







# Facilitator Guide







Sector

**Telecom** 

Sub-Sector

**Passive Infrastructure** 

SATCOM Operation Technician

Occupation

**Network Operation and Maintenance** 

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**NSQF Level: 5** 

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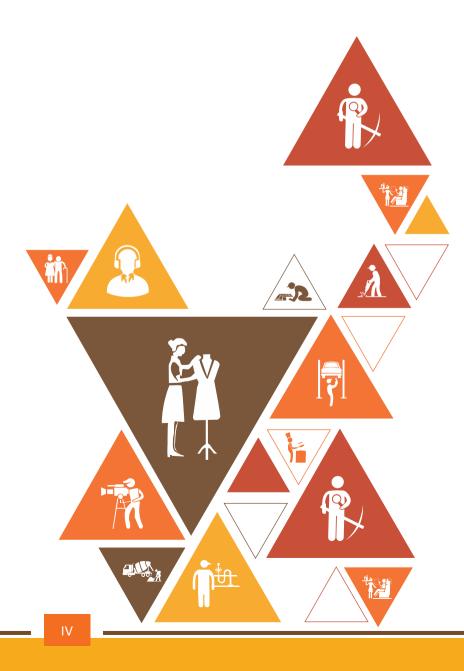




Skilling is building a better India.

If we have to move India towards
development then Skill Development
should be our mission

Shri Narendra Modi
Prime Minister of India



# **Acknowledgement**

We are thankful to all organizations and individuals who have helped us in the preparation of this Facilitator Guide. We also wish to extend our gratitude to all those who reviewed the content and provided valuable inputs for improving the quality, coherence and content presentation of chapters. This Facilitator Guide will lead to the successful rollout of the skill development initiatives, helping greatly our stakeholders particularly trainees, trainers and assessors etc. We are thankful to our Subject Matter Expert for the content and for helping us in the preparation of this Facilitator Guide.

It is expected that this publication would meet the complete requirements of QP/NOS based training delivery. We welcome suggestions from users, industry experts and other stakeholders for any improvement in future.

#### About the Book —

The objective of the guide is to provide an approach map for interacting with the trainees undergoing training in this job role. The course aims to provide both theoretical and practical knowledge to the trainees and also to guide them about SATCOM Operation Technician. The guide is neither a substitute nor a complete road map, but an aid to help to pass on the knowledge on all the aspects to the trainees in a systematic manner. It is expected that the trainer is fully conversant with all the contents of the guide. The guide is just to indicate how to proceed in covering a topic and includes some additional information that may be necessary for the trainer to develop better comprehension of the following aspects:

- **Knowledge and Understanding:** Satisfactory operational learning and comprehension to play out the required chore.
- **Performance Criteria:** Pick up the required aptitudes through hands-on preparation and play out the required operations inside the predetermined measures.
- Professional Skills: Capacity to settle on operational choices relating to the zone of work.

The job will also include judging comprehension and also help them learn more through hands-on training. But it has to be ensured that these are following the knowledge imparted and time spent on each unit. It is expected that irrespective of the region, knowledge of all aspects will be imparted to trainees.

# Symbols Used —

















Ask

Activity

Do

Demonstrate

e Elaborate

Exercise

**Facilitation Notes** 

Field Visit

















**Learning Outcomes** 

Notes

Objectives

Tips

Resources

Summarize

Say

Team Activity



Explain

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# 1. Introduction to the Telecom Industry and about SATCOM Operation

Unit 1.1 - Overview of the Telecom Industry and SATCOM Operations

Unit 1.2 - Workplace Practices and Operational Preparedness



**Bridge Module** 

# Key Learning Outcomes 👸



#### By the end of this module, the participants will be able to:

- Describe the size and scope of the Telecom industry and its subsectors.
- Discuss the role and responsibilities of a SATCOM Operation Technician.
- Identify various employment opportunities for a SATCOM Operation Technician.
- Describe the process workflow in the organization and the role of a SATCOM Operation Technician.
- Discuss the organizational policies on workplace ethics, managing sites, quality standards, personnel management, and public relations (PR).
- Enlist the various daily, weekly, and monthly operations/activities that take place at the site under a SATCOM Operation Technician.
- Analyse the requirements for the course and prepare for the prerequisites of the course.
- Demonstrate the size and scope of the Telecom industry and its subsectors through data or visuals.
- Show how to perform role-play based on case studies, outlining the scope, responsibilities, and challenges of a SATCOM Operation Technician.

# Unit 1.1: Introduction to the Telecom Industry and about **SATCOM Operation**

# Unit Objectives 6



#### By the end of this unit, the trainees will be able to:

- 1. Explain the size and scope of the Telecom industry and its subsectors.
- 2. Discuss the role and responsibilities oif a SATCOM Operation Technician.
- 3. Enlist various employment opportunities for a SATCOM Operation Technician.
- 4. Describe the process workflow in the organization and the role of a SATCOM Operation Technician.

# Resources to be used



#### **Theory**

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Charts related to Telecom sector and SATCOM operations, and Visual aids on Satellite communications and Government initiatives.

# Say 🗣



- Good morning and welcome to the training program on "SatCom Operation Technician."
- Start with an ice-breaking session. Introduce yourself and ask participants to introduce themselves.
- In this session, we will discuss the telecom industry, its subsectors, and the critical role SATCOM plays in ensuring seamless communication.
- Icebreaker:
- **Purpose:** This activity aims to familiarise the participants in the group with one another.
- **Tentative Duration: 15 minutes**

#### Procedure:

- Ask participants to introduce themselves with an adjective that begins with the initial letter of their name (e.g., "Astronomer Nakul, Scientist Nimisha").
- Request that they additionally share their interest in the telecom sector.

Expected Outcome: The outcome of this activity is that the Participants build camaraderie, creating a collaborative learning environment.



- Start the session by asking these questions:
  - What do you know about the telecom industry?
  - Can you name any subsectors within the telecom industry?
  - What comes to mind when you hear "SATCOM"? 0
- Write down their responses on a whiteboard or flipchart. Use these inputs to introduce the topics.

### **Elaborate**



In this session, we will cover the following points:

- **Telecom Industry Overview:** 
  - Market size, scope, and subsectors like wireless communication, passive infrastructure, and SATCOM.
- **Passive Infrastructure:** 
  - Role in ensuring connectivity, recent advancements, and its importance in SATCOM.
- Satellite Communication (SATCOM):
  - Definition, significance in remote areas, and role in global communication.
- **SATCOM Technician Responsibilities:** 
  - Installing antennas, establishing links, maintaining ground stations, and incident management.

# Activity-1



Name: Telecom Industry and SATCOM Integration MapObjectives:

- · Objectives:
  - Help trainees understand the relationship between different telecom subsectors.
  - Highlight where SATCOM fits within the telecom ecosystem.

#### • Materials Needed:

o Large chart paper, markers, sticky notes, and an example process diagram (optional).

#### • Procedure:

- a) Divide the trainees into small groups.
- b) Provide each group with chart paper and markers.
- c) Ask them to map the telecom ecosystem, showcasing subsectors and their interconnections.
- d) Each group must include SATCOM's role and contribution in their map.
- e) After 20 minutes, have each group present their map.

# **Activity-2**



#### Name: Role Exploration of a SATCOM TechnicianObjectives:

- Objectives:
  - o Familiarize trainees with the daily tasks and responsibilities of a SATCOM technician.
  - o Encourage critical thinking about problem-solving in SATCOM operations.
- Materials Needed:
  - o Participant handbook, notepad, pen, and a projector for visual aids (optional).
- Procedure:
  - a) Assign each trainee or pair a specific task related to SATCOM (e.g., setting up an antenna, troubleshooting signals, or managing NOC).
  - b) Give them 10 minutes to think through their task and come up with a brief enactment.
  - c) Have each trainee/pair present their role play to the group.
- Outcome:
  - o Trainees will better understand the hands-on responsibilities of a SATCOM technician and gain insight into real-world scenarios.

# - Notes for facilitation



- Ensure active participation by encouraging all trainees to contribute.
- Use visuals (e.g., charts, slides) to explain technical concepts.
- Address queries by drawing on examples from industry practices.
- Summarize the unit and ensure all objectives are covered.

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# **Unit 1.2: Workplace Practices and Operational Preparedness**

# **Unit Objectives ©**



#### By the end of this unit, the trainees will be able to:

- 1. Explain the organizational policies on workplace ethics, managing sites, quality standards, personnel management, and public relations (PR).
- 2. Enlist the various daily, weekly, and monthly operations/activities that take place at the site under a SATCOM Operation Technician.
- 3. Analyse the requirements for the course and prepare for the prerequisites of the course.
- 4. Show how to role-play based on case studies, outlining the scope, responsibilities, and challenges of a SATCOM Operation Technician.

# Resources to be used



- Theory
  - Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.
- **Practical** 
  - Charts related to Telecom sector and SATCOM operations, and Visual aids on Satellite communications and Government initiatives.

- · Good morning! In today's session, we will delve into the essential workplace practices and operational preparedness needed for SATCOM operations.
- Let's explore how organizational policies, site management, and daily operations shape the responsibilities of a SATCOM Operation Technician.

### Ask (ask)



- What workplace policies and practices are critical for maintaining operational efficiency?
- Can you identify some challenges a SATCOM technician might face while managing a site?

# **Elaborate**



During this session, we will focus on:

- **Organizational Policies and Standards:** 
  - Ethics and compliance, quality standards, and PR practices.
- Scheduling and Tracking Operations:
  - Overview of daily, weekly, and monthly site tasks.
- **Challenges and Solutions:** 
  - Identifying common site challenges and formulating effective responses.
- **Key Skills for Success:** 
  - Technical expertise, interpersonal skills, and proactive problem-solving.

# **Activity-1**



#### Name: Case Study Challenge

- · Objectives:
  - o Encourage trainees to think critically and respond to on-the-job challenges.
  - o Develop problem-solving and decision-making skills.
- Materials Needed:
  - o Pre-prepared case studies, notepads, pens, and whiteboard for discussion.
- Procedure:
  - a) Provide trainees with a case study describing a site-related challenge (e.g., antenna malfunction, public complaints, or scheduling conflicts).
  - b) Assign roles (e.g., SATCOM Technician, site manager, customer).
  - c) Trainees role-play the scenario and present their resolution strategies.
  - d) Facilitator moderates the discussion, highlights effective approaches, and offers suggestions.
- Outcome:
  - Trainees gain hands-on experience in dealing with workplace challenges and learn to apply practical solutions.

# **Activity-2**



#### Name: Role-Play - Resolving Site ChallengesObjectives:

- Objectives:
  - o Encourage trainees to think critically and respond to on-the-job challenges.
  - o Develop problem-solving and decision-making skills.
- Materials Needed:
  - o Pre-prepared case studies, notepads, pens, and whiteboard for discussion.
- Procedure:
  - a) Provide trainees with a case study describing a site-related challenge (e.g., antenna malfunction, public complaints, or scheduling conflicts).

- b) Assign roles (e.g., SATCOM Technician, site manager, customer).
- Trainees role-play the scenario and present their resolution strategies.
- Facilitator moderates the discussion, highlights effective approaches, and offers suggestions.

#### • Outcome:

Trainees gain hands-on experience in dealing with workplace challenges and learn to apply practical solutions.

# Notes for facilitation



- Encourage participation by asking open-ended questions.
- Use real-world examples to illustrate key points.
- Summarize the key takeaways from each activity and connect them to the session objectives.
- Address trainee queries with practical insights and encourage peer-to-peer learning.

### Exercise



Key Solutions to PHB Exercise

#### **Short Questions:.**

#### 1. What are the main subsectors of the Telecom industry?

The main subsectors of the Telecom industry include mobile communication, satellite communication, broadband, and networking.

#### 2. What are the key responsibilities of a SATCOM operation technician?

A SATCOM operation technician is responsible for installing, monitoring, maintaining, and troubleshooting satellite communication systems to ensure seamless data and signal transmission.

#### 3. Name two employment opportunities available for SATCOM operation technicians.

Satellite ground station operators

Telecommunications service providers

#### 4. How do organizational policies on workplace ethics impact SATCOM operations?

Organizational policies on workplace ethics ensure adherence to security protocols, encourage transparent communication, and promote accountability, which are critical for the efficiency and reliability of SATCOM operations.

# 5. Describe the role of a SATCOM operation technician in the process workflow of a telecom organization.

A SATCOM operation technician plays a vital role by ensuring the installation, configuration, and maintenance of satellite systems, monitoring signal quality, and troubleshooting any operational issues to support seamless communication services

#### Fill in the Blanks:

- 1. The Telecom industry consists of various subsectors, including **mobile communication** and **networking**.
- 2. A SATCOM operation technician is responsible for **installing** and **maintaining** satellite communication systems.
- 3. In a telecom company, policies on personnel management focus on ensuring **efficiency** and maintaining **compliance**.
- 4. One of the key responsibilities of a SATCOM operation technician is to conduct **signal analysis** on satellite signals.
- 5. The daily operations of a SATCOM operation technician involve tasks such as **monitoring**

#### systems and performing maintenance checks.

#### **True/False Questions:**

- 1. True/False: SATCOM operation technicians are responsible for the installation and maintenance of satellite communication systems.
  - True
- 2. True/False: Public Relations (PR) in a telecom company is mainly about managing internal communication among employees.
  - False (PR primarily focuses on managing the company's external image and relationships with stakeholders.)
- 3. True/False: The role of a SATCOM operation technician includes ensuring signal analysis and ground station security implementation.
  - True
- 4. True/False: The telecom industry's subsectors include mobile communication, satellite communication, and networking.
  - True
- 5. True/False: The daily, weekly, and monthly operations of a SATCOM operation technician include tasks like signal analysis, maintenance, and system checks.
  - True

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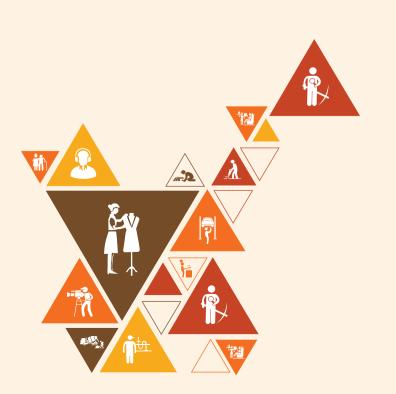


# 2. Install of Antenna at Remote End and Establish Link

Unit 2.1 – Tools and Equipment Preparation

Unit 2.2 – Antenna Assembly

Unit 2.3 – Software Installation, Network Configuration, and System Libraries





# Key Learning Outcomes 🙄



#### After the end of this module, participants will be able to:

- Explain the importance of identifying the telnet tools and configuring IPv4 settings in a laptop.
- Discuss the necessary guidelines, including antenna assembly instructions, safety precautions, and specific requirements.
- Enlist the necessary tools for antenna assembly, such as wrenches, screwdrivers, cable cutters, crimping tools, etc.
- Describe the components of the antenna system, such as the reflector, feed assembly, mounting brackets, cables, and connectors.
- Demonstrate how to assemble the antenna according to the provided guidelines using prescribed tools.
- Show how to test and commission the antenna to ensure proper functionality.
- Demonstrate how to set up a clean and organized work area for antenna assembly.
- Elucidate the steps involved in mounting the antenna on the designated structure or mount following the provided guidelines.
- Explain the importance of proper grounding of the antenna system to minimize the risk of electrical hazards and protect against lightning strikes.
- Show how to secure the antenna assembly properly using prescribed tools.
- Demonstrate how to attach cables to the appropriate connectors on the feed assembly and ensure they are securely fastened.
- Show how to use cable cutters, crimping tools, or other specified tools for cable termination or connector installation.
- Demonstrate how to use a torque wrench to tighten bolts and nuts to the recommended torque values.
- Show how to double-check all connections, ensuring they are correctly installed and tightened.
- Demonstrate how to inspect the entire antenna assembly for any visible damage, loose components, or irregularities.
- Demonstrate how to physically connect the IDU modem to the computer or server using the appropriate interface (Ethernet, USB, serial connection).
- Show how to install and configure software according to the IDU modem requirements.

- Demonstrate how to perform tests to ensure proper signal acquisition, data transmission, and system functionality.
- Show how to access the modem with the master IP in a web browser.
- Demonstrate how to connect a computer to the network using an Ethernet cable or Wi-Fi connection.
- Show how to apply IP assignment on a laptop or computer.
- Demonstrate how to use a multimeter for voltage measurement during SATCOM operations.
- Define the master IP address and explain its role in the SATCOM network.
- Explain the steps to access and configure network settings for the IDU modem, including IP address, subnet mask, default gateway, and other parameters.
- Describe the process of checking for firmware or software updates for the IDU modem.
- Discuss how to access the modem's configuration interface using a web browser.
- Describe the process of obtaining the master IP address and the methods for connecting a computer to the network.
- Discuss the significance of regularly monitoring the performance and health of the IDU modem software.

# **Unit 2.1: Tools and Equipment Preparation**

# **Unit Objectives ©**



#### By the end of this unit, the trainees will be able to:

- 1. Explain the importance of identifying the correct telnet tools and configuring IPv4 settings for SATCOM operations.
- 2. Describe the process of assembling an antenna as per provided guidelines using the prescribed
- 3. Elucidate the necessary guidelines for antenna assembly, including safety precautions and specific requirements.
- 4. Enlist the different types of tools needed for antenna installation, and how to properly collect and organize them.
- 5. Discuss the importance of work area preparation, including ensuring it is free from clutter and provides adequate lighting.
- 6. Describe how to follow instructions for cable routing, ensuring cables are not bent or under excessive tension.
- 7. Explain the grounding procedures for SATCOM installations and the importance of connecting grounding wires or conductors.
- 8. Elucidate the proper use of prescribed tools and testing equipment for carrying out RF tests accurately.
- 9. Describe the safety features that must be in place during antenna assembly, such as protective covers or shields.

# Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Antenna components and assembly materials, Wrenches, Screwdrivers, Cable cutters, Crimping tools, Torque wrenches, Alignment tools, Multimeter, Network cables, Modem or gateway device, IDU modem, gloves, safety goggles, Documentation and manuals.

# Say 뎍

- Good morning! In today's session, we will explore the crucial tools and equipment used in SATCOM installations.
- Understanding how to select, organize, and use these tools efficiently is vital to ensure a smooth installation process and successful operation of satellite communication systems.

#### Ask



- What tools do you think are essential for a SATCOM operation technician?
- How do you think the correct configuration of IPv4 settings can impact SATCOM operations?
- Can you think of any potential challenges you might face during antenna assembly?

## **Elaborate**



During this session, we will focus on:

- Identifying the Correct Tools:
  - o Importance of selecting the right tools such as telnet tools for SATCOM operations.
  - o How improper tool selection can lead to operational inefficiency or system failure.

#### • Configuring IPv4 Settings:

o A brief overview of configuring IPv4 settings on a laptop, a critical skill for SATCOM technicians to ensure proper network communication.

#### • Antenna Assembly:

o Step-by-step process of antenna assembly, including how to follow guidelines, safety measures, and component handling.

#### • Organizing and Maintaining Tools:

 Best practices for keeping tools organized to ensure smooth operations and quick access when needed.

#### • Work Area Preparation:

o The importance of a clean, organized, and safe work area. Ensuring proper lighting and removing clutter can prevent accidents and improve efficiency

#### Cable Routing and Grounding:

- o The importance of proper cable routing to prevent damage to cables.
- o How grounding ensures safety in SATCOM installations and prevents electrical hazards.

#### • RF Testing and Safety Features:

Understanding the use of RF testing tools and ensuring all necessary safety features,
 such as protective covers, are in place during assembly.

# **Activity-1**



#### Name: Antenna Assembly and Tool Collection Exercise

#### • Objectives:

- o Understand the process of antenna assembly using prescribed tools.
- o Learn how to organize and collect tools for antenna installation.
- Ensure proper safety measures during assembly.

#### • Materials Needed:

- o Antenna assembly kit (tools, antenna components)
- Workbench or installation space
- o Instruction manual
- o Safety gear (gloves, safety glasses)

#### • Procedure:

- o Distribute antenna assembly kits and tools.
- o Instruct trainees to organize the tools needed for antenna assembly based on the provided instruction manual.
- o Guide them through the assembly process, highlighting safety features and proper handling.
- Have them set up a clean and well-lit workspace.
- o After assembly, ensure the antenna's alignment and functionality.

#### • Outcome:

o Trainees will learn how to assemble an antenna, organize tools, and maintain a safe work environment.

