

Template for Submitting Comments/Inputs on the Revision of the draft GR for “Millimeter Wave (E-Band) Microwave Equipment” (Draft Standard No. TEC 36060:2026)

Name of manufacturer/Stakeholder:

Organization:

Contact Details: Phone/Mobile Email

<u>S.</u> <u>No.</u>	<u>Clause No.</u>	<u>Clause Description</u>	<u>Comments, if any</u>	<u>Remarks, if any</u>

Note: The comments/inputs are invited on the draft revised GR, Standard No. TEC 36060:2026 – “Millimeter Wave (E-Band) Microwave Equipment”, in the prescribed format through email to ra2-radio.tec-dot@govcontractor.nic.in with copy to ddgsat.tec@gov.in and adetr.tec@gov.in, at the earliest and within the prescribed time period of 60 days.



वर्गीय आवश्यकताओं के लिए मानक

टीईसी ३६०६०:२०२२~~२६~~

(सं: TEC/TX/GR/MMW-001/01. MAR-12 को अधिक्रमित करता है)

STANDARD FOR GENERIC REQUIREMENTS

TEC 36060:20~~26~~22

(Earlier No. TEC ~~36060:2022/TX/GR/MMW-001/01. MAR-12~~)

मिलीमीटर वेव (ई- बैंड) माइक्रोवेव उपकरण
MILLIMETER WAVE (E-BAND) MICROWAVE
EQUIPMENT



ISO 9001:2015

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DOT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This Standard on Generic Requirements (GR) pertains to Millimeter Wave (E-Band) Microwave equipment used in point-to-point digital integrated radio relay systems in 71-76/81-86 GHz frequency band. It covers requirements for interoperability, Quality, Electromagnetic Compatibility, Safety, Energy Consumption Rating and other performance and maintenance related parameters.

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HISTORY SHEET

<i>Sl. No.</i>	<i><u>Standard / Document No. GR No.</u></i>	<i><u>Name of Document / Title</u></i>	<i>Remarks</i>
1.	TEC/TX/GR/MMW-001/01. MAR-12	Millimeter Wave (E-Band) Microwave Equipment	First Issue
2.	TEC 36060: 2022	Standard for Generic Requirement _____ for Millimeter WAVE (E-Band) Microwave Equipment	Supersedes TEC GR No. TEC/TX/GR/MMW-001/01. MAR-12
3.	<u>TEC 36060: 2026</u>	<u>Millimeter Wave (E-Band) Microwave Equipment</u>	<u>Third issue</u> <u>(Requirements in</u> <u>respect of some of the</u> <u>parameters have been</u> <u>changed in the relevant</u> <u>clauses to incorporate</u> <u>advancements, more</u> <u>optional features for the</u> <u>purchaser and for</u> <u>better clarity)</u>

REFERENCES

S. No.	Document No.	Title/Document Name
1.	TEC 11016:2026 TEC/SD/DD/EMC-221/05/OCT-16	Standard for Electromagnetic Compatibility Standard for Telecommunication Equipment Electromagnetic Compatibility Standard for Telecommunication Equipment or latest issue
2.	TEC 14016:2010 (Old No. QM-333) QM-333 (Issue: March:2010)	Standard for Environmental testing of Telecommunication Equipments for operation, transportation and storage
3.	TEC 74046:202 <u>20</u>	Standard for Energy Consumption Rating and Energy Passport for Telecommunications Products, Equipment and Network/ Services
4.	QM-115 {January 1997}	<u>BSNL QA document on</u> Reliability Methods and predictions
5.	M.3010 (02/2000)	Principles for Telecommunications Management Network
6.	M.3100 (2005)	Generic network information model
7.	M.3120 (2001)	CORBA generic network and network element level information model
8.	CISPR 32 (2015) <u>+</u> <u>A1:2019</u>	Electromagnetic compatibility of multimedia equipment - Emission requirements
9.	IEC 61000-4-2 {20 <u>25</u> 08 }/EN 61000-4-2	Testing and measurement techniques of Electrostatic discharge immunity test.
10.	IEC 61000-4-3{20 <u>20</u> 10 }/EN 61000-4-3	Testing and measurement techniques of Radiated RF Electromagnetic Field Immunity test.

S. No.	Document No.	Title/Document Name
11.	IEC 61000-4-4{2012)/ EN 61000-4-4	Testing and measurement techniques of electrical fast transients/ burst immunity test.
12.	IEC 61000-4-5{2014) <u>+ A1: 2017</u> /EN 61000-4-5	Testing and measurement techniques of Surge immunity test.
13.	IEC 61000-4-6{ 2013 2014)/EN 61000-4-6	Testing and measurement techniques of Immunity to conducted disturbances, induced by radio frequency fields
14.	IEC 61000-4-11(20 <u>04</u>) / EN61000-4-11	Testing measurement techniques- voltage dips, short interruptions and voltage variations immunity tests.
15.	IEC 61000-4-29 (2000)	Testing and measuring techniques – Voltage dips, short interruptions and voltage variations immunity tests
16.	IS 13252 part 1: 2010	Information Technology Equipment –Safety- Part 1: General Requirements
17.	IS 10437{1986}	Safety requirements for radio transmitting equipments
18.	IEC 60950-1 {2005}	Information Technology Equipment –Safety- Part 1: General Requirements
19.	<u>IS</u> /IEC 62368-1: 20 <u>23</u> 18	Audio/video, information and communication technology equipment - Part 1: Safety requirements
20.	ISO 9001:2015	International Quality Management System.
21.	IS 12063 (1987) (Reaffirmed in 1999)	Classification of degrees of protection provided by enclosures of electrical equipment

