JMRC – PRESENTATION

FIBER OPTICS TRANSMISSION SYSTEM (FOTS)

6335 / 6350

By:-
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Topics to be covered:-

1. FOTS Theory

2. Network Connectivity

3. Hardware detail

4. Protection Mechanism

5. Backup & Recovery

6. Alarms

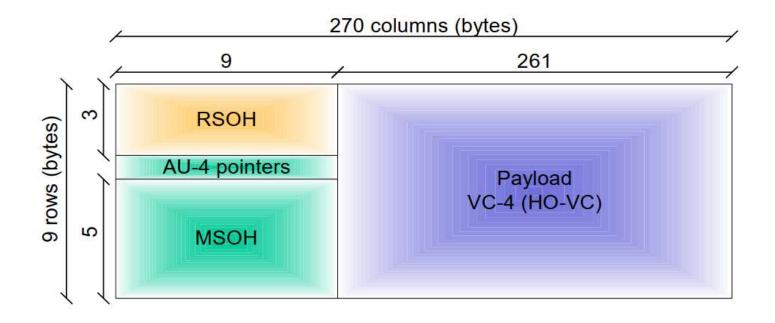7. Preventive maintenance

8. Corrective maintenance

FOTS/SDH THEORY

- FOTS provides a Synchronous transport network of voice, data and video signals between different nodes.

- It consists of Single core optical fiber network, SDH equipments and NMS to monitor

- With Flexible bandwidth

- Higher rate signals in the hierarchy either can be a multiplex of lower rate signals or can themselves constitute a new, high-capacity single channel.
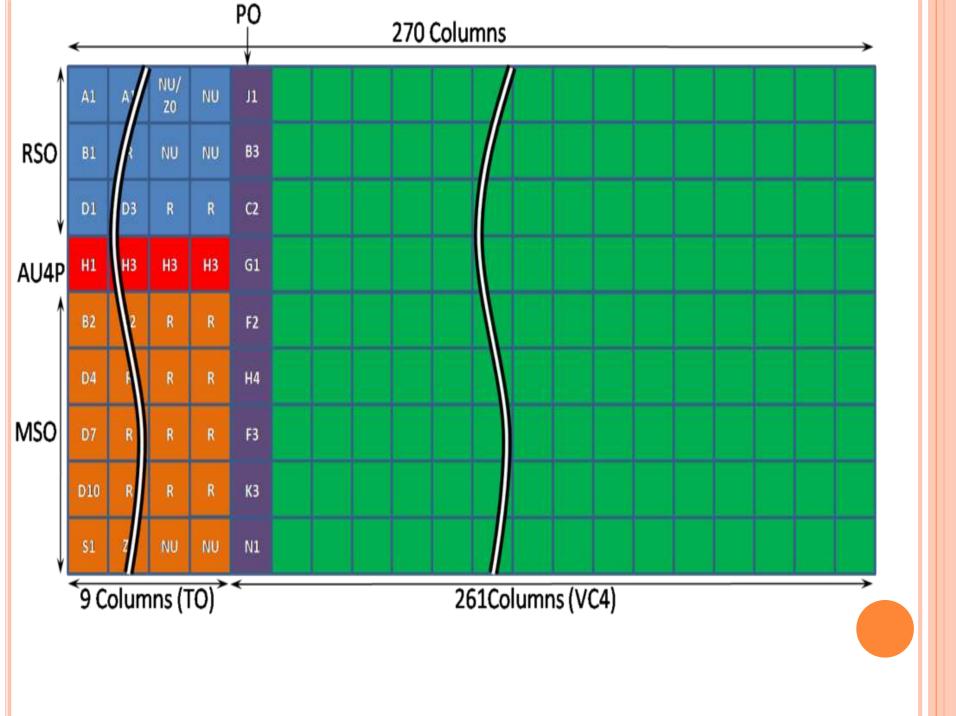
- With Traffic protection

SDH Bit Rates & Hierarchy

❑ E-1= (8000sample/s X 8 bits/sample X 32channels/frame)=2.048 Mbps

❑ STM-1 = (2430 bytes/frame X 8bits/byte X 8000 frames/s)=155.52 Mbps

❑ STM-4 =(4 X STM 1) = 622.08 Mbps

❑ STM-16=(4 X STM 4) = 2488.32 Mbps~2.5Gbps

❑ STM-64=(4 X STM 16) = 9953.28 Mbps~10Gbps

STM-1 Frame

270 columns (bytes)

9 | 261

9 rows (bytes)

3 | RSOH

AU-4 pointers

5 | MSOH

Payload
VC-4 (HO-VC)

2430 bytes/frame × 8 bit/byte × 8000 frame/s = 155.52 Mbit/s
transmitted from top to bottom and left to right

TOH: Transport Overhead (**RSOH + AU4P + MSOH**)
MSOH: Multiplex Section Overhead
RSOH: Regeneration Section Overhead
AU4P: AU-4 Pointers
VC4: Virtual Container-4 payload (**POH + VC-4 Data**)
POH: Path Overhead