# Activity-1



#### Name: IPv4 Configuration and Cable Routing Practice

- Objectives:
  - Learn to configure IPv4 settings on a laptop for SATCOM operations.
  - Understand the best practices for cable routing and grounding.
- Materials Needed:
  - Laptop with network interface
  - Ethernet cable
  - Cable management tools
  - Grounding wire 0
  - Instruction manual

#### • Procedure:

- Walk trainees through configuring IPv4 settings on the laptop. o
- Explain the process of verifying the settings using a connectivity test.
- Show how to route cables without bending them or causing excessive tension. 0
- Teach proper grounding procedures, ensuring all connections are safe.
- Have trainees secure cables neatly using clips or ties.

#### • Outcome:

Trainees will be able to configure IPv4 settings, properly route cables, and ensure correct grounding for safety.

# Notes for facilitation | | -



- Engage trainees by asking open-ended questions and encouraging participation in discussions.
- Use real-world examples to clarify key points.
- Summarize key takeaways from each activity and relate them to practical scenarios in SATCOM operations.
- Provide hands-on demonstrations and walk trainees through the activities to ensure they understand each step.
- Encourage collaboration during activities to foster peer-to-peer learning.

# **Unit 2.2: Antenna Assembly**

# **Unit Objectives ©**



#### By the end of this unit, the trainees will be able to:

- 1. Explain the process for testing and commissioning the antenna system.
- 2. Describe how to set up a clean and organized work area for antenna assembly.
- 3. Elucidate the components of an antenna system and their roles, such as the reflector, feed assembly, mounting brackets, cables, and connectors.
- 4. Discuss the guidelines to follow for mounting the antenna on the designated structure.
- 5. Enlist the prescribed tools for securing the antenna assembly and ensuring proper installation.
- 6. Explain how to correctly attach cables to the appropriate connectors on the feed assembly and secure them.
- 7. Discuss the use of cable cutters, crimping tools, or other specified tools for cable termination and connector installation.
- 8. Explain the process of using a torque wrench to tighten bolts and nuts to the recommended torque values.
- 9. Discuss the importance of grounding the antenna system to reduce the risk of electrical hazards and protect against lightning strikes.
- 10. Elucidate the procedures for double-checking all connections to ensure proper installation.
- 11. Discuss the inspect antenna assembly for visible damage, loose components, or irregularities.

# Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Antenna components and assembly materials, Wrenches, Screwdrivers, Cable cutters, Crimping tools, Torque wrenches, Alignment tools, Multimeter, Network cables, Modem or gateway device, IDU modem, gloves, safety goggles, Documentation and manuals.

# Say 🖳

- Good morning! In today's session, we'll be diving into the critical process of antenna assembly.
- We'll cover everything from the components that make up the antenna system to the guidelines for installation, cable attachment, and field testing.
- Understanding these procedures is essential for ensuring the antenna works efficiently and reliably in SATCOM operations.

### Ask



- What do you think are the most critical components of an antenna system?
- How do you ensure the antenna installation is safe and effective for SATCOM operations?
- Why do you think torque values are important in the installation process?
- What could go wrong if connections are not verified before commissioning the antenna?

## **Elaborate**



During this session, we will focus on:

#### Overview of Antenna Installation:

- o The process of antenna assembly and its role in SATCOM operations.
- o The necessary guidelines and components involved in the installation.

#### Antenna System Components:

- o Reflector, feed assembly, mounting brackets, cables, and connectors.
- o Understanding the function of each component and how they work together.

#### Mounting the Antenna:

The guidelines for mounting the antenna on a designated structure, ensuring stability and alignment.

#### Attaching Cables:

 How to correctly connect cables to the feed assembly and secure them to prevent damage or poor signal transmission.

#### Use of Tools for Cable Termination and Connector Installation:

The role of cable cutters, crimping tools, and other tools in ensuring secure and reliable connections.

#### **Importance of Torque Values:**

How using a torque wrench to tighten bolts and nuts to the correct torque values ensures the stability and functionality of the antenna.

#### **Grounding the Antenna System:**

The need for proper grounding to protect the antenna from electrical hazards and lightning strikes.

#### **Final Inspections and Field Testing:**

- Verifying all connections and ensuring the system is ready for operation.
- Performing field tests to confirm RF parameters and overall performance.

# Activity-1



#### Name: Antenna Assembly and Mounting Exercise

#### • Objectives:

- Understand the assembly process of an antenna system.
- Learn how to mount the antenna securely following the installation guidelines.
- Practice connecting cables and ensuring proper grounding.

#### Materials Needed:

- Antenna assembly kit (reflector, feed assembly, mounting brackets, cables, connectors)
- Mounting structure or test stand 0
- Torque wrench
- Cable cutters and crimping tools 0
- Safety gloves and goggles
- Grounding wire

#### Procedure:

- Distribute the antenna assembly kits and tools.role.
- Guide trainees through the assembly process, explaining each component's role.

- Demonstrate proper mounting techniques, emphasizing stability and alignment. 0
- Instruct trainees on how to attach cables to the feed assembly and ensure proper cable management.
- Use the torque wrench to tighten bolts to the specified torque values.
- Ensure that grounding procedures are followed and connections are verified.

#### • Outcome:

Trainees will practice assembling an antenna, mounting it on a structure, connecting cables correctly, and ensuring proper grounding and safety during the installation.

# Activity-2



#### Name: Cable Termination and Connector Installation Drill

- Objectives:
  - Learn how to properly use cable cutters and crimping tools for cable termination.
  - Understand how to install connectors securely to prevent signal loss or interference.
  - Ensure the safety of the cable and connection process.
- Materials Needed:
  - Cable (various types, e.g., coaxial)
  - Cable cutters
  - Crimping tools
  - Connectors (e.g., BNC connectors) 0
  - Instruction manual for cable termination

#### Procedure:

- Provide each trainee with cables, cutters, crimping tools, and connectors.
- Demonstrate the process of cutting cables to the correct length and stripping them for connector attachment.
- Show how to properly attach connectors using crimping tools, ensuring tight and secure fittings.
- Instruct trainees to follow the same process and ensure their connections are reliable.
- Perform a quality check on the finished connections.

#### Outcome:

Trainees will gain hands-on experience with cable termination and connector installation, ensuring they can perform these tasks accurately and efficiently.

# Notes for facilitation 3



- Encourage participation by asking trainees to describe what they think each step of the antenna assembly process involves before demonstrating.
- Use real-world scenarios where possible, such as explaining how improper torque or grounding could lead to antenna failure or operational inefficiencies.
- Monitor the hands-on activities closely to ensure trainees understand and follow safety protocols during installation.
- Encourage peer-to-peer feedback during the practical activities to promote collaborative learning.
- Summarize the session with a review of the key points, emphasizing the importance of each step in the antenna assembly and installation process.

Notes 🗒			

## Unit 2.3: Software Installation, Network Configuration, and **System Libraries**

## Unit Objectives | ©



#### By the end of this unit, the trainees will be able to:

- 1. Explain the process for testing and commissioning the antenna system.
- 2. Explain the process of installing and configuring software for the IDU modem.
- 3. Describe the minimum system requirements for installing software and connecting the IDU modem to the computer or server.
- 4. Elucidate the procedure for physically connecting the IDU modem to the computer or server using appropriate interfaces.
- 5. Discuss how to configure the network settings of the IDU modem, including IP address, subnet mask, and gateway.
- 6. Enlist the steps to verify software and firmware updates for the IDU modem.
- 7. Explain how to check the connectivity between the IDU modem and the satellite network or other devices.
- 8. Discuss the procedure for testing signal acquisition, data transmission, and system functionality after software installation.
- 9. Elucidate how to maintain records of software installation and configuration details.
- 10. Explain the importance of regularly monitoring the IDU modem software performance.
- 11. Discuss the process of accessing and configuring the modem with a master IP address.
- 12. Describe the necessary settings for connecting the computer to the SATCOM network via the modem.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Antenna components and assembly materials, Wrenches, Screwdrivers, Cable cutters, Crimping tools, Torque wrenches, Alignment tools, Multimeter, Network cables, Modem or gateway device, IDU modem, gloves, safety goggles, Documentation and manuals.

## Say 🖳

- Welcome! Today, we are going to focus on the critical process of software installation, network configuration, and managing system libraries for the IDU modem in SATCOM systems.
- By the end of this session, you'll have a complete understanding of the steps involved in configuring the modem, connecting it to the network, and ensuring it operates optimally for satellite communication.

## Ask



- Why do you think proper software installation and configuration are important for the functionality of the IDU modem?
- Can anyone explain the difference between software and firmware updates in the context of SATCOM modems?
- What could happen if the network settings on the IDU modem are misconfigured?
- How do you think a multimeter can be useful during the modem installation and testing process?

## **Elaborate**



#### Overview of SATCOM Modem Operation:

- Understand the function of an IDU (Indoor Unit) modem in satellite communications.
- Learn how it connects and transmits signals between the satellite network and the ground station.

#### • Installing and Configuring Software for the IDU Modem:

- o Discuss the steps for installing the modem's software and configuring it to communicate with the satellite system.
- Overview of the software required and how to ensure proper installation.

#### • System Requirements for Software Installation:

 Learn the minimum hardware and software requirements for successful installation, including operating system specifications and necessary interface ports.

#### • Connecting the IDU Modem to the Computer or Server:

o Detailed steps on physically connecting the modem to your computer or server. This includes selecting the correct interface cables and ports.

#### • Configuring Network Settings:

 Explanation of how to configure the IP address, subnet mask, and gateway for the IDU modem to ensure proper communication within the SATCOM network.

#### • Verifying Software and Firmware Updates:

o How to check if the modem's software and firmware are up to date, and why keeping them updated is crucial for optimal performance.

#### • Verifying Connectivity:

o Steps to verify the connection between the IDU modem and the satellite network to ensure functionality and signal transmission.

#### • Testing Signal Acquisition and Data Transmission:

 Learn how to test if the modem is receiving the signal from the satellite, transmitting data, and functioning as expected.

#### • Monitoring and Maintenance:

o Discuss the importance of regularly monitoring the modem's software performance and maintaining installation and configuration records for troubleshooting and future updates.

#### • Using a Multimeter for Voltage Measurement:

o Demonstrate how to use a multimeter to measure voltage levels and ensure that the modem's power supply is functioning correctly.

## **Activity-1**



#### Name: IDU Modem Software Installation and Configuration

### Objectives:

- o Understand the process for installing and configuring the software on the IDU modem.
- o Learn to connect the IDU modem to the server/computer and configure the network settings.

#### • Materials Needed:

- o IDU modem
- o Laptop or server with the appropriate operating system
- Installation software (CD or download)
  - o Ethernet cables or USB cables for connections
  - User manual for configuration

#### Procedure:

- Guide the trainees through the software installation process step-by-step.
- Show how to connect the modem physically to the server or computer using the correct interface cables.
- Assist in configuring the network settings (IP address, subnet mask, gateway) for the modem.
- Demonstrate how to check the software installation status and verify that the modem is ready for use.

#### Outcome:

Trainees will be able to install the software, configure the modem's network settings, and connect the device to a server/computer.

## Activity-2



#### Name: IDU Modem Connectivity and Signal Testing

#### Objectives:

- Learn how to verify the connectivity between the IDU modem and the satellite network.
- Understand how to test signal acquisition and data transmission post-configuration.

#### Materials Needed:

- Configured IDU modem o
- Laptop or server
- Satellite connection (or simulation setup)
- Multimeter
- Test software for connectivity verification

#### Procedure:

- Show how to check the modem's connection status and verify if it is properly communicating with the satellite network.
- Use a multimeter to measure voltage levels at the modem's input and output to ensure correct power supply.
- Guide trainees through testing signal acquisition and data transmission.
- Ensure trainees understand how to identify and troubleshoot connectivity issues.

#### Outcome:

Trainees will practice checking connectivity, testing signal strength, and ensuring that the system is transmitting and receiving data as expected.

## Notes for facilitation



- Monitor closely during the practical activities, ensuring all trainees understand each step and can perform the tasks independently.
- Provide additional resources for troubleshooting common installation and configuration issues.
- Encourage trainees to ask questions, especially when dealing with technical aspects like network settings and signal testing.
- Use real-time feedback to adjust the pace of the training based on the trainees' understanding and progress.
- Reinforce safety and accuracy in testing, ensuring the correct use of tools like the multimeter to avoid equipment damage.

## **Exercise**



Key Solutions to PHB Exercise:

#### **Short Questions:**

#### 1. What tools are necessary for assembling an antenna?

The tools necessary for assembling an antenna include wrenches, torque wrenches, cable cutters, crimping tools, pliers, screwdrivers, and spanners for tightening bolts and connectors.

#### 2. Why is proper grounding of the antenna system important in SATCOM?

Proper grounding is important in SATCOM to reduce the risk of electrical hazards, prevent equipment damage, and protect the system from lightning strikes or other electrical surges.

#### 3. What is the role of a master IP address in a SATCOM network?

The master IP address serves as the central address used to access and configure the SATCOM network, allowing network administrators to manage and monitor all connected devices.

#### 4. How can you verify connectivity between the IDU modem and the satellite network?

Connectivity can be verified by checking the modem's status indicators, running connectivity tests (ping tests), verifying the signal strength, and ensuring that the modem communicates successfully with the satellite system.

#### 5. What are the steps to access the modem's configuration interface?

To access the modem's configuration interface:

- Connect the modem to a computer using the appropriate interface.
- Open a web browser and enter the modem's IP address.
- Login using the admin credentials.
- Access and configure the settings as needed.

#### Fill in the Blanks:

- 1. The master IP address is used to access and manage the SATCOM network.
- 2. Multimeter tools are used to measure voltage and ensure proper electrical functioning of SATCOM equipment.
- 3. Proper grounding of the antenna system minimizes electrical hazards and protects against lightning
- 4. Cable termination involves using **crimping** tools to install connectors securely.
- 5. The subnet mask and default gateway settings are configured in the network setup of the IDU modem.

#### **True/False Questions:**

- 1. The purpose of grounding the antenna system is to prevent damage from mechanical misalignment.
  - False. (Grounding is for electrical safety, not for preventing mechanical misalignment)
- 2. A torque wrench is used to ensure bolts are tightened to recommended torque values.
  - True.
- 3. Regular monitoring of the IDU modem software helps maintain system performance.
  - True.
- 4. Telnet tools are used for configuring and accessing IPv4 settings in a laptop.
  - False. (Telnet is primarily used for remote device management; IP configuration is done through network settings)
- 5. Firmware updates for the IDU modem are not necessary unless there is a connectivity issue.
  - False. (Firmware updates should be done regularly to ensure the modem is operating with the latest features and bug fixes, not just when issues occur)







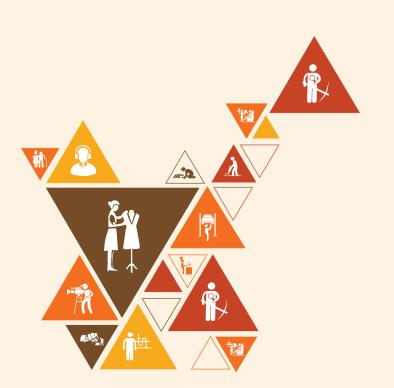




# 3. Set up and Operate Ground Station

Unit 3.1 – Ground Station Antenna Installation and Alignment

Unit 3.2 – Antenna Tracking and Pointing





## Key Learning Outcomes 🙄



#### By the end of this module, the participants will be able to:

- Define the key components and requirements of a ground station antenna system.
- Explain the importance of proper antenna alignment and positioning for optimal signal reception and transmission.
- Identify the different signal quality parameters and explain their significance in assessing the performance of a communication link.
- Describe the principles and techniques involved in grounding and protecting the antenna system against electrical hazards and lightning strikes.
- Outline the steps involved in selecting an appropriate location for a ground station antenna to ensure a clear line of sight to the satellite.
- Demonstrate how to install and align a ground station antenna to achieve the required gain, polarization, and optimal signal reception/transmission.
- Show how to determine the azimuth and elevation angles required to align the antenna with a specific satellite.
- Demonstrate the use of bubble levels or inclinometers to achieve precise positioning and levelness of the antenna.
- Show how to fine-tune the antenna's azimuth, elevation, and polarization adjustments using signal strength meters or receivers.
- Demonstrate how to verify signal quality and strength using appropriate equipment such as spectrum analyzers or satellite signal meters.
- Show how to securely fasten mounting brackets, bolts, and nuts to ensure the stability and alignment of the antenna over time.
- Describe the role of tracking software and mechanisms in maintaining a stable communication link with the satellite.
- Explain the concept of satellite tracking and the factors involved in determining the azimuth and elevation angles for optimal signal reception.
- Show how to track and point the antenna towards the satellite, maintaining precise azimuth and elevation angles for a stable communication link.
- Demonstrate how to verify the accuracy and calibration of azimuth and elevation indicators on the antenna and tracking system.

- Discuss the importance of regular maintenance and inspections in ensuring the reliability and proper functioning of ground station equipment.
- Explain the importance of access controls, encryption protocols, and intrusion detection systems in securing the ground station and communication link against unauthorized access and cyber threats.
- Demonstrate how to implement security measures such as access controls, encryption protocols, and intrusion detection systems to protect the ground station and communication link from unauthorized access and cyber threats.
- Show how to configure intrusion detection and prevention systems to detect and mitigate potential security breaches or unauthorized activities.
- Discuss the need for updating software, firmware, and operating systems to address security vulnerabilities and protect against potential attacks.
- Show how to update and patch software, firmware, and operating systems used in the ground station setup to address security vulnerabilities.
- Outline the key elements of an incident response plan and backup/disaster recovery procedures for effective handling of security incidents or system failures.
- Demonstrate how to develop an incident response plan outlining the steps to be taken in the event of a security breach or cyber-attack.
- Establish backup and disaster recovery procedures to ensure timely recovery and continuity of operations in case of a security incident or system failure.
- Demonstrate how to implement continuous monitoring tools to track and analyze network activity, system logs, and security events in real-time.
- Show how to maintain records of measured signal quality parameters at regular intervals.
- Demonstrate how to analyze the recorded data to assess signal quality parameters over time.
- Demonstrate how to perform functional tests on the ground station equipment to ensure proper functioning and alignment.
- Show how to monitor and analyze signal quality parameters such as SNR, BER, and C/N to optimize the performance of the communication link.

## **Unit 3.1: Ground Station Antenna Installation and Alignment**

## Unit Objectives | ©



#### By the end of this unit, the trainees will be able to:

- 1. Explain the key components involved in ground station antenna installation and alignment, including antennas, thermal control systems, power systems, and attitude and orbit control systems.
- 2. Describe the importance of proper antenna alignment, polarization, and gain in ensuring optimal signal reception and transmission.
- 3. Discuss the factors that influence the selection of an appropriate location for the ground station antenna.
- 4. Elucidate the methods and tools used for precise alignment of antennas, such as bubble levels, inclinometers, and signal strength meters.
- 5. Explain the principles of satellite communication, including frequency bands, modulation techniques, link budgets, and propagation characteristics.
- 6. Enlist the safety protocols and procedures for grounding the antenna system to protect against electrical hazards and lightning strikes.
- 7. Discuss the various performance parameters such as SNR, C/N, and BER, and their significance in assessing signal quality.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Network cables, electrical wires, alarms, indicators, tools and equipment, AC, DG, PIU, SMPS and battery bank, Auto Man Failure (AMF) panel, alarm panel, tools like pliers, power drill, screwdrivers, spanner, measurement tools, like multi-meter and thermometer, diagnostic tools, Sample of preventive and corrective maintenance formats and checklists Laptop with software such as MS Office and CRM.

- "Welcome to today's session on Ground Station Antenna Installation and Alignment.
- In this unit, we will cover the critical aspects of setting up and maintaining ground station antennas.
- You'll learn about the components that make up an antenna system, the principles behind antenna alignment, and the importance of selecting the right location for your ground station.
- This session will also introduce you to safety protocols and the performance metrics used to monitor signal quality."

## Ask (ask)



- What do you think are the most important factors to consider when setting up a ground station antenna?
- Why do you think precise alignment and positioning of the antenna are crucial in satellite communication?
- Can anyone share what tools or equipment they might use to align an antenna? How do you think these tools help ensure proper signal reception?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

- Key Components of Ground Station Antenna Installation:
  - Antenna: The key component that receives and transmits signals.
  - Thermal Control Systems: Ensure that the antenna and associated components do not overheat.
  - Power Systems: Provide the necessary electrical supply for the antenna and other
  - Attitude and Orbit Control Systems: Help the antenna maintain the correct orientation and alignment with the satellite.
- Importance of Proper Alignment, Polarization, and Gain:
  - Alignment ensures the antenna is positioned at the correct angle to maintain a strong connection with the satellite.
  - Polarization refers to the orientation of the electromagnetic waves transmitted or received by the antenna, which must match the satellite's polarization.