S. No.	Document No.	Title/Document Name
<u>22.</u>	<u>ETSI 302 217-2</u> <u>(2025-07)</u>	<u>Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2: Digital systems operating in frequency bands from 1 GHz to 174.8 GHz; Harmonised Standard for access to radio spectrum</u>
<u>23.</u>	<u>ITU-T X.1089</u> <u>(05/2008)</u>	<u>Telebiometrics authentication infrastructure (TAI)</u>
<u>24.</u>	<u>ITU-T G.8261</u>	<u>Timing and synchronization aspects in packet networks</u>
<u>25.</u>	<u>ITU-T G.8262</u>	<u>Timing characteristics of synchronous Ethernet equipment slave clock (EEC)</u>
<u>26.</u>	<u>ITU-T G.8265.1</u>	<u>Precision time protocol telecom profile for frequency synchronization</u>
<u>27.</u>	<u>ITU- T G.8261.1</u>	<u>Packet delay variation network limits applicable to packet-based methods (Frequency synchronization)</u>
<u>28.</u>	<u>ITU- T G.8271.1</u>	<u>Network limits for time synchronization in packet networks with full timing support from the network</u>
<u>29.</u>	<u>ITU-T G.8275.1</u>	<u>Precision time protocol telecom profile for phase/time synchronization with full timing support from the network</u>
	<u>ITU-T G.8275.2</u>	<u>Precision time protocol telecom profile for time/phase synchronization with partial timing support from the network</u>
<u>30.</u>	<u>ITU-T G8273.3</u>	<u>Timing characteristics of telecom transparent clocks for use with full timing support from the network</u>

Note: Unless otherwise explicitly stated, the latest approved issue of the standard, with all amendments in force, listed in references, on the issuance date of this GR is applicable.

Draft_Public_Consultation

CHAPTER 1

~~Department of Telecommunications Telecommunication~~

~~Engineering Center (Radio Division)~~

1.0 Introduction

This document contains the standard for generic requirements of point-to-point digital integrated radio relay system in 71-76/81-86 GHz frequency band for the Indian telecommunication network. The system shall be of typically integrated type.

The Microwave System shall be used for intra-city traffic requirements on short-haul routes with capacity requirements up to 10Gbps net radio throughput. The typical applications are enterprise connectivity, small-cell backhaul, GTTH etc. The equipment shall be able to support Ethernet Services. Its performance shall conform to the relevant IEEE/IETF/ITU-T and ITU-R Recommendations.

2.1.1.1 Technical and Functional Requirements.

2.1.1.1.1 Technical Requirements

2.1.1.1.1.1 Frequency Range: 71-76/81-86 GHz (Referred as IND 34 in NFAP 2025)

2.1.1.1.1.2 Operating Modes: FDD/TDD (Frequency Division Duplexing/Time Division Duplexing) / SF-STAR (Single Frequency Simultaneous Transmit and Receive)

2.1.1.1.1.3 Adjacent channel spacing : 62.5 MHz to 2000 MHz

2.1.1.1.1.4 Trans/Receive Separation : 10GHz (System shall support TX-RX separations as specified in National frequency allocation plan)

2.1.1.1.1.5 Capacity:

The L1 layer throughput values in Mbps for different modulation schemes and channel bandwidth shall be as follows (For 64 bytes frame size):

Bandwidth (MHz) / Modulation Scheme	62.5	125	250	500	750	1000	1500	2000
BPSK	47	94	188	375	563	750	1125	1500
QPSK	94	188	375	750	1125	1500	2250	3000
16 QAM	188	375	750	1500	2250	3000	4500	6000
32 QAM	235	469	938	1875	2813	3750	5625	7500
64 QAM	282	563	1125	2250	3375	4500	6750	9000
128 QAM	329	657	1313	2625	3938	5250	7875	9000
256 QAM	375	750	1500	3000	4500	6000	9000	<u>N/A</u> <u>9000</u>
512 QAM	422	844	1688	3375	5063	6750	<u>N/A</u> <u>9000</u>	<u>N/A</u> <u>9000</u>
1024 QAM (Optional)	<u>N/A</u> <u>4693</u>	<u>N/A</u> <u>9383</u>	<u>21564</u> <u>875</u>	<u>43133</u> <u>7504</u>	<u>N/A</u> <u>5625</u>	<u>N/A</u> <u>7500</u>	<u>N/A</u> <u>9000</u>	<u>N/A</u> <u>9000</u>

Table 1: L1 Layer Throughput (Mbps) for Various Modulation Schemes and Channel Bandwidths for 64 bytes frame size.

2.1.6 1.1.1.6 The equipment shall support native Ethernet Services.

2.1.7 1.1.1.7 System shall support BPSK modulation and shall be upgradable to support 512 QAM or higher (Optional). Procurer shall provide the requirement for higher order modulation. This shall be through Adaptive Modulation.

2.1.8 1.1.1.8 The system shall operate in one of the following configurations as per Procurer/Purchaser requirements.

a. Type I : (1+0) non-redundant

- b. Type II : 2x (1+0) radio configuration (East-west)
- c. Type III : (2+0) XPIC Radio LAG L1 protection configuration.
- d. Type IV : (3+0) E-band (1+0)+Traditional MW (2+0) (15/18/23GHz) with L1 Radio LAG with single Dual Band antenna.

~~2.1.9~~ 1.1.1.9 The equipment shall have in built XPIC functionality. It shall be possible upgrade 1+0 link to XPIC link by adding another E-Band outdoor unity.

~~2.1.10~~ 1.1.1.10 –It shall be possible to combine Carrier Aggregation (CA) E-Band carrier with traditional band carrier (15/18/23 GHz) using single 2 feet dual band antenna to meet longer HOP length requirement. Carrier Aggregation of E-band and Traditional band shall support L1 radio LAG to efficiently combine the two carriers.

