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केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
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PUBLIC NOTICE

CEA had published draft Technical Standards for Communication System Regulations, 2018 in newspapers on 12/04/2018 to seek public comments. The mandatory 45 days' period of public notice is over on 26/05/2018.

Considering public comments and detailed discussions with stakeholders, the draft document has been modified and attached below. The members of public are requested to send comments on the Draft "**Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations 2018"** by 20th Oct,2018 to the above stated postal address, and also email at nbnareshbhandari@gmail.com for suitable consideration.

(**Naresh Bhandari)**
Chief Engineer

सत्यमेव जयते

DRAFT TECHNICAL STANDARDS FOR COMMUNICATION SYSTEM IN POWER SYSTEM OPERATION

(Proposed under Section 177- subsection (1) and (2g) read with Section 73-subsection (b) of Electricity Act, 2003)

केविप्रा
cea

CENTRAL ELECTRICITY AUTHORITY
New Delhi – 110066

AUGUST 2018

Draft Technical Standards for Communication System in Power System Operation

1. Short Title and Commencement

(1) These regulations shall be called the Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations 2018.

(2) They shall come into force on the date of their publication in the official Gazette.

2. Definitions

In these regulations, unless the context otherwise requires –

a) "Act" means the Electricity Act, 2003 as amended from time to time;

b) "Advanced Metering Infrastructure (AMI)" is a network to enable two-way communication between Smart Meter and Head End System (HES) to enable remote reading, monitoring & control of electrical energy meters, etc.;

c) "Ancillary Services" means in relation to power system (or grid) operation, the services necessary to support the power system (or grid) operation in maintaining power quality, reliability and security of the grid e.g. active power support for load following, reactive power support, black start, etc.;

d) "Ancillary Service Providers" means a person or entity providing service like ancillary service to facilitate system operation;

e) "ANSI Standards" means those standards and specifications approved by the American National Standards Institute;

f) "Associated Communication System" means a communication system associated with a project set up for exchange of voice/video/data with load despatch center/control center as per Grid Code;

g) "Analog Signal" means digital representation of a continuous value (for example, a power flow);

h) "Auxiliary Power Supply" means dedicated alternate DC power source which serves as back-up in the absence of primary power source;

i) "BIS Standards" means those standards and specifications approved by Bureau of Indian Standards;

j) "Commission" means the Central Electricity Regulatory Commission referred to in sub-section (1) of Section 76 of the Act for Inter State Transmission System; and State Electricity Regulatory Commission referred to in sub-section (1) of Section 82 of the Act for Intra State transmission and distribution System;

k) "Central Transmission Utility" means any Government Company which the Central Government may notify under sub-section (1) of Section 38 of the Act;

l) "Communication Channel" means a dedicated physical/virtual path configured from one user node to another user node, either directly or through intermediary node(s) to facilitate voice, video and data communication and tele-protection system;

m) "Communication Interface" means a dedicated physical connectivity to the communication network for exchange of data and information for the Data provider and intervening communication system;

n) "Communication Network" means an interconnection of communication nodes through a combination of media, either directly or through intermediary node(s);

o) "Communication Protocol" means a system of rules and well-defined formats that allow two or more entities of a communications system to exchange information via any kind physical medium;

p) "Communication System" is a collection of individual communication networks, communication media, relaying stations, tributary stations, terminal equipment usually capable of inter-connection and inter-operation to form an integrated communication backbone for power sector. It also includes existing communication system and their auxiliary power supply system, etc.;

q) "Control Command" means a representation of an instruction to perform a defined action (for example a generation increase);

r) "Control Centre" means National Load Despatch Centre or Regional Load Despatch Centre or Renewable Energy Management Centre or State Load Despatch Centre or Area LDC or Sub-LDC or DISCOM LDC including main and backup, as applicable, as well as market operators centre;

s) "Communication Service Provider" means a person or Utility authorized to establish and/or operate communication system;

t) "Communication Equipment" means any part of equipment used to transmit Operational Data between Data Provider's station and another station / Control Centre;

u) "Data" means a set of values of analog or digital signal including a text, voice, video, tele-protection, alarm, control signal, phasor, status of device, weather parameter, parameter of a machine or the power system, market related data, clearing house information, etc.;

v) "Data Provider" means a person such as a Generating Company including Grid connected Captive Generating Plant, Renewable Energy Generator, Transmission Licensee, Distribution Licensee, a Bulk Consumer, whose electrical system is connected to the ISTS or the intra-State transmission system or Distribution System, Market Operators and Service Providers (Ancillary, Weather and Forecast) providing service to facilitate system operation functions;

w) “Data Concentrator Unit (DCU)” means a secured aggregate router which facilitates secured two-way data transfer in transparent/store and forward mode as per system designs.

x) “Data Collecting Node” means a wideband node established to collect data from multiple Data Providers, Market Operators and Ancillary Service Providers;

y) “Digital Signal” means digital representation of equipment status information (for example, a circuit Breaker and isolator status);

z) "Earth Connection" means connection between conducting parts and general mass of earth by an earthing device;

aa) "Forecasting Service Provider (FSP)" means a service provider who provides forecast data related to Renewable Energy Resources and Demand for use of Users;

bb) “Generating station” means a generating station as defined in Section 2 (30) of the Act.

cc) “Grid Code” means the Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations, 2010 as amended from time to time or subsequent reenactment thereof;

dd) “Head End System (HES)” means a set of ICT based systems situated at the top of AMI system which receives data and events over NAN (Neighbourhood Area Network) / WAN.