- o Gain is a measure of the antenna's ability to focus energy in a specific direction, directly affecting signal strength.
- Factors for Selecting Antenna Location:
  - Avoid obstructions such as buildings or trees.
  - o Ensure the location is free from interference and electromagnetic noise.
  - o Consider geographical location relative to the satellite orbit path.
- Tools for Alignment:
  - o Bubble Levels: Used to ensure the antenna is level.
  - o Inclinometers: Measure the tilt angle of the antenna.
  - o Signal Strength Meters: Measure the quality of the signal to ensure alignment accuracy.
- Principles of Satellite Communication:
  - Frequency Bands: The bands of electromagnetic frequencies used in communication (e.g., Ku-band, C-band).
  - Modulation Techniques: Methods of varying the carrier signal to transmit information (e.g., QPSK, BPSK).
  - o Link Budgets: A calculation that ensures the transmitted signal will be strong enough to reach the satellite receiver.
  - o Propagation Characteristics: The way signals travel through the atmosphere, which can be affected by weather, terrain, and frequency band.
- Safety Protocols and Grounding:
  - Proper grounding of the antenna system prevents electrical hazards and reduces the risk of lightning strikes.
  - Ensuring that grounding is done correctly is essential for protecting both personnel and equipment.
- Performance Parameters:
  - o SNR (Signal-to-Noise Ratio): Measures the signal strength relative to background noise.
  - o C/N (Carrier-to-Noise Ratio): The ratio of signal strength to noise, which is crucial for clear communication.
  - BER (Bit Error Rate): Measures the rate at which errors occur in transmitted data, impacting signal integrity.

# Activity-1



#### Name: Antenna Alignment with Signal Strength Meter

- Objectives:
  - To practice aligning an antenna using a signal strength meter.
  - To understand the importance of signal strength in achieving optimal alignment.
- Materials Needed:
  - Signal strength meter 0
  - Antenna and mounting system
  - Bubble level
  - Inclinometer
  - Satellite receiver
- Procedure:
  - Set up the antenna in the general location.
  - Use the bubble level and inclinometer to ensure the antenna is positioned correctly.
  - Connect the signal strength meter and monitor the signal strength.
  - Slowly adjust the antenna's direction and angle to maximize signal strength.
  - Record the signal strength at various positions to find the optimal alignment.
- Outcome:
  - The antenna will be aligned with the satellite, achieving the best possible signal strength, ensuring effective communication.

## Activity-2 /



#### Name: Grounding System Setup for Antenna Protection

- Objectives:
  - To understand the grounding procedures and their role in protecting the antenna system.
  - To practice grounding the antenna system to prevent electrical hazards.
- Materials Needed:
  - Grounding wire
  - Ground rod

- Earth connection tools
- Multimeter
- MultimeterProcedure:
  - Identify the grounding points on the antenna system.
  - Install the grounding rod at the designated location. 0
  - Connect the grounding wire from the antenna system to the grounding rod.
  - Use the multimeter to ensure the grounding connection is effective. 0
  - Check the system periodically to ensure the grounding remains intact.
- Outcome:
  - The antenna system will be correctly grounded, minimizing electrical risks and ensuring safety during operations.

## Notes for facilitation



- · Encourage trainees to ask questions throughout the session, especially during the practical activities.
- During the antenna alignment activity, highlight the importance of both theoretical understanding and hands-on practice.
- Ensure safety protocols are followed during the grounding activity, including wearing appropriate protective gear.
- Discuss real-world scenarios where improper antenna alignment or poor grounding could lead to system failures or safety hazards.

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## **Unit 3.2: Antenna Tracking and Pointing**

## Unit Objectives 🎯



#### By the end of this unit, the trainees will be able to:

- 1. Explain the key components involved in antenna tracking and pointing, including the azimuth and elevation angles and tracking mechanisms.
- 2. Describe the process of performing accurate tracking and pointing of the antenna to maintain a stable communication link with the satellite.
- 3. Elucidate the specifications of the antenna, including its range of motion, azimuth, elevation angles, and tracking mechanisms.
- 4. Discuss the importance of calibrating azimuth and elevation indicators on the antenna and tracking system to ensure accurate communication.
- 5. Explain the role of tracking software or mechanisms in managing antenna position and optimizing communication links.
- 6. Enlist the protocols and techniques used in satellite communication, such as TCP/IP, UDP, SNMP, and satellite-specific protocols.
- 7. Discuss the regulatory and security measures that ensure compliant and secure SATCOM operations, including spectrum usage and data protection regulations.
- 8. Explain how to monitor and adjust the antenna position based on signal strength and quality indicators.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Network cables, electrical wires, alarms, indicators, tools and equipment, AC, DG, PIU, SMPS and battery bank, Auto Man Failure (AMF) panel, alarm panel, tools like pliers, power drill, screwdrivers, spanner, measurement tools, like multi-meter and thermometer, diagnostic tools, Sample of preventive and corrective maintenance formats and checklists Laptop with software such as MS Office and CRM.

## Say 🕞

- "Welcome to the session on Antenna Tracking and Pointing. In this unit, we will explore the crucial concepts of how antennas maintain communication with satellites.
- You will learn how tracking systems help ensure a stable communication link, the importance of
  precise positioning, and how to use both manual and software tools for accurate antenna pointing.
- By the end of this session, you'll understand the technical aspects of antenna tracking, including the use of azimuth and elevation angles, and the role of software in optimizing satellite communication."

### **Ask**



- What do you think happens if the antenna is not properly aligned with the satellite?
- Why might an antenna tracking system need regular calibration?
- Can you think of any challenges you might face when using tracking software to manage antenna position?
- How important do you think the role of azimuth and elevation is in ensuring a stable satellite link?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

- Key Components of Antenna Tracking and Pointing:
  - o **Azimuth:** The horizontal angle at which the antenna must point to connect with the satellite.
  - o **Elevation:** The vertical angle of the antenna, which adjusts to maintain a line of sight with the satellite.
  - o **Tracking Mechanisms:** These include motorized systems or actuators that adjust the antenna's azimuth and elevation angles to track the satellite's movement.
- Tracking and Pointing Process:
  - o **Initial Positioning:** This is the first step, where the antenna is positioned roughly toward the satellite based on known parameters like azimuth and elevation angles.
  - o **Fine-tuning:** Once in the general position, adjustments are made to ensure a stronger signal, often by using signal strength meters or tracking software.

- Antenna Specifications:
  - o **Range of Motion:** The extent to which the antenna can rotate in the azimuth and elevation axes.
  - o **Tracking Systems:** These systems either use motors to move the antenna or employ software to adjust its position in real-time as the satellite moves across the sky.
- Calibrating the System:
  - o **Calibration of the azimuth and elevation indicators** ensures accurate pointing of the antenna, thus maintaining an optimal signal for communication.
  - o **Tracking Software:** This software assists in adjusting the antenna position automatically based on the satellite's location and movement.
- Communication Protocols:
  - o **TCP/IP:** Commonly used for reliable data transmission in SATCOM operations.
  - o **UDP:** Often used in situations where speed is prioritized over error correction.
  - SNMP: Allows monitoring and management of satellite communication equipment.
  - Satellite-Specific Protocols: Protocols tailored to satellite systems, ensuring seamless communication.
- Regulatory and Security Considerations:
  - Spectrum Usage: Regulatory bodies allocate frequency bands for satellite communication to avoid interference.
  - o **Data Protection:** Security measures are put in place to ensure the confidentiality and integrity of the transmitted data.
- Monitoring and Adjusting the Antenna:
  - Signal Strength: It is essential to continuously monitor the signal to ensure the antenna is properly aligned with the satellite.
  - Quality Indicators: Parameters like SNR (Signal-to-Noise Ratio) and BER (Bit Error Rate) help assess the performance of the communication link.

## **Activity-1**



#### Name: Antenna Position Adjustment

- Objectives:
  - o To practice the manual adjustment of the antenna to improve signal strength.
  - To understand the relationship between antenna alignment and communication quality.

#### Materials Needed:

- o Signal strength meter
- o Antenna and tracking mount
- o Bubble level
- o Inclinometer
- o Satellite receiver

#### Procedure:

- o Set the antenna to the initial position based on predefined azimuth and elevation angles.
- o Use the signal strength meter to check the initial signal reception.
- o Adjust the antenna's azimuth and elevation angles slightly, checking the signal strength after each adjustment.
- o Record the optimal position that results in the highest signal strength.

#### Outcome:

o The antenna will be accurately adjusted to the satellite, maximizing the signal strength and ensuring optimal communication.

## **Activity-2**



#### Name: Using Tracking Software for Accurate Positioning

- Objectives:
  - o To familiarize trainees with the use of tracking software for managing antenna position.
  - o To simulate automatic antenna alignment through software.
- Materials Needed:
  - o Tracking software
  - o Computer or laptop
  - o Antenna with tracking mechanism
  - o Signal strength meter

#### • Procedure:

o Open the tracking software and input the relevant satellite data (e.g., satellite ID, orbit parameters).

- Let the software automatically adjust the antenna's azimuth and elevation to track the satellite.
- Monitor the signal strength and check for any fluctuations as the antenna tracks the satellite.
- Manually intervene to adjust parameters if necessary, comparing the results with the software's recommendations.

#### Outcome:

Trainees will gain hands-on experience in using tracking software and understand how automation can optimize antenna positioning.

## Notes for facilitation



- · Encourage trainees to experiment with both manual and automated tracking methods to understand the differences and advantages of each.
- Remind trainees that while tracking software offers ease and precision, manual adjustments are crucial when technology fails or is unavailable.
- Discuss real-world situations where poor antenna alignment or failure to calibrate could lead to communication breakdowns.
- Emphasize the importance of continual monitoring of signal quality and adjusting antenna position as needed during satellite communication.

## **Exercise**



Key Solutions to PHB Exercise:

#### **Short Questions:**

- 1. What factors should be considered when choosing a location for the ground station antenna installation?
  - Clear line of sight to the satellite
  - Minimal obstructions like buildings, trees, or mountains
  - · Stable and secure ground for mounting
  - Minimal interference from nearby electronic devices or other antennas
- 2. What tools can be used to achieve precise antenna positioning during installation?
  - Compass
  - Inclinometer
  - Signal strength meter
  - · Satellite tracking software
- 3. How do you determine the azimuth and elevation angles required to align the antenna with the satellite?
  - Use satellite location data (longitude and latitude)
  - Calculate the angles using tracking software or online tools based on the ground station's location
- 4. What is the importance of monitoring signal parameters such as SNR, C/N, and BER during antenna installation and alignment?
  - Ensures optimal signal quality and strength
  - Helps identify alignment errors or interference issues
  - · Maximizes communication reliability
- 5. Why is it important to securely fasten the mounting brackets, bolts, and nuts on the antenna system?
  - Prevents the antenna from moving due to wind or vibrations
  - Maintains alignment with the satellite
  - Ensures safety and longevity of the installation

#### Fill in the Blanks:

- 1. The antenna must be positioned on the mounting structure while ensuring that it is **level** and **secure**.
- 2. To achieve precise antenna positioning, a **compass** or **inclinometer** can be used.
- 3. The **azimuth** angle is required to align the antenna with the satellite's position.
- 4. The **signal strength meter** is used to verify the signal quality and strength after aligning the antenna.
- 5. Proper **grounding** for the antenna system is necessary to protect against electrical hazards and lightning strikes.

#### **True/False Questions:**

- 1. The azimuth and elevation angles need to be adjusted periodically to maintain the alignment of the antenna.
  - True
- 2. Only manual tracking methods are used in antenna tracking systems for satellite communication.
  - False (Modern antenna tracking systems often include automated mechanisms, such as motorized drives and software-based tracking, to maintain alignment with satellites as they move or account for slight adjustments caused by external factors)
- 3. The use of spectrum analyzers helps to monitor and adjust signal strength during antenna alignment.
  - True
- 4. Fine-tuning of the antenna should be done without monitoring the signal strength or quality indicators.
  - False (Fine-tuning must be performed while monitoring signal strength and quality indicators like SNR, C/N, and BER to ensure that the alignment is optimized for the best communication performance)
- 5. Ensuring proper grounding is essential for preventing electrical hazards and lightning strikes in the antenna system.
  - True











# 4. Signal Analysis, Ground Station Maintenance, and Security Implementation

Unit 1.1 -Overview of the Telecom Industry and SATCOM Operations

Unit 1.2 - Workplace Practices and Operational Preparedness





## Key Learning Outcomes 🙄



#### By the end of this module, the participants will be able to:

- Explain the signal quality parameters, including Signal-to-Noise Ratio (SNR), Bit Error Rate (BER), and Carrier-to-Noise Ratio (C/N).
- Elucidate the tools and equipment used for measuring signal quality parameters in a ground station setup.
- Enlist the key components of a ground station, such as the antenna, feed system, and tracking mechanisms.
- Discuss the significance of maintaining a record of measured signal quality parameters at regular intervals.
- Describe the process of connecting monitoring equipment to relevant points in a ground station setup.
- Demonstrate how to utilize appropriate tools and equipment to measure and assess signal quality parameters in a practical setting.
- Discuss the steps involved in conducting functional tests on ground station equipment.
- Evaluate the impact of maintenance and inspection on the proper functioning and reliability of ground station equipment.
- Compare different security measures and their effectiveness in protecting a ground station from unauthorized access and cyber threats.
- Assess the alignment of access control policies with evolving security requirements.
- Critically review incident response plans and backup procedures for their adequacy in handling security incidents.
- Design access levels and user roles based on job responsibilities and the principle of least privilege.
- Formulate an incident response plan outlining the steps to be taken in the event of a security breach or cyberattack.
- Demonstrate how to keep monitoring equipment running to continuously monitor signal quality parameters during operation.
- Show how to conduct regular maintenance and inspections of ground station equipment, including antenna, feed system, and tracking mechanisms.
- Demonstrate how to check tracking mechanisms, such as azimuth and elevation systems, for proper calibration.
- Show how to inspect cables and connectors for signs of damage, wear, or loose connections.

- Demonstrate how to configure the IDPS to detect and alert on suspicious network events, such as unauthorized access attempts or abnormal traffic patterns.
- Show how to install firewalls to enforce network security policies and control traffic entering and leaving the ground station network.
- Demonstrate how to develop backup and disaster recovery procedures for timely recovery and continuity of operations in case of a security incident or system failure.
- Show how to implement continuous monitoring tools to track and analyze network activity, system logs, and security events in real-time.

## **Unit 4.1: Ground Station Equipment Maintenance and Performance Assurance**

## · Unit Objectives 🏻 🎯



#### By the end of this unit, the trainees will be able to:

- 1. Explain the importance of regular maintenance and inspections of ground station equipment to ensure reliability.
- 2. Describe the steps to establish an effective maintenance schedule for ground station equipment.
- 3. Elucidate the process of antenna alignment verification and tracking mechanism calibration.
- 4. Discuss the best practices for maintaining ground station components such as cables, connectors, and electrical systems.
- 5. Enlist strategies and techniques for diagnosing and resolving signal quality issues in ground station equipment.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Network cables, electrical wires, alarms, indicators, tools and equipment, AC, DG, PIU, SMPS and battery bank, Auto Man Failure (AMF) panel, alarm panel, tools like pliers, power drill, screwdrivers, spanner, measurement tools, like multi-meter and thermometer, diagnostic tools, Sample of preventive and corrective maintenance formats and checklists Laptop with software such as MS Office and CRM.



- Maintenance is the cornerstone of any reliable satellite communication system.
- In this session, we'll explore the essential maintenance practices that ensure the performance and longevity of ground station equipment.
- Whether it's checking cables, calibrating tracking mechanisms, or resolving signal issues, each step is critical to the system's overall success.

## **Ask**



- What do you think are the consequences of poor maintenance practices in a ground station?
- How would you prioritize components during routine inspections?
- Have you ever encountered equipment failure due to a lack of maintenance? What happened?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

#### • Importance of Maintenance:

- o Reliability of satellite communication depends on the consistent performance of ground station equipment.
- o Regular maintenance prevents unexpected breakdowns and ensures uninterrupted communication.

#### • Establishing a Maintenance Schedule:

- o Categorize tasks as daily, weekly, monthly, or annual.
- o Use a checklist to ensure all components, such as antennas, cables, and connectors, are inspected and tested.

#### • Antenna Alignment and Calibration:

o Regularly verify antenna alignment and recalibrate tracking mechanisms to account for environmental or operational changes.

#### • Best Practices for Component Maintenance:

- o Inspect cables and connectors for wear and tear.
- o Check electrical systems for proper grounding and functionality.
- o Use tools such as multimeters and spectrum analyzers for functional testing.

#### Signal Issue Diagnosis and Resolution:

- o Monitor signal parameters such as SNR, BER, and C/N ratios to identify potential issues.
- o Implement corrective actions, such as replacing faulty components or realigning antennas.

## Activity-1



#### Name: Inspection and Scheduling Maintenance

- Objectives: Learn to inspect ground station components and create a maintenance schedule.
- Materials Needed: Inspection checklist, multimeter, spectrum analyzer, sample maintenance logs.
- Procedure:
  - Review the checklist and identify components for inspection.
  - Perform an inspection of cables, connectors, and electrical systems.
  - Log observations and prioritize maintenance tasks.
  - Develop a schedule for routine and advanced maintenance tasks.

#### Outcome:

Trainees will be able to inspect ground station components and create an actionable maintenance plan.

## **Activity-2**



#### **Activity 2: Diagnosing Signal Quality Issues**

- Name: Signal Parameter Testing and Resolution
- Objectives: Understand how to monitor and resolve signal quality issues.
- Materials Needed: Signal analyzer, cables, connectors, sample ground station setup.
- Procedure:
  - Use a signal analyzer to measure SNR, BER, and C/N values.
  - Identify areas of concern, such as weak signals or interference.
  - Perform corrective actions like replacing faulty cables or realigning the antenna.
  - Verify improvements by rechecking signal parameters.

#### Outcome:

Trainees will gain hands-on experience in identifying and resolving signal quality issues.

## Notes for facilitation 3



- Emphasize safety protocols when working with electrical systems and equipment.
- Encourage collaborative problem-solving during activities to mimic real-world maintenance team dynamics.
- Provide detailed feedback on inspection and maintenance plans to reinforce best practices.

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## Unit 4.2: Signal Quality Monitoring, Analysis, and Security **Measures Implementation**

## - Unit Objectives │◎



#### By the end of this unit, the trainees will be able to:

- 1. Explain how to measure and analyze signal quality parameters such as Signal-to-Noise Ratio (SNR), Bit Error Rate (BER), and Carrier-to-Noise Ratio (C/N).
- 2. Describe the process of using measurement tools to assess signal quality in a ground station setup.
- 3. Discuss the importance of maintaining accurate records and analyzing signal quality over time.
- 4. Enlist the necessary security measures, including encryption protocols and access controls, to protect the ground station and communication link.
- 5. Elucidate the process of implementing an incident response plan and disaster recovery procedures in case of security breaches or system failures.

# Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Network cables, electrical wires, alarms, indicators, tools and equipment, AC, DG, PIU, SMPS and battery bank, Auto Man Failure (AMF) panel, alarm panel, tools like pliers, power drill, screwdrivers, spanner, measurement tools, like multi-meter and thermometer, diagnostic tools, Sample of preventive and corrective maintenance formats and checklists Laptop with software such as MS Office and CRM.

- Signal quality and security are the foundation of reliable satellite communication.
- In this session, we'll explore tools and techniques to measure and analyze signal quality, while also implementing security measures to protect communication systems from potential threats.



- What factors can affect the quality of a satellite signal in a ground station setup?
- How would you detect and mitigate a security breach in a satellite communication system?
- Why is it essential to maintain historical signal quality data?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

#### **Signal Quality Parameters:**

- SNR, BER, and C/N are critical indicators of communication performance.
- Tools such as spectrum analyzers and signal testers are used to measure these parameters.

#### Monitoring and Recording Signal Quality:

- Connect the equipment correctly to monitor real-time signal parameters.
- Maintain accurate logs to track trends and identify anomalies over time.

#### **Security Measures:**

- Network Security: Use encryption protocols, firewalls, and access controls.
- IDPS: Detect and prevent unauthorized access or malicious activities.
- Regularly update software and systems to address vulnerabilities.

#### **Incident Response and Disaster Recovery:**

- Develop a step-by-step incident response plan, including communication protocols.
- Implement disaster recovery procedures, such as backup systems, to restore operations quickly.

#### **Continuous Monitoring and Compliance:**

- Use automated tools to continuously monitor signal quality and system security.
- Ensure compliance with regulatory standards for secure and efficient SATCOM operations.