The STM-1 base frame is structured with the following characteristics:
Length: 270 column × 9 row = 2430 bytes
Byte: 1-byte = 8 bit
Duration (Frame repetition time): 125 µs i.e. 8000 frame/s
Rate (Frame capacity): 2430 × 8 × 8000 = 155.52 Mbit/s
Payload = 2349 bytes × 8 bits × 8000 frames/sec = 150.336 Mbit/s
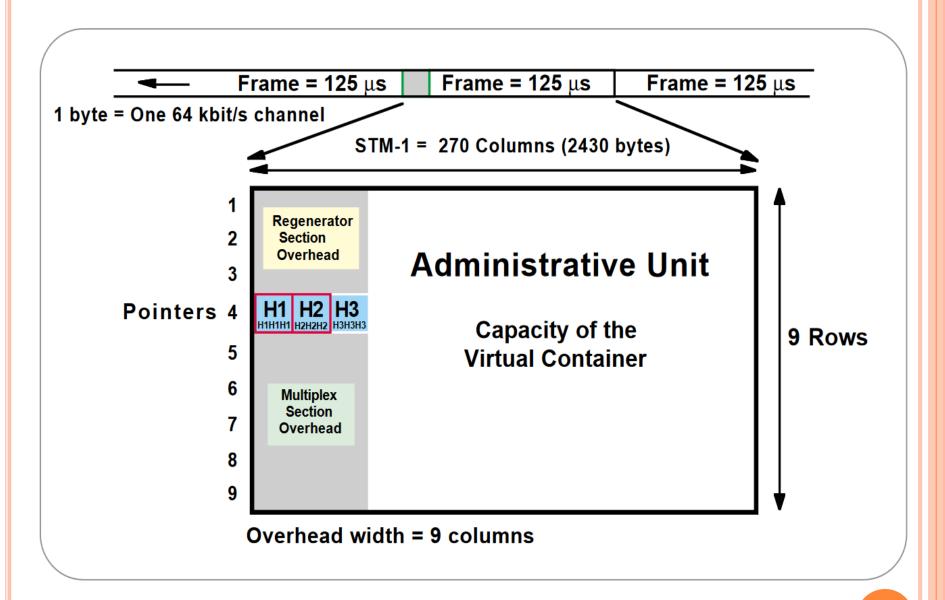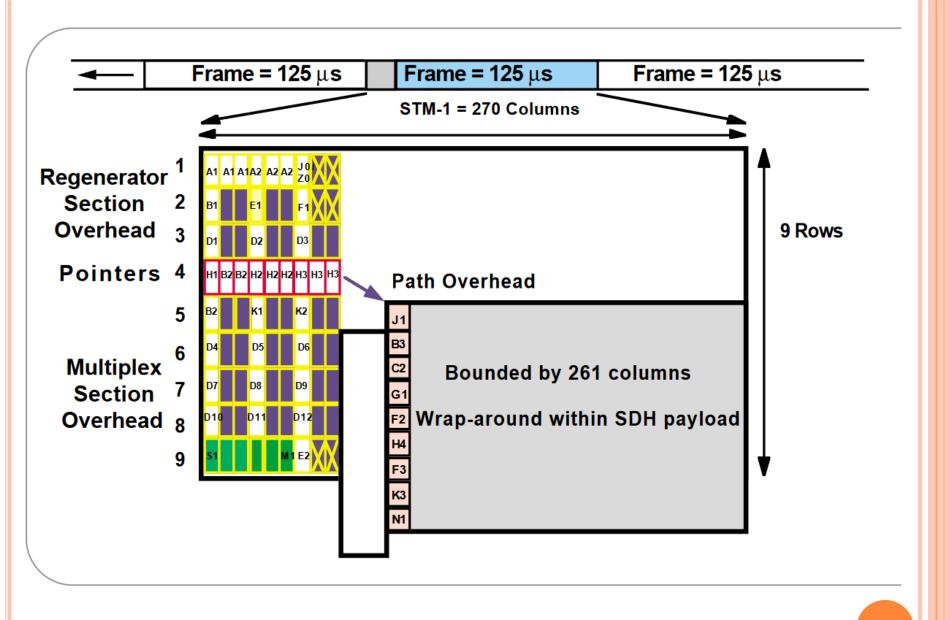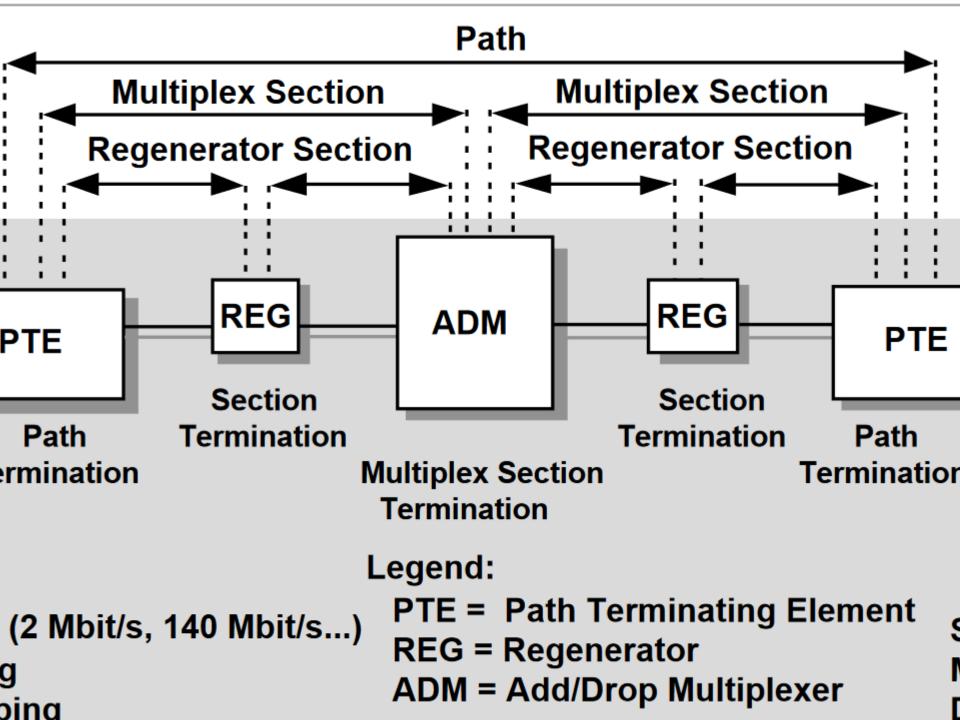
Virtua l Conta iners (VC) SDH Digital
Bit Rate Size of VC
 VC-11 1.728 Mbit/s 9 rows, 3 columns
VC-12 2.304 Mbit/s 9 rows, 4 columns
VC-2 6.912 Mbit/s 9 rows, 12 columns
VC-3 48.960 Mbit/s 9 rows, 85 columns
VC-4 150.336 Mbit/s 9 ro

Frame = 125 μs | Frame = 125 μs | Frame = 125 μs

STM-1 = 270 Columns

9 Rows

Regenerator Section Overhead

1 | A1 A1 A1 A2 A2 A2 J0/Z0

2 | B1 E1 F1

3 | D1 D2 D3

Pointers

4 | H1 B2 B2 H2 H2 H2 H3 H3 H3

Path Overhead

5 | B2 K1 K2 — J1

6 | D4 D5 D6 — B3

Multiplex Section Overhead

7 | D7 D8 D9 — C2

8 | D10 D11 D12 — G1

9 | S1 M1 E2 — F2

H4
F3
K3
N1

Bounded by 261 columns

Wrap-around within SDH payload

Path

Multiplex Section

Multiplex Section

Regenerator Section

Regenerator Section

PTE

REG

ADM

REG

PTE

Path
Termination

Section
Termination

Section
Termination

Path
Termination

Multiplex Section
Termination

(2 Mbit/s, 140 Mbit/s...)