ee) "Inter-State transmission system" means the ISTS as defined in Section 2 (36) of the Act;

ff) “Intervening Communication” means a communication system that transfer the Data from one communication system to others seamlessly;

gg) “Interoperability” means the measure of ease of integration between two systems or software components to achieve a functional goal;

hh) “ITU-T Standards” means those standards and specifications approved by the International Telecommunications Union – Telecommunication Group;

ii) “Lead Communication Service Provider” means a person or Utility authorized to set up communication system backbone at Regional, State, DISCOM level as communication service provider to “Control Centre” and the “Users” for Information / Data exchange;

jj) “Meter” means a device suitable for measuring, indicating and recording consumption of electricity or any other quantity related with electrical system and shall include, wherever applicable, other equipment such as Current Transformers (CT), Voltage Transformer (VT) or Capacitor Voltage Transformer (CVT) with necessary wiring and accessories;

kk) “Market Operation Service” means a person or entity providing services to facilitate market operation like Power Exchanges, Market Clearing House etc.

ll) “Mission Critical System or Application in power system” is a system or application that is essential for the survival of the power system and whose disruption or failure may affect the safety and security of the Grid.

mm) "National Load Despatch Centre" means the centre established under subsection of Section 26 of the Act;

nn) “Person” shall include any company or body corporate or association or body of individuals, whether incorporated or not, or artificial juridical person;

oo) "Real time operation" means action to be taken at a given time at which information about the electricity system is made available to the concerned Load Despatch Centre;

pp) “Real time data” denotes information relating to current operating state of power system in accordance with system operation and control requirements;

qq) “Regional Load Despatch Centre" means the Centre established under subsection of Section 27 of the Act;

rr) “Remote Terminal Units” (RTU) means a device suitable for measuring, recording and storing the consumption of electricity or any other quantity related with electrical system, weather and status of the equipment in real time basis and exchanging such information with the data acquisition system for display and control and shall include, wherever applicable, other equipment such as transducers, relays with necessary wiring and accessories.

ss) "Renewable Energy Management Centres (REMC)" means the centres being established in India to enable forecasting, scheduling and monitoring of renewable energy generation;

tt) “Round trip delay” is the total time taken for a signal to be sent and the acknowledgement to be received between the two communication endpoints;

uu) "SCADA" means Supervisory Control and Data Acquisition System that acquires data from Data provider locations over communication links and processes it at control centre for monitoring, supervision, control as well as decision support;

vv) Smart Meter is an ac static watt-hour meter with time of use registers, internal connect and disconnect switches with two-way communication capability;

ww) “State Load Despatch Centre (SLDC)” means the centre established under subsection of Section 31 of the Act;

xx) “State Transmission Utility” means the board or the Government Transmission Company as specified by the State Government under sub -section (1) of Section 39 of the Act;

yy) "Site Common Drawing" means a drawing prepared for every interface point at site, which depicts layout of connectivity, allocation of channels/users and common services for the interface;

zz) "Site Responsibility Schedule" (SRS) means a Schedule for demarcating the ownership, responsibility for control, operation and maintenance of the equipment at the interface point;

aaa) “System Operation Function” includes monitoring of grid operations, supervision and control over the Transmission System, real time operations for grid control and dispatch,

system restoration following grid disturbances, compiling and furnishing data pertaining to system operation, congestion management, black start coordination and any other function(s) assigned to the control centre under the Act or any regulations and orders of the Commission;

bbb) "Weather Service Providers (WSP)" means a service provider who provides data related to weather like wind speed, temperature, humidity, irradiation, cloud cover etc. for use of forecasting application at Control Center;

ccc) "Wide band Node" means interface point on the wideband data communication system with an ability to simultaneously transport multiple signals of very high bandwidth requirement;

ddd) "Wide Area Measurement Systems (WAMS)" is advanced measurement technology, information tools, and operational infrastructure that facilitate the understanding and management of the increasingly complex behaviour exhibited by large power systems to enhance the system operator's situational awareness for safe and reliable grid operation;

3. The words and expressions used and not defined in these Regulations but defined in the Act shall have the meaning assigned to them in the Act.

4. OBJECTIVES

(i) To ensure seamless integration, reliable, redundant and secure communication;

(ii) To ensure that any network change shall not cause any adverse effect on functioning of existing Communication System. The Communication System shall continue to perform intended function with specified reliability, security and quality;

(iii) A Data Provider or an intervening Communication System Provider is required to be aware, in advance, of the standards and conditions his system has to meet for being connected into the Communication System.

5. APPLICABILITY

These standards shall be applicable to all Communication Service Providers, Central & State Generating Company including Grid connected Captive Generating Plant, RE Generator, Transmission Licensee, Distribution Licensee, a Bulk Consumer, a consumer whose electrical system is connected to transmission system, distribution system, Market Operation Service Providers and other Service Providers like Forecast, Weather and Ancillary services; etc.

6. FUNCTIONAL REQUIREMENT

The primary function of the communication network is to provide a highly secured and reliable voice and data communication system in support of the WAM (Wide Area Monitoring) System, SCADA/EMS (Energy Management System) system, Protection System, Remote Operation, Market Operation Service and Service Providers (Forecast, Weather and Ancillary services), Automatic Generation and Control (AGC), Video Conferencing (VC), Surveillance System, Automatic Meter Reading (AMR) / Advanced metering Infrastructure (AMI), Smart Grid implementations, Electric Vehicles (EVs), Distributed Energy Resources, Demand Side Management, etc. and any other activities related to power system operation. The required communication interfaces shall be provided both at sending (User) and receiving (Control Centre) ends for all such functionalities as indicated above for low & high speed data, express voice circuits and administrative voice circuits.