~~2.1.11~~ 1.1.1.11 –E-band Outdoor shall be equipped with more than 250Mbytes/ 2Gbits QoS adjustable buffer.

~~2.1.12~~ 1.1.1.12 E-band Outdoor shall support 1588V2 TC.

~~2.1.13~~ 1.1.1.13 E-band Outdoor shall support Y1731 BNM (bandwidth notification).

~~2.1.14~~ 1.1.1.14 E-band Outdoor shall comply to IP65 or higher. The Procurer/Purchaser shall prescribe the requirement of the higher IP standard.

~~2.1.15~~ 1.1.1.15 It shall be possible to monitor the system remotely using Web Based LCT (local craft terminal) and element management system (EMS). System shall support SNMP V3; and HTTP/HTTPS based EMS or CLI (TELNET, SSH) or, SDN (NETCONF/YANG).

~~2.1.16~~ 1.1.1.16 System shall support the loop backs for radio or traffic interfaces.

~~2.1~~ 1.1.2 Transmitter

~~2.2.1~~ 1.1.2.1 Maximum Transmitter Power output at antenna ports (excluding antenna gain) (for 250Mhz channel)

Bandwidth (MHz) / Modulation Scheme	62.5	125	250	500	750	1000	1500	2000
BPSK	-76.8	-73.8	-70.8	-67.8	-66	-64.8	-63	-61.8
QPSK	-72	-69	-66	-63	-61.2	-60	-58.2	-57
16 QAM	-65	-62	-59	-56	-54.2	-53	-51.2	-50
32 QAM	-61.8	-58.8	-55.8	-52.8	-51	-49.8	-48	-46.8
64 QAM	-58.8	-55.8	-52.8	-49.8	-48	-46.8	-45	-43.8
128 QAM	-55.7	-52.7	-49.7	-46.7	-44.9	-43.7	-41.9	-40.7
256 QAM	-52.7	-49.7	-46.7	-43.7	-41.9	-40.7	-38.9	<u>N/A-</u> <u>37.7</u>
512 QAM	-49.7	-46.7	-43.7	-40.7	-38.9	-37.7	<u>N/A-</u> <u>35.9</u>	<u>N/A-</u> <u>34.7</u>
1024 QAM (Optional)	<u>N/A-</u> <u>46.7</u>	<u>N/A-</u> <u>43.7</u>	-40.7	-37.7	<u>N/A-</u> <u>35.9</u>	<u>N/A-</u> <u>34.7</u>	<u>N/A-</u> <u>32.9</u>	<u>N/A-</u> <u>31.7</u>

Table 3: Receiver Sensitivity (dBm) at BER 10^{-6} for different Modulation Schemes and Channel Bandwidths (MHz).

2.4 1.1.4 Interface Requirement

The outdoor unit in E-Band shall provide any of the following combination of Ethernet Interfaces as per the Purchaser's requirements:

- i. TYPE I : 1x GE (electrical) + 1x GE (optical)
- ii. TYPE II : 2x GE (optical)
- iii. TYPE III : 1x10G (Optical via SFP+) + 1x GE
- iv. TYPE IV : 1x10G (Optical via SFP+)
- v. TYPE V : 25G (Optical) interface
- iv.vi. TYPE VI : FE (electrical) interface

NOTE: GE port can also be PoE enabled. The requirement for the same may be specified by the procurer.

~~1.1.4~~ **1.1.4.1 Ethernet Interface Standards**

- i. GE (electrical/optical) ports shall comply with IEEE 802.3.
- ii. 25 G (Optical) ports shall comply with IEEE 802.3-2018, Clause 114.
- iii. FE (electrical) ports shall comply with IEEE 802.3.

~~2.5-1.1.5~~ **Modulation method**

- i. The system shall support the Adaptive Modulation. The Adaptive Modulation shall support the modulations from BPSK to 512 QAM or higher (Optional). The procurer shall specify the requirement for higher order modulation. With the Adaptive Modulation enabled by software, the system shall automatically change the Modulation scheme according to the actual environment/external conditions. It shall be possible to enable or disable the Adaptive modulation feature according to the requirement. Both the aforesaid modulation states shall be supported by the Single modem.
- ii. It must be possible to switch hitless between the modulation states.
- iii. The supplier must explain its implementation of the adaptive modulation feature, i.e., which criteria are used to switch to a lower modulation state and back to higher modulation scheme. These criteria should be configurable.

~~2.2.1~~ **1.1.5.1** The equipment shall support all modulation schemes by one ODU only. The supplier shall provide a table stating all supported Ethernet throughput against each modulation scheme combinations together with the total supported bit rate per combination.

~~2.5.2-1.1.5.2~~ **Specify the Co-channel C/I (Carrier-to-Interference ratio) for threshold degradation of 1.0 & 3.0 dB for a BER of 10^{-6} for 250Mhz channel:**

- a) Values for 1 dB degradation:

Modulation	C/I for BER = 10^{-6} RSL degradation of 1Db
BPSK	<u>44</u> <u>12</u>
QPSK	<u>16.5</u> <u>14</u>
16QAM	<u>23</u> <u>22</u>
32QAM	<u>26</u> <u>25</u>
64QAM	<u>29</u> <u>26.5</u>
128QAM	<u>32</u> <u>27.2</u>
256QAM	<u>35</u> <u>34</u>
512QAM	38
<u>1024QAM (Optional)</u>	<u>45</u>

Table 4: Co-Channel C/I (dB) for 1 dB Threshold Degradation at BER 10^{-6} (250 MHz Channel).

b) Values for 3 dB degradation:

Modulation	C/I for BER = 10^{-6} RSL degradation of 3dB
BPSK	<u>40</u> <u>8</u>
QPSK	<u>12.5</u> <u>11</u>
16QAM	19
32QAM	22
64QAM	<u>25</u> <u>24</u>
128QAM	<u>28</u> <u>27</u>
256QAM	<u>31</u> <u>30</u>
512QAM	34
<u>1024QAM (Optional)</u>	<u>39</u>

Table 5: Co-Channel C/I (dB) for 3 dB Threshold Degradation at BER 10^{-6} (250 MHz Channel).