Legend:

PTE = Path Terminating Element

REG = Regenerator

ADM = Add/Drop Multiplexer

Regenerator Section
Multiplex Section
Path
The layers have a hierarchical relationship, with each layer
building on the services provided by all the lower layers.

The SDH standard was developed using a client/server
layer approach (see Figure 3). The overhead and
transport functions are divided into layers. They are

Regenerator Section Overhead

The Regenerator Section Overhead contains only the information required for the elements located at both ends of a section. This might be two regenerators, a piece of line terminating equipment and a regenerator, or two pieces of line terminating equipment.

The Regenerator Section Overhead is found in the first three rows of Columns 1 through 9 of the STM-1 frame

Multiplex Section Overhead

The Multiplex Section Overhead contains the information required between the multiplex section termination equipment at each end of the Multiplex section (that is, between consecutive network elements excluding the regenerators).
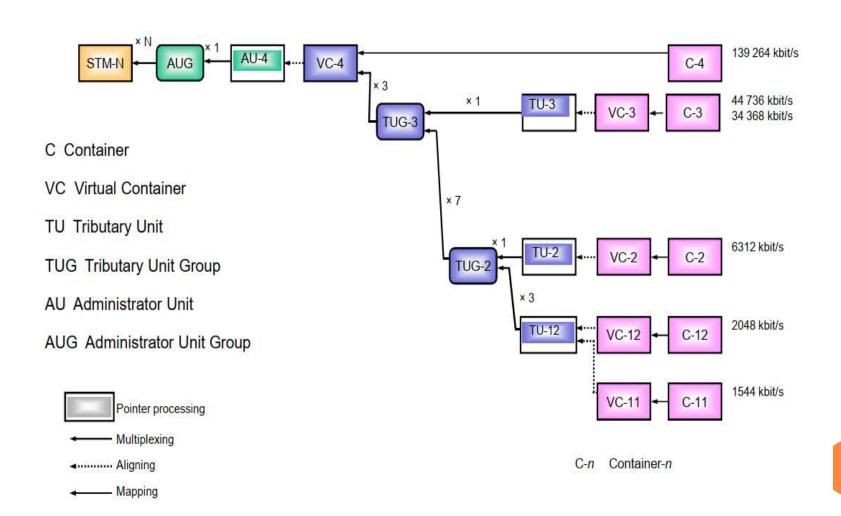
The Multiplex Section Overhead is found in Rows 5 to 9 of Columns 1 through 9 of the STM-1 frame

Higher-Order Path Overhead (VC-4/VC-3)
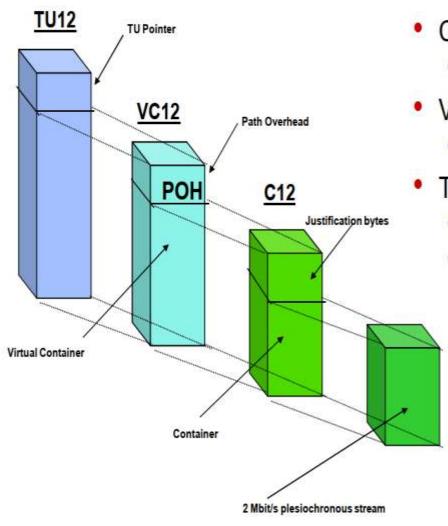
The Path Overhead is assigned to, and transported with the Virtual Container from the time it's created by path terminating equipment until the payload is demultiplexed at the termination point in a piece of path terminating equipment.

The Path Overhead is found in Rows 1 to 9 of the first column of the VC-4 or VC-3
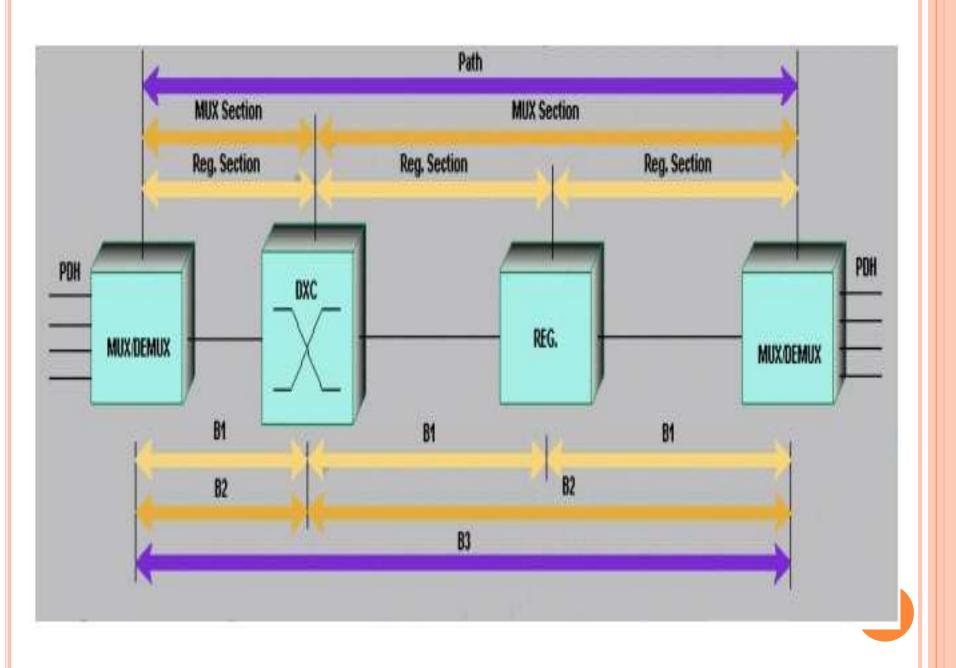
SDH Multiplexing Structure (ETSI)

