

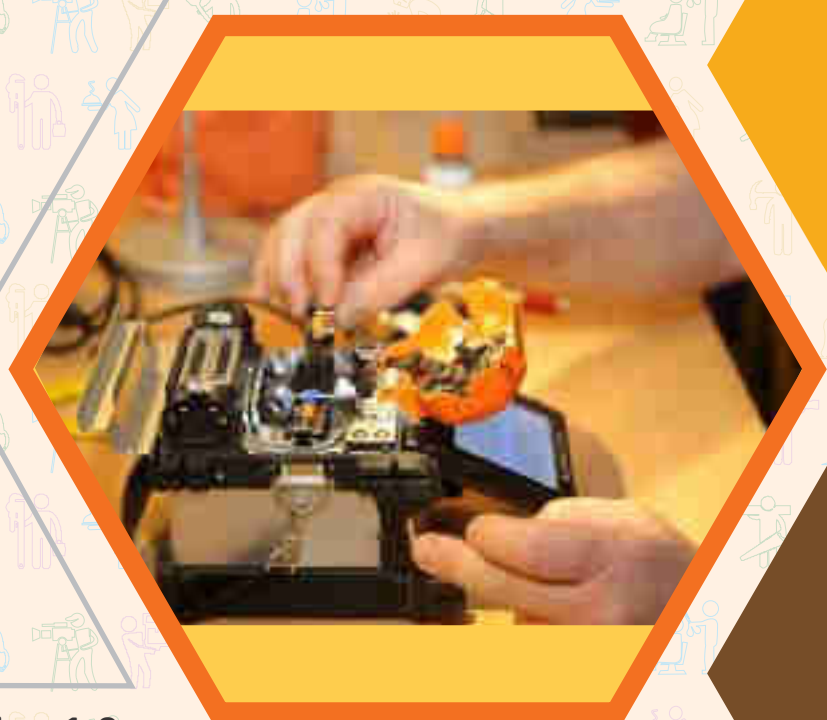
# Participant Handbook

Sector  
**Telecom**

Sub-Sector  
**Network Managed Services**

Occupation  
**Network O & M - Optical**

Reference ID : TEL/Q6401, Version 1.0  
NSQF Level 4



## Optical Fiber Technician

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**Shri Narendra Modi**  
Prime Minister of India

“ Skilling is building a better India.  
If we have to move India towards  
development then Skill Development  
should be our mission. ”



## Certificate

### COMPLIANCE TO QUALIFICATION PACK NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

**TELECOM SECTOR SKILL COUNCIL**

for

#### SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of  
Job Role / Qualification Pack : 'Optical Fiber Technician'  
QP No. 'TEL/Q6401, NSQF Level 4'

Date of Issuance: **May 26<sup>th</sup>, 2017**  
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*\*Valid up to the next review date of the Qualification Pack or the  
'Valid up to' date mentioned above (whichever is earlier)*

Authorised Signatory  
(Telecom Sector Skill Council)

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The preparation of this manual would not have been possible without the telecom Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the Industry.

This participant manual is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavors.

## About this book

In the last five years, the growth of the Indian telecommunications sector has outpaced the overall economic growth. This sector is poised for strong growth of about 15 percent in short term during 2013–17, driven by growth in organized retail, technological advancements, changing consumer preferences and government support. With over 1000 million subscribers, India is the second largest telecom market in the world.

The sector currently employs over 2.08 million employees and is slated to employ more than 4.16 million employees by 2022. This implies additional creation of ~2.1 million jobs in the nine-year period.

This Participant book is designed to impart theoretical and practical skill training to students for becoming an Optical Fiber Technician. Optical Fiber Technician is responsible for maintaining uptime and quality of the network segment (both optical media & equipment) assigned to him by undertaking periodic preventive maintenance activities and ensuring effective fault management in case of fault occurrence. He is also required to coordinate activities for installation and commissioning of Optical Fiber Cable (OFC) as per the route plan.

This Trainee Manual is based on Optical Fiber Technician Qualification Pack (TEL/Q6401) & includes the following National Occupational Standards (NOSs)

1. Co-ordinate Installation & Commissioning of Optical fiber cables (OFC)
2. Undertake Condition based Maintenance & Planned repair activities
3. Perform corrective maintenance/restoration of optical fault

The Key Learning Outcomes and the skills gained by the participant are defined in their respective units.