2.5.3-1.1.5.3 Specify the adjacent-channel C/I for threshold degradation of 1.0 & 3.0 dB for a BER of 10^{-6} for 250Mhz Channel :

a) Values for 1 dB degradation:

Modulation	C/I for BER = 10^{-6} RSL degradation of 1dB
BPSK	-15.5 <u>-23</u>
QPSK	-15 <u>-21</u>
16QAM	-14.7 <u>-16</u>
64QAM	-14.4 <u>-10</u>
128QAM	-14.3 <u>-7</u>
256QAM	-13.9 <u>-4</u>
512QAM	-10.9 <u>0</u>
<u>1024QAM (Optional)</u>	<u>7</u>

Table 6: Adjacent-Channel C/I (dB) for 1 dB Threshold Degradation at BER 10^{-6} (250 MHz Channel).

b) Values for 3 dB degradation:

Modulation	C/I for BER = 10^{-6} RSL degradation of 3dB
BPSK	-27 <u>17</u>
QPSK	-24 <u>17.4</u>
16QAM	-19 <u>16.5</u>

Modulation	C/I for BER = 10^{-6} RSL degradation of 3dB
64QAM	-13 <u>16.5</u>
128QAM	-10 <u>16.2</u>
256QAM	-7 <u>15.6</u>
512QAM	-4 <u>7.5</u>
<u>1024QAM (Optional)</u>	<u>1</u>

Table 7: Adjacent-Channel C/I (dB) for 3 dB Threshold Degradation at BER 10^{-6} (250 MHz Channel).

1.1.5.4 Local Supervision:

_____ Web-based and/or Laptop/PC and/or hand held terminal (local craft terminal) for monitoring parameters such as Transmit power, Receive RF level.

1.1.5.5 Alarm : Alarm indication at EMS for parameters such as

- i. equipment hardware failure,
- ii. power supply output failure,
- iii. Transmit power low,
- iv. Microwave Link failure,
- v. quality deterioration {high BER settable at 1×10^{-6} }, sync failure},
- vi. no data input
- vii. status of protection switching

1.1.5.6 Remote Supervision:

_____ The values of the following parameters are to be monitored locally and conveyed to terminal station. In case the value of any of the parameters

exceeds the specified limits an alarm shall also be extended to the terminal station on either side.

- i. RF Transmit Power.
- ii. Receive RF level.
- iii. Hop performance deterioration.
- iv. Ethernet (GE) performance parameters.

The details of alarms provided by the system shall be indicated.

~~4.1~~ 1.1.5.7 Latency

The equipment shall ensure low latency for one way network traffic as follows: (for 64 Bytes frame size, in microseconds)

Bandwidth (MHz)/ Modulation Scheme	62.5	125	250	500	750	1000	1500	2000
BPSK	1014	491	229	123	94	75	59	53
QPSK	519	260	128	74	59	49	41	38
16 QAM	278	145	78	50	42	37	32	30
32QAM	229	122	68	45	38	34	31	30
64 QAM	197	107	61	42	36	33	30	29
128QAM	174	96	56	39	34	31	29	29
256 QAM	157	88	52	38	33	31		-
512 QAM	145-	82	50	36	33-	31-	-	-
<u>1024 QAM</u> <u>(Optional)</u>	<u>N/A</u>	<u>N/A</u>	<u>17</u>	<u>10</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>

Table 8: Network Latency (μ s) for Various Modulation Schemes and Channel Bandwidths (Frame Size: 64 bytes).

~~5.1~~ **1.1.5.8** —The equipment shall provide features to ensure low latency for delay-sensitive services. Where high-priority frames are pushed ahead of lower priority frames, even if transmission of the lower priority frames has already begun.

1.1.5.9 Multiband for Type-IV configuration

-The unit shall support Multi-band technology. Multi-band backhaul links consist of running multiple channels at different frequency bands (mmW + Traditional license MW) on a single link to improve capacity and reliability. Traffic aggregation between the two bands should be done at layer-1 LAG without additional IDU with 99% efficiency.

~~6.1~~ **1.1.5.10** The equipment must support jumbo frames 9216 Bytes (at least).

~~7.1~~ **1.1.5.11 (Optional)** The equipment shall support Flexible transport and encapsulation via 802.1q, ~~and 802.1ad (Q in Q)~~, at ingress and egress. The Procurer/Purchaser shall specify the requirement of 802.1ad (Q in Q/VLAN) if required.

~~2.5.12~~ **1.1.5.12** The equipment shall support High precision, flexible frame synchronization solution including SyncE as well as 1588v2 (Transparent Clock).

~~2.5.13~~ **1.1.5.13** The equipment shall support CoS based on:

- VLAN ID
- 802.1p bits
- IPv4 DSCP bits/TOS bits
- IPv6 traffic class

~~8.1~~ ~~2.5.14~~ **1.5.14** The equipment shall support Weighted Random Early Detection mechanism in order to increase capacity utilization.

~~2.5.15~~ **1.5.15** The equipment shall support the system management using IPV4 and IPV6.

~~2.5.16~~ System shall support P-bit marking/remarking.

~~9.1~~ 1.1.5.17 System shall support 4K VLANs.

~~10.1~~ 1.1.5.18 The equipment shall support frequency scanner embedded application to determinate the current interference level for each channel.