C   Container

VC   Virtual Container

TU   Tributary Unit

TUG   Tributary Unit Group

AU   Administrator Unit

AUG   Administrator Unit Group

Pointer processing

Multiplexing

Aligning

Mapping

C-*n*   Container-*n*

STM-N ← AUG ← AU-4 ← VC-4 ← C-4   139 264 kbit/s

×N   ×1   ×3

TUG-3 ← TU-3 ← VC-3 ← C-3   44 736 kbit/s / 34 368 kbit/s

×1

×7

TUG-2 ← TU-2 ← VC-2 ← C-2   6312 kbit/s

×1

×3

TU-12 ← VC-12 ← C-12   2048 kbit/s

VC-11 ← C-11   1544 kbit/s
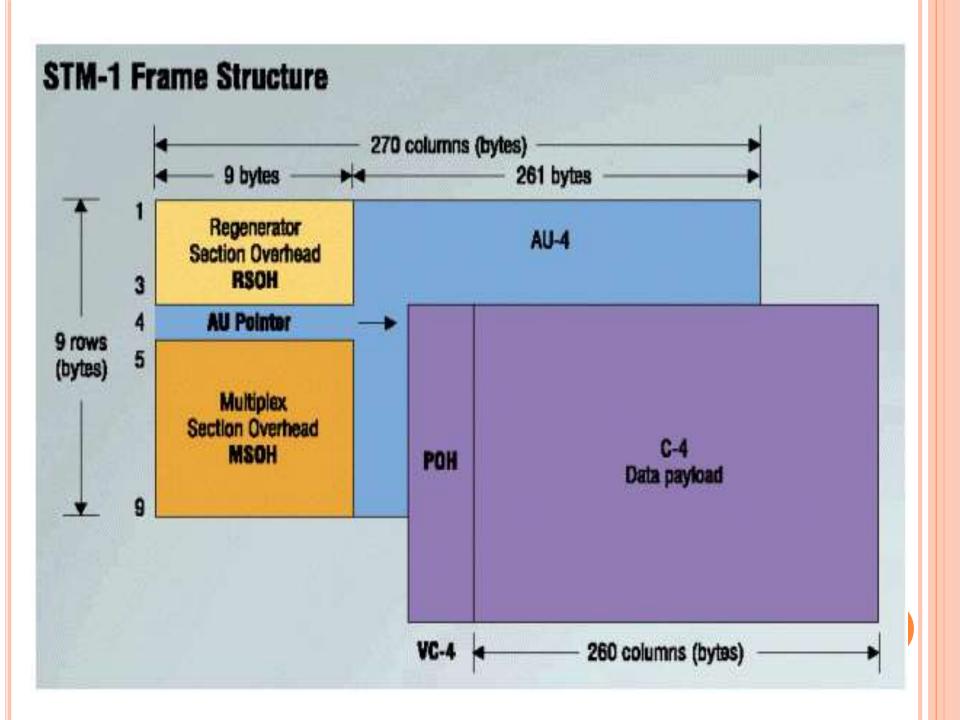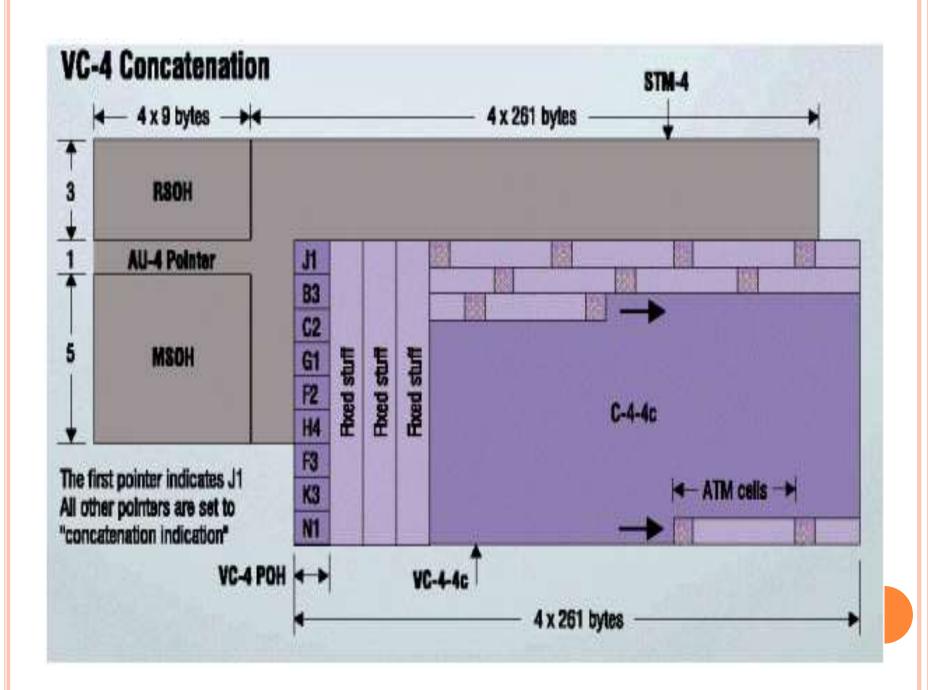
PDH over SDH
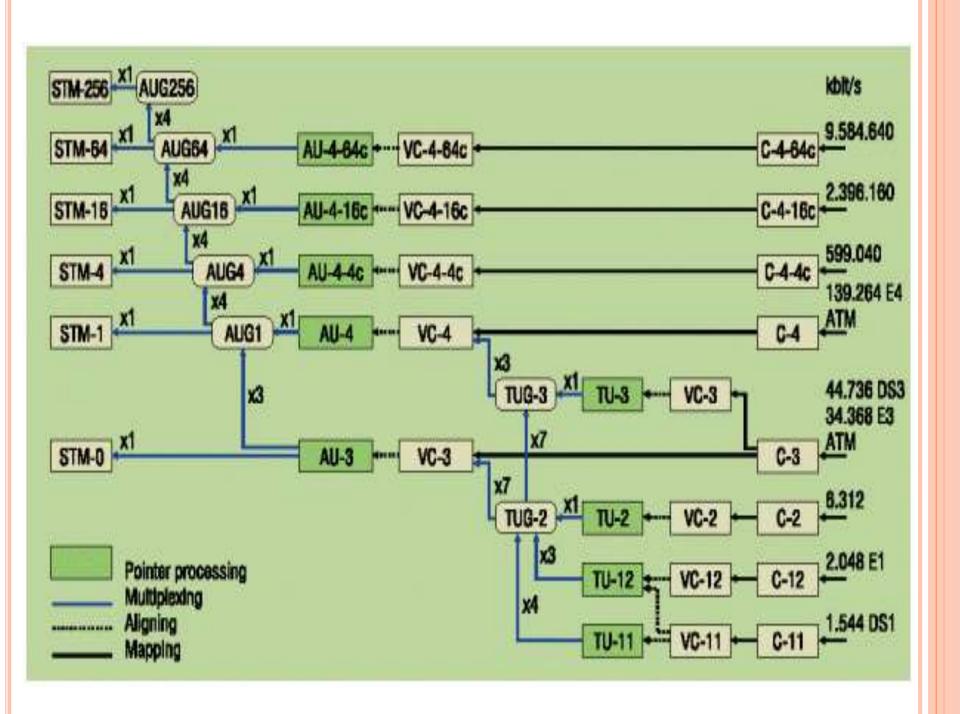
- **Container (C)**
  - basic payload unit
- **Virtual Container (VC)**
  - C + POH (path overhead)
- **Tributary Unit (TU)**
  - VC + pointer
  - The pointer indicates the start of the VC and allows dynamic alignment of the VC within the TU frame.