The communication system shall finally form a wideband backbone to support the requirement of the Power System Operation and Market operation. The Standards of Wideband Communication are given at Schedule (Part-II).

7. STANDARDS AND CODES OF PRACTICE

(i) The Communication Service Providers shall follow the industry best practices and applicable industry standards in respect of the equipment installation and its operation and maintenance.

(ii) The communication equipment shall comply with the relevant standards of Bureau of Indian Standards (BIS). If BIS Standards are not available for a particular equipment or material, the relevant British Standard (BS), International Electro-Technical Commission (IEC) Standard, IEEE, EIA (Electronic Industries Association Standards), American National Standards Institute (ANSI), ITU-T (International Telecommunications Union–Telecommunication) / CCITT (Consultative Committee for International Telephony and Telegraphy), CISPR (International Special committee on Radio Interference), Fiber Optic Association (FOA) or any other equivalent International Standard shall be followed. Provided that whenever an International Standard is followed, necessary corrections or modifications shall be made for prevailing local ambient conditions before adoption-of the said Standard.

(iii) The latest version of Standards shall be followed.

(iv) The effects of wind, storms, floods, lightening, elevation, temperature extremes, icing, contamination, pollution and earthquakes etc. shall be considered in the design and operation of the connected facilities.

8. LIGHTNING & SURGE PROTECTION

Communication Service Provider shall have proper earth connection of its communication equipment (indoor & outdoor), and shall be solely responsible for failure of its communication equipment due to any problem related to earthing. Communication system shall preferably have a separate earth connection, which is isolated from grounding of electrical equipment in the premises. Sufficient protection shall be provided for lightning and electric surge as per relevant standards of IEC (model by IEC 61000-4-5 and compliant to relevant parts of IEC 62305). Earth connection shall be done in accordance with the norms of the Institute of Electrical and Electronics Engineers (IEEE)-80 or BIS:3043. The resistibility of communication equipment installed against over voltage and over current shall be as per ITU-T (K 20) recommendations.

9. ACCESS POLICY

Data & Information is a valuable asset for the Indian Power System where strict confidentiality shall be maintained. Protecting information assets from unauthorized, incorrect or accidental access, use, modification, destruction or disclosure is responsibility and obligation of concerned person involved. Communication System access shall be designed, developed, built, configured and maintained in such a way that only authorized users have access to all information and every tool permitted to do their job.

The Communication Service Provider is responsible for developing, implementing, and maintaining the Access Policy including Access Control and the related Procedures in compliance with ISMS (Information Security Management System) requirements. Compliance with this Policy is mandatory.

10. GENERAL CONDITIONS

10.1 TRANSMISSION

(i) Communication System shall be planned up to the interface points of the Data provider and the respective control centre including the interfacing equipment at the respective location.

(ii) Interface point of the Data Provider shall be substations and generating stations connected to Inter State Transmission System and Intra State Transmission System, respective LDC control center, DISCOMs, Market Operator and Service provider (Ancillary, Weather and Forecast) for the dedicated Wideband Backbone network. The Standards for Interfacing to the Communication System are given at Schedule (Part-I).

(iii) Cellular and RF based communication technology shall not be considered for control and protection functions.

(iv) Communication service provider shall be responsible for Design & Engineering, implementation, reliable operation, security of its own equipment as per the Communication planning criteria and guidelines for development of reliable communication system for the Power System subject to the compliance of operation and maintenance guideline and other statutory standards.

(v) Central/State Transmission Utility while planning should consider the intervening communication service provider's design of the communication system for seamless interfacing of the intervening communication system to have Wideband Backbone.

(vi) Communication service provider shall ensure Centralized monitoring / management of its communication network and shall provide necessary facilities for monitoring / managing the system for identification of fault and generation of various reports on availability of the communication system.

(vii) Data Provider shall be responsible for the planning, design, implementation and secured operation of its own equipment to be interfaced with the communication System.

(viii) Data Provider, whose system is proposed to be interfaced with the communication system, shall furnish the Data to the appropriate Control Centre as prescribed by them.

(ix) Communication Service Provider, whose system is proposed to be interfaced with the communication system, shall furnish the requisite interface information to the Load Despatch Centre as per the format prescribed by Lead Communication Service Provider.

(x) Communication service provider and Lead Communication service provider shall ensure that all the communication equipment installed are interoperable, so as to allow seamless integration between different vendors.

(xi) Every connection/interfacing with the intervening communication system shall be covered by a connection agreement between the parties sharing the communication service as below:

a) Intervening Communication System shall be of State Communication service provider or a Distribution System Communication Provider as the case may be.

b) Intervening physical communication media provider shall be of Transmission Licensee (Private / Govt.), JVs as the case may be.

c) The interface agreement shall contain general and specific technical conditions supported by interfacing details and layout drawings for the interfacing.

10.2 DISTRIBUTION

(i) Communication system shall be planned up to the interface points of the respective data providers and the respective control centers including the interfacing equipment.