# Activity-1



## Name: Signal Monitoring and Analysis

- Objectives:
  - Learn to monitor and interpret signal quality parameters.
- Materials Needed:
  - Spectrum analyzer, signal quality meter, sample ground station setup, data logs.
- Procedure:
  - Connect the spectrum analyzer to the ground station system.
  - Measure SNR, BER, and C/N values under normal operating conditions.
  - Record and analyze the data, identifying any deviations or anomalies.
  - Propose corrective measures to optimize signal quality.
- Outcome:
  - Trainees will understand how to measure, record, and analyze signal quality to ensure system reliability.

## **Activity-2**



#### **Name: Network Security Simulation**

- Objectives:
  - Learn to apply basic security measures to a ground station network.
- Materials Needed:
  - Network setup (real or simulated), firewall software, IDPS tools, encryption software.
- Procedure:
  - Set up the ground station network and enable basic communication.
  - Configure a firewall to block unauthorized access.
  - Simulate a potential security threat and observe how IDPS tools respond.
  - Implement encryption for data communication and verify its effectiveness.
- Outcome:
  - Trainees will be able to apply and verify the effectiveness of security measures in a ground station setup.

# Notes for facilitation 🗐



- Highlight the interdependence of signal quality and security for successful satellite communication.
- Provide hands-on practice with monitoring tools and security software to reinforce theoretical concepts.
- Encourage group discussions on real-world scenarios for incident response and recovery planning.

## Exercise



## Key Solutions to PHB Exercise:

#### **Short Answer Questions**

- 1. What are the three key signal quality parameters commonly used in satellite communication? Signal-to-Noise Ratio (SNR), Bit Error Rate (BER), and Carrier-to-Noise Ratio (C/N).
- Name two types of tools used for measuring signal quality parameters in a ground station setup.
   Spectrum analyzers and signal quality meters.
- 3. What are the key components of a ground station setup?

Antenna, feed system, tracking mechanisms, and communication equipment.

4. Why is it important to maintain a record of measured signal quality parameters in a ground station?

It helps track trends, identify anomalies, and ensure consistent performance over time.

5. What is the role of incident response plans in maintaining the security of a ground station?

They provide a structured approach to addressing and mitigating security breaches or system failures, minimizing downtime and ensuring operational continuity.

### Fill-in-the-Blanks

- 1. The signal quality parameter that measures the clarity of a signal in relation to noise is called **Signal-to-Noise Ratio (SNR)**.
- 2. The equipment used for measuring signal quality parameters, such as Signal-to-Noise Ratio, includes tools like spectrum analyzers and **signal quality meters**.
- 3. A ground station typically includes an antenna, feed system, and **tracking** mechanisms for tracking satellites.
- 4. In order to protect a ground station network from unauthorized access, it is important to install **firewalls** to control network traffic.
- 5. The process of recovering from a security breach or system failure is addressed by a **disaster recovery** plan.

#### **True/False Questions**

- 1. Signal-to-Noise Ratio (SNR) is used to assess the data transmission quality in satellite communication.
  - True.

- 2. It is not necessary to maintain records of measured signal quality parameters once the equipment is installed and functioning.
  - False. (Regularly maintaining records helps monitor system performance and detect issues early)
- 3. Functional tests on ground station equipment ensure that the equipment is working as intended.
  - True.
- 4. Incident response plans do not need to be reviewed regularly as long as they are initially created.
  - False. (Regular reviews are essential to ensure plans remain effective and relevant to changing threats)
- 5. Continuous monitoring tools are essential for tracking network activity and detecting potential security breaches in real-time.
  - True.











# 5. Manage Network Operation Centre (NOC) or Hub

Unit 5.1 – Gateway ID Management and Configuration for NOC

Unit 5.2 – Data Connectivity, Performance Analysis & Monitoring for Cross-Verification

Unit 5.3 – Antenna, Transceiver Selection, and Fault Management for NOC Operations





## Key Learning Outcomes 🙄

#### By the end of this module, the participants will be able to:

- Demonstrate how to monitor data connections for errors or anomalies using appropriate tools to measure error rate and bit error rate (BER).
- Explain the monitoring process for data connections and measuring error rate and bit error rate (BER).
- Demonstrate how to simulate link failures or switchovers and verify the continuity of data connectivity.
- Describe the simulation of link failures or switchovers to verify data connectivity.
- Discuss the field testing process for assessing data connectivity under varying conditions.
- Demonstrate configuring IP addresses, ensuring no overlap or conflicts, and determining subnet masks for each subnet.
- Demonstrate how to set up network monitoring tools to monitor performance, availability, and security of the SATCOM network.
- Demonstrate how to configure DHCP (Dynamic Host Configuration Protocol) for IP address allocation.
- Demonstrate how to configure SATCOM devices with their respective static IP addresses, subnet masks, and other network parameters.
- Demonstrate how to assign LAN IP addresses and provide network names.
- Demonstrate how to configure NATing (Network Address Translation) for address translation between private and public networks.
- Demonstrate how to monitor Rx and TX of the remote site at regular intervals.
- Demonstrate how to control data rate or data packages as required.
- Demonstrate how to back up NMS for data protection and disaster recovery.
- Demonstrate how to add routes on specific routing tables as needed.
- Demonstrate how to choose appropriate antennas with high gain and narrow beam width for improved RX and TX signals.
- Demonstrate how to conduct thorough frequency planning to select suitable frequencies for SATCOM operations.
- Demonstrate how to analyze interference patterns and ensure compatibility with the desired satellite system.

- Explain the database schema design for SATCOM operations and its specific requirements.
- Discuss the creation of a relational database using a database management system (DBMS) and importing relevant data.
- Explain the utilization of Network Management Systems (NMS) to monitor and manage the SATCOM network.
- Describe the collection and analysis of performance data using the database and NMS.
- Demonstrate how to implement fault management features within the NMS for anomaly detection and response.
- Explain the use of the database for storing and managing configurations of SATCOM devices.
- Demonstrate how to apply commands to query data from the database.

## **Unit 5.1: Gateway ID Management and Configuration for NOC**

## Unit Objectives ©



## By the end of this unit, the trainees will be able to:

- 1. Explain the importance and role of gateway IDs in SATCOM networks, emphasizing their necessity for managing remote sites.
- 2. Elucidate the process of assigning unique gateway IDs to SATCOM gateways, ensuring they follow a standardized and consistent format.
- 3. Describe how gateway ID information is integrated into the Network Management System (NMS) for seamless operation and monitoring of remote sites.
- 4. Discuss the configuration management processes required to track and manage any changes to gateway IDs to ensure network integrity.
- 5. Demonstrate how gateway IDs are used for monitoring the performance of SATCOM gateways, including troubleshooting and fault detection.
- 6. Elucidate the security measures needed to protect gateway IDs and the importance of conducting periodic audits to ensure their accuracy and validity.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Computer or Laptop, Projector or Smartboard, Internet connectivity, Network performance Measurement and analysis tools, Spectrum analyzers, Network simulation software, Base station equipment, Antennas, Routers, User Equipment (UE), Radio Access Network (RAN) equipment, Intelligent Controller (RIC), Service Management and Orchestration (SMO) solution, Components of 5G Service-Based Architecture (SBA), Network Function Virtualization (NFV) components, Virtual Infrastructure for hosting VNFs, Frequency band allocation tools, Network integration tools, Network monitoring and analytics tools, Troubleshooting equipment, Simulation environment or lab setup for practical exercises.



Gateway IDs play a critical role in ensuring the seamless operation and management of SATCOM networks, especially for remote sites.

- In this session, we will explore the significance of gateway IDs, their structure, and their role in network management and performance monitoring.
- By the end, you will understand how to assign, configure, and secure gateway IDs effectively.

## Ask ask



- Why do you think it's important to assign unique identifiers to gateways in a SATCOM network?
- What could be the consequences of incorrect or duplicate gateway ID assignments?
- How do you think gateway IDs contribute to troubleshooting and fault detection?
- Write down responses on the whiteboard and encourage discussion.

## Elaborate |



During this session, we will focus on:

- Introduction to Gateway IDs: Define gateway IDs as unique identifiers assigned to SATCOM gateways for effective management and monitoring. Highlight their role in distinguishing between remote sites.
- Structure and Format: Discuss the standardized format of gateway IDs, including examples and conventions to ensure consistency across the network.
- Assigning Unique IDs: Explain the step-by-step process for generating and assigning gateway IDs, emphasizing the importance of avoiding duplication.
- Integration into NMS: Highlight how gateway IDs are integrated into the Network Management System (NMS) to enable seamless monitoring and management of remote sites.
- Configuration Management: Discuss processes for tracking changes to gateway IDs, ensuring network integrity, and maintaining updated records.
- Performance Monitoring and Troubleshooting: Explain how gateway IDs are used to monitor gateway performance, detect faults, and simplify troubleshooting efforts.
- Security Measures: Emphasize the need for securing gateway IDs through encryption, access controls, and periodic audits.

# Activity-1

## Name: Gateway ID Assignment and Configuration

- Objective:
  - o Learn to assign unique gateway IDs and integrate them into a Network Management System.
- Materials Needed:
  - o Sample SATCOM gateway data
  - o Access to a simulated Network Management System (NMS)
  - o Configuration guidelines
- Procedure:
  - Review the structure and format of gateway IDs.
  - o Assign unique IDs to a set of sample gateways following standardized guidelines.
  - Input the assigned IDs into the simulated NMS.
  - o Validate the integration and verify if all IDs are correctly recognized in the system.

## **Activity-2**



#### Name: Conducting a Gateway ID Security Audit

- Objective:
  - o Learn to identify and rectify potential vulnerabilities in gateway ID management.
- Materials Needed:
  - o Sample gateway ID records
  - o Checklist for security measures (encryption, access controls, etc.)
- Procedure:
  - o Analyze sample gateway ID records to identify missing or outdated IDs.
  - o Cross-check security measures, such as encryption protocols and access controls.
  - o Propose updates or corrections to enhance the security of the gateway ID management system.
- Outcome:
  - o Trainees understand the importance of periodic audits and can implement improvements to protect gateway ID records.

## – Notes for facilitation 🗐



- Use real-world scenarios to illustrate the significance of gateway IDs in SATCOM networks.
- Encourage trainees to collaborate during practical activities for a hands-on learning experience.
- Provide detailed feedback on assignments to reinforce correct practices and address gaps.
- Highlight best practices for securing gateway IDs and ensuring compliance with network management protocols.

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## Unit 5.2: Data Connectivity, Performance Analysis & **Monitoring for Cross-Verification**

## Unit Objectives 🎯



#### By the end of this unit, the trainees will be able to:

- 1. Explain the critical factors that influence data connectivity and signal strength in SATCOM networks, and their impact on remote site communication.
- 2. Describe the methods for testing signal strength and ensuring that satellite links meet the required specifications for reliable data transmission.
- 3. Discuss the importance of proper antenna alignment and its direct effect on signal quality and network performance.
- 4. Elucidate the process of conducting a link budget analysis to predict satellite link performance and identify potential performance issues.
- 5. Explain how to configure a test environment and set up necessary equipment to perform data connectivity and performance tests for SATCOM systems.
- 6. Elucidate how to use specialized network tools for monitoring satellite data links, ensuring highquality transmission, and detecting anomalies.
- 7. Discuss the process of performing latency and error rate testing to measure data transfer efficiency and reliability of satellite communication.
- 8. Elucidate the procedures for simulating link failures and testing network redundancy systems to ensure uninterrupted service in case of disruptions.
- 9. Discuss the field testing process, including factors that impact connectivity and the importance of assessing performance across different environments.

# Resources to be used



## Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

- Computer or Laptop, Projector or Smartboard, Internet connectivity, Network performance Measurement and analysis tools, Spectrum analyzers, Network simulation software, Base station equipment, Antennas, Routers, User Equipment (UE), Radio Access Network
- (RAN) equipment, Intelligent Controller (RIC), Service Management and Orchestration (SMO) solution, Components of 5G Service-Based Architecture (SBA), Network Function

Virtualization (NFV) components, Virtual Infrastructure for hosting VNFs, Frequency band

o allocation tools, Network integration tools, Network monitoring and analytics tools, Trobleshooting equipment, Simulation environment or lab setup for practical exercises.

## Say 6

- Data connectivity and performance analysis are crucial for ensuring the reliability and efficiency of SATCOM systems.
- In this session, we'll explore how to test and analyze connectivity, perform link budget assessments, and simulate failures to verify redundancy systems.
- By the end, you will be equipped to assess and enhance the performance of SATCOM networks effectively.

## Ask ask



- What do you think are the key factors that can affect data connectivity in SATCOM systems?
- How do you think antenna alignment influences signal strength and data transmission quality?
- Why is it important to simulate link failures in a controlled environment?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

- **Introduction to Data Connectivity:** Explain the factors affecting connectivity, such as signal strength, weather conditions, and system configuration.
- **Testing Connectivity and Signal Strength:** Outline the methods for measuring and optimizing signal strength, including spectrum analyzers and signal meters.
- Performance Assessment and Link Budget Analysis: Describe the steps involved in link budget analysis, including calculating power levels, losses, and margins.
- **Setting Up Test Environments:** Highlight the equipment and procedures needed for testing data connectivity, including data traffic generation and performance measurement.
- . Monitoring and Error Analysis: Discuss the use of tools for real-time monitoring, identifying

anomalies, and analyzing error rates in data transmission.

• **Simulating Link Failures:** Explain the importance of testing network redundancy systems and the process for simulating and troubleshooting link failures.

## **Activity-1**



### Name: Signal Strength Measurement and Optimization

- Objective:
  - o Learn to measure and optimize signal strength for reliable data connectivity.
- Materials Needed:
  - Spectrum analyzer
  - o Signal meter
  - o Antenna setup (simulated or real)
- Procedure:
  - o Set up the antenna and align it based on predefined parameters.
  - Use the signal meter to measure the Signal-to-Noise Ratio (SNR) and identify weak signals.
  - o Adjust the antenna alignment to optimize the signal strength.
  - Record the data and analyze the results to determine the best alignment.
- Outcome:
- Trainees can measure and optimize signal strength for improved data connectivity.

## **Activity-2**



#### Name: Network Redundancy Testing Through Link Simulation

- Objective:
  - o Understand how to simulate link failures and test redundancy mechanisms.
- Materials Needed:
  - o Network simulation tools
  - o Test scripts for link failure
  - o Data connectivity test environment

#### • Procedure:

- Configure a SATCOM test network with redundancy mechanisms enabled. o
- Simulate a link failure using network simulation tools.
- Monitor how the redundancy system responds to maintain connectivity. o
- Analyze the time taken for recovery and identify potential improvements.

#### • Outcome:

Trainees can simulate link failures and verify the effectiveness of redundancy systems.

## Notes for facilitation



- Use visual aids, such as diagrams and charts, to explain link budget analysis and redundancy testing.
- Encourage trainees to collaborate during practical activities and share observations.
- Provide real-world examples of network disruptions and how redundancy systems prevented major issues.
- Offer hands-on practice with monitoring tools to build confidence in troubleshooting techniques.

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## Unit 5.3: Antenna, Transceiver Selection, and Fault **Management for NOC Operations**

## Unit Objectives | ©



#### By the end of this unit, the trainees will be able to:

- 1. Explain the process of selecting antennas with high gain and narrow beamwidth for optimal RX and TX signals.
- 2. Discuss the importance of frequency planning and its role in preventing interference in SATCOM operations.
- 3. Elucidate the features of high-quality transceivers, including RX sensitivity and TX power output.
- 4. Describe the steps to design a database schema specific to SATCOM operations and import relevant data.
- 5. Enlist the tools and techniques used in Network Management Systems (NMS) for SATCOM monitoring and management.
- 6. Explain how fault management features in NMS can be implemented to detect and resolve anomalies.
- 7. Describe compliance procedures for hosting and testing applications at remote ends in SATCOM networks.
- 8. Discuss the concept of MAC and its application in verifying data transmission.

# Resources to be used | ©



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Computer or Laptop, Projector or Smartboard, Internet connectivity, Network performance Measurement and analysis tools, Spectrum analyzers, Network simulation software, Base station equipment, Antennas, Routers, User Equipment (UE), Radio Access Network (RAN) equipment, Intelligent Controller (RIC), Service Management and Orchestration (SMO) solution, Components of 5G Service-Based Architecture (SBA), Network Function Virtualization (NFV) components, Virtual Infrastructure for hosting VNFs, Frequency band allocation tools, Network integration tools, Network monitoring and analytics tools, Troubleshooting equipment, Simulation environment or lab setup for practical exercises.

- · Antenna selection, transceiver optimization, and fault management are critical components of effective SATCOM NOC operations.
- In this session, we'll dive into the principles of frequency planning, transceiver selection, and fault detection through NMS tools.
- By the end, you will gain practical insights and hands-on experience to manage SATCOM networks efficiently.



- Why do you think antenna gain and beamwidth are important in SATCOM operations?
- What role do you think frequency planning plays in avoiding interference in satellite communication?
- How do you think fault management systems impact the reliability of SATCOM networks?
- Write down responses on the whiteboard and encourage discussion.

## Notes for facilitation



During this session, we will focus on:

- Frequency Planning and Interference Management: Explain the process of selecting frequencies to avoid interference, and its importance in maintaining clear communication channels.
- Antenna and Transceiver Selection: Highlight the features of antennas with high gain and narrow beamwidth, and transceivers with optimal RX sensitivity and TX power output.
- Database Management: Discuss designing database schemas for SATCOM operations, focusing on data organization and importing operational data.
- Network Monitoring with NMS: Provide an overview of tools and techniques used in NMS to monitor SATCOM operations in real time.
- Fault Management: Describe methods for detecting and resolving anomalies, including generating real-time alerts and implementing corrective actions.
- Remote Hosting and MAC Verification: Explain the procedures for hosting applications at remote

## Activity-1



## Name: Optimizing Antenna and Transceiver for SATCOM Operations

- Objective:
  - Understand the criteria for selecting antennas and transceivers for optimal performance.
- Materials Needed:
  - Sample antenna models (or specifications)
  - Transceiver datasheets
  - Signal analysis tool
- Procedure:
  - Analyze the specifications of different antenna models, focusing on gain and beamwidth.
  - Review transceiver datasheets to evaluate RX sensitivity and TX power output.
  - Choose the optimal antenna-transceiver combination based on a given SATCOM scenario.
  - Justify your selection with data and performance expectations.
- Outcome:
  - Trainees will be able to select suitable antennas and transceivers for specific SATCOM needs.

# Activity-2



## Name: Fault Detection and Resolution Using NMS

- Objective:
  - Learn how to use NMS tools to identify and resolve faults in SATCOM networks.
- Materials Needed:
  - NMS simulation software
  - Sample fault scenarios
  - User guide for NMS tools
- Procedure:
  - Set up a simulated SATCOM network in the NMS tool.
  - Introduce predefined faults, such as signal loss or interference.
  - Use the NMS fault management features to detect anomalies and generate alerts.
  - Implement corrective actions and verify that the faults are resolved.
- Outcome:
  - Trainees will understand how to leverage NMS tools for fault detection and resolution.

## – Notes for facilitation 🗐



- Use real-world examples to explain the impact of poor frequency planning and transceiver selection.
- Demonstrate NMS functionality live, if possible, to familiarize trainees with its interface and features.
- Encourage group discussions to compare antenna-transceiver combinations and justify choices.
- Provide a checklist for fault management steps to help trainees follow a structured approach.

## Exercise



#### Answer the following questions:

#### **Key Solutions to PHB Exercise**

1. What is the significance of assigning unique gateway IDs to SATCOM gateways?

Unique gateway IDs are essential for identifying and managing SATCOM gateways, ensuring effective tracking, configuration, and monitoring within the network.

2. How are gateway ID information integrated into Network Management Systems (NMS)?

Gateway ID information is input into the NMS as part of the configuration database, enabling seamless monitoring, performance tracking, and fault detection.

3. What is a link budget analysis, and why is it important in SATCOM operations?

Link budget analysis calculates the gain and losses in a satellite communication link to predict its performance, ensuring the system meets operational requirements and identifies potential issues.

4. Describe the purpose of performing ping or latency tests in SATCOM networks.

Ping or latency tests measure the time it takes for data to travel between two points in a network, helping assess connection quality, detect delays, and troubleshoot performance issues.

5. How can gateway IDs be used to troubleshoot issues with SATCOM gateways?

Gateway IDs help isolate specific gateways experiencing issues, enabling targeted diagnostics, configuration checks, and fault resolution.