TU12

TU Pointer

VC12

Path Overhead

POH

C12

Justification bytes

Virtual Container

Container

2 Mbit/s plesiochronous stream

STM-1 Frame Structure

VC-4 Concatenation

STM-4

4 x 9 bytes | 4 x 261 bytes

3 RSOH

1 AU-4 Pointer

5 MSOH

J1
B3
C2
G1
F2
H4
F3
K3
N1

Fixed stuff | Fixed stuff | Fixed stuff

C-4-4c

ATM cells

The first pointer indicates J1
All other pointers are set to
"concatenation indication"

VC-4 POH

VC-4-4c

4 x 261 bytes

Example of Cross-connect (XC)

SDXC 4/1

	STM-16		16 x			16 x		STM-16
STM-4			4 x	SDH multiplexer		4 x		STM-4
STM-1			1 x			1 x		STM-1

AUG

HO XC

VC-4

LO XC

VC-12 | VC-3

2(1.5) Mbit/s   34 (45) Mbit/s

7. NETWORK DIAGRAM

The network diagram for the JAIPUR MRTS PROJECT is as shown below:

PHASE 1A NETWORK DIAGRAM

2. NETWORK DIAGRAM

The network diagram for the JAIPUR MRTS PROJECT is as shown below:

SDH Phase-1A Network Diagram

- Layer 3 Switch
- Mansarover station
- OCC
- Chandpole
- New Atish Market
- Sindhi camp
- Vivek Vihar
- Railway Station
- Shyam Nagar
- Ram Nagar
- Civil Lines

SDH Phase-1B Network Diagram

- Layer 3 Switch
- OCC
- Chandpole
- Choti Chouper
- Badi Chouper

Legend:
- Existing 48 Core Optical Cable
- 96 Core Optical Cable
- 2 Core of Existing 48 core Fiber Cable

PHASE 1B NETWORK DIAGRAM & INTERFACE WITH PHASE 1A FOTS
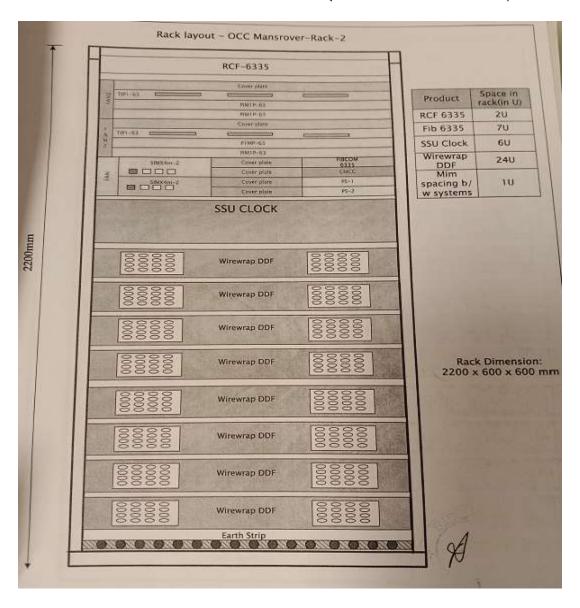
FIBER OPTICS DISTRIBUTION PLAN
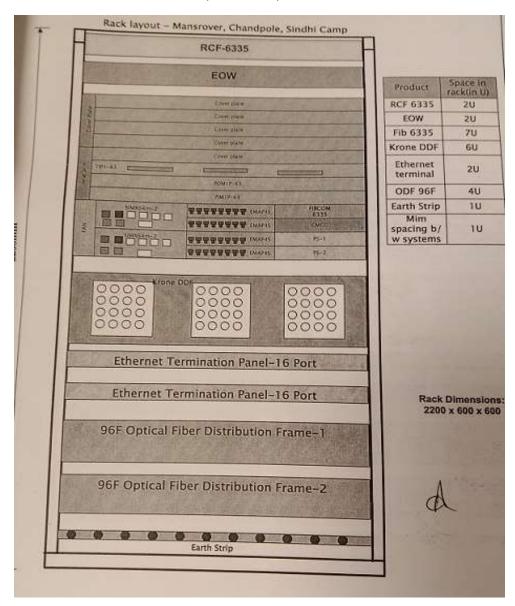
OCC-6350 SDH RACK (CATEGORY A)

Rack layout – OCC Mansrover– Rack–1

Product	Space in rack(in U)
RCF 6350	2U
EOW	1U
Flb 6350	21U
Eth Patch panel	3U
ODF 96F	4U
Earthing Strip	1U
Mim spacing b/w systems	1U

Rack Dimension: 2200 x 600 x 600 mm

OCC- 6335 SDH RACK (CATEGORY A)

Rack layout – OCC Mansrover–Rack–2

Product	Space in rack(in U)
RCF 6335	2U
Fib 6335	7U
SSU Clock	6U
Wirewrap DDF	24U
Mim spacing b/w systems	1U

Rack Dimension: 2200 x 600 x 600 mm
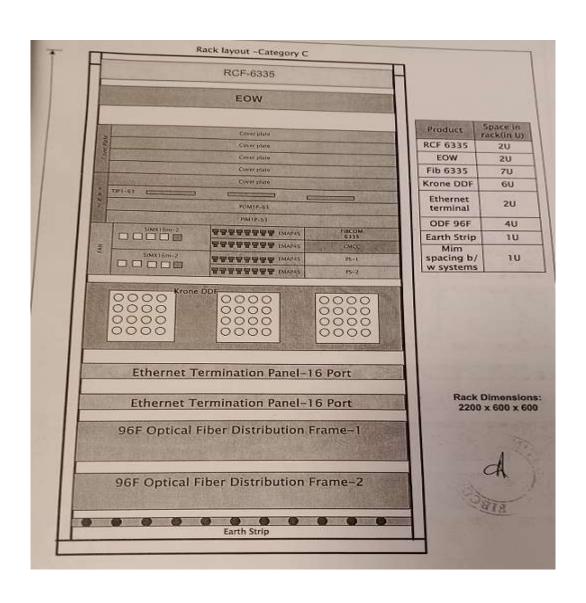
6335 SDH RACK (CATEGORY B)
MSOR,SICP,CDPE