Post this training, the participant will be able maintain uptime and quality of the network segment by undertaking periodic preventive maintenance activities & effective fault management.

We hope that this Trainee Manual will provide a sound learning support to our young friends to build an attractive career in the telecom industry.

## Symbols Used



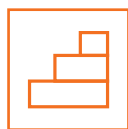
Learning  
Outcomes



Unit  
Objectives



Tips



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# 1. Introduction

UNIT 1.1 Brief overview of Telecom & Fiber Optics



## Key learning Outcomes



**At the end of this module, you will be able to understand:**

1. Broadband industry overview
2. Fiber technician role & responsibility
3. PSTN (public switch telephone network) operations
4. Overview of Transmission media
5. Important Terminologies used in Fiber Optic

## UNIT 1.1: Brief overview of Telecom & Fiber Optics

### Unit Objectives

**At the end of this unit, you will be able to understand:**

1. Broadband Industry Overview
2. Fiber technician role & responsibility
3. PSTN (public switch telephone network) operations
4. Overview of Transmission media
5. Important Terminologies used in Fiber Optic

### 1.1.1 Broadband Industry

In the present Global context, telecommunication is playing a key role on changing the whole dimension and taking the progress to next level. Telecommunication is not only influencing urban scenarios but also changing the economy and means operations at rural parts of the country. Indian telecom is bringing considerable revenue by telecom services increasing its customer range in the country across. The Government of India has recognized this fact and has taken various measures over the years to stabilize the telecom sector. Indian telecom sector stands in 2nd position after China wireless market.

A stable transmission and transport systems strengthen the mobile network which further helps in providing the best services to users. To bring the best result system should possess strong back haul network built. Indian dream project digital India led to construct digital back bones across the country to fulfill the vision of end reachability across PAN INDIA. Indian Government initiated Bharath net – NOFN (National Optical Fiber Network) to build data coverage reach till last milestones (connecting remote to remote villages via internet). Under this project fiber has been laid across 2.5 lakh Gram panchayat with the ideal plan of 100 MBPS broadband coverage. The Project initiated by Indian Government made phase mode approaches for implementations, over the time tentatively with deadline of 2019, it intends to connect all villages across the India together. Existing large telecom network and increasing government initiative to connect rural and semi-urban areas, there is a huge scope for development in Indian telecom sector.

## 1.1.2 Optical Fiber Technician

By allowing foreign direct investment, the government has attracted large amount of investments in the booming Indian telecom sector. This, in turn, will drive growth and employment in the sector. With the growth in Indian telecom industry the demand for various professionals such as optical fiber technician, telecom engineer, etc., is bound to increase.

Ideal attributes identified for optical fiber technician job role: The resource that holds this job role should have clarity on geography where he/she works as the role demands to work with different groups and systems across the areas. Fiber technician should hold good skills of communication and analytical skills to gauge the situation and identify the problems. He/she should ready to take up challenges and work pressures (time limits). Being familiar with local language brings effectiveness in getting task done from the local workers.

### **Job Description: Fiber Optic Technician**

The Job holder must hold good understanding of his duties. He/she must possess qualities and capabilities for holding system maintenance under guidelines. Some of the highlights of the duties are, maintaining optical connectivity and line ,maintenance, keeping system on with no off-time of system on record periodic checks, practicing the best practices for fault management, ensuring correctness in system operation, identifying the issues, and do the regulatory activities to overcome the issue, being present and supportive to installation, commissioning, optimization and troubleshooting teams and coordinating between the teams.