#### Fill-in-the-Blanks

- 1. A **gateway ID** is a unique identifier assigned to each SATCOM gateway for tracking and management.
- 2. Tools such as **signal analyzers** and spectrum analyzers are used to measure satellite signal strength.
- **3. Traffic** testing involves generating traffic and measuring data transfer rates in a SATCOM network.
- 4. Monitoring tools are used to check **uplink** and **downlink** signals at remote sites regularly.
- **5. DHCP (Dynamic Host Configuration Protocol)** is a protocol configured to allocate dynamic IP addresses in SATCOM networks.

#### **True/False Questions**

1. Unique gateway IDs are unnecessary for performance monitoring in SATCOM networks.

- False. (Unique gateway IDs are critical for effective performance monitoring as they allow network operators to distinguish between different gateways. This identification is essential for tracking, diagnostics, fault isolation, and ensuring that performance metrics are correctly attributed to the respective gateways)
- 2. The process of link budget analysis helps assess the expected performance of a satellite link.
  - True.
- 3. Simulating link failures is not essential for verifying data connectivity in SATCOM networks.
  - False. (Simulating link failures is an important step to test the robustness of the network and ensure that redundancy mechanisms, such as backup links or automatic failurer systems, are functioning as intended. Without this testing, network reliability during actual failures cannot be guaranteed)
- 4. Spectrum analyzers can confirm satellite antenna alignment and signal strength compliance.
  - True.
- 5. Network Address Translation (NATing) is used to translate between private and public IP addresses in SATCOM operations.
  - True.







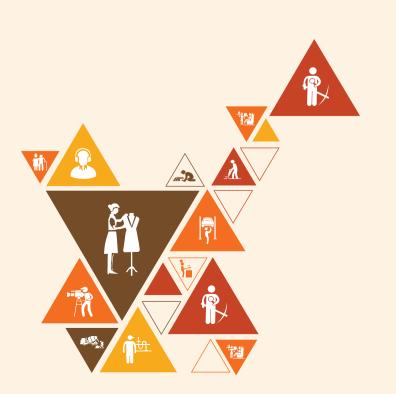




# 6. Incident Management or PM (Primitive Maintenance) Activity

Unit 6.1 – Analyzing and Resolving Down Calls

Unit 6.2 – Signal Strength Optimization and Antenna Alignment





## Key Learning Outcomes 🔯

#### By the end of this module, the participants will be able to:

- Explain the factors that can cause a down call in a SATCOM system.
- Describe the types of SATCOM equipment that may contribute to a down call and their functions.
- Show how to examine SATCOM equipment for signs of malfunction or failure in troubleshooting a down call.
- Show how to inspect transceivers, modems, routers, or other components that may contribute to a down call.
- Analyze potential sources of interference in a SATCOM system, including adjacent satellites, other communication systems, and electromagnetic interference.
- Discuss the use of diagnostic tools or software to perform tests such as ping tests, latency measurements, or bit error rate (BER) calculations to identify the cause of a down call.
- Show how to utilize diagnostic tools or software to perform tests such as ping tests, latency measurements, or bit error rate (BER) calculations to pinpoint the cause of a down call.
- Show how to assess satellite signal strength using a satellite signal meter or spectrum analyzer to ensure it meets required specifications.
- Explain the importance of assessing satellite signal strength and alignment of the satellite antenna in troubleshooting a down call.
- Demonstrate how to confirm the alignment of the satellite antenna to ensure it is accurately pointing towards the desired satellite.
- Describe the process of performing a link budget analysis to assess the expected performance of a satellite link.
- Show how to perform a link budget analysis to assess the expected performance of the satellite link.
- Discuss the significance of network configuration, including IP addresses, subnet masks, routing tables, and NATing settings, in troubleshooting a down call.
- Show how to analyze network configuration, including IP addresses, subnet masks, routing tables, and NATing settings, to troubleshoot a down call.
- Explain the use of network monitoring tools to analyze network traffic and identify abnormal patterns, packet loss, or congestion.
- Show how to utilize network monitoring tools to analyze network traffic and identify abnormal patterns, packet loss, or congestion.

- Describe the importance of verifying data connectivity and monitoring the data connection for errors or anomalies in troubleshooting a down call.
- Demonstrate how to verify data connectivity between the SATCOM gateway and remote locations.
- Show how to monitor the data connection for errors or anomalies.
- Discuss the value of conducting field tests at different locations within the coverage area to assess data connectivity under varying conditions.
- Demonstrate conducting field tests at different locations within the coverage area to assess data connectivity under varying conditions.
- Explain the role of a database management system (DBMS) and network management system (NMS) in collecting and analyzing performance data.
- Show how to utilize a database management system (DBMS) and network management system (NMS) to collect and analyze performance data.
- Demonstrate how to monitor signal strength, link utilization, latency, and throughput to identify anomalies or areas for improvement.
- Show how to perform testing of SATCOM accessories to ensure proper functioning and compatibility.
- Describe the industry associations and standards that govern SATCOM operations, such as the International Telecommunication Union (ITU), Global VSAT Forum (GVF), or Satellite Industry Association (SIA).

## **Unit 6.1: Analyzing and Resolving Down Calls**

## Unit Objectives | ©



## By the end of this unit, the trainees will be able to:

- 1. Explain the common causes of down calls in SATCOM systems.
- 2. Elucidate the parameters such as signal power, path loss, antenna gain, and interference that affect SATCOM performance.
- 3. Describe the process of examining SATCOM equipment for malfunction or failure during a down call.
- 4. Discuss potential sources of interference in SATCOM systems, including adjacent satellites, other communication systems, or electromagnetic interference.
- 5. Explain the role of diagnostic tools in performing tests such as ping tests, latency measurements, and Bit Error Rate (BER) calculations.
- 6. Enlist the steps for identifying traffic or network bottlenecks that may cause down calls.
- 7. Describe the escalation matrix for reporting incidents, trouble, or emergencies in SATCOM operations.

## Resources to be used



## Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Computer or Laptop, Projector or Smartboard, Internet connectivity, Network Performance Measurement and Analysis Tools, Network Access Control Mechanisms, Firewalls, Intrusion Detection/Prevention Systems (IDS/IPS), Content Filtering Mechanisms, Traffic Analysis Tools, Anomaly Detection Systems, Monitoring Equipment for 5G NR Physical Channels and Signals, Signal Capture Equipment, Frequency Analysis Tools, Error Handling Mechanisms, Channel Estimation and Equalization Tools, Demodulation and Decoding Tools, Analog Beamforming Equipment, Digital Beamforming Equipment, Monitoring Equipment for Beamforming Reconstruction, Beamforming Configuration Tools.

- Good day, everyone! In this session, we will be exploring the critical topic of 'Down Calls' in SATCOM systems.
- These issues are crucial as they can severely impact communication reliability. We'll delve into the common causes of down calls, how to identify the factors affecting performance, and how to resolve these issues effectively.
- By understanding the equipment, diagnostic tools, and potential interference sources, we can minimize downtime and ensure continuous, reliable communication.

## Ask ask



- What do you think could be the main causes of a 'down call' in a SATCOM system?
- Can anyone share an experience where signal loss or interference impacted the performance of a satellite communication system?
- What diagnostic tools have you used before to troubleshoot communication systems, and how effective were they?
- Why do you think antenna alignment is so critical for maintaining a stable connection in SATCOM?
- Write down responses on the whiteboard and encourage discussion.

## Elaborate | .



During this session, we will focus on:

- **Understanding Down Calls:** Down calls occur when there is a disruption in the communication link, resulting in dropped calls or failure to establish a connection. These interruptions can be caused by multiple factors, including equipment malfunction, interference, or environmental conditions.
- **Parameters Affecting SATCOM Performance:** 
  - Signal Power: The strength of the signal transmitted or received can directly impact the clarity and reliability of communication.
  - Path Loss: This refers to the loss of signal strength as the signal travels through the atmosphere. Higher distances or poor weather conditions can lead to greater path loss.
  - Antenna Gain: The ability of an antenna to focus energy in a specific direction. Poor antenna alignment can reduce gain and cause signal degradation.
  - Interference: Adjacent satellites, other communication systems, or electromagnetic interference can disrupt signal clarity, causing down calls.

#### Equipment Examination and Fault Diagnosis:

o When troubleshooting down calls, it's important to check both the transmitting and receiving equipment for malfunctions. Key equipment to inspect includes satellite transceivers, antennas, and cabling.

#### • Interference Analysis:

o Interference can arise from adjacent satellites operating on similar frequencies or from terrestrial communication systems. External sources like electromagnetic interference (EMI) from power lines or equipment can also affect signal quality.

#### Diagnostic Tools:

- o Ping Tests: Test connectivity and measure response time to identify network latency.
- Latency Measurements: High latency can contribute to down calls, especially in satellite networks where the distance signals travel is substantial.
- o Bit Error Rate (BER) Calculations: Measure the error rate in received data to identify signal quality issues.

#### • Escalation Matrix:

o The escalation matrix outlines the procedures for reporting incidents based on their severity. It ensures that issues are promptly addressed and escalated to the right technical or management level for resolution.

## Activity-1



## Name: Signal Power and Interference Detection

- Objectives:
  - To test the effect of signal power and interference on the communication link.
- Materials Needed:
  - Signal strength meter, spectrum analyzer, satellite dish, cables.
- Procedure:
  - Set up the satellite dish and connect it to the signal strength meter.
  - Measure the signal power at the receiver's end.
  - Introduce controlled interference by placing an adjacent communication device nearby.
  - Measure the change in signal power and identify potential interference sources.
- Outcome:
  - Trainees will learn how signal strength and interference affect SATCOM performance and

## **Activity-2**



#### Name: Fault Diagnosis and Incident Reporting

- Objectives:
  - To practice identifying faults and escalating issues through the proper channels.
- Materials Needed:
  - Faulty SATCOM equipment (e.g., antenna, transceiver), diagnostic tools (ping tester, BER calculator).
- Procedure:
  - Use diagnostic tools to test the equipment for faults.
  - Identify any failures or weak signals affecting communication.
  - Simulate the incident reporting process, escalating the issue based on severity.
- Outcome:
  - Trainees will gain hands-on experience in identifying and diagnosing faults, as well as reporting issues through the escalation matrix.

## - Notes for facilitation 🗐



- Ensure clarity when explaining the parameters affecting SATCOM performance, especially signal power, path loss, and interference.
- Encourage participation by asking trainees about their own experiences with down calls and troubleshooting techniques.
- Provide step-by-step guidance during the diagnostic tool demonstrations to help trainees understand how to conduct proper tests.
- Use real-life scenarios for fault diagnosis and escalation to help trainees understand the practical applications of their learning.
- Reinforce the importance of escalation protocols to ensure that issues are addressed in a timely and organized manner.

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## **Unit 6.2: Signal Strength Optimization and Antenna Alignment**

## Unit Objectives **©**



#### By the end of this unit, the trainees will be able to:

- 1. Explain the importance of signal strength and antenna alignment in ensuring SATCOM performance.
- 2. Elucidate the factors affecting SATCOM signal reliability, such as path loss, satellite power, antenna gains, and cable losses.
- 3. Describe the tools and methods used to measure satellite signal strength and assess antenna alignment.
- 4. Discuss the process of conducting a link budget analysis for evaluating the performance of a satellite link.
- 5. Enlist safety, health, and environmental (SHE) guidelines relevant to SATCOM operations.
- 6. Describe the role of weather, terrain, and interference scenarios in SATCOM performance evaluation.
- 7. Explain the procedure for providing customers with network monitoring access if required.

## Resources to be used



## Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Computer or Laptop, Projector or Smartboard, Internet connectivity, Network Performance Measurement and Analysis Tools, Network Access Control Mechanisms, Firewalls, Intrusion Detection/Prevention Systems (IDS/IPS), Content Filtering Mechanisms, Traffic Analysis Tools, Anomaly Detection Systems, Monitoring Equipment for 5G NR Physical Channels and Signals, Signal Capture Equipment, Frequency Analysis Tools, Error Handling Mechanisms, Channel Estimation and Equalization Tools, Demodulation and Decoding Tools, Analog Beamforming Equipment, Digital Beamforming Equipment, Monitoring Equipment for Beamforming Reconstruction, Beamforming Configuration Tools.

- Welcome to today's session on Signal Strength Optimization and Antenna Alignment!
- In this unit, we will explore how factors like path loss, satellite power, and antenna gain affect performance.

- In SATCOM systems, reliable communication hinges on the strength and quality of the signals transmitted and received, as well as the proper alignment of antennas.
- We will also look at the tools and techniques used to measure and optimize signal strength, perform link budget analysis, and ensure the SATCOM network operates at its peak.
- By the end of this unit, you'll understand the steps to improve signal strength and the importance of proper antenna alignment.

## Ask ask



- Why do you think signal strength and antenna alignment are so critical for SATCOM performance?
- What tools or equipment do you think are needed to measure the strength of a satellite signal?
- How do you think environmental factors like weather or terrain could impact SATCOM operations?
- Can anyone describe what a link budget is and why it would be important in SATCOM?
- How does signal interference affect communication between satellites, and how can we mitigate this?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

#### 1. Importance of Signal Strength and Antenna Alignment:

Signal strength directly affects the quality of communication in SATCOM systems. If the signal is too weak, data loss, reduced quality, or complete failure can occur. Proper antenna alignment is also crucial because any misalignment can lead to a loss of signal or poor performance. Antenna orientation must be precise to ensure maximum signal capture from the satellite.

#### 2. Factors Affecting SATCOM Signal Reliability:

- Path Loss: The reduction in signal strength as it travels through the atmosphere. Higher distances or certain obstacles can increase path loss.
- Satellite Power: The strength of the signal transmitted by the satellite itself. Lower power levels can cause weak reception at the ground station.
- Antenna Gain: The ability of an antenna to focus the energy it receives in a particular direction. Higher antenna gain improves signal strength.

- **Cable Losses:** Signal loss that occurs in the cables connecting the antenna to the receiver. High-quality cables can minimize this loss.
- 3. Tools for Signal Measurement and Antenna Alignment:
  - Signal Strength Meters: Measure the power of the received signal.
  - **Spectrum Analyzers:** Analyze the frequency spectrum to identify any interference or weak signals.
  - **Theodolites:** Precision instruments used for aligning antennas to the correct angle for satellite communication.
- 4. Link Budget Analysis:
  - Link budget analysis involves calculating the total gain and losses in the signal path to determine whether the satellite link will provide adequate performance. It takes into account various factors, including satellite power, antenna gain, path loss, and cable losses.
- 5. Evaluating SATCOM Performance Under Varying Conditions:
  - Weather (rain, snow, or fog), terrain (mountains, valleys), and interference from other signals can all affect the performance of SATCOM links. Understanding these conditions and optimizing the equipment accordingly is essential for reliable service.
- 6. SHE Guidelines for SATCOM Operations:
  - Safety, Health, and Environmental (SHE) guidelines are vital to ensure that SATCOM operations are conducted in a safe and environmentally responsible manner. This includes proper handling of equipment, following protocols during installations, and minimizing environmental impact.
- 7. Network Monitoring and Customer Support:
  - Network monitoring tools help ensure the SATCOM system is running smoothly. These tools
    can detect signal strength variations, faults, and other issues in real-time. Providing customers
    with network monitoring access can help identify and resolve performance issues quickly.

## - Activity-1



#### Name: Signal Strength Measurement and Optimization

- Objectives:
  - o To measure the strength of a satellite signal and optimize it for improved communication quality.
- Materials Needed:
  - o Signal strength meter, spectrum analyzer, satellite dish, alignment tools, cables.

#### Procedure

- Set up the satellite dish and connect the signal strength meter.
- Measure the received signal strength. 0
- Adjust the antenna alignment slightly and recheck the signal strength. 0
- Use the spectrum analyzer to check for any interference in the frequency band. 0
- Optimize antenna orientation for maximum signal strength.

## **Activity-2**



#### Name: Link Budget Analysis

- Objectives:
  - To practice calculating a link budget and assess the expected performance of a satellite link.
- · Materials Needed:
  - Link budget calculator, signal strength data, satellite power data, antenna gain values.
- Procedure:
  - Collect all required data, such as satellite power, path loss, antenna gain, and cable losses.
  - Use the link budget calculator to input the data and calculate the overall link performance.
  - Analyze the results and identify any areas where performance could be improved (e.g., through antenna adjustment or reducing cable losses).
- Outcome:
  - Trainees will learn how to conduct a link budget analysis to evaluate satellite link performance and make necessary adjustments.

## Notes for facilitation



- Provide clear instructions during practical activities, especially for measuring signal strength and performing link budget analysis.
- Encourage discussions around real-life scenarios where weather or terrain might affect SATCOM operations, especially in challenging environments.

- Highlight the importance of SHE guidelines and ensure that trainees understand the significance of safety during all operations.
- Use diagrams and visuals to explain the concept of link budgets and antenna alignment to make complex concepts more digestible.
- Ensure hands-on practice with tools like signal strength meters, spectrum analyzers, and link budget calculators to build confidence in using these instruments.

## **Exercise**



Key Solutions to PHB Exercise

#### **Short Answer Questions:**

#### 1. What are the factors that can cause a down call in a SATCOM system?

The factors that can cause a down call in a SATCOM system include signal degradation due to path loss, interference from adjacent satellites or other communication systems, incorrect antenna alignment, weather conditions (rain fade, snow, fog), equipment malfunctions, cable losses, and satellite power issues.

#### 2. How do diagnostic tools like ping tests and BER calculations help identify the cause of a down call?

Diagnostic tools like ping tests help determine if the signal is being received by the intended satellite or ground station, identifying any packet loss or delays. Bit Error Rate (BER) calculations measure the number of corrupted bits received, helping to assess the quality of the transmission and determine if errors are caused by weak signal strength, interference, or equipment failure.

#### 3. Why is the alignment of a satellite antenna important in SATCOM operations?

The alignment of a satellite antenna is crucial because if the antenna is not properly aligned with the satellite, it can lead to poor signal reception or complete loss of the signal. Proper alignment ensures maximum signal strength and optimal performance of the SATCOM system.

#### 4. What is a link budget analysis, and how does it contribute to assessing satellite link performance?

A link budget analysis is a calculation that evaluates the total gain and losses within the satellite communication link. It factors in parameters like satellite power, antenna gains, path loss, and cable losses to predict whether the link will have enough signal strength to ensure reliable communication. It helps assess the overall performance and potential issues that could arise in the link.

#### 5. Describe the role of a network management system (NMS) in troubleshooting SATCOM network issues.

An NMS monitors the performance of the SATCOM network by collecting real-time data on signal strength, bandwidth usage, and device status. It helps identify problems such as congestion, packet loss, or equipment failure. The NMS can also provide alerts and logs for troubleshooting, allowing engineers to resolve issues quickly and optimize network performance.

#### Fill-in-the-Blanks

- 1. Factors like adjacent satellites, other communication systems, and electromagnetic interference can affect SATCOM systems.
- 2. A spectrum analyzer is used to measure satellite signal strength and ensure optimal performance

- 3. The process of assessing expected satellite link performance is called link budget analysis.
- 4. Tools like **network** monitoring systems help detect network traffic abnormalities and packet loss.
- 5. The International Telecommunication Union (ITU) governs **frequency** standards and regulations in SATCOM operations.

#### Tru e/False Questions:

- 1. Electromagnetic interference cannot affect SATCOM operations.
  - False Electromagnetic interference (EMI) can significantly impact SATCOM operations by causing signal degradation, leading to poor communication quality or link failure.
- 2. Performing a link budget analysis is a critical step in evaluating SATCOM link performance.
  - True.
- 3. Network monitoring tools can help detect congestion and abnormal traffic patterns in SATCOM systems.
  - True.
- 4. Field tests at different locations are unnecessary for assessing data connectivity.
  - False Field tests at different locations are important for assessing the real-world performance of the SATCOM system and identifying any coverage or connectivity issues that may not be apparent in lab conditions.
- 5. Database management systems (DBMS) are used to analyze performance data in SATCOM networks.
  - True.