(ii) Interface point of Data Provider shall be planned up to electrical energy meters of consumers, distributed energy sources, charging stations of EVs, Sub-Stations & Generating stations' control centre, Grid Stations, Centralized and/or Distributed Load control centres and call centres of the Organization, Market operator, Service provider, etc. The Standards for Interfacing to the Communication System are given at *Schedule (Part-I).*

(iii) Communication service provider shall be responsible for Design & Engineering, implementation, reliable operation, security of its own equipment as per the Communication planning criteria and guidelines for development of reliable communication system for the Distribution Power System subject to the compliance of operation and maintenance guideline and other statutory standards.

(iv) Distribution Utility while planning should consider the communication service provider design/interface of the existing/hierarchically connected communication system for seamless data/information/control/ voice flow.

(v) Communication service provider shall ensure Centralized monitoring of its communication network and shall provide necessary facilities for monitoring the system for identification of fault and generation of various reports on availability of the communication system.

(vi) Communication Service Provider shall furnish the requisite information to the Discom Load Despatch Centre as per the format prescribed by them.

(vii) Communication service provider and Lead Communication service provider shall ensure that all the communication equipment installed are interoperable, so as to allow seamless integration between different vendors to facilitate data/information/control flow.

(viii) AMI system shall include reliable communications links to ensure the desired performance level.

(ix) There shall be adequate redundancy in the system, for ensuring high availability of mission critical applications.

(x) Distribution Power Utilities shall refer to CEA's guidelines/ regulation/ any other information related to Communication in Distribution Power System, if any, as published from time to time.

11. SITE RESPONSIBILITY

(i) A Site Responsibility Schedule (SRS) for every interface point shall be prepared by the owner of the Data Provider and Communication Service Provider where interfacing is taking place.

(ii) Following information shall be included in the Site Responsibility Schedule, namely, -

a) Schedule of telecommunication interface equipment;
b) Schedule of Auxiliary Power supply equipment catering the tele-communication equipment;
c) Schedule of physical and software access if any;
d) Schedule of patching details (for example in STM level, E-1 level, TCP/IP level) for channel routing, and numbers of fiber connectivity;
e) Schedule of maintenance requirement; and
f) Cyber Security rules applicable to each equipment.
g) Type of connectors required for making the connection through
h) Any other specific information provided by the Equipment manufacturer
i) Any other specific requirement with mutual discussion
j) Site / Node Common Drawings for each interface point

(iii) Following information shall also be furnished in the Site Responsibility Schedule for each item of equipment installed at the interfacing site, namely: -

a) the ownership of equipment;
b) the responsibility for access to equipment;
c) the responsibility for maintenance of equipment;
d) the responsibility for operation of equipment;
e) the Responsible person (s) for the site; and
f) the responsibility for all matters relating to safety/security of equipment at site.

(iv) If Packet technology is being used in backhaul network, Communication service provider should ensure the following details as well:

(a) Mode of Connectivity
(b) Protocol used (Level 2/Level 3)

(c) Bandwidth Provisioning
(d) QoS (Quality of Service) policy of circuit
(e) Traffic engineering
(f) Communication Service provider is expected to adhere to agreed Standard latency / Performance parameters at any given point of time
(g) Communication Service provider shall ensure Standard Latency output in minimum nos. of hops in case Unit Protection Schemes (i.e. Line Differential Relay) connectivity is provisioned throughout the equipment

12. ACCESS AT CONNECTION SITE / NODE

The Data Provider or the Intervening Communication Service Provider, as the case may be, owning the interface site / node shall provide reasonable access and other required facilities (including reasonable space) and 24x7 access to the communication Service provider or its authorized representative, whose equipment is installed or proposed to be installed at the interface Site for installation, configuration, testing, operation and maintenance, etc. of the equipment.

13. PERFORMANCE

13.1 VOLUME OF DATA

(i) Communication Service Provider shall be capable of transmitting all Operational Data / Market operation data required by appropriate Control Centre and includes but not limited to all data that:
   a) was in use at the time this Standard came into effect;
   b) has been requested in writing by appropriate Control Centre and other Service Provider

(ii) The transmission of additional Operational Data beyond that required by Control Centre for System Operation as specified in Grid Code or any agreement between System Operator and Data Provider does not diminish the obligations of the Data Provider to comply with this Standard.

13.2 AGE OF DATA (Response to poll and automatic response)

Communication System shall be planned with required bandwidth to conform the data interval time. Data, either on poll or automatic, from all the Data Providers shall be within the time intervals as specified in following Tables.

TRANSMISSION:

Category	Data Type	Time Interval (Seconds)			Time Interval Via Data Concentrator (Seconds)		
		765/ 400 kV	220/ 132* kV	Below 132* kV	765/ 400 kV	220/ 132* kV	Below 132* kV
AGC Signal	Analog Value	2	2	3	2	2	3
Despatch Data	Status Indication	2	3	4	2	3	5
	Analog Value	4	5	6	4	5	7
Phasor Data	Analog	0.04 to 0.01	0.04 to 0.01	0.04 to 0.02	0.04 to 0.01	0.04 to 0.01	0.04 to 0.02
	Status	0.04 to 0.01	0.04 to 0.01	0.04 to 0.02	0.04 to 0.01	0.04 to 0.01	0.04 to 0.02

* Wherever 110kV is used in transmission system, 132kV may be replaced with 110kV

Category	Data Type	Time Interval (Seconds)			Time Interval Via Data Concentrator (Seconds)		
Forecast Data	Value	60	60	60	60	60	60
Weather Data	Value	60	60	60	60	60	60
Market Data	Value	60	60	60	60	60	60

DISTRIBUTION:

Category	Data Type	Time Interval (Seconds)	Time Interval Via Data Concentrator (Seconds)
Despatch Data	Status Indication	4	5
	Analog Value	6	7
Weather Data	Value	60	60
Market Data	Value	60	60

13.3 CONTROL COMMAND DELAY

Communication System shall relay the Control Command from the Control Centre to relevant equipment within 2 seconds for SCADA and within 1 sec for WAMs, whether the command is transmitted directly or via a Data Concentrator.