~~2.4~~ 1.1.6 NETWORK RESILIENCY (OPTIONAL)

~~1.1~~ 1.1.6.1 Equipment shall support network level resiliency (G.8032) standard for ring/mesh support, with a maximum of 50msec convergence time (OPTIONAL).

~~2.1~~ 1.1.6.2 Radio failures should propagate back on the Ethernet port related to the proper radio.

~~3.1~~ 1.1.6.3 —Local Ethernet port failures should propagate to the remote side of the link (supporting Link Loss Forwarding (LLF) capabilities).

~~2.4~~ 1.1.7 Synchronization

~~1.1~~ 1.1.7.1 —The system shall support frequency synchronization performance as defined in ITU-T G.8261 and G.8262

~~2.1~~ 1.1.7.2 —The System's hardware shall fully support precision time protocol (PTP) clock synchronization according to IEEE 1588v2.

~~3.1~~ 1.1.7.3 —System shall comply with the following ITU-T recommendations for frequency synchronization:

- G.8261.1
- G.8265.1

~~4.1~~ 1.1.7.4 System shall comply with the following ITU-T recommendations for time/phase synchronization:

- G.8271.1
- G.8275.1

1.1.7.5 —Product shall support the following operation modes, for transparent clock (1588v2 Transparent Clock) according to ITU-T G.8275.1 or optionally G.8275.2 and G.8273.3:

- one-step/two-step clock mode
- unicast/multicast mode

- PTP over Ethernet/PTP over UDP/IPv4

~~5.1~~ 1.1.7.6 —The system serves as Transparent Clock (1588v2 TC) will have accuracy of 2-way time error < 50ns

~~6.1~~ 1.1.7.7 —The System shall support NTPv3 and NTPv4, complying with the RFC 5905 (for NTPv4) and RFC 1305 (compatibility with NTPv3).

~~2.4~~ 1.1.8 SDN Ready

~~1.1~~ 1.1.8.1 —Platform should support NETCONF/YANG protocols

~~2.1~~ 1.1.8.2 —Customers are able to manage, configure, and monitor the unit as part of SDN network architecture using Vendor SDN controller or other 3rd party SDN controller that follow the ONF TR-532/ONF-TAPI and MEF requirements.

~~1.2.1~~ 1.2-QUALITY REQUIREMENTS

1.2.1 The manufacturer shall furnish the MTBF value. Minimum value of MTBF shall be 500,000 hours. The calculations shall be based on the guidelines given in either BSNL QA document No. QM-115 {January 1997} "Reliability Methods and Predictions" or any other international standards.

1.2.2 The equipment shall be manufactured in accordance with international quality management system ISO 9001:2015 or any other equivalent ISO certificate for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted.

~~1.2.1~~1.2.3 The equipment shall conform to the ~~requirements for~~ Environmental requirements specified as per the in-TEC QA standards TEC 14016:2010 (latest issue) on "Environmental Testing of Telecommunication Equipment", (old no. QM-333, Issue- March, 2010)} ~~"Standard for Environmental testing of Telecommunication Equipments"~~ or any other equivalent international standard, for operation, transportation and storage. The applicable tests shall be for environmental category "D", including vibration and corrosion (salt mist). For equipment with an integrated antenna assembly (i.e. where the antenna is not a separable component), the integrated unit shall be assessed

under Category D. Category E applies only to antenna assemblies submitted separately as passive components.

4.0 1.3 ~~GENERAL~~ ELECTROMAGNETIC COMPATIBILITY (EMC)

REQUIREMENTS: -

The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report from accredited test lab shall be furnished from a test agency.

- a) Conducted and radiated emission (applicable to telecom equipment):

~~Name of EMC Standard: "CISPR 32 (2015) with amendments—Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment".~~

~~Limits:-~~

- ~~i) To comply with Class B of CISPR 32 (2015) with amendments for indoor deployments and Class A of CISPR 32 (2015) with amendments with amendments for outdoor deployments.~~

Applicable as per relevant table: emission requirements of TEC 11016 (Latest issue)

- i) Limits for Radiated emission test shall be as per applicable Table(s) in TEC 11016 for the respective class of the equipment (Class A/Class B).
- ii) Limits for Conducted emission test shall be as per applicable Table(s) in TEC 11016 for the respective class of the equipment (Class A/Class B).

- b) Immunity to Electrostatic discharge:

~~Name of EMC Standard: IEC 61000-4-2 (2008) "Testing and measurement techniques of Electrostatic discharge immunity test".~~

~~Limits:-~~

- ~~i) Contact discharge level 2 {± 4 kV} or higher voltage;~~

ii) ~~Air discharge level 3 (± 8 kV) or higher voltage;~~

Limits shall be as per applicable Clause of TEC 11016 (Latest issue) for Performance Criteria B.

e) Immunity to radiated RF:

i) ~~Name of EMC Standard: IEC 61000-4-3 (2010) "Testing and measurement techniques Radiated RF Electromagnetic Field Immunity test".~~

c) Limits:

Limits shall be as per applicable Clause of TEC 11016 (Latest issue) for Performance Criteria A, Test Level 2 (80 MHz–6 GHz) and Test Level 3 (800–960 MHz & 1.4–6.0 GHz).

~~For Telecom Equipment and Telecom Terminal Equipment without Voice interface (s)~~

~~Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz and for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.~~

d) Immunity to fast transients (burst):

~~Name of EMC Standard: IEC 61000-4-4 (2012) "Testing and measurement techniques of electrical fast transients/burst immunity test".~~

Limits:-

Limits shall be as per applicable Clause of TEC 11016 (Latest issue) for Performance Criteria B.