# 7. Network Management, Performance Optimization and Testing

Unit 7.1 – Network Management and Monitoring

Unit 7.2 – Satellite Communications, Industry Associations, and Advanced Network Testing





## Key Learning Outcomes 🙄

#### By the end of this module, the participants will be able to:

- Explain the factors that can cause a down call in a SATCOM system.
- Define the components of network configuration, including IP addresses, subnet masks, routing tables, and NATing settings.
- Explain the purpose and significance of monitoring tools in analyzing network traffic.
- Describe the process of conducting field tests to assess data connectivity under varying conditions.
- Differentiate between normal and abnormal patterns in network traffic.
- Interpret the results of a link budget analysis and its impact on satellite communication performance.
- Explain the role of industry associations like the International Telecommunication Union (ITU) and the Global VSAT Forum (GVF) in the satellite communication sector.
- Demonstrate troubleshooting techniques to identify and resolve errors or anomalies in a monitored data connection.
- Demonstrate the use of specialized network testing tools or software to generate traffic and measure data transfer rates.
- Demonstrate the simulation of link failures or switchovers to verify continuous data connectivity.
- Show how to use monitoring tools to analyze network traffic and identify abnormal patterns, high packet loss, or congestion.
- Show how to perform a link budget analysis to assess the expected performance of a satellite link.
- Show how to conduct field tests at different locations within a coverage area to assess data connectivity under varying conditions.
- Demonstrate the simulation of link failures or switchovers to verify the maintenance of data connectivity without significant interruptions.
- Show how to utilize a Database Management System (DBMS) to collect and organize performance data.
- Show how to employ a Network Management System (NMS) to analyze performance data and make informed decisions.
- Show how to monitor signal strength, link utilization, latency, and throughput using appropriate tools to identify areas for improvement.
- Demonstrate how to generate traffic and measure data transfer rates using specialized network testing tools or software.

- Demonstrate the process of inspecting industry associations such as the International Telecommunication Union (ITU), Global VSAT Forum (GVF), or Satellite Industry Association (SIA) to understand their roles in the satellite communication industry.
- Demonstrate practical testing of SATCOM accessories to assess their functionality and compatibility with the communication system.

## **Unit 7.1: Network Management and Monitoring**

## Unit Objectives **Solution**



#### By the end of this unit, the trainees will be able to:

- 1. Explain the concept of Network Management and its significance in modern IT infrastructures.
- 2. Describe the key components involved in Network Configuration and their roles in network setup.
- 3. Discuss the various monitoring tools used for Network Traffic Analysis and their effectiveness.
- 4. Elucidate the common Troubleshooting Techniques employed to resolve network issues.
- 5. Determine the relationship between Database Management Systems (DBMS) and Network Management Systems (NMS) in maintaining network performance.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Computer or Laptop, Projector or Smartboard, Internet connectivity, Network Performance Measurement and Analysis Tools, Network Access Control Mechanisms, Firewalls, Intrusion Detection/Prevention Systems (IDS/IPS), Content Filtering Mechanisms, Traffic Analysis Tools, Anomaly Detection Systems, Monitoring Equipment for 5G NR Physical Channels and Signals, Signal Capture Equipment, Frequency Analysis Tools, Error Handling Mechanisms, Channel Estimation and Equalization Tools, Demodulation and Decoding Tools, Analog Beamforming Equipment, Digital Beamforming Equipment, Monitoring Equipment for Beamforming Reconstruction, Beamforming Configuration Tools.



- Welcome to today's session on Network Management and Monitoring. In today's interconnected world, efficient network management is crucial for ensuring reliable and secure communication.
- This session will help you understand how networks are managed, monitored, and optimized, especially in Satellite Communication (SATCOM) networks.
- We'll discuss key concepts like network configuration, monitoring tools, and troubleshooting techniques, and explore their importance in maintaining a high-performing network.

## Ask ask



- Why do you think network management is so important for IT infrastructures?
- Have you used any network monitoring tools before? What did you learn from them?
- What challenges do you think network engineers face while troubleshooting SATCOM networks?
- How does network traffic analysis help in maintaining network performance?
- Can anyone share an example of a network issue they've encountered and how it was resolved?
- Write down responses on the whiteboard and encourage discussion.

### Elaborate |



During this session, we will focus on:

#### 1. Network Management and its Need:

Network management involves monitoring, controlling, and optimizing network performance to ensure seamless connectivity and security. It is crucial in modern IT infrastructures to prevent downtime, enhance productivity, and improve service quality.

#### 2. Key Elements of Network Management:

The key elements include:

- Configuration Management: Ensures that devices and systems are properly configured to work within the network.
- Fault Management: Identifies, isolates, and resolves network faults.
- Performance Management: Monitors network performance to identify bottlenecks and inefficiencies.
- Security Management: Ensures network security against unauthorized access, malware, and cyber-attacks.
- Accounting Management: Tracks and measures network usage to ensure optimal resource allocation.

#### 3. Satellite Communication Networks (SATCOM):

SATCOM networks enable global communication through satellites orbiting the Earth. These networks provide essential services like data transfer, voice communication, and broadcasting in areas where terrestrial networks cannot reach.

#### 4. Components of SATCOM Network Configuration:

SATCOM network configuration involves several components, including satellite antennas, transceivers, routers, and network management systems. Proper configuration is necessary for optimal performance and efficient use of bandwidth.

#### 5. Monitoring and Traffic Analysis in SATCOM:

Monitoring tools help track network performance and identify issues like latency, jitter, or packet loss. Traffic analysis tools evaluate network traffic to ensure the efficient use of resources and maintain performance standards.

#### 6. Troubleshooting SATCOM Errors and Anomalies:

Troubleshooting involves identifying the root cause of network issues, such as signal interference, equipment failure, or misconfiguration. Techniques like ping tests, latency checks, and using monitoring tools help resolve these problems.

## Activity-1



#### Name: Network Configuration and Monitoring Exercise

- Objectives:
  - To understand the process of network configuration for SATCOM systems.
  - To practice using network monitoring tools to identify performance issues.
- · Materials Needed:
  - SATCOM network simulation software or actual network equipment (if available).
  - Network monitoring tool (e.g., Wireshark, SolarWinds).
  - Laptop or computer with access to network monitoring tools.
- Procedure:
  - Configure a basic SATCOM network setup using the available tools or simulator.
  - Perform network monitoring to assess the system's performance.
  - Identify and troubleshoot any performance issues (e.g., latency, packet loss).
  - Use network monitoring tools to generate traffic reports and analyze network performance.
- Outcome:
  - Trainees will understand the essential components of SATCOM network configuration and will be able to monitor network traffic and troubleshoot issues effectively.

## **Activity-2**



#### Name: Network Configuration and Monitoring Exercise

• Objectives:

- To practice troubleshooting common network issues in SATCOM systems.
- To learn how to use diagnostic tools to resolve network anomalies.

#### Materials Needed:

- SATCOM simulation or test equipment with pre-configured issues.
- Diagnostic tools such as ping testers, signal strength meters, and latency analyzers.
- Laptop or computer with troubleshooting software.

#### Procedure:

- Use diagnostic tools to detect network issues such as packet loss, high latency, or equipment malfunction.
- Troubleshoot and resolve the issues by adjusting configurations or rerouting traffic.
- Document the steps taken to resolve the issue and verify network performance after troubleshooting.

#### · Outcome:

Trainees will be able to identify and resolve common SATCOM network issues using troubleshooting tools and techniques, ensuring optimized network performance.

## Notes for facilitation



- Encourage Active Participation: Prompt trainees to share their experiences and challenges with network management and monitoring.
- Hands-On Practice: Ensure that trainees have sufficient hands-on time with network configuration and monitoring tools. Practical exercises enhance learning and make the concepts clearer.
- Real-World Scenarios: Use real-world examples of network issues and troubleshooting steps to make the session more relatable.
- Emphasize Best Practices: While discussing network configuration, highlight industry best practices for security, performance optimization, and error prevention.
- Safety and Compliance: If discussing tools or troubleshooting in live environments, emphasize safety and compliance with health and environmental standards.

Notes 🗐 —		

## Unit 7.2: Satellite Communications, Industry Associations, and Advanced Network Testing

## Unit Objectives | ©



#### By the end of this unit, the trainees will be able to:

- 1. Explain the concept of link budget analysis in satellite communications and its importance in ensuring reliable connectivity.
- 2. Describe the role of industry associations in the development and regulation of satellite communications.
- 3. Discuss how simulating link failures and maintenance procedures help in assessing the reliability of satellite communication systems.
- 4. Elucidate the process and importance of practical testing for satellite communication (SATCOM) accessories.
- 5. Determine how network management systems (NMS) and database management systems (DBMS) can be used for performance analysis in satellite communications.
- 6. Explain the use of monitoring tools in evaluating satellite and network performance for optimal operations.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Computer or Laptop, Projector or Smartboard, Internet connectivity, Network Performance Measurement and Analysis Tools, Network Access Control Mechanisms, Firewalls, Intrusion Detection/Prevention Systems (IDS/IPS), Content Filtering Mechanisms, Traffic Analysis Tools, Anomaly Detection Systems, Monitoring Equipment for 5G NR Physical Channels and Signals, Signal Capture Equipment, Frequency Analysis Tools, Error Handling Mechanisms, Channel Estimation and Equalization Tools, Demodulation and Decoding Tools, Analog Beamforming Equipment, Digital Beamforming Equipment, Monitoring Equipment for Beamforming Reconstruction, Beamforming Configuration Tools.



Welcome to today's session on Satellite Communications, Industry Associations, and Advanced Network Testing.

- In the rapidly evolving world of satellite communications, understanding the technical and regulatory landscape is key to ensuring seamless connectivity.
- Today, we'll explore the concept of link budget analysis, the role of industry associations, simulating link failures for better reliability, practical testing of SATCOM accessories, and how monitoring and network management systems can optimize satellite performance.

### Ask ask



- What do you understand by the term 'link budget' in satellite communications?
- Can you think of any examples where satellite communication might fail and why those failures happen?
- Why do you think industry associations play such an important role in satellite communications?
- Have you used any network management or monitoring tools before? What was your experience with them?
- How would you test a satellite communication accessory to ensure it works properly in the field?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

#### The Link Budget Equation:

Link budget analysis is a critical calculation that ensures the reliability of satellite communications. It involves measuring the total gains and losses from the transmitter, through the free space, and to the receiver. Factors like satellite power, antenna gains, cable losses, and weather conditions all impact the link budget. The link budget equation helps engineers understand whether the satellite communication system will provide the required signal strength for reliable communication.

#### • Role of Industry Associations:

Industry associations like the Satellite Industry Association (SIA), International Telecommunication Union (ITU), and the Global VSAT Forum (GVF) are integral to the development and regulation of satellite communications. These organizations set industry standards, develop best practices, and help address regulatory issues that affect satellite operators, manufacturers, and service providers globally. They ensure fair competition and the sustainable growth of the satellite communication industry.

#### Simulating Link Failures and Maintenance:

o Simulating link failures and maintenance procedures is essential to assess the reliability and resilience of SATCOM systems. Engineers simulate these failures under controlled conditions to identify vulnerabilities and improve system designs. Maintenance procedures, when tested thoroughly, help ensure that the satellite communication system can recover quickly and maintain operations during unforeseen issues.

#### • Practical Testing of Satellite Communication (SATCOM) Accessories:

Practical testing is crucial for ensuring that SATCOM accessories such as antennas, transceivers, and cables work under real-world conditions. These tests check performance metrics such as signal strength, frequency stability, and power consumption. The goal is to identify potential weaknesses before these accessories are deployed for mission-critical applications.

#### Using Network Management Systems (NMS) and DBMS for Performance Analysis:

Network Management Systems (NMS) monitor network components and provide insights into network health and performance. NMS helps in identifying bottlenecks, outages, and performance degradation. Database Management Systems (DBMS) store historical data that can be analyzed for trends and anomalies in network performance. Both tools are crucial for optimizing satellite network operations.

#### • Monitoring Tools for Satellite and Network Performance:

Monitoring tools like satellite tracking systems, signal analyzers, and performance meters are used to evaluate satellite and network performance. These tools help ensure that the system operates within its specified parameters and can provide alerts in case of any irregularities. Proper monitoring ensures optimal satellite performance, reducing downtime and maintaining service quality.

## Activity-1

#### Name: Link Budget Calculation

#### Objectives:

- To calculate the link budget for a given satellite communication setup.
- To understand the effect of various factors on satellite link performance.

#### • Materials Needed:

- Calculator
- Link budget formula
- Satellite parameters (e.g., satellite power, antenna gains, cable losses, path loss)
- Laptop (optional, for simulation software)

#### • Procedure:

- Provide the trainees with values for satellite power, antenna gains, cable losses, and free space path loss.
- Using the link budget formula, calculate the total gain/loss for the given satellite system.
- Analyze the result to determine if the system will have sufficient signal strength for reliable communication.
- Discuss how changes in parameters (e.g., higher path loss or lower antenna gain) affect the link budget and system performance.

#### • Outcome:

Trainees will learn how to calculate a link budget and interpret its impact on satellite communication performance. They will also understand how various factors contribute to signal strength and reliability.

## Activity-2



#### Name: Network Configuration and Monitoring Exercise

- Objectives:
  - To simulate a link failure in a satellite communication system.
  - To practice troubleshooting techniques to restore connectivity.

#### • Materials Needed:

- SATCOM simulator or live equipment (e.g., satellite receiver, transmitter)
- Network monitoring tools (e.g., signal analyzers, troubleshooting software) o
- Documentation for troubleshooting steps

#### • Procedure:

- Simulate a link failure scenario by introducing issues such as misalignment or signal interference in the SATCOM system.
- Use monitoring tools to detect the failure and identify its cause (e.g., misalignment, equipment malfunction).
- Follow troubleshooting steps to restore the link, adjusting the antenna alignment or replacing faulty cables.
- Document the process and discuss ways to prevent future failures.

#### • Outcome:

Trainees will gain hands-on experience in diagnosing and resolving link failure issues in a satellite communication system, helping them understand the steps required to maintain reliability.

## Notes for facilitation



- Hands-on Learning: Ensure that trainees have the opportunity to practice with simulators or live equipment during activities to gain practical experience.
- Real-World Scenarios: Use examples from industry case studies to demonstrate how link budget analysis and troubleshooting are applied in actual satellite communication systems.
- Interactive Discussion: Encourage trainees to discuss the challenges and best practices in using NMS, DBMS, and monitoring tools for satellite performance analysis.
- Emphasize Accuracy: Stress the importance of accurate measurements in both link budget analysis and troubleshooting to prevent operational issues.
- Engage with Industry Associations: If possible, invite guest speakers from industry associations to share insights on standards, regulations, and the evolving landscape of satellite communications.

## **Exercise**



Key Solutions to PHB Exercise

#### **Short Answer Questions:**

#### 1. Define the key components of network configuration.

The key components of network configuration include IP addresses, subnet masks, routing tables, Network Address Translation (NAT), DNS settings, and gateway configurations. These components are essential for ensuring the proper functioning of a network and allowing seamless communication between devices.

#### 2. Explain the purpose of monitoring tools in network traffic analysis.

Monitoring tools in network traffic analysis are used to continuously track and evaluate the flow of data within a network. They help identify traffic patterns, detect congestion, monitor data transfer speeds, and pinpoint any abnormalities or performance issues such as packet loss, latency, or security breaches.

#### 3. What is a link budget analysis, and how does it impact satellite communication performance?

Link budget analysis is the process of calculating the total gain and loss of a satellite communication link. It considers factors like transmitter power, antenna gains, free space path loss, and receiver sensitivity. A proper link budget analysis ensures that the signal strength is sufficient for reliable communication. Insufficient signal strength may lead to dropped connections or degraded performance.

#### 4. Differentiate between normal and abnormal patterns in network traffic.

Normal network traffic patterns are consistent and predictable, with expected levels of data flow, latency, and response times based on network usage. Abnormal patterns, on the other hand, include unusual spikes in traffic, delays, packet loss, or congestion, which may indicate issues such as network failure, attacks, or configuration errors.

#### 5. What roles do organizations like ITU and GVF play in the satellite communication industry?

The International Telecommunication Union (ITU) and the Global VSAT Forum (GVF) are industry associations that play crucial roles in setting global standards, promoting best practices, and addressing regulatory and operational challenges in satellite communications. ITU establishes guidelines for satellite spectrum allocation and interference management, while GVF supports the development of satellite services and technologies.

#### Fill-in-the-Blanks

- 1. The components of network configuration include IP addresses, subnet masks, routing tables, and NATing settings.
- 2. Monitoring tools are used to analyze **network** traffic and identify abnormal patterns or congestion
- 3. Link budget analysis is conducted to assess the expected performance of a satellite link.

- 4. A **Network** Management System (NMS) is used to analyze performance data and make informed decisions.
- 5. Field tests assess data connectivity under varying **environmental** conditions.

#### **True/False Questions:**

- 1. Specialized network testing tools can measure data transfer rates and generate traffic.
  - True.
- 2. Monitoring tools cannot identify packet loss or congestion in network traffic.
  - False. (Monitoring tools are specifically designed to identify issues like packet loss, congestion, and abnormal traffic patterns in network traffic. They can track metrics such as latency, throughput, and error rates to detect congestion or packet loss, which are key indicators of network performance problems)
- 3. A Database Management System (DBMS) helps collect and organize performance data.
  - True.
- 4. Industry associations like ITU and GVF play no significant role in satellite communication.
  - False. (Industry associations like the International Telecommunication Union (ITU) and the Global VSAT Forum (GVF) play crucial roles in the satellite communication industry. ITU is responsible for regulating global satellite spectrum allocation, ensuring coordination to prevent interference, and promoting international communication standards. GVF supports the growth and development of satellite communication services, offering guidelines and promoting best practices within the industry. Their involvement is vital for the advancement and regulation of satellite technologies)
- 5. The simulation of link failures helps verify continuous data connectivity.
  - True.











# 8. Manage Work, Resources and Safety at Workplace

Unit 8.1 – Workplace Safety, Resource Management, and Task Handling

Unit 8.2 – Waste Management, Workplace Cleanliness, and Safety Procedures





## Key Learning Outcomes 🙄



#### By the end of this module, the participants will be able to:

- Explain the importance of following the standard operating procedures of the company with respect to privacy, confidentiality, and security.
- Enlist the key performance indicators for the new tasks.
- Identify the opportunities for team-building workshops and motivational training.
- List and explain the work requirements to be followed by the team.
- Identify the issues with work processes and how to handle them.
- Discuss the correct way to show emotions at the workplace.
- Describe the importance of timely completion of tasks.
- Explain the importance of the escalation matrix.
- Explain the importance of providing and receiving feedback constructively.
- Analyse ways to optimize the usage of resources.
- Enlist the importance, causes, and effects of greening of jobs.
- Identify different types of hazards such as illness, accidents, and fires.
- Enlist the causes of risks and potential hazards in a work area and ways to prevent them.
- Enlist the steps to report accidents and health-related issues as per SOP.
- Explain the concept of waste management.
- Enlist the methods of waste disposal.
- Identify the different categories of waste for the purpose of segregation.
- Differentiate between recyclable and non-recyclable waste.
- Enlist electronic waste disposal procedures.
- Demonstrate techniques to save on cost and time.
- Demonstrate routine cleaning of tools, equipment, and machines to ensure the team follows the same.
- Show how to use resources such as water judiciously.
- Show how to check for malfunctions in equipment and report as per SOP.
- Show how to report any breaches in safety and security to the concerned person.

- Illustrate ways to keep the work area clean, such as mopping spills and leaks or cleaning grease stains.
- Show how to check for spills and leaks and plug the same.
- Demonstrate segregation of types of hazardous waste.
- Illustrate steps to minimize waste.
- Illustrate proper waste disposal procedures and how to dispose of hazardous waste.
- Illustrate ways to find the exact cause of a problem and validate the same in case done by a team member.

## **Unit 8.1: Network Management and Monitoring**

## **Unit Objectives**

#### By the end of this unit, the trainees will be able to:

- 1. Explain the importance of following company SOPs related to privacy, confidentiality, and security in the workplace.
- 2. Describe how KPIs can be defined and tracked to improve performance and task management.
- 3. Discuss how team-building opportunities and motivational training can foster collaboration and engagement within teams.
- 4. Elucidate the process of setting clear work requirements and expectations and how to handle conflict resolution within a team.
- 5. Discuss the importance of emotional intelligence in the workplace and how to manage emotions and conflicts professionally.
- 6. Explain the significance of timely task completion and its impact on team productivity and how to manage deadlines effectively.
- 7. Describe when and how to escalate issues and the importance of providing and receiving constructive feedback.
- 8. Determine how to optimize resources for productivity and apply techniques for resource conservation, including time, equipment, and personnel.

## Resources to be used



#### Theory

Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.

#### **Practical**

Personal Protection Equipment: safety glasses, head protection, rubber gloves, safety footwear, warning signs and tapes, fire extinguisher and first aid kit.

Today's session focuses on workplace safety, efficient resource management, and handling tasks professionally.

- These skills not only enhance your personal performance but also contribute to a cohesive, productive team environment.
- Let's explore practical strategies to optimize our work and achieve organizational goals effectively.