14. RELIABILITY

1) The total period of outages shall be less than 16 hours on monthly basis for Data Provider's interface with total outages in a rolling 12-months assessment period shall be less than 48 hours. Accordingly, Data Provider shall maintain adequate redundancy while designing the system.
2) The total period of outages shall be less than 16 hours on monthly basis for wideband node with total outages in a rolling 12-months assessment period shall be less than 48 hours.
3) The total period of outages shall be less than 16 hours on monthly basis for communication media with total outages in a rolling 12 months' assessment period shall be less than 48 hours.
4) Communication service Provider shall have above redundancy while designing the system taking into account the following:
    a. Route diversity required to take care likely failure of the physical path
    b. The Mean Time Between Failure (MTBF) of their elements
    c. The Mean Time to Repair (MTTR) of their elements
    d. The assessment for planned outages for their elements
    e. Any other required factor

15. CYBER SECURITY

Data Provider, Communication Service Provider and Control Centre Owner connected to the communication system shall have robust programs in place to adequately and continuously manage cyber security risks that could have adversely impact power system communications and supporting system and infrastructure.

The cyber security program shall use reasonable endeavors to address the following functions:

(i) Understanding of cyber security risks to the systems, assets and risk assessment and implement risk management strategies.

(ii) To have controls and safeguards necessary to protect or deter cyber security threats with implementation of access control, data security, data protection.

(iii) Continuous monitoring to provide proactive and real time alerts of cyber security related events

(iv) Analysis of observation(s) related to various activities related to violation of cyber security; and implement mitigation policy.

(v) Business continuity plans/Disaster Management Plan to maintain resilience and recovery capabilities after a cyber-breach.

(vi) Adequate training to the persons, who are authorized to have access to the communication system, on cyber security to continuously update the threat perception.

(vii) Carry out cyber security audit at least once in a year, through Govt. approved agencies to ensure security.

(viii) Implementation of relevant provision(s) contained in the Cyber Security Policy issued by Govt. of India from time to time.

(ix) Robust back-up and restoration process of configuration files of terminating equipment with clearly defined policies for storing media in off-site location.

(x) Implementation of necessary controls and safeguards to protect data in-transit and at rest.

(xi) Creation and regular maintenance of asset register including but not limited to capturing of application and firmware versions.

(xii) Ensure availability of necessary logs and audit trails for three months.

(xiii) Ensure hardening of all communication / network system components (e.g. disable all ports and services which are not required for the operation and maintenance of the device.)

(xiv) Implementation of appropriate software, service and security updates and/or workarounds to mitigate all vulnerabilities associated with the communication or network components to maintain system security.

(xv) Ensure that solution provider shall return or destroy all sensitive data in its possession when solution provider is no longer able to maintain the product.

(xvi) All network components shall adhere to least privileged permission schemes for all user accounts and application to application communications.

(xvii) Solution provider shall ensure that the addition of security features does not adversely affect connectivity, latency, bandwidth, response time and throughput.

(xviii) Solution provider shall adhere to NCIIPC (National Critical Information Infrastructure Protection Centre) standards (if any) from cyber security perspective.

(xix) Solution provider shall adhere to CEA (Central Electricity Authority)'s other Cyber Security Standards / Regulations (if any), as published from time to time.

(xx) In case of any cyber incidence or cyber threat, the same needs to be reported to CERT-IN (Computer Emergency Response Team – India)

16. SAFETY OF COMMUNICATION EQUIPMENT

Communication Service Provider shall be responsible for the safety of its equipment installed at the premises as well as equipment located outside the premises of Data Provider, Control Centre Owner.

Data Provider, Control Centre Owner and Market operator shall be responsible for the safety of the communication equipment installed by them for interfacing with the equipment installed by the communication service provider.

17. TESTING TO CONFIRM COMPLIANCE

Testing shall be carried out as and when the equipment of Data Providers, the communication service provider, intervening communication system Provider, the Control Center or of other service provider's is replaced / upgraded to confirm the compliance to these standards. Prior to test, the concerned person, which intend to upgrade / replace the communication equipment shall

a. Coordinate with all the concerned for relaying the data to be tested
b. Prepare and submit a test procedure for the testing to all the concerned
c. Submit detailed equipment test report to the Concerned LDC for compliance

18. SITE COMMON DRAWINGS

Site / Node Common Drawings shall be prepared for each interface point where connection is taking place by the Communication Service Provider jointly in coordination with the Users / Service Provider.

19. MAINTENANCE

Communication service provider shall have a centralized monitoring facility to support maintenance activity.

(i) The response time to failure shall be decided to maintain the outage time specified under para 14 of these standards.

(ii) Monthly Outage may be planned and got approved by the Transmission Communication Service Provider in concerned RPC as per detailed procedure finalized by RPC. In case of Distribution Communication Service Provider, in place of RPC, it would be the concerned LDC.