*1.1.2: An optical fiber technician at work*

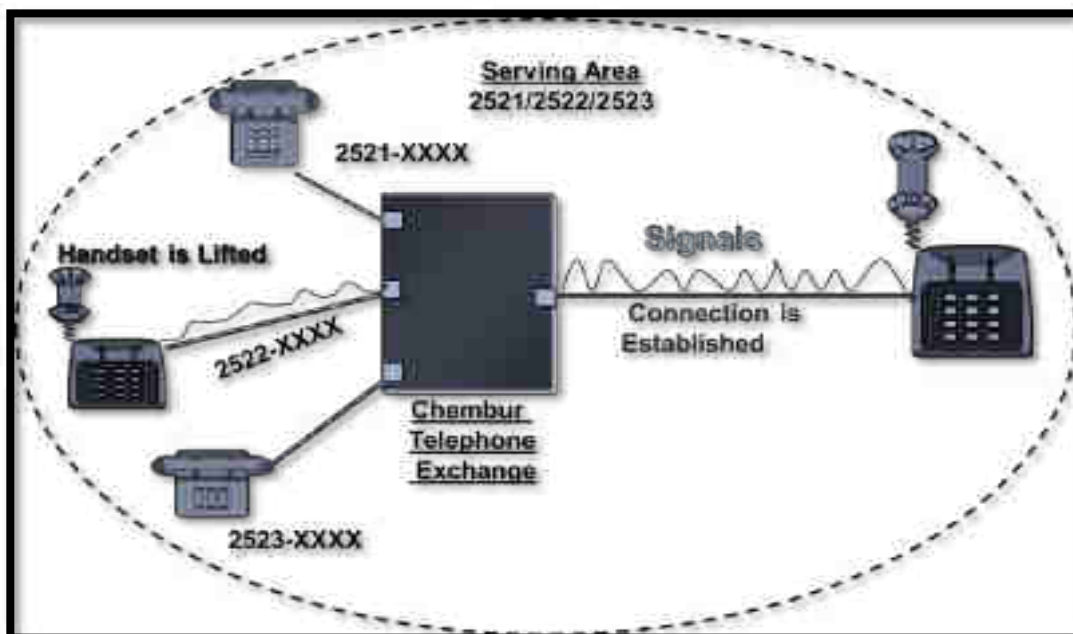
### 1.1.3 Public Switched Telephone Network (PSTN)

#### PSTN (Public Switched Telephone Network):

- Standard telephone service, e.g. BSNL, MTNL, etc.
- Through a 'SWITCH'

**PSTN** – uses end to end closed connectivity, it adopts Switch concept in implementing the network. Every user will be given with a closed-circuit line. Circuit is connection of devices with wired cables which could be controlled to opens and closes. PSTN is fully wired network, every end user is connected to main controlling station (called exchange). These exchanges further inter connected with rest of the surrounding exchanges with wires/cables, connectivity continues till the national gateway which continues to build connectivity with surrounding countries. The connectivity may be further enriching with satellite and microwave connectivity.

When a customer picks up the handset of the landline from the cradle his/her connection at the telephone exchange is ready to receive the signals which he dials from his telephone in the form of the number to which he/she wants to speak. Through his connection the exchange starts sending signal to mobile or landline phone (depending on the number he is dialing). As the person picks up the phone the circuit is complete and they can now start talking to each other.



1.1.3: Public switched telephone network

## 1.1.4 Transmission Media

Cable type in which the two conductors are twisted and same is used in circuit connections. This type of cables is termed as twisted pair. The twist made from the cable will avoid the external charge influence.



1.1.4 (a): Twisted copper wire

Copper being the inner core of twisted wire cable protected with protective material. There are plenty of coaxial cables in market comes out with protective jacket and multiple layered protective sheets.



1.1.4 (b): Coaxial cable

### 1.1.4 Transmission Media (Contd.)

Optical fiber cable could be used in a fashion of single modal or multi modal holding single fiber or multiple fibers in the cable. The fibers are used based on the application and the best practices followed in the system.



1.1.4 (c): Optical fiber cable

Microwave is part of electromagnetic spectrum used in parallel with Radio frequency range of frequencies. As microwaves are best resulted in long distance and line of sight travel, it is used effective in RADAR operations. Satellite are the system device setups hosted from earth to space, located at different orbit of earth where the system made operational and it is away from earth gravitation pull.



1.1.4 (d): Microwave

These devices work on microwave frequencies and connect to the stations on earth. Satellite systems serves for weather forecasting, television, communications, military and many other purposes.



