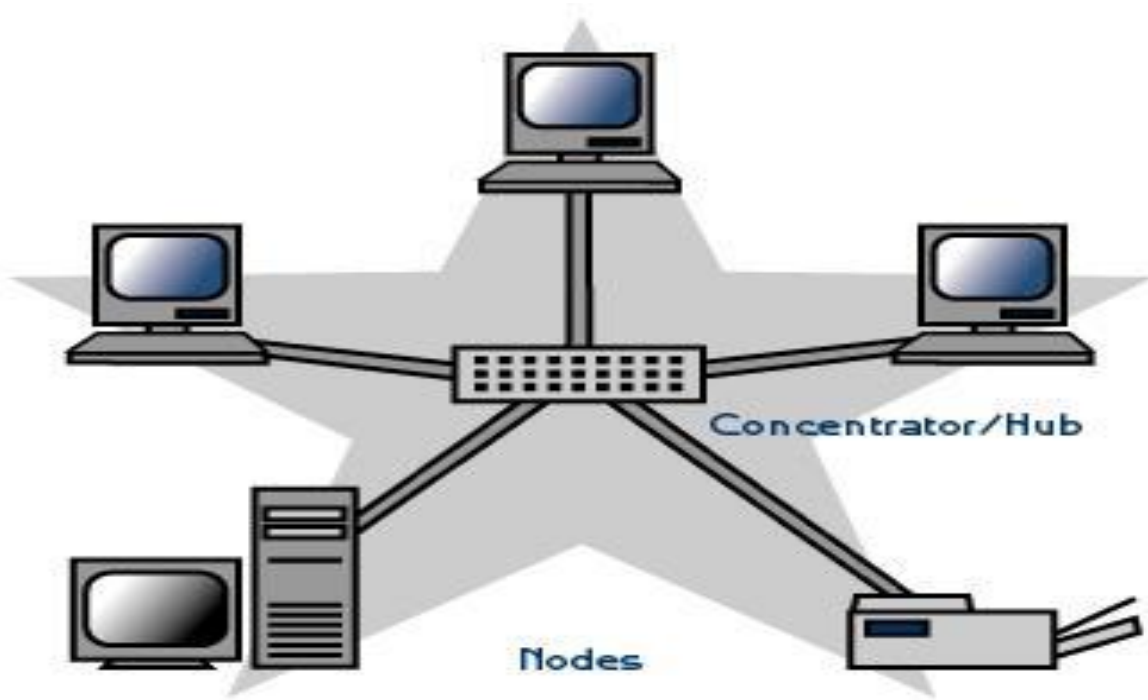
List of Items of Hub is as below:

A : ViaSat Hub systems:				
No.	Description	Supplier / Make	Model / P/N If any	Qty
1	GPS Receiver	ViaSat / Brandywine communication	GPS8 071000001	01
2	Digital Modulator	ViaSat	DM-240-VS	01
3	L-band splitter 1:16	ViaSat / ETL Systems	22186 1033087	01
4	Gateway channel units (GCU)	ViaSat / LinkStar	CL0006399-01	04
5	IP Encapsulator (SMR-24)	Viasat / Sky stream network	P/N 1035546	01
6	Router	ViaSat / Cisco	Cisco-2851	01
7	Intelligent Timing Distribution unit (TDU)	ViaSat / Link Star	P/N:CL0006725-01	01
8	Sun Server with NMS software	ViaSat / Sunmicro System	Sunfire V210	01
9	NMS PC	DELL	Gx 280	01
10	Anti Virus Server	BEL / HP	Proliant ML-350 P/N:416892-371	01
11	LMS Server (with TrainNet Teacher Software, ROBO Group, Israel)	BEL / HP	Proliant ML110	01
12	10 KVA On line UPS	BEL / Electronics & Controls Power Systems Pvt. Ltd. Bangalore (E & C)	Model:4310	01
B : Digital uplink hardware base band and RF systems				
1	6.3 Mtr Antenna with Motor Control Unit (MCU) including INVAC-AC freq. variable drives for Only Az/El Movement without indications. (Az Motor:1HP,El Motor:2HP)	Arraycom / Comsat	Parabolic with cassetrain, 4-port feed system.	01
2	IF t0 L band Converter	ISRO/Polar sat	XCVR-6001	01
3	MPEG-2 Professional Encoder	Arraycom/ SCOPUS Network Technologies	DVB Codico E-1000	01
4	40W Ext C Band SSPB	ISRO/Agilis	Model:ALB180112 D P/N ALB1801120B	01
5	Ext C Band LNA	Arraycom/ Paradise Data com	Model: RF34560B4	01
6	Ext. C to L Band Down Convertor	Arraycom/ NPC/Elso V	BDC – CL	01
7	Audio/Video distribution amplifier	Arraycom/ LEITCH	FR-683AV	01
8	Video Audio Switcher (Stereo)	Arraycom/MCBS	VAMS-402DBS	01
9	Professional Receiver Decoder(IRD)	Arraycom/ SCOPUS Network Technologies	Codico/IRD 2600	02
10	Preset Power Supply (For LNA) (Output: 21.6 to 26.4V, 1 Amp.)	Arraycom/Aplab	FL 2401	01

TRAFFIC FLOW IN THE HUB NETWORK



NETWORK TOPOLOGIES



STAR TOPOLOGY

TDM/TDMA Technology