(iii) Notice to be issued to concerned Data Provider as well as to the concerned Load Despatch Center / Service Provider / Market Operator five days' notice of a planned outage of any of the service likely to cause failure of data communication.

(iv) Concerned Load Despatch Center / Service Provider / Market Operator may defer the request in case it will adversely affect the Power System Security.

(v) Inform the progress of related rectification work to Data Provider as well as to the concerned Load Despatch Center / Service Provider / Market Operator.

(vi) Consult with the concerned Load Despatch Center / Service Provider / Market Operator about the priority of the related rectification works in case the failure is causing or likely to cause Outage.

20. ADOPTION OF NEW TECHNOLOGIES

Data Providers, the communication service provider, intervening communication system Provider, the Control Center or of other service provider shall make out a plan for introduction and adoption of new technologies, with the approval of the Appropriate Commission or as per the regulations or directions of the Appropriate Commission or pursuant to the reforms programme of the Appropriate Government.

The Standards related to some of the existing communication technologies in Power System operation are given at *Schedule {Part-III (A&B) to IX}*

21. RELAXATION OF REGULATIONS

The Authority by order in writing may relax any provision of the said regulations on its own or in respect of the matters referred to the Authority on case to case basis.

22. INTERPRETATION

If a question arises relating to the interpretation of any provision of these regulations or its relationship and interplay with any other regulation of CEA, the decision of the Authority shall be final.

SCHEDULE

PART- I

Standards for Interfacing to the Communication System

1. Standard Interfaces

The following standards may be followed while interfacing the equipment with the communication system:

Interfaces	Type	Standards
Electrical Interface	Ethernet	IEEE 802.3 / IEEE 802.3u
	Ethernet VLAN	IEEE 802.1 P/Q
	Serial	RS-232 / RS 422 / RS 485 / X.21 / X.25 / G.703 / V.35
Optical Interface		ITU-T G.957, G.958
Teleprotection /Control	Relay	IEEE C37.94 ,ITU-T G.703
Voice		2-wire FXO/2-wire FXS/ 4- wire E&M, VOIP
SDH		ITU-T G.821/G.826
IP - Packet Switched Networks	Layer 2.5 OSI	RFC 2702, RFC 4379, RFC 4090 & RFC 4553 – Circuit Emulation
RF Mesh		IEEE 802.11s
Cyber Security		MD5 Authentication, 3.SNMPv3, Radius/TACS+
Video		H.323

2. Local Monitoring

All the interfaces shall be provided with audio/visual status indication to indicate its normal operation as per respective standards.

3. Centralized Supervision & Monitoring

Lead Communication Service Provider / System Integrator shall have centralized supervision and monitoring system by integrating Network Management/Monitoring System (NMS) /

Element Management System of his own and other communication service provider within a region.

Management Console (MC) / Element Management System (EMS) / Network Management Console (NMS) for other communication service provider within a region shall provide necessary support to interface their NMS with that of Lead communication service provider. However, these communication service providers shall take necessary action for operation and maintenance of all the interfaces of communication system under their jurisdiction.

The Centralized NMS as well as the MC / EMS / NMS of other communication service providers should have features to store necessary information and facility to generate report on communication system availability like channel/node/fibre etc. on daily/weekly/monthly basis.

The system shall have displays for audio/visual alarm generation facility to the operator to facilitate quick fault detection and shall have alarm generation and logging facility. The NMS / MC / EMS shall facilitate access to the equipment for configuration and fault restoration as well to facilitate monitoring the performance of the communication system through generation of reports on availability of major equipment as well as the data channels.

Communication service provider's NMS should report NBI/SBI (North Bound/South Bound Interface) for integration with INMS (Integrated Network Management/Monitoring System) / centralized NMS of the utility.

4. Data Retention

The Communication Service provider shall keep evidence of compliance on availability for the previous two calendar years plus the current year for all the interfaces which are in operation. Communication service provider shall keep 90 days of historical data.

5. Maintainability

The communication system provider shall permit in-service diagnostic testing to be executed both locally and from remote (NMS) locations to facilitate performance trending, efficient diagnosis and corrective resolution of all the interfaces in operation. The communication service provider shall maintain required testing equipment and tools to facilitate testing of the interfaces of the communication system at the time of fault and during the course of maintenance.

6. System Upgradability & Expandability

All Communication interfaces shall be sized (though not necessarily equipped) to support system / subsystem expansion / upgradation to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated with appropriate termination interfaces.

7. Training

Specialized training shall be provided to the persons manning the centralized monitoring center and the field support staff to ensure quick fault detection and restoration of the communication system. Training shall be provided to the maintenance persons on all communication equipment for its operation and maintenance.

SCHEDULE

Part – II

Standards applicable to Wideband Communication (Wideband Network)

1. General Requirement

a) The wideband network shall be planned in such a manner to connect all Generating Stations/Sub-stations and all wind plant developer having aggregate capacity more than 50MW capacity (at a single connection point) and solar developer of more than 10MW aggregate capacity (at a single connection point), all Control Centres of DISCOM, State, Regional and National Level, Renewable monitoring Centre, Market data monitoring and Billing Centre for data exchange and voice connectivity.

b) The wideband network shall be planned to cater protection requirement of power system as envisaged by the concerned Utility.

c) Wideband network shall be planned with route diversity and shall ensure channel redundancy for different data exchange and voice communication requirements.

d) Network equipment shall be synchronized through provision of GPS clock to achieve the desired functionality as per standard ITU-T G.811 criterion specially the protection requirements. The holdover quality of clock shall meet ITU-T G.812 standard requirements.

e) At least 10 hrs battery backup shall be provided for the communication equipment for all the nodes; for repeater stations housed in repeater shelter, depending upon requirement, the extended backup shall be provided.

f) Supply voltage 48V DC +15%, –10%. (positive pole earthed)

g) The minimum guaranteed life for all the wideband communication equipment shall be 10 years.