#### **Ask**



- What do you understand about the construction industry?
- Can you share an instance where team collaboration helped complete a task more effectively?
- Why do you think emotional intelligence is important in the workplace?
- What methods have you used or seen for managing tasks and meeting deadlines?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

#### • The Link Budget Equation:

Link budget analysis is a critical calculation that ensures the reliability of satellite communications. It involves measuring the total gains and losses from the transmitter, through the free space, and to the receiver. Factors like satellite power, antenna gains, cable losses, and weather conditions all impact the link budget. The link budget equation helps engineers understand whether the satellite communication system will provide the required signal strength for reliable communication.

#### • Privacy, Confidentiality, and Security:

- Adherence to SOPs ensures trust and compliance with organizational standards.
- o Safeguarding sensitive data prevents breaches and enhances organizational reputation.

#### • Key Performance Indicators (KPIs):

- o Define measurable goals for team and individual performance.
- o Regularly track progress to identify areas for improvement.

#### • Team Building and Motivation:

- o Foster collaboration through team activities and training.
- o Encourage open communication and celebrate team achievements.

- **Emotional Intelligence in the Workplace:** 
  - Recognize and manage emotions for better interpersonal relationships.
  - Approach conflicts with empathy and a problem-solving mindset.
- **Time and Resource Optimization:** 
  - Prioritize tasks based on urgency and importance.
  - Conserve resources through efficient use of time, equipment, and personnel. These skills not only enhance your personal performance but also contribute to a cohesive, productive team environment.

## Activity-1



#### Name: Deadline Dash

- Objective:
  - To teach prioritization and deadline management skills.
- Materials Needed:
  - Task cards with varying levels of urgency and importance, timers.
- Procedure:
  - Distribute task cards to trainees.
  - Ask them to prioritize and complete tasks within a set timeframe.
  - Discuss their prioritization choices and time management techniques.
- Outcome:
  - Trainees learn to prioritize tasks effectively and manage deadlines.

## Activity-2



#### Name: The Team Dynamics Challenge

- Objective:
  - To develop conflict resolution and emotional intelligence skills.
- · Materials Needed:
  - Scenario scripts, role assignments for trainees.

#### • Procedure:

- Assign roles based on a workplace conflict scenario (e.g., team disagreement on task allocation).
- Facilitate a role-play exercise where trainees resolve the conflict professionally
- . Provide feedback on their approach and suggest improvements.

#### • Outcome:

Trainees gain hands-on experience in managing workplace conflicts effectively.

## - Notes for facilitation 🗐



- Ensure discussions are inclusive and encourage sharing of personal experiences.
- Provide real-world examples to illustrate key points for better understanding.
- Highlight the importance of active listening and constructive feedback in both activities and discussions.
- Use visual aids or flowcharts for explaining concepts like KPIs, resource optimization, and escalation matrices.

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# Unit 8.2: Waste Management, Workplace Cleanliness, and Safety Procedures

## Unit Objectives

By the end of this unit, the trainees will be able to:

- 1. Explain how to identify different types of workplace hazards, such as illness, accidents, and fires, and their prevention methods.
- 2. Discuss the concept of waste in the workplace and how waste minimization can save on cost and time.
- 3. Describe the proper techniques for routine cleaning of tools, equipment, and machines to ensure safety and functionality.
- 4. Elucidate the procedures for managing work area cleanliness, handling spills, and ensuring safe disposal of hazardous waste.

#### Resources to be used

- Theory
  - o Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films.
- Practical
  - o Personal Protection Equipment: safety glasses, head protection, rubber gloves, safety footwear, warning signs and tapes, fire extinguisher and first aid kit.

## Say 🗣

- Workplace safety and cleanliness are essential for a productive and hazard-free environment.
- In this session, we will explore effective waste management strategies, safety protocols, and cleanliness procedures to ensure both environmental sustainability and workplace safety.
- Let's learn how small actions can make a big difference.

## Ask @



- Can you identify a hazard in your workplace that could be prevented with better safety measures?
- Why do you think waste minimization is crucial for a sustainable work environment?

- What routine cleaning practices can enhance the lifespan of tools and equipment?
- Write down responses on the whiteboard and encourage discussion.

## **Elaborate**



During this session, we will focus on:

- Safety and Environmental Awareness:
  - o Types of workplace hazards: physical (accidents, slips), chemical (spills), and biological (illness).
  - o Preventive measures: safety gear, signage, and regular hazard audits.
- Waste Management and Sustainability:
  - o Types of workplace waste: recyclable, non-recyclable, and hazardous.
  - Waste minimization techniques: segregating waste, reusing materials, and proper disposal methods.
- Equipment Maintenance and Safety:
  - o Importance of regular cleaning to prevent wear, tear, and accidents.
  - o Use of appropriate cleaning agents and protective equipment.
- Work Area Cleanliness and Safety Procedures:
  - o Steps for handling spills: contain, clean, and dispose.
  - o Safe disposal of hazardous waste to prevent environmental harm.

## **Activity-1**



#### Name: Sort It Right

- · Objective:
  - o To teach proper waste segregation and disposal techniques.
- Materials Needed:
  - o Waste items (plastic, paper, hazardous material, etc.), labeled bins (recyclable, non-recyclable, hazardous).
- Procedure:
  - o Provide trainees with mixed waste items.

- Ask them to segregate items into appropriate bins.
- Discuss common mistakes and the importance of accurate segregation.
- Outcome:
  - Trainees will understand the importance and process of waste segregation for sustainability.

## **Activity-2**



#### Name: Clean It Safe

- Objective:
  - To teach proper handling of spills and hazardous waste disposal.
- Materials Needed:
  - Colored water (to simulate a spill), absorbent materials, gloves, safety signs, cleaning tools.
- Procedure:
  - Simulate a spill scenario in a designated area.
  - Ask trainees to follow spill management steps: contain, clean, and dispose.
  - Provide feedback on their actions and explain how to improve.
- Outcome:
  - Trainees will learn safe spill management techniques to ensure workplace safety.

## - Notes for facilitation 🗐



- Use visual aids to highlight types of hazards, waste segregation techniques, and spill management procedures.
- Encourage active participation in activities to reinforce practical learning.
- Provide real-world examples of safety lapses and successful waste management practices.
- Emphasize the link between cleanliness, safety, and productivity.

## **Exercise**



Key Solutions to PHB Exercise

#### **Short Answer Questions:**

1. Why is it important to follow the standard operating procedures related to privacy, confidentiality, and security?

SOPs ensure that sensitive information is protected, fostering trust, compliance with legal standards, and preventing security breaches.

2. What are some key performance indicators that should be considered for new tasks?

Examples include task completion time, accuracy, resource utilization, and team collaboration metrics.

3. How can team-building workshops and motivational training contribute to team performance?

They improve communication, foster trust, and enhance team cohesion, leading to better collaboration and productivity.

4. What are some common work requirements that need to be followed by a team?

These include adherence to deadlines, following SOPs, maintaining workplace cleanliness, and ensuring safety protocols.

5. How can you identify and address issues in work processes?

By conducting regular audits, gathering feedback, analyzing performance metrics, and implementing corrective actions promptly.

#### Fill-in-the-Blanks

- 1. One of the main reasons to follow the escalation matrix is to ensure proper **resolution** in case of problems or emergencies.
- 2. The concept of **waste** management includes the collection, sorting, recycling, and disposal of waste in a responsible manner.
- 3. The steps to report an accident or health-related issue as per SOP include **documenting** and notifying the relevant authorities.
- 4. The correct procedure to manage hazardous waste involves **segregation** to avoid contamination and ensure safe disposal.

#### **True/False Questions:**

- 1. Specialized network testing tools can measure data transfer rates and generate traffic.
  - True.

- 2. It is acceptable to ignore the escalation matrix if you feel the issue is minor.
  - False. (Ignoring the escalation matrix, even for minor issues, can lead to unresolved problems escalating into larger ones. Following the matrix ensures proper communication, accountability, and timely resolution, reducing potential risks)
- 3. Feedback should only be given when it's positive, as negative feedback can be harmful.
  - False. (Constructive feedback, whether positive or negative, is essential for growth and improvement. Negative feedback, when delivered professionally, helps individuals identify areas of improvement and develop solutions to perform better)
- 4. Segregating waste into recyclable and non-recyclable categories is crucial for effective waste management.
  - True.
- 5. Waste disposal procedures are the same for all types of waste, including hazardous waste.
  - False. (Different types of waste require specific disposal methods. Hazardous waste, such as chemicals or biomedical waste, must be handled and disposed of following strict guidelines to prevent environmental contamination and health risks)

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# 9. Employability Skills (60 Hours)

It is recommended that all trainings include the appropriate Employability Skills Module. Content for the same can be accessed



DGT/VSQ/N0102









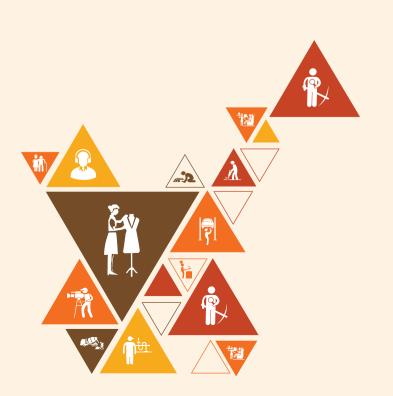


## 10. Annexures

Annexure I - Training Delivery Plan

Annexure II - Assessment Criteria

Annexure III - QR Codes - Video Links





## -Annexure I

## **Training Delivery Plan**

Training Delivery Plan							
Program Name:	SATCOM Operati	on Technician					
Qualification Pack Name & Ref. ID	SATCOM Operation	on Technician, TSC/Q6222					
Version No.	1.0	<u>'</u>					
Prerequisites to Training (if any)	(Electrical/ Electr OR Completed 2nd relevant experier OR Completed 3-yea experience) OR Previous relevant	Completed 2nd year diploma after 12th (in relevant field with 1 year of relevant experience)  OR  Completed 3-year diploma after 10th (in relevant field with 1 year of relevant experience)  OR  Previous relevant Qualification of NSQF Level (4 (Infrastructure Technician-5G Network, Technician 5G- Active Network Installation)) with 3 Years of					
Training Outcomes	<ul> <li>Install of Anter</li> <li>Set up and Ope</li> <li>Signal Analysis,</li> <li>Manage Netwo</li> <li>Incident manage</li> <li>Network Manage</li> </ul>	this program, participants will I nna at remote end and establish erate Ground Station Ground Station Maintenance, and ork Operation Centre (NOC) or Hugement or PM Activity gement, Performance Optimization Resources and Safety at workplankills (60 Hours)	nd Security Implementation  ub  on and Testing				

SI. No.	Module	Unit	Session Name	Session Objectives	NOS Reference	Method -ology	Training Tools / Aids	Duration (hours)
1	Chapter 1: Introduction to the Telecom Industry and about SATCOM Operation T- 10:00	Unit 1.1: Overview of the Telecom Industry and SATCOM Operations	1. Introduction to the Telecom Industry and SATCOM	Explain the size and scope of the Telecom industry and the role of SATCOM in the telecom ecosystem.	TSC/N6267, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16,	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Charts	T- 02:00 P- 02:00
	P- 20:00 (HH: MM)		2. Role and	Identify the key responsibilities of a SATCOM Operation Technician in the process workflow of telecom operations.	PC17, PC18, PC19, PC20, PC21, PC22, PC23, PC24, PC25, PC26, PC27, PC28, PC29, PC30, PC31, PC32, PC33, PC34,	Classroom lecture, games, group participation, group activity	related to Telecom sector and SATCOM operations, and Visual aids on Satellite	T- 02:00 P- 06:00
			3. Career Pathways and Employment Opportunities in SATCOM	Enlist various career pathways and employment opportunities available for a SATCOM Operation Technician.	PC35, PC36, PC37, PC38, PC39, PC40, PC41, PC42, PC43, PC44, PC45, PC46 KU1, KU2, KU3, KU4, KU5, KU6,	Classroom lecture, games, group participation, group activity		T- 02:00 P- 06:00
		Unit 1.2: Workplace Practices and Operational Preparedness	4. Understanding Organizational Policies and Site Operations	Explain organizational policies on workplace ethics, site manag ement, quality standards, and the scheduling of site operations.	KU7, KU8, KU9, KU10, KU11, KU12, KU13, KU14, KU15, KU16, KU17, KU18, KU19, KU20, KU21 GS1, GS2, GS3, GS4, GS5, GS6,	Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:00
			5. Role-Playing for Operational Preparedness and Problem- Solving	Demonstrate role-playing based on case studies to outline the scope, responsibilities, and challenges of a SATCOM Operation Technician.	GS7, GS8.	Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:00

2	Chapter 2: Install of Antenna at Remote End and Establish Link (TEL/ N6267) T- 30:00 P- 30:00 (HH: MM)	Unit 2.1 – Tools and Equipment	1. Introduction to Tools and Equipment for SATCOM Operations	Explain the importance of identifying the correct telnet tools, configuring IPv4 settings, and understanding antenna types and sizes.	TSC/N6267, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC17, PC18, PC19, PC20, PC21, PC22, PC23, PC24, PC25, PC26, PC27, PC38, PC39, PC30, PC31, PC32, PC33, PC34, PC35, PC36, PC37, PC38, PC39, PC40, PC41, PC42, PC43, PC44, PC45, PC46KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU12, KU13, KU14, KU15, KU16, KU17, KU18, KU19, KU20, KU21 GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8.	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Antenna components and assembly materials, Wrenches, Screwdrivers, Cable cutters, Crimping tools, Torque wrenches, Alignment tools, Multimeter, Network cables, Modem or gateway device, IDU modem, gloves, safety goggles, Documentation and manuals	T- 03:00 P- 02:00
			2. Preparing and Organizing Tools for Antenna Installation	Enlist and organize the tools required for antenna installation while ensuring proper maintenance and work area preparation.		Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:00
			3. Antenna Assembly and Cable Routing	Describe the process of assembling an antenna and demonstrate best practices for cable routing while adhering to safety guidelines.		Classroom lecture, games, group participation, group activity		

		4. Grounding and RF Testing Procedures	Explain grounding procedures and demonstrate the use of prescribed tools and testing equipment for accurate RF testing.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
	Unit 2.2 – Antenna Assembly Components and Work Area Preparation	5. Overview of Antenna System	Describe the components of an antenna system and demonstrate how to set up a clean and organized work area for antenna assembly	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
		6. Antenna Mounting and Cable Termination techniques.	Explain the guidelines for mounting the antenna and demonstrate proper cable termination	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
		7. Securing Antenna Assembly and Grounding Procedures	Demonstrate the use of tools for securing the antenna assembly and explain grounding procedures to reduce electrical hazards.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
		8. Antenna Commissioning and Final Inspection	Explain the process of antenna commissioning and demonstrate final inspection and verification procedures.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:0

	Unit 2.3 – Software Installation, Network Configuration, and System Libraries	9. Overview and Software Installation for IDU Modem	Explain the process of installing and configuring software for the IDU modem, including understanding the minimum system requirements	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
	Components and Work Area Preparation	10. Physical Setup and Network Configuration	Describe the procedure for physically connecting the IDU modem to a computer or server and demonstrate network settings configuration.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
		11. System Testing and Signal Acquisition	Explain the process of testing signal acquisition, data transmission, and system functionality after software installation	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
		12. Record Maintenance and Advanced Configuration	Elucidate the process for maintaining installation records and demonstrate advanced configuration, including setting a master IP address.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 02:00

3	Set up and Operate Ground Station (TEL/ N6268) T- 10:00 P- 20:00 (HH: MM)	Unit 3.1  – Ground Station Antenna Installation and Alignment	1. Ground Station Antenna Installation and Key Components	Explain the key components involved in ground station antenna installation, including antennas, thermal control systems, power systems, and attitude	TSC/N6268, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC17, PC18, PC19, PC20, PC21, PC22.KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU12, KU13, KU14, KU15, KU16, KU17, KU18, KU19, KU20.GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8, GS9, GS10, GS11, GS12, GS13.	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Network cables, electrical wires, alarms, indicators, tools and equipment, AC, DG, PIU, SMPS and battery bank, Auto Man Failure (AMF) panel, alarm panel, tools like pliers, power drill, screwdrivers, spanner, measurement tools, like multimeter and thermometer, diagnostic tools, Sample of preventive and corrective maintenance formats and checklists Laptop with software such as MS Office and CRM	T- 02:00 P- 03:00
		Components and Work Area Preparation	2. Antenna Alignment Techniques and Tools	Elucidate the methods and tools used for precise antenna alignment, including bubble levels, inclinometers, and signal strength meters, and describe the importance of proper alignment in optimizing signal reception.		Classroom lecture, games, group participation, group activity		T- 02:00 P- 04:00
			11. System Testing and Signal Acquisition	Explain the process of testing signal acquisition, data transmission, and system functionality after software installation		Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:00

		3. Grounding, Safety, and Maintenance	Discuss the safety protocols for grounding antenna systems to protect against electrical hazards and explain the procedures for antenna maintenance and troubleshooting	Classroom lecture, games, group participation, group activity	T- 01:00 P- 03:00
	Unit 3.2 – Antenna Tracking and Pointing Components and Work Area Preparation	4. Introduction to Antenna Tracking and Specifications	Explain the key components involved in antenna tracking and pointing, including azimuth and elevation angles, tracking mechanisms, and antenna specifications.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
		5. Calibrating and Monitoring Antenna Systems	Discuss the importance of calibrating azimuth and elevation indicators, and explain the process of monitoring and adjusting antenna position based on signal strength and quality.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 04:00
		6. Communication Protocols, Security, and Troubleshooting		Classroom lecture, games, group participation, group activity	T- 01:00 P- 03:00

4	Signal Analysis, Ground Station	Unit 4.1  – Ground Station Equipment	1. Importance of Ground Station Maintenance	Explain the importance of regular maintenance and inspections of ground station equipment to ensure reliability and performance.	TSC/N6269, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC17, PC18, PC19, PC20, PC21, PC22, PC23, PC24.  KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU12.  GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8, GS9, GS10, GS11, GS12, GS13	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Network cables, electrical wires, alarms, indicators, tools and equipment, AC, DG, PIU, SMPS and battery bank, Auto Man Failure (AMF) panel, alarm panel, tools like pliers, power drill, screwdrivers, spanner, measurement tools, like multimeter and thermometer, diagnostic tools, Sample of preventive and corrective maintenance formats and checklists Laptop with software such as MS Office and CRM	T- 02:00 P- 04:00
		Components and Work Area Preparation	2. Establishing a Maintenance Schedule	Describe the steps to establish an effective maintenance schedule for ground station equipment.		Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:00

		3. Antenna Alignment and Tracking Calibration	Elucidate the process of antenna alignment verification and tracking mechanism calibration	Classroom lecture, games, group participation, group activity	Т	T- 02:00 P- 04:00
		4. Maintenance of Ground Station Components	Enlist strategies and techniques for diagnosing and resolving signal quality issues in ground station equipment	Classroom lecture, games, group participation, group activity		T- 02:00 P- 04:00
	Unit 4.2 – Signal Quality Monitoring, Analysis, and Security Measures	1. Introduction to Signal Quality Parameters	Explain how to measure and analyze signal quality parameters such as Signal-to-Noise Ratio (SNR), Bit Error Rate (BER), and Carrier-to- Noise Ratio (C/N).	Classroom lecture, games, group participation, group activity		T- 02:00 P- 04:00
		2. Using Measurement Tools for Signal Quality Monitoring	Describe the process of using measurement tools to assess signal quality in a ground station setup	Classroom lecture, games, group participation, group activity		T- 02:00 P- 04:00
		3. Recording and Analyzing Signal Quality Data	Discuss the importance of maintaining accurate records and analyzing signal quality over time	Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:0
		4. Network Security Measures in Ground Stations	Enlist the necessary security measures, including encryption protocols and access controls, to protect the ground station and communication link	Classroom lecture, games, group participation, group activity		T- 02:00 P- 04:00

			5. Incident Response and Disaster Recovery	Elucidate the process of implementing an incident response plan and disaster recovery procedures in case of security breaches or system failures.		Classroom lecture, games, group participation, group activity		T- 02:00 P- 04:00
5	Gateway ID Management and Configuration for NOC (TSC/ N6270) T- 30:00 P- 30:00 (HH: MM)	Unit 5.1 – Gateway ID Management and Configuration for NOC	1. Introduction to Gateway IDs and Their Role in SATCOM Networks	Explain the importance and role of gateway IDs in SATCOM networks, emphasizing their necessity for managing remote sites. Elucidate the process of assigning unique gateway IDs to SATCOM gateways, ensuring they follow a standardized and consistent format.	TSC/N6270, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC17, PC18, PC19, PC20, PC21, PC22, PC23, PC24, PC25, PC26, PC27, PC30, PC31, PC32, PC33, PC34, PC35, PC36, PC37, PC38, PC39, PC40KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU12, KU13, KU14GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8, GS9, GS10.	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer or Laptop, Projector or Smartboard, Internet connectivity, Network performance Measurement and analysis tools, Spectrum analyzers, Network simulation software, Base station equipment, Antennas, Routers, User Equipment (UE), Radio Access Network (RAN) equipment, Intelligent Controller (RIC), Service Management and Orchestration (SMO) solution, Components of 5G Service-Based Architecture (SBA), Network Function Virtualization (NFV) components, Virtual Infrastructure for hosting VNFs, Frequency band allocation tools, Network integration tools, Network monitoring	T- 03:00 P- 02:00