Test Level 2 i.e.:

a) ~~1 kV for AC/DC power lines;~~

b) ~~0.5 kV for signal / control / data / telecom lines;~~

e) Immunity to surges:

~~Name of EMC Standard: IEC 61000-4-5 (2014) "Testing & Measurement techniques for Surge immunity test".~~

~~Limits:-Limits shall be as per applicable clause of TEC 11016 (Latest issue) pertaining to Power port and the Telecom Port, wherever applicable.~~

- ~~i) For mains power input ports : (a) 2 kV peak open circuit voltage for line to ground coupling (b) 1 kV peak open circuit voltage for line to line coupling~~
- ~~ii) For telecom ports : (a) 2kV peak open circuit voltage for line to ground (b) 2KV peak open circuit voltage for line to line coupling.~~

f) Immunity to conducted disturbance induced by Radio frequency fields:

~~Name of EMC Standard: IEC 61000-4-6 (2013) with amendments) "Testing & measurement techniques-Immunity to conducted disturbances induced by radio frequency fields".~~

~~Limits:-Limits shall be as per applicable clause of TEC 11016 (Latest issue).~~

~~Under the test level 2 {3 V r.m.s.} in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.~~

g) Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any):

~~Name of EMC Standard: IEC 61000-4-11 (2004) "Testing & measurement techniques-voltage dips, short interruptions and voltage variations immunity tests".~~

~~Limits:-Limits shall be as per applicable Clause of TEC 11016 (Latest issue) for Performance Criteria B & C.~~

- ~~i) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e. 70 % supply voltage for 500 ms)~~
- ~~ii) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e. 40% supply voltage for 200ms) and~~
- ~~iii) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s.~~

~~iv) a voltage interruption corresponding to a reduction of supply voltage of >95% for 10s.~~

h) Immunity to voltage dips & short interruptions (applicable to only DC power input ports, if any):

~~**Name of EMC Standard:** IEC 61000-4-29:2000: Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests.~~

~~**Limits:** Limits shall be as per applicable Clause of TEC 11016 (Latest issue) for Performance Criteria B & C.~~

- ~~i. Voltage Interruption with 0% of supply for 10ms. Applicable Performance Criteria shall be B.~~
- ~~ii. Voltage Interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms. Applicable Performance Criteria shall be C.~~
- ~~iii. Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms. Applicable Performance Criteria shall be B.~~
- ~~iv. Voltage dip corresponding to 40% & 70% of supply for 100ms, 300 ms and 1000ms. Applicable Performance Criteria shall be C.~~
- ~~v. Voltage variations corresponding to 80% and 120% of supply for 100 ms to 10s as per Table 1c of IEC 61000-4-29. Applicable Performance Criteria shall be B.~~

Note: - For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC 11016 (latest issue) ~~TEC/SD/DD/EMC-221/05/OCT-16~~ and the referenced base standards i.e. IEC and CISPR standards and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (h) and TEC Standard TEC 11016:2026 ~~TEC/SD/DD/EMC-221/05/OCT-16~~. The details of IEC/CISPR and their corresponding Euro Norms are as follows:

IEC/CISPR

Euro Norm

CISPR 11	EN 55011
CISPR 32	EN55032
IEC 61000-4-2	EN 61000-4-2
IEC 61000-4-3	EN 61000-4-3
IEC 61000-4-4	EN 61000-4-4
IEC 61000-4-5	EN 61000-4-5
IEC 61000-4-6	EN 61000-4-6
IEC 61000-4-11	EN 61000-4-11
IEC 61000-4-29	EN 61000-4-29

1.4.1 1.4 SAFETY REQUIREMENTS:

1.4.1 ~~The equipment shall conform to:~~ The equipment shall conform to relevant safety requirements for "Audio/video, Information and Communication Technology Equipment", and, wherever applicable, for "Radio Transmitting Equipment (Other than CPE)", as prescribed under Table no. 1 of the TEC Standard for "SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT: **TEC10009**" as amended time to time.

~~i. IS 13252 part 1: 2010 "Information Technology Equipment – Safety – Part 1: General Requirements" [equivalent to IEC 60950-1 {2005} – "Information Technology Equipment – Safety – Part 1: General Requirements"]~~

OR

~~IEC 62368-1: 2018 "Audio/video, information and communication technology equipment – Part 1: Safety requirements"~~

6.01.5 Energy Consumption Rating:

6.1.1.5.1 ~~–~~ Energy Consumption and Energy Passport of equipment shall be calculated as per TEC standard TEC 74046:2020 (or latest version).

1.6.1 1.6 GENERAL REQUIREMENT

1.6.1 OPERATIONAL REQUIREMENTS

1.6.1.1 The manufacturer shall guarantee the satisfactory performance of the equipment without any degradation at an altitude upto 3,000 meters.

1.6.1.2 The equipment should be able to work without any degradation in saline atmosphere near coastal areas and should be protected against corrosion.

1.6.2 MAINTENANCE REQUIREMENTS:

Maintenance philosophy is to replace faulty units/subsystems after quick on-line analysis through alarm indications and Built-in Test Equipment or laptop/ Personal Computer. The actual repair will be undertaken at centralized repair centers. The corrective measures at site shall involve replacement of faulty units/sub-systems.

1.6.2.1 The NMS /EMS shall be compliant with latest EMS TMF 814 standard/state of the art REST APIs and/or as per TEC Standard No. SD/NMS-02/01 FEB. 05, as applicable for Radio Transmission equipment with L2 services (based on TMN architecture as per ITU-T Recommendation M.3010, M.3100/3120), including the following features. It shall communicate with NEs over standard protocols like SNMP V2/V3, HTTPs or XML on text mode or use proprietary protocols for providing full FCAPS feature.