2. Standards and codes of Practices

a) Transmission quality shall be as per ITU-T G.821, G.823, G.826

b) Terminal equipment shall be designed as per ITU-T G.783

c) Optical interface shall be FC-PC and shall be as per ITU-T G.957, G.958

d) Wideband communication (wideband network) shall be optical interface LC (Lucent Connector) conforming to IEC 61754-20 (part 20)

e) Network synchronization shall be as per ITU-T G.813

f) Management Functions shall be as per ITU-T G.774, G.784

g) Protection architecture shall be as per ITU-T G.841

h) Built-in testing and Alarm shall be as per ITU-T G.774, G.783, G.784

i) The link performance for ES, SES and BER for the fibre optic links shall correspond to National Network as defined in ITU-T G.826

3. Functional Requirement

a) The wideband network shall be designed in a manner to ensure absolute channel delay less than 25 ms and Channel delay asymmetry less than 0.1 ms required for protection applications.

b) Network shall be configured for automatic switchover to the alternate path/ route in case of failure of one path and the switching time delay shall be less than 50ms.

c) At any digital signal level, reapplication of a lost signal shall result in automatic resynchronization and full restoration to normal operation without manual intervention. All alarms incident to the signal failure, shall be automatically cleared at the equipment, rack and monitoring levels and normal operation indications restored and reported.

d) Terminal Equipment shall support automatic switchover function between the redundant modules. All required modules and hardware to support the automatic switch over shall be provided.

e) Network Management System (NMS) shall provide the capability to monitor, reconfigure and control elements of the telecommunications network from a centralized location and at each node of the network.

f) The new node, when added to the existing network, the terminal equipment shall be compatible to the existing one and shall be possible to integrate with the existing respective centralized monitoring equipment i.e. Network Management System (NMS) either at State level or at Central level for complete monitoring, reconfiguration and control.

g) Equipment planned shall be sized (though not necessarily equipped) to support system/ subsystem expansion to full capacity. Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies and TMN shall be sized for maximum equipped system capacity.

h) Terminal equipment shall be designed with required number of directions considering the route redundancy required and future expansion, at least for next 5 years of the network expansions.

i) The centralized monitoring system shall have provisions to generate Management information reports showing availability of the communication nodes, availability of configured channels, and type of failures/faults etc. for performance analysis.

SCHEDULE

Part – III A
Standards Applicable to Wideband Communication

The primary function of the communication network is to provide a highly reliable voice, video and data communication system in support of the WAM System, SCADA/EMS system, Protection System & Market Operation Service. The communication interfaces for WAM system, SCADA/EMS system is for low & high speed data, express voice circuits and administrative voice circuits as defined as follows:

(a) High speed bundled n x E1 support including Ethernet, GbE (Gigabit Ethernet)
(b) High speed E1 channel support
(c) 64kbps & n x 64 kbps data & Protection channel support
(d) Low speed (300 -1200 bps) data channel support
(e) Voice (2 wires, 4 wires) channel support.
(f) Data transport supporting Network Management channels
(g) C37.94 Interface card for tele protection of lines
(h) Additional requirement, if any

The communication system shall finally form a wideband backbone to support the requirement of the Power System Operation and Market operation.

SCHEDULE

Part – III B

Standards Applicable to Wideband Communication (Fibre Optic cable)

1. General Requirement

a) All wideband communications shall be established using fibre optic communication consisting of underground Fibre optic cable, OPGW & ADSS.

b) Un-armored cable shall be laid within a PVC/ Hume duct pipe. The cable shall be rodent and termite proof.

c) The cable may contain 12/24/48 nos. Dual Window Single Mode (DWSM) or Dual Window Multi Mode (DWMM) fibre depending on the local network design and requirement envisaged and shall consider the overall design and requirement of the backbone network.

d) Approach cable for OPGW termination to Fibre Optic Distribution Panel (FODP) shall be armoured cable/Unarmored with suitable protection and matching the fiber count equal to OPGW cable to maintain uniformity and ease of utilization of fibers.

e) Attenuation coefficient of the fibre shall be $\leq$ 0.35 dB/km at wavelength of 1310 nm and $\leq$ 0.21 dB/km at wavelength of 1550 nm. Attenuation coefficient for each splicing and connector shall $\leq$ 0.05 dB. Induced attenuation due to temperature shall be $\leq$ 0.05dB (-60^{O} C to $+85^{O}$ C)

f) The central fibre optic cable shall be protected through anti-hygroscopic tape/yarn, etc. and shall be protected from damage due to forces like crushing, bending, twisting, tensile stress and moisture, wide temperature variation, Hydrogen evolution etc.

g) The short Circuit Current for the OPGW cable shall be ≥ 6.32 kA for 1.0 second (for 220kV and above lines) and ≥ 5.60 kA for 1.0 second (for 132kV and 66kV lines); and D.C. resistance at 20^{O} C shall be < 1.0 ohm/km.

h) Everyday Tension (EDT) of the OPGW shall be $\leq$ 20% of the Ultimate Tensile Strength (UTS) of the OPGW.