1.1.4 (e): Satellite

### 1.1.5 Important Terminologies

Terminology	Definition
<b>Signal</b>	Frequency representation which conveys information could be a form of simple data or in complex message format.
<b>Signaling</b>	Signaling is the process of connecting source and destination by doing authentication of the service and users and authorizing the session
<b>Frequency</b>	The number of times in a second an electric signal or electromagnetic wave, completes a cycle.
<b>Network</b>	Group of systems interconnected in a fashion where they could share, exchange data, and communicate the necessary.
<b>Mode</b>	Fashion/ way of propagation in a media, in specific to Fiber cable mode is the light patterns which are made to travel across.
<b>Multimode fiber</b>	Kind of mode in which more than one light signal can travel across is called as multimodal fiber. It naturally little bigger than single mode fiber. (Almost always 50 or 62.5 microns - a micron is one millionth of a meter).
<b>Single mode fiber</b>	Fiber which allows single Light wave to travel across is termed as Single mode fiber. It has smaller core compare to multimodal fibers (about 8-9 microns). Single mode is mostly preferred for telecommunication services like telephony, fiber to the home and CATV.
<b>Fiber ID</b>	Based on the fiber inner and outer core construction Fiber ID tagged for identification. Core and cladding diameters are expressed in microns; most multimode and single mode fibers have an outside diameter of 125 microns. Fiber IDs are internationally standardized with specifications that include all characteristics.
<b>Plastic optical fibers (POF)</b>	One type of multimodal fibers. Normally preferred for short distance for networks which run effectively with low speed.
<b>Cable</b>	Cables come in various colors and sizes. These protect the fiber from weather, provides protection from stress. Cables are manufactured based on the number of fibers to be accommodated. There are many types of cables few in list are tight buffer (with hard plastic coating on fiber preferred for mainly indoors), loose-tube, (light coating on fiber), ribbon (fibers made ribbons).



### 1.1.5 Important Terminologies (Contd.)

Terminology	Definitions
<b>Jacket</b>	The outermost cover on the cable is termed as jacket. These jackets provide additional safety to the cables.
<b>Strength members</b>	The supportive element used for safety and operations
<b>Armor</b>	Armor Discourages rodents from chewing through it.
<b>Connector</b>	Device used for connecting fibers. The connectors could be kept in system and could be disconnected based on requirement.
<b>Ferrule</b>	A tube which holds a fiber for alignment, usually part of a connector. / No need to change.
<b>Splice</b>	Joining fibers /broken fibers is carried out with a tool termed as splicer and process called as splicing. This joint (splice) between two fibers made will be permanent.
<b>Hardware</b>	Terminations and splices require hardware for protection and management patch panels, splice closures, etc.
<b>Attenuation</b>	Loss in the power while signal travels across is termed as attenuation. Mostly expressed in decibels (dB). For fibers, considerable is attenuation coefficient or attenuation per unit length with unit of dB/km.
<b>Bandwidth</b>	Group of frequencies could be termed as Bandwidth. The difference between the frequencies ranges transmitted is considered as Delta Frequency in turn called as bandwidth.
<b>Decibels (dB)</b>	A unit of measurement of optical power which indicates relative power. A -10 dB means a reduction in power by 10 times, -20 dB means another 10 times or 100 times overall, -30 mean another 10 times or 1000 times overall, & so on
<b>dB</b>	Optical power measurement is done by dB (decibel). Decibel helps in understanding the power variation dB representation, -10 dB refers to a reduction of power by 10 times, -20 dB means further reduction 10 times or 100 times overall, and so on.
<b>dBm</b>	absolute Optical power measurement referring to 1 milli watt
<b>Optical Loss</b>	The amount of optical power lost as light is transmitted through fiber, splices, couplers, etc., expressed in "dB"
<b>Switch</b>	A mechanical or electronic device that opens or closes circuits completes or breaks an electrical path or selects paths or circuits.
<b>Multiplexing</b>	Process of missing multiple signals before transmitting over media.

### 1.1.5 Important Terminologies (Contd.)

Terminology	Definition
<b>Optical Power</b>	Capacity of optical signal strength represented in terms of power, measured in dBm/decibels.
<b>Scattering</b>	Dispersion of light ray due to obstacles. Tag name given for the light ray changing the path of travel and splitting energy into multiple angles this will cause majority of loss in optical fibers and is used to make measurements by an OTDR.
<b>Wavelength</b>	Wavelength a term for the color of light, usually expressed in nanometers (nm) or microns (m). Fiber is mostly used in the infrared region where the light is invisible to the human eye. Most fiber specifications (attenuation, dispersion) are dependent on wavelength.
<b>Dispersion</b>	Pulse spreading caused by modes in multimode fiber (modal dispersion), the difference in speed of light of different wavelengths (CD or chromatic dispersion in multimode or single mode fiber) and polarization (PMD or polarization mode dispersion in single mode)
<b>PSTN (Public Switched Telephone Network )</b>	Traditional wired phone service. It refers to the standard telephone service, e.g., BSNL.
<b>BTS (Base Transceiver Station)</b>	It is a wireless interface with a mobile handset in mobile communication. It has an antenna mounted on a tower and a trans-receiver
<b>BSC (Base Station Controller)</b>	BTS are administered by a BSC Signaling.
<b>MSC (Mobile Switching Center)</b>	It is the hub of the mobile communication network. It connects mobile stations to PSTN.
<b>Roaming</b>	Realization of all frequency ranges in sequential manner.
<b>Spectrum</b>	Device used for the TRX operations from user end.
<b>Telephony</b>	Word used to describe the science of transmitting voice over a telecommunications network.
<b>Modem</b>	A device that both modulates and demodulates signals.