- a. It shall communicate over standard SNMP/NETCONF for complete FCAPS functionality. However, if all FCAPS functionality are not supported by this interface, then the same functionality shall be supported using XML/CSV/HTTPs/REST APIs interface.
- b. It shall be the access point for maintenance personnel to access the network.
- c. It shall support open web interfaces for maintenance personnel to log into the NMS/EMS and do the management activities as per the authorization.
- d. LCT tolerance accuracy value to be furnished by the vendor.

1.6.2.2 Ratings and types of fuses used are to be indicated by the supplier, if any.

1.6.3 POWER SUPPLY:

The power supply to the equipment shall be fed from the station power plant. The equipment shall meet the following requirements in respect of the power supply.

1.6.3.1 Nominal power supply is -48 volts DC, with a variation over the range 44V to -57V. The equipment should operate over this range without any degradation in performance.

1.6.3.2 The equipment shall be protected in case of voltage variation beyond the above-specified range and also against input reverse polarity. The manufacturer shall furnish the value of guaranteed input voltage up to which no irreversible damage to the equipment will occur.

1.6.3.3 The actual power consumption shall be furnished by the manufacturer.

1.6.3.4 The derived DC voltages in the equipment shall have protection against over-voltage, short-circuit.

1.6.3.5 If power supply is of Power over Ethernet (PoE) type then it should comply with IEEE 802.3 at standard or any equivalent, and it shall also support the separate power supply input as well.

1.6.3.6 If the equipment requires ac mains, then it shall operate from ac power supply without any degradation in the performance.

Nominal AC voltage for Single Phase shall be 230V with variation of - 15% to +10%, at 50 ± 2 Hz. Nominal AC voltage for three phase Supply systems shall be 415V with variation of $\pm 10\%$ at 50 ± 2 Hz wherever applicable.

1.6.4 ACCESSORIES

1.6.4.1 The supplier shall provide one complete set of:

- a. All the necessary interfaces, connectors, connecting cables and accessories required for satisfactory and convenient operation of the equipment. Types of connectors, adopters to be used and the accessories of the approved quality shall be clearly indicated in the

operating manuals, which should be in conformity with the detailed list in the GR.

- b. Software and the arrangement to load the software at site. Additional sets may be ordered optionally.

1.6.4.2 Special tools, extender boards, extender cables and accessories essential for installation, operation and maintenance of the equipment shall be clearly indicated and supplied along with the equipment.

1.6.4.3 Installation, Operation and Maintenance Manual

- a. Safety measures to be observed in handling the equipment.
- b. Precautions for installation, operation and maintenance.

1.6.5 PROTECTION REQUIREMENTS

1.6.5.1 The equipment shall have a terminal for grounding the rack/Tower.

1.6.5.2 Protection against short circuit/ open circuit in the accessible points shall be provided.

1.6.5.3 All switches/controls on front panel shall have suitable safeguards against accidental operation (if applicable).

1.6.6 Antenna- General Requirements

The Antenna used together with Microwave equipment shall meet the following requirements:

Sl. <u>NoS. No.</u>		Antenna with 30cm. Diameter	Antenna with 60cm. Diameter	Embedded Antenna
1	Type	Parabolic Cassegrain	Parabolic Cassegrain	Flat panel/
2	Material			
	Reflector	Aluminium or FRP	Aluminium or FRP	Aluminium or FRP

Sl. No.		Antenna with 30cm. Diameter	Antenna with 60cm. Diameter	Embedded Antenna
	Radome	UV resistant Flexible Planar Radome made of Teglar or PTFE coated fiberglass or Raydel	UV resistant Flexible Planar Radome made of Teglar or PTFE coated fiberglass or Raydel	
3	Gain			38 dBi
	Low Band	43 dBi	50 dBi	
	Middle Band	43.5 43.8 dBi	50.851 dBi	
	High Band	44.6 dBi	51.5 52 dBi	
4	3 dB Beam width	0.9°	0.4°	0.9°-2.2°
5	Cross Pole Discrimination	30 Db	30 dB	25 Db
6	Front to Back Ratio	61.4 Db	70 60 dB	60 dB

Table 9: General Requirements for Antennas Used with Microwave Equipment.

1.6.6.1 The antenna shall be manufactured in accordance with International quality standard ISO 9001:2000 for which the manufacturer shall be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted.

1.6.6.2 The joints in the antenna assembly shall have protection as per BIS Standard IS 12063 {1987} "Classification of degrees of protection provided by

enclosures of electrical equipment" {equivalent to IEC - 60529} to meet at least the protection level of IP -65.

The equipment shall conform to the ~~requirements for~~ Environmental requirements as per the specified in TEC standard TEC 14016:2010 (latest issue) on "Environmental Testing of Telecommunication Equipment", (old no. QM-333, Issue- March, 2010) or any other equivalent international standard, TEC QA standards QM-333 (Issue- March, 2010) "Standard for Environmental testing of Telecommunication Equipments" for operation, transportation and storage. The applicable tests shall be for environmental category "E" including vibration and corrosion (salt mist).

1.6.6.3 Documentation

Technical literature in English with complete layout, detailed construction diagram and detailed block schematic wherever applicable shall be provided in hard copy. All aspects of installation, operation, maintenance, trouble shooting and replacement shall be covered in this manual. Additionally, a soft copy /QR code on the system in respect of technical literature shall also be provided both in Hindi and English.

CHAPTER 2 ~~Annex for the reference of the purchaser~~

Information for the Procurer / Purchaser

2.0 The following clauses are for the reference of the purchaser. The purchaser will indicate specific requirements under these clauses while placing the purchase order.