Rack layout – Mansrover, Chandpole, Sindhi Camp

Product	Space in rack(in U)
RCF 6335	2U
EOW	2U
Fib 6335	7U
Krone DDF	6U
Ethernet terminal	2U
ODF 96F	4U
Earth Strip	1U
Mim spacing b/w systems	1U

Rack Dimensions:
2200 x 600 x 600

6335 SDH RACK (CATEGORY C) AT REMAINING STATIONS

Rack layout – Category C

Product	Space in rack(in U)
RCF 6335	2U
EOW	2U
Fib 6335	7U
Krone DDF	6U
Ethernet terminal	2U
ODF 96F	4U
Earth Strip	1U
Mim spacing b/w systems	1U

Rack Dimensions:
2200 x 600 x 600
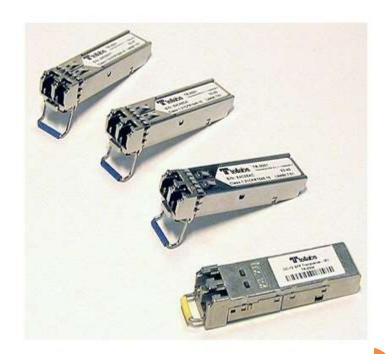
Module																							
															Module Slot								
Module	1	11	12	13	14	21	22	23	24	31	32	33	34	2	3	41	42	43	44	45	46	47	48
Fan	x																						
Fan2														x	x								
CMCC										x	x												
PS-DC												x	x										
SIMX16m-2		x		x																			
SIMX4m-2		x		x																			
SIMX64m-2						x	x	x	x														
SIMX16m						x	x	x	x														
SIMX4m						x	x	x	x														
SIMX16						x	x	x	x														
SIMX4						x	x	x	x														
SPIMX16m						x	x	x	x														
SPIMXm						x	x	x	x														
SPIMX2						x	x	x	x														

Module										Module Slot													
	1	11	12	13	14	21	22	23	24	31	32	33	34	2	3	41	42	43	44	45	46	47	48
PIM1						x	x	x	x														
PIM1-63																x	x	x	x	x	x	x	x
PIM1P-63																		x	x			x	x
PIM1P-126																		x	x			x	x
TIP1-63																x	x			x	x		
PIM3P						x	x	x	x														
ETEX10S							x		x														
EMAP						x	x	x	x														
OM-C		x	x	x	x	x	x	x	x														
OM-D		x	x	x	x	x	x	x	x														
OAD1-C		x	x	x	x	x	x	x	x														
OAD1-D		x	x	x	x	x	x	x	x														
MP4		x	x	x	x	x	x	x	x														
TR4		x	x	x	x	x	x	x	x														

Small Form Factor Pluggable (SFP)

– Small Form factor Pluggables (SFP) used for all
  optical interfaces
  Application codes can be mixed on same
  module
  Provide features like
  CWDM / DWDM
  Long Distance applications with external
  Booster
  Bi-directional transmission over single fiber

Standard Parameters Rx Sensitivity:-

Module	Rx Sensitivity in dB
STM1 S1.1	-28
STM4 S4.1	-28
STM16 S16.1	-18

Standard Parameters for Optical Trans Power – As applicable

Module	Tx Power in dB
STM1 S1.1	-15 to -8 dBm
STM4 S4.1	-15 to -8 dBm
STM16 S16.1	-5 to 0 dBm

Different types of SDH Cards used in JMRC Network:-

1. **SIM-1/4/16** :- it provides eight optical interfaces. The optical interfaces consists of two groups of four interfaces each of supporting a max. capacity of STM-16.

2. **SIM-1/4** :- it provides eight optical interfaces. The each can be equipped with a pluggable transceiver for optical STM 1, STM 4.

3. **ETEX16S**:-it provides sixteen optical 100 BASE-FX interfaces. It makes it possible to interconnect two Ethernet routers via an SDH core network

4. **ETEX6S**:- it provides 6 X Gbs optical Ethernet interfaces. It contains layer 2 MAC switch as well as MPLS capabilities.

5. **OHA**:- To switch management traffic from/to ETEX modules. To provide one common access point for management of ETEX modules.

6. **M-6**:- It is the switch core module. It provides higher order cross connection 100 G and lower order XC up to 20 G.

7. **CMCC**:- It performs configuration management, performance management, fault management and communication functions. It holds the application software for all element. All other modules will load software from CMCC.

8. **PSF**:- Operates from standard -48 V or -60 v power system (-40.5 to -72V). Filters the DC lines, hold energy storage and switches between main and protection power supply.
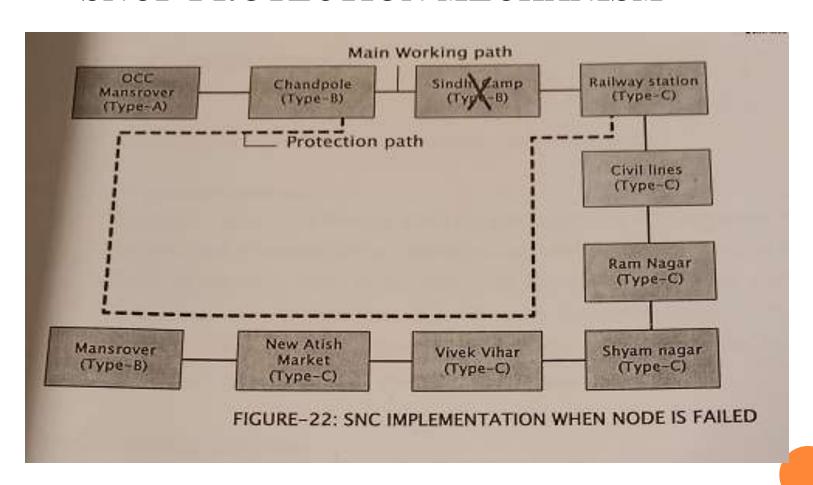
9. **SIMX64m-2, SIMX16m-2, SIMX4m-2**:- it is switch core and interface module for 6335 node. It provides central synchronization.

10. **PIMIP-63** :- PDH interface module provides termination and interfaces for 63 E1. Equipment protection is provided with duplication.

11. **TIP1-63**:- Provides physical interfaces for external 63 E1. External connector are three high density MDR connector each serving 21 E1s

12. **EMAP4S** :- Ethernet switching and mapping module. Provides 6 X 10/100 BASET and 2 X FE/GBE

13. **RCF**:- Provides rack station alarm interface and distributes power to Fibcom rack.