		2. Assigning and Structuring Gateway IDs	Elucidate the process of assigning unique gateway IDs to SATCOM gateways, ensuring they follow a standardized and consistent format.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
		3. Integrating Gateway IDs into Network Management Systems (NMS)	Describe how gateway ID information is integrated into the Network Management System (NMS) for seamless operation and monitoring of remote sites.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
		4. Security and Configuration Management of Gateway IDs	Discuss the configuration management processes required to track and manage any changes to gateway IDs and demonstrate security measures to protect them.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
	Unit 5.2  – Data Connectivity, Performance Analysis & Monitoring for Cross- Verification	5. Introduction to Data Connectivity and Signal Strength in SATCOM Networksg	Explain the critical factors that influence data connectivity and signal strength in SATCOM networks, and their impact on remote site communication	monitoring and analytics tools,	T- 02:00 P- 04:00
		6. Testing Signal Strength and Ensuring Satellite Link Reliability	Describe the methods for testing signal strength and ensuring that satellite links meet the required specifications for reliable data transmission.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:0

		7. Performance Assessment, Link Budget Analysis, and Antenna Alignment	Explain the process of conducting a link budget analysis to predict satellite link performance and the importance of proper antenna alignment for optimal signal quality.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
		8. Monitoring, Testing, and Simulating Link Failures for Network Redundancy	Explain how to monitor satellite data links, perform latency and error rate testing, and simulate link failures to ensure network redundancy and uninterrupted service.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
	Unit 5.3 – Antenna, Transceiver Selection, and Fault Management for NOC Operations	9. Frequency Planning, Interference Management, and Antenna Selection	Explain the process of selecting antennas with high gain and narrow beamwidth for optimal RX and TX signals and discuss frequency planning to prevent interference in SATCOM operations.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 02:00
	Connectivity, Performance Analysis & Monitoring for Cross- Verification	10. Transceiver Selection, Optimization, and Database Management for SATCOM	Elucidate the features of high-quality transceivers and describe the steps to design a database schema specific to SATCOM operations.	monitoring and analytics tools,	T- 03:00 P- 02:00

			11. Network Management Systems (NMS) for SATCOM Monitoring and Fault Management	Discuss the tools and techniques used in NMS for SATCOM monitoring and explain how fault management features can detect and resolve anomalies in realtime.		Classroom lecture, games, group participation, group activity		TT- 02:00 P- 03:00
			12. Data Transmission Verification and Compliance Procedures	Explain the concept of MAC and its application in verifying data transmission, and describe compliance procedures for hosting and testing applications at remote ends in SATCOM networks.		Classroom lecture, games, group participation, group activity		T- 02:00 P- 03:00
6	Signal Analysis, Ground Station Maintenance, and Security Implementation (TEL/N6271)  T- 30:00 P- 30:00 (HH: MM)	Unit 6.1 – Analyzing and Resolving Down Calls	1. Understanding Down Calls and Parameters Affecting SATCOM Performance	Explain the common causes of down calls in SATCOM systems and elucidate parameters such as signal power, path loss, antenna gain, and interference that affect SATCOM performance.	TSC/N6271, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10.KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9.GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8, GS9, GS10, GS11.	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer or Laptop, Projector or Smartboard, Internet connectivity, Network Performance Measurement and Analysis Tools, Network Access Control Mechanisms, Firewalls, Intrusion Detection/ Prevention Systems (IDS/ IPS), Content Filtering Mechanisms, Traffic Analysis Tools, Anomaly Detection Systems, Monitoring Equipment for 5G NR Physical Channels and Signals, Signal Capture Equipment, Frequency Analysis Tool,	T- 03:00 P- 03:00

	2. Equipment Examination, Fault Diagnosis, and Interference Analysis	Describe the process of examining SATCOM equipment for malfunction or failure during a down call and analyze potential sources of interference in SATCOM systems.	Classroom lecture, games, group participation, group activity	Error Handling Mechanisms, Channel Estimation and Equalization Tools, Demodulation and Decoding Tools, Analog Beamforming Equipment, Digital Beamforming Equipment for Beamforming Equipment for Beamforming Configuration Tools	TT- 02:00 P- 03:00
	3. Diagnostic Tools, Testing, and Traffic/Network Bottleneck Identification	Explain the role of diagnostic tools in performing tests such as ping tests, latency measurements, and Bit Error Rate (BER) calculations, and identify traffic or network bottlenecks that may cause down calls.	Classroom lecture, games, group participation, group activity		T- 03:00 P- 03:00
	4. Incident Reporting, Escalation, and Signal Optimization	Describe the escalation matrix for reporting incidents and trouble in SATCOM operations and explain signal strength optimization and antenna alignment to resolve down calls.	Classroom lecture, games, group participation, group activity	Beamforming Equipment, Digital Beamforming Equipment, Monitoring Equipment for Beamforming Reconstruction, Beamforming Configuration Tools	T- 03:00 P- 03:00

	Unit 6.2 – Signal Strength	5. Evaluating SATCOM Performance and Safety, Health, and Environmental (SHE) Guidelines  6. Importance of Signal Strength and Antenna Alignment	Evaluate SATCOM performance under varying conditions and discuss the importance of adhering to Safety, Health, and Environmental (SHE) guidelines during operations.  Explain the importance of signal strength	Classroom lecture, games, group participation, group activity  Classroom lecture, games, group	T- 03:00 P- 03:00 T- 03:00
	Optimization and Antenna Alignment		and antenna alignment in ensuring SATCOM performance.	participation, group activity	P- 03:00
		7. Factors Affecting SATCOM Signal Reliability	Elucidate the factors affecting SATCOM signal reliability, such as path loss, satellite power, antenna gains, and cable losses.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 03:00
		8. Tools for Signal Measurement and Antenna Alignment	Describe the tools and methods used to measure satellite signal strength and assess antenna alignment.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 03:00
		9. Link Budget Analysis for SATCOM Performance Evaluation	Discuss the process of conducting a link budget analysis for evaluating the performance of a satellite link.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 03:00
		10. Evaluating SATCOM Performance under Varying Conditions and SHE Guidelines	Elucidate the role of weather, terrain, and interference scenarios in SATCOM performance evaluation and describe the safety, health, and environmental (SHE) guidelines relevant to SATCOM operations.	Classroom lecture, games, group participation, group activity	T- 03:00 P- 03:00

7	Network Management, Performance Optimization and Testing (TEL/N6272) T- 10:00 P- 20:00 (HH: MM	Unit 7.1 – Network Management and Monitoring	1. Introduction to Network Management and its Need	Explain the concept of Network Management and its significance in modern IT infrastructures.	TSC/N6272, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12. KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU12.GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8, GS9, GS10, GS11.	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Computer or Laptop, Projector or Smartboard, Internet connectivity, Network Performance Measurement and Analysis Tools, Network Access Control Mechanisms, Firewalls, Intrusion Detection/ Prevention Systems (IDS/ IPS), Content Filtering Mechanisms, Traffic Analysis Tools, Anomaly Detection Systems, Monitoring Equipment for 5G NR	T- 03:00 P- 03:00
			2. Network Configuration and Traffic Analysis in SATCOM	Describe the key components involved in Network Configuration and their roles in network setup. Discuss various monitoring tools used for Network Traffic Analysis and their effectiveness.		Classroom lecture, games, group participation, group activity	Physical Channels and Signals, Signal Capture Equipment, Frequency Analysis Tools, Error Handling Mechanisms, Channel Estimation and Equalization	

		3. Troubleshooting Techniques and Relationship Between DBMS and NMS	Discuss the various Troubleshooting Techniques employed to resolve network issues. Determine the relationship between Database Management Systems (DBMS) and Network Management Systems (NMS) in maintaining network performance.	Classroom lecture, games, group participation, group activity	T- 01:00 P- 03:00
	Unit 7.2 – Satellite Communications, Industry Associations, and Advanced Network Testing	4. Link Budget Analysis in Satellite Communications	Explain the concept of link budget analysis in satellite communications and its importance in ensuring reliable connectivity.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
		5. Role of Industry Associations and Simulating Link Failures	Describe the role of industry associations in the development and regulation of satellite communications. Discuss how simulating link failures and maintenance procedures help in assessing the reliability of satellite communication systems.	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00

			6. Practical Testing of SATCOM Accessories and Network Performance Monitoring	Elucidate the process and importance of practical testing for satellite communication (SATCOM) accessories. Determine how network management systems (NMS) and database management systems (DBMS) can be used for performance analysis in satellite communications.		Classroom lecture, games, group participation, group activity		T- 01:00 P- 04:00
8	Manage Work, Resources and Safety at Workplace (TEL/ N9104) T- 10:00 P- 20:00 (HH: MM)	Unit 8.1: Workplace Safety, Resource Management, and Task Handling	1. Workplace Safety, Privacy, and Security	Explain the importance of following company SOPs related to privacy, confidentiality, and security in the workplace.	TSC/ N9104, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC17, PC18, PC20, PC21. KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU11,	Classroom lecture, games, group participation, group activity	Trainer Guide & Participant Handbook, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films, Personal Protection Equipment: safety glasses, head protection, rubber gloves, safety footwear, warning signs and tapes, fire extinguisher and first aid kit	T- 01:00 P- 03:00

		2. Key Performance Indicators (KPIs), Task Planning, and Team Motivation	Describe how KPIs can be defined and tracked to improve performance and task management. Discuss how teambuilding	Classroom lecture, games, group participation, group activity	T- 02:00 P- 03:00
		3. Time Management, Conflict Resolution, and Resource Optimization	Discuss the importance of emotional intelligence in the workplace and how to manage emotions and conflicts professionally. Explain the significance of timely task completion and its impact on team productivity, and how to optimize resources for productivity.	Classroom lecture, games, group participation, group activity	T- 01:00 P- 04:00
	Unit 8.2: Waste Management, Workplace Cleanliness, and Safety Procedures	4. Safety and Environmental Awareness	Explain how to identify different types of workplace hazards, such as illness, accidents, and fires, and discuss prevention methods.	Classroom lecture, games, group participation, group activity	T- 01:00 P- 03:00

and	agement concep in the v ainability and ho minimi	s the of of waste workplace w waste zation can n cost and	Classroom lecture, games, group participation, group activity	T- 01:30 P- 03:30
Mair Wor Clea and	edure equipm machir ensure and fur Elucida proced manag area cli handlir and en safe dis	oper ques tine ag of tools, nent, and nes to safety nctionality.	Classroom lecture, games, group participation, group activity	T- 01:30 P- 03:30

9	DGT/VSQ/N0102: Employability Skills (60 Hours)	Unit 9.1: Employability Skills	1. Introduction to Employability Skills	Discuss the Employability Skills required for jobs in various industries. List different learning and employability related GOI and private portals and their usage.	DGT/VSQ/ N0102, PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC17, PC18, PC29, PC20, PC21, PC22, PC23, PC24, PC25, PC26, PC27, PC28, PC29, PC30, PC31, PC32, PC33. KU1, KU2, KU3, KU4, KU5, KU6, KU7, KU8, KU9, KU10, KU11, KU12, KU13, KU14, KU15, KU16, KU17, KU18, KU19, GS1, GS2, GS3, GS4, GS5, GS6, GS7, GS8, GS9.	Classroom lecture, games, group participation, group activity, field visit	Handbook	2
			2. Constitutional values - Citizenship	Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen. Show how to practice different environmentally sustainable practices.		Classroom lecture, games, group participation, group activity, field visit	Handbook	2

	3. Becoming a Professional in the 21st Century	Discuss importance of relevant 21st century skills. Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, critical and adaptive thinking, problemsolving, creative thinking, social and cultural awareness, emotional awareness, learning to learn etc. in personal or professional life. Describe the benefits of continuous learning.	Classroom lecture, games, group participation, group activity, field visit	Handbook	2
	4. Basic English Skills	Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone. Read and interpret text written in basic English. Write a short note/ paragraph / letter/e -mail using basic English.	Classroom lecture, games, group participation, group activity, field visit	Handbook	4
	5. Career Development & Goal Setting	By the end of this course, participants will have the knowledge and skills to set clear, achievable	Classroom lecture, games, group participation, group activity, field visit	Handbook	4

	6. Communication Skills	Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette. Explain the importance of active listening for effective communication. Discuss the significance of working collaboratively with others in a team.	Classroom lecture, games, group participation, group activity, field visit	Handbook	4
	7. Diversity & Inclusion	Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen. Show how to practice different environmentally sustainable practices.	Classroom lecture, games, group participation, group activity, field visit	Handbook	2
	8. Financial and Legal Literacy	Outline the importance of selecting the right financial institution, product, and service. Demonstrate how to carry out offline and online financial transactions, safely and securely. List the common components of salary and compute income, expenditure, taxes, investments etc. Discuss the legal rights, laws, and aids.	Classroom lecture, games, group participation, group activity	Handbook	8

9. Essential Digital Skills	devices and use the associated applications and features, safely and securely. Discuss the significance of displaying responsible online behavior while browsing, using various social media platforms, e-mails, etc., safely and securely. Create sample word documents, excel sheets and presentations using basic features utilize virtual collaboration tools to work effectively.	Classroom lecture, games, group participation, group activity, field visit	Handbook	6
10. Entrepreneurship	Explain the types of entrepreneurship and enterprises. Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal risks with its mitigation plan. Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per requirement. Create a sample business plan, for the selected business opportunity	Classroom lecture, games, group participation, group activity, field visit	Handbook	14

	11. Customer Service	Describe the significance of analysing different types and needs of customers. Explain the significance of identifying customer needs and responding to them in a professional manner. Discuss the significance of maintaining hygiene and dressing appropriately.	Classroom lecture, games, group participation, group activity, field visit	Handbook	8
	12. Getting Ready for apprenticeship & Jobs	Create a professional Curriculum Vitae (CV). Use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively. Discuss the significance of maintaining hygiene and confidence during an interview. Perform a mock interview. List the steps for searching and registering for apprenticeship opportunities.	Classroom lecture, games, group participation, group activity, field visit	Handbook	4

### **Annexure - II**

Assessment Guidelines and Assessment Weightage					
Job Role	SATCOM Operation Technician				
Qualification Pack	TEL/Q6222				
Sector Skill Council	Telecom				

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council.
2	Element/Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each Element/PC.
3	The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
4	Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
5	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below).
6	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/ training center based on these criteria.
7	To pass the Qualification Pack assessment, every trainee should score the Recommended Pass % aggregate for the QP.
8	In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack.
9	Every Trainee should score a minimum aggregate passing percentage 70%, to successfully clear the Qualification Pack assessment.

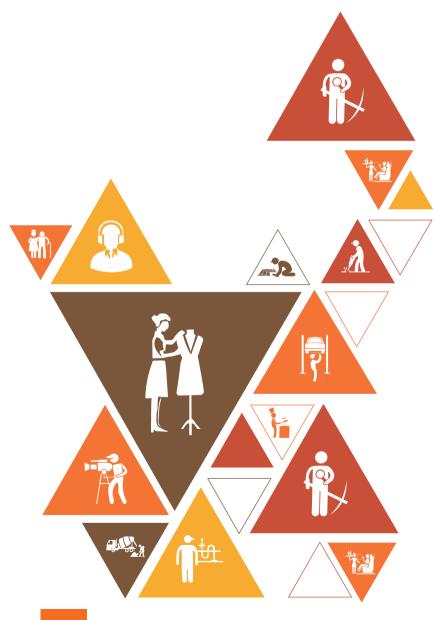
National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
TEL/N6267: Install of Antenna at remote end and establish link	30	60	-	10	100	20
TEL/N6268: Set up and Operate Ground Station	30	60	-	10	100	15
TEL/N6269: Signal Analysis, Ground Station Maintenance, and Security Implementation	30	60	-	10	100	15
TEL/N6270: Manage Network Operation Centre (NOC) or Hub	30	60	-	10	100	15
TEL/N6271: Incident management or PM Activity	30	60	-	10	100	10
TEL/N6272: Network Management, Performance Optimization and Testing	30	60	-	10	100	10
TEL/N9104: Manage Work, Resources and Safety at workplace	40	50	-	10	100	10
DGT/VSQ/N0102: Employability Skills (60 Hours)	20	30	-	-	50	10
Total	240	440	0	70	750	100

### **Annexure-III**

Chapter Name	Unit Name	Topic Name	URL	QR Code	Video Duration
Chapter 1: Introduction to the Telecom Industry and about SATCOM Operation	UNIT 1.1: Overview of the Telecom Industry and SATCOM Operations	Telecom Industry Overview - Major Industry Trends	https://youtu. be/5wlF17PNt-0		00:05:57
		How do Satellites work?	https://youtu.be/ ror4P1UAv_g	回52% (2005) [20 (2005) [20 (2005) [20 (2005) [20 (2005) [20 (2005) [20 (2005) [20 (20) [20 (20) [20] [20] [20 (20) [20] [20] [20 (20) [20] [20] [20 (20) [20] [20] [20] [20 (20) [20] [20] [20] [20] [20] [20] [20] [20]	00:08:21
		Basic Introduction to Satellite Communications	https://youtu.be/ WARM4fwsoT4		00:17:55
Chapter 2: Install of Antenna at Remote End and Establish Link (TEL/ N6267)	Unit 2.1 – Tools and Equipment Preparation	What is TELNET? How TELNET works?	https://youtu. be/2JjILZPOC5g		00:06:57
	Unit 2.2 – Antenna Assembly	Antenna Types for Satellite Communication	https://youtu.be/ d0PEGhITDN0		00:02:58
	Unit 2.3 – Software Installation, Network Configuration, and System Libraries	Installation of an Earth Station Antenna	https://youtu.be/ iLCrJyATpCs		00:03:38

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Chapter 3: Set up and Operate Ground Station (TEL/N6268)	UNIT 3.1: – Ground Station Antenna Installation and Alignment	Earth station technology in satellite communication	https://youtu.be/ lqrU1fO_CR4		00:12:16
	UNIT 3.2: Antenna Tracking and Pointing	Tracking system	https://youtu. be/4GPfea5ye1c		00:08:57
Chapter 4: Signal Analysis, Ground Station Maintenance, and Security Implementation (TEL/N6269)	Unit 4.1 – Ground Station Equipment Maintenance and Performance Assurance	The Orbits Explained - What is LEO, MEO & GEO?	https://youtu.be/ NFc3oU_wq7I		00:04:02
	UNIT 4.2: Signal Quality Monitoring, Analysis, and Security Measures Implementation	Signal to Noise Ration   SNR in Telecommunication	https://youtu.be/_ DBFZxLV9fM		00:09:11
Chapter 5: Manage Network Operation Centre (NOC) or Hub (TEL/ N6270)	Unit 5.1 – Gateway ID Management and Configuration for NOC	Function of gateway in computer network	https://youtu.be/ ai5bFPVToMU		00:03:39

	UNIT 5.2: Data Connectivity, Performance Analysis & Monitoring for Cross-Verification	About Network Operations Center (NOC)	https://youtu.be/i_ xVIx31krI	00:03:05
Chapter 6: Incident Management or PM (Primitive Maintenance) Activity (TEL/ N6271)	Unit 6.1 – Analyzing and Resolving Down Calls	About Satellite Communications Toolbox	https://youtu.be/ XF7f6Zx1x_0	00:02:17
	UNIT 6.2: Signal Strength Optimization and Antenna Alignment	Attitude and orbit control system in satellite communication	https://youtu.be/ Extpw2NWbOw	00:20:38
Chapter 7: Network Management, Performance Optimization and Testing (TEL/N6272)	Unit 7.1 – Network Management and Monitoring	About Network Operations Center (NOC)	https://youtu. be/184SWNhdK4s	00:07:21
	UNIT 7.2: Satellite Communications, Industry Associations, and Advanced Network Testing	Link Budget Analysis	https://youtu.be/ XnIEjqvlpqo	00:10:09







Transforming the skill landscape



सत्यमेव जयते GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

Telecom Sector Skill Council of India

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