### 1.1.5 Important Terminologies (Contd.)

Terminology	Definition
<b>NLD</b>	National Long-Distance Telephony – pertains to calls outside the local area, to any place in India.
<b>ILD</b>	International Long-Distance Telephony – outside India.
<b>SDCA</b>	Short Distance Charging Area – There are total of 2647 SDCA in India, each having a unique STD code.
<b>LDCA</b>	Long Distance Charging Area. A few SDCAs make a LDCA. A call beyond 50 km distance is considered as a long-distance call.
<b>Service Plan</b>	The plan under which it operate publicize the service lists to user is termed as service plan. This plan may have altered over time.
<b>Tariff</b>	Services offered to users are categorized based on the subscription and categories known as tariff.



1.1.5: Optical fiber technology has tremendous potential

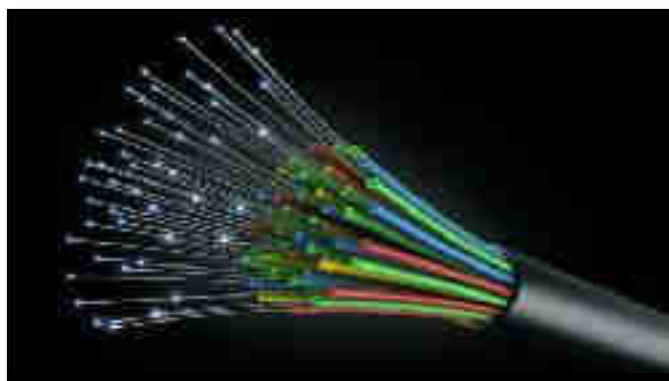
## 1.1.6 Optical Fiber Technology

Optical transmissions over the fiber cables need immense strengthen technology associated. Optical cables inner core glass is made in a way to propagate complete ray travelling by giving zero resistance and losses. To achieve connectivity over long distance optical medium proven to be the best even though it is laying and maintenance takes more economy. Unlike in copper cable electrical signal converted into light and it is transmitted over fiber cables. It began about 40 years ago in the R&D labs (Corning, Bell Labs, ITT UK, etc.) and was first installed commercially in Dorset, England by STC and Chicago, IL, USA in 1976 by AT&T. By the early 1980s, fiber telecommunications networks connected the major cities on each coast. By the mid-80s, fiber was replacing all the telecom-copper, microwave and satellite links. In the 90s, transoceanic fiber optic cables replaced sate llites between most continents.

Over the period fiber optics took over the entire major service provider favorite as its effectiveness ruled out the cost. DTH and CATV are few services mostly relied on fiber network. Adding on the Research prove that the network will be the reliable to provide Internet services, mobile services network development.

Slowly the fiber placed in the small networks and then tried with LAN, WAN, MAN, and most of implantations is taking place with fiber network in today's data. As the cables could be routed fascinatingly without disturbing the infra, more company's showed interest in having fiber network. Fiber is effective in huge data transfer and connectivity with reliability. Fiber is implemented in most Multinational companies with fiber LANs backbones, connections to systems for employees or design workstations with many wireless AP (access point).

Some more applications for consideration are: mobile -cell network connections, Ship & aircraft, automation and automobile connecting lines, security like CCTV, & digital stereos for consumers. Fiber optics users in current time zones are systems who use it for connecting social blocks like Educational institutes, stores/ departments, transport& traffic lights, security add on like CCTV surveillance systems. Fiber to home is another upcoming big business which provides the best connections to their users. Optical fiber is either predominant medium or choice made logically for most of communication system. With reduced Costs fiber to the home is most likely accepted by user ends, the fantasy come true for users as fiber to home provides all means of data and services which other medium fails to provide.



1.1.6 (a): An optical fiber