LED Alarm section has three alarms of A, B & R category

A- Red Critical

B- Yellow/ Orange Major

R- Green remind after acknowledgement of alarms

14. **EOW**:- It provides phone functionality between sites over a single embedded 64 kbps channel.

SNCP PROTECTION MECHANISM

FIGURE–22: SNC IMPLEMENTATION WHEN NODE IS FAILED

Network elements O&M using Two Management type:-

1. Local Management using Local Craft Terminal
2. Remote Management using Network Management System(NMS)

Local Craft Terminal:-

- Nodes and ETEX cards can be accessed locally from management port at CMCC and OHA respectively through ECT.

NMS:-

- Nodes and ETEX cards can be accessed remotely at NMS through EMS client software.

To check optical level of SFP in SIMX card:-

Go to Element Management

↓

Click on Performance

↓

Go to Optical level

↓

Select SIMX card(viz. 11-5)

↓

Read counter

↓

TX & RX power display on right window

↓

Replace the SFP if Tx or Rx power level is not under tolerance

Backup and Restore of CMCC card data and embedded software and firmware

Go to Equipment

↓

File Management

↓

Click on create backup

↓

Select backup file (backup file will be created in Zip format in CMCC Card and will be visible in network element table)

↓

Browse the path where to save

↓

Click on upload from NE

Go to Equipment

↓

File Management

↓

Browse the backup file from path where it is saved (in Management system head)

↓

Click on Download to NE

↓

The backup file will be saved in CMCC card and will be visible in network element table

↓

Click on Restore Backup

SDH ALARMS

- **Actual module not expected**

Appears when the actual module in question is present but not expected .

- **Actual transceiver not expected**

Appears when the actual transceiver in question is present but not expected

- **AIS**

Appears when AIS is detected in the signal.

- **Fan degraded**

One of the three fans in the fan module is not functioning correctly. This maybe due to a reduced nominal normal speed or that the fan has stopped completely.

- **Fan failure**

Replace the Fan

- **Firmware File Missing**

Download the necessary file , select and Soft reboot the system

- **Frequency out of range**

Appears when the frequency of the signal received at the input port in question is out of range, or when the frequency of the clock signal is unlocked.

- **Commercial power failure**

Applies when the AUX port in question is configured as an input AUX port with Alarm Text set to Commercial power failure. Appears when the signal on the port is high or low depending on the setting of Polarity.Check The Availability of AC Power

- **Cooling fan failure**

Applies when the AUX port in question is configured as an input AUX port with Alarm Text set to Cooling fan failure. Appears when the signal on the port is high or low depending on the setting of Polarity.

- **CTRL CRC error**

Appears when five consecutive LCAS control packets are received with incorrect CRCs on a VCG member.

- **Degraded signal**

Appears when the bit error ratio for the signal in question exceeds the threshold defined in the BER Threshold attribute.

- **DTMF EOW failure**

Applies when the AUX port in question is configured as an input AUX port with Alarm Text set to DTMF EOW failure. Appears when the signal on the port is high or low depending on the setting of Polarity.

- **Enclosure door open**

Applies when the AUX port in question is configured as an input AUX port with Alarm Text set to Enclosure door open. Appears when the signal on the port is high or low depending on the setting of Polarity.

- **ETEX critical**

Appears if one or more critical alarms are active in the ETEX NE in question.

- **ETEX major**

Appears if one or more major alarms are active in the ETEX NE in question.

- **ETEX minor**

Appears if one or more minor alarms are active in the ETEX NE in question.

- **ETEX warning**

Appears if one or more warning alarms are active in the ETEX NE in question.

- **Excessive errors**

Appears when the bit error ratio in the multiplex section exceeds 10.

- **Internal section failure**

Appears when the frame signal on the internal section interface in question is lost.

- **ISI Degraded**

Appears when erroneous bits are transferred between modules on the internal section interface (the NE backplane). This could indicate a problem with one or more of the modules.

- **ISI Failure**

Appears when there is an equipment failure. Either a module or the backplane itself has a critical error and needs immediate attention.

- **Laser Bias Current Out of Range**

Appears when the laser bias increases above or decreases below the fixed threshold values defined by the equipment.

- **Loss of frame**

Appears when the frame alignment of the incoming signal is lost.

- **Loss of frame delineation**

Appears when the frame delineation algorithm of the protocol cannot identify the frame start, and therefore the incoming signal is lost.

- **Loss of multiframe**

Appears when the multiframe alignment of the incoming signal is lost.

- **Loss of pointer**

Appears when the pointer in the incoming signal cannot be recovered correctly.

- **Loss of reference source**

Appears when the timing signals from the input port in question is considered lost.

- **Loss of signal**

Appears when the incoming signal is lost.

- **Loss of timing**

Appears when the module in question has lost its timing signal from the internal clock.

- **Low battery threshold**

Applies when the AUX port in question is configured as an input AUX port with   Alarm Text set to Low battery threshold. Appears when the signal on the port is high or low depending on the setting of Polarity.

- **Low humidity**

Applies when the AUX port in question is configured as an input AUX port with Alarm Text set to Low humidity. Appears when the signal on the port is high or low depending on the setting of Polarity.

- **Module Response Fail**

The CCMC module cannot communicate with the module in the slot.

- **SSF**

Appears when an SSF (server signal fail) is detected, that is the normal signal has been interrupted due to a failure in the server layer.

- **Synchronisation source frequency out of range**

Appears when frequency of the signal in question is out of range.

- **Total Loss of Capacity Rx**

Appears when no members of the VCG are carrying traffic in the receive (Rx) direction.

- **Total Loss of Capacity Tx**

Appears when no members of the VCG are carrying traffic in the transmit (Tx) direction.

- **UB1 power missing**

Appears when the UB1 secondary supply voltage is lost.

- **UB2 power missing**

Appears when the UB2 secondary supply voltage is lost.

- **Unexpected MEP**

Appears when a MEP has received an ETH Segment OAM frame with the correct MEG Level and the correct MEG ID but an unexpected MEP ID.

- **Unexpected period**

Appears when a MEP has received an ETH Segment OAM frame with the correct MEG Level, correct MEG ID, and correct MEP ID, but an unexpected value of continuity check period. In this NE, the continuity check period is fixed 100 ms.

- **Unit main type mismatch**

Appears when the expected subrack or module type does not match the actual subrack or module type. When the alarm appears on a module, the module cannot be managed.