i) The maximum permissible dynamic strain shall be +/- 150 micro strains.

j) Proof Stress Level shall be $\geq$ 0.69 Gpa

k) Chromatic Dispersion; Maximum shall be 18ps/ (nm x km) @ 1550 nm ;3.5 ps/ (nm x km) @ 1288-1339, 5.3 ps/ (nm x km) @ 1271-1360 nm

l) Zero Dispersion Wavelength shall be 1300 to 1324 nm

m) Zero Dispersion Slope shall be 0.092 ps/(nm²xkm) maximum

n) Cable Cut-off Wavelength λcc shall be < 1260 nm

o) Bend Performance shall be:

@ 1310 nm (75±2 mm dia Mandrel), 100 turns: Attenuation Rise < 0.05 dB

@1550 nm (30±1 mm radius Mandrel), 100 turns; Attenuation Rise < 0.05 dB

@ 1550 nm (32±0.5 mm dia Mandrel), 1 turn; Attenuation Rise < 0.50 dB

p) Polarization mode dispersion coefficient shall be < 0.2 ps/km^{½}

2. Standards and Code of Practices

The fibre cable shall be conform to standards as below:

i) ITU-T recommended G.652D

ii) IEEE – 1138- 1994, IEEE – 1138-2009

iii) Electronics Industries Association (EIA)/ Telecommunications Industry Association (TIA) 455-78A, 455-3A, 455-62A, 455-164A/167A/174, 455-168A/168A/175A, 455-176, 455-59, EIA/TIA 598, EIA 455-104.

iv) International Electro Technical Commission Standards, IEC 60304, IEC 60794-1-2, IEC60811-5-1, IEC 60794 – 4 – 10, IEC 60793 – 1 – 20, IEC 60793 – 1 – 40, IEC 60793 – 1 – 42, IEC 60793 – 1 – 45, IEC 60793 – 1– 47

v) Bell core GR-20

vi) Telecommunication Engineering Centre (TEC) Specification no. GR/OFC-17/01 June 2007 (including all subsequent amendments)

vii) American Society for Testing and Materials (ASTM): AI67-92, ASTM:751-92b, ASTM: A370-82, ASTM: D2581-91, ASTM: D2287-81, ASTM: D638 for FRP, ASTM: D217, 556,93-IP-34 for Jelly, ASTM: D 570,211 for PBTP, ASTM: D1505 for poly Carbonate, ASTM: D1633, 150 for HDPE, ASTM: D1248 for Jacket density.

viii) Applicable standards for testing the cables shall be:

a. Max. Tensile Strength – IEC60794 – I – E 1 (Under Ground Cable), IS 802:1995 and IS 875:1987 (OPGW), IEEE 1138-2009 clause 6.4.1.4 (OPGW)

b. Cable bend test – IEC 60794 – 1 – E 11

c. Repeated bending test – EIS – 455 – 104 IEC 60794 – 1 – E6

d. Crush Strength – IEC60794 – 1 – E3 (UG Cable) IEC 60794 – 1 – 2 Method E3 or EIA/TIA 455 – 41B (OPGW)

e. Impact Test IEC60794 - 1 – E4 (UG Cable), IEC60794 - 1 – 2 E4 or EIA/TIA 455-25B (OPGW)

f. Torsion Resistance – IEC 60794 – 1 – E 7
g. Kink Test IEC 60794 – 1 - E 10
h. Drip Test IEC 60811 – 5 – 1 or IEC 60794 – 1 – E14
i. Water ingress test IEC60794 – 1 – 2 F 5 or EIA/TIA 455-82B
j. Attenuation variation with Wavelength IEC 60793 – 1 – 40 or EIA/TIA 455 – 78A
k. Attenuation at water Peak IEC 60793 – 1 – 40 or EIA/TIA 455 – 78A
l. Temperature Dependence on Attenuation IEC 60793 – 1 – 52 or EIA/TIA 455 – 3A (UG Cable) IEEE 1138-2009 clause 6.4.3.7 or IEC 60794 – 1 – 2 Method F1 (OPGW)
m. Bend Performance IEC 60793 – 1 – 47 or EIA/TIA 455 – 62A (UG cable), IEEE 1138-2009 clause 6.4.2.3 or IEC 60794 – 1 – 2 method E11 (for OPGW)
n. Mode Field diameter IEC 60793 – 1 – 45 or EIA/TIA 455 – 164A/167A/174
o. Chromatic desperation IEC 60793 – 1 – 42 or EIA/TIA 455 – 168A/169A/175A
p. Cladding diameter IEC 60793 – 1 – 20 or EIA/TIA 455-176
q. Point discontinuities of attenuation IEC 60793 – 1 – 40 or EIA/TIA 455 – 59
r. Core – Clad concentricity error IEC 60793 – 1 – 20 or EIA/TIA 455 – 176
s. Fibre tensile Performance IEC 60793 – 1 – 31 or EIA/TIA 455 – 31B (UG cable), IEEE 1138-2009 clause 6.4.1.3 or IEC60794 – I – 2 E1 or EIA/TIA 455 – 33B (OPGW)
t. Seepage of filling compound EIA/TIA 455 – 81B
u. Short Circuit Test IEC 60794 – 4 – 10 or IEC 60794 – 1 – 2 (2003) Method H1 or IEEE 1138-2009 clause 6.4.3.3
v. Aeolian Vibration Test IEC 60794 – 4 – 10 or