- 1.** The manufacturer/supplier shall furnish the list of recommended spares.
- 2.** The purchaser shall indicate the requirement of modulation levels supported by the equipment against the clause no. ~~2.4.7~~1.1.1.7.
- 3.** The purchaser shall indicate the requirement of Type of configuration against the clause no. ~~2.4.8~~1.1.1.8.
- 4.** The purchaser shall indicate the interface requirement against clause no. ~~2.4~~1.1.4
- 5.** The purchaser shall indicate the requirement of antenna size/type against the clause no. ~~7.6~~1.6.6.
- 6.** In the document, some features (including those requirements which have been marked as per purchaser / procurer requirements) need to be examined by the purchaser / procurer and shall be suitably specified in the tender conditions / ordering information as per their requirement.

ABBREVIATIONS

AGC	Automatic Gain Control
AIS	Alarm Indication Signal
ANT	Antenna
ASK	Amplitude-shift keying
ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
BITE	Built in test equipment
BIS	Bureau of Indian Standards
BPSK	Binary Phase Shift Keying
BSNL	Bharat Sanchar Nigam Limited
CLI	Command Line Interface
CISPR	International Special Committee on Radio Interference
CRS	Central Radio Station
CS	Central Station
CSV	Command Separated Values
CW	Continuous Wave
dB	Decibel
dBm	Decibel with reference to one mill watt
dBmop	Psophometric Power with reference to zero dBm
DC	Direct Current
D/U	Desired to Undesired signal ratio
E1	2.048 Mbps
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMS	Element Management System
ENV	European Pre standard

ETSI	European Telecommunications Standards Institute
FCAPS	Fault-management, configuration, accounting, performance, and security
FCC	Federal Communications Commission
<u>FE</u>	<u>Fast Ethernet</u>
GbE	Gigabit Ethernet
GHz	Giga Hertz
GR	Generic Requirement
GTTH	Gigabit to the Home
HHT	Hand Held Terminal
HPBW	Half Power Band Width
HSB	Hot Stand By
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electromechanical Commission
IETF	Internet Engineering Task Force
IF	Intermediate Frequency
IFbw	Intermediate Band width
IP	Internet Protocol
IRF	Interference Reduction Factor
IS	Bureau of Indian Standards
ISDN	Integrated Service Digital Network
ISO	International Organization of Standardization
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union – Radio Communication Sector
ITU-T	International Telecommunication Union – Telecommunications Standardization Sector
Kbps	Kilo bits per second

KHz	Kilo Hertz
KV	Kilo Volts
LAG	Link Aggregation
LCT	Local Craft Terminal
LSP	Layered Service Provider
MAC	Media Access Control address
Mbps	Mega bits per second
MEF	Metro Ethernet Forum
MHz	Mega Hertz
MIBs	Management Information Bases
mm	millimeter
MPLS	Multiprotocol Label Switching
mW	milli Watt
MST	Multiplex Section Termination
MTNL	Mahanagar Telephone Nigam Limited
MTBF	Mean time between failures
MTP	Mean Transmit Power
MUX	Multiplexer
NETCONF	Network Configuration Protocol
NMS	Network Management System
NTP	Network Time Protocol
OAM	Operation, Administration, and Maintenance
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
ONF	Open Networking Foundation
OSI	Open System Interconnection
PA	Power Amplifier
PC	Personal Computer

PCM	Pulse Code Modulation
PDH	Plesiochronous Digital Hierarchy
PDR	Pressurisable Type D Rectangular Flange
PLMN	Public Land Mobile Network
P-MP	Point to Multipoint
ppm	part per million
PRBS	Pseudo-random Binary Sequence
PSU	Power Supply Unit
PTFE	Poly Tetra Fluoro Ethylene
PTP	Precision Time Protocol
PWE3	Pseudo Wire Emulation Edge to Edge
QA	Quality Assurance
QAM	Quadrature Amplitude Modulation
QM	Quality Manual
QPSK	Quadrature Phase Shift Keying
REST	Representational State Transfer
RF	Radio Frequency
RFC	Request for Comments
RFCOH	Radio Frame Complementary Overhead
RLO	Receiver Local Oscillator
r.m.s	root mean square
RPE	Radiation Pattern Envelope
RS	Repeater Station
RSL	Receive Signal Level
RST	Regenerator Section Termination
RX	Receiver
SDH	Synchronous Digital Hierarchy
SDN	Software-Defined Networking

S/I	Signal to Interference
S/N _q	Signal to total quantisation noise ratio
SNMP	Simple Network Management Protocol
SOH	Section Overhead
SPV	System Performance Value
SSH	Secure Shell
STM	Synchronous Transport Module
Sync.	Synchronization
TAPI	Transport Application Program Interface
TDMA	Time Division Multiplexing Access
TE	Terminal Equipment
TEC	Telecommunication Engineering Centre
TELNET	Teletype Network Protocol
TLO	Transmitter Local Oscillator
TMF	Tele Management Forum
TMN	Telecommunications Management Network
TX	Transmitter
UDP	User Datagram Protocol
V/m	Volt per meter
VF	Voice Frequency
<u>VLAN</u>	<u>Virtual Local Area Network</u>
VSWR	Voltages Standing Wave Ratio
XML	Extensible Markup Language
XPD	Cross Polar Discrimination
XPIC	Cross polar interference canceller
XPIF	Cross polar improvement factor
μW	Microwatt

Annex for the reference of the purchaser

The following clauses are for the reference of the purchaser. The purchaser will indicate specific requirements under these clauses while placing the purchase order.

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2. The purchaser shall indicate the requirement of modulation levels supported by the equipment against the clause no. 2.1.7.
3. The purchaser shall indicate the requirement of Type of configuration against the clause no. 2.1.8.
4. The purchaser shall indicate the interface requirement against clause no. 2.4
5. The purchaser shall indicate the requirement of antenna size/type against the clause no. 7.6.