- **Unit missing**

Appears when a module is expected in the slot in question, but no module is physically present in the slot.

- **Unit temperature too high**

Appears when the temperature of the module increases above a fixed threshold value defined by the equipment.

PREVENTIVE MAINTENANCE

Periodic maintenance should be performed on Fiber and Fibcom Optical   transmission equipment in order to minimize the fault in equipment in future Following tools and   action is required during preventive maintenance.
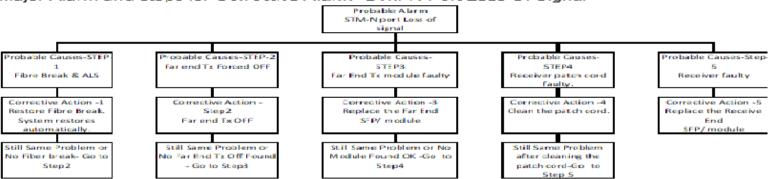
Tools Required:-

1) Laptop with Fibcom Software and applicable Login Cable

2) BER Meter

3) Power Meter

4) Tool kit
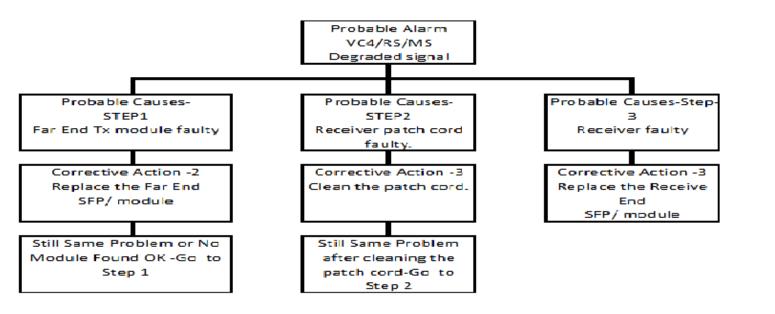
Prevention Aspects	Frequency	Action To be taken
Check for hardware errors	Daily,	Review the logs for any signs of hardware problems. Fiber Cuts, Any Unwanted Alarm (Through Fibcom NMS),
Temperature/Humidity	Daily	We recommend that TER Room must have ambient environment.
Optical Power	Monthly	Check for the Optical Power through Fibcom Software in the Optical Power Window.
Cable- Fiber/ Ethernet / E1 Cable	Quarterly	Check for the Bending Radius (20 C.m.) of Patch Cord. Check for the Proper Routing of E1 cable and Ethernet Cable .
Fan Cleaning	Quarterly	Clean the Fan of Fibcom 6335 and 6340 for Dust Particles.
Synchronization	Quarterly	Check the Synch Sources in the network as per configured plan

CORRECTIVE MAINTENANCE
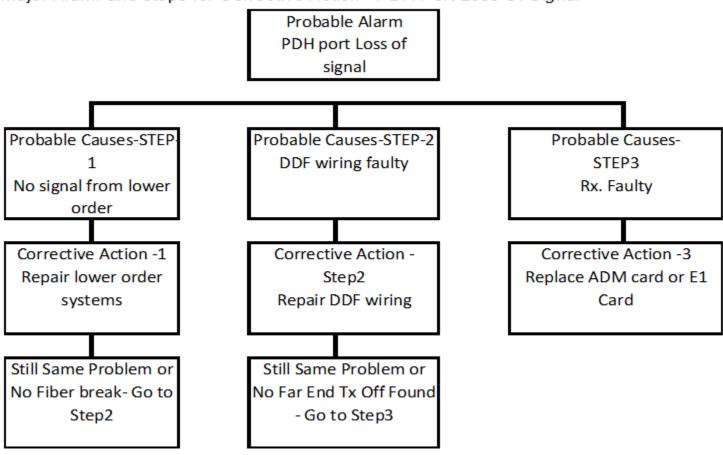
Major Alarm and steps for Corrective Alarm- STM-N Port Loss Of Signal

```
                        ┌─────────────────────┐
                        │   Probable Alarm    │
                        │  STM-N port Loss of │
                        │       signal        │
                        └─────────────────────┘
```

Probable Causes-STEP 1 Fibre Break & ALS	Probable Causes-STEP-2 Far end Tx Forced OFF	Probable Causes- STEP3 Far End Tx module faulty	Probable Causes- STEP4 Receiver patch cord faulty.	Probable Causes-Step- 5 Receiver faulty
Corrective Action -1 Restore Fibre Break. System restores automatically.	Corrective Action – Step2 Far end Tx OFF	Corrective Action -3 Replace the Far End SFP/ module	Corrective Action -4 Clean the patch cord.	Corrective Action -5 Replace the Receive End SFP/ module
Still Same Problem or No Fiber break- Go to Step2	Still Same Problem or No Far End Tx Off Found – Go to Step3	Still Same Problem or No Module Found OK -Go to Step4	Still Same Problem after cleaning the patch cord-Go to Step 5	

Major Alarm and steps for Corrective Alarm- VC4/RS/MS Degraded Signal

```
                        ┌─────────────────────┐
                        │   Probable Alarm    │
                        │     VC4/RS/MS       │
                        │   Degraded signal   │
                        └─────────────────────┘
```

Probable Causes- STEP1 Far End Tx module faulty	Probable Causes- STEP2 Receiver patch cord faulty.	Probable Causes-Step- 3 Receiver faulty
Corrective Action -2 Replace the Far End SFP/ module	Corrective Action -3 Clean the patch cord.	Corrective Action -3 Replace the Receive End SFP/ module
Still Same Problem or No Module Found OK -Go to Step 1	Still Same Problem after cleaning the patch cord-Go to Step 2	

Major Alarm and steps for Corrective Action –PDH Port Loss Of Signal

```
                    ┌─────────────────────┐
                    │   Probable Alarm    │
                    │   PDH port Loss of  │
                    │       signal        │
                    └─────────────────────┘
```

Probable Causes-STEP-1 No signal from lower order	Probable Causes-STEP-2 DDF wiring faulty	Probable Causes- STEP3 Rx. Faulty
Corrective Action -1 Repair lower order systems	Corrective Action - Step2 Repair DDF wiring	Corrective Action -3 Replace ADM card or E1 Card
Still Same Problem or No Fiber break- Go to Step2	Still Same Problem or No Far End Tx Off Found - Go to Step3	

Below mentioned Possible fault occur in Fiber and Fibcom 6335 .

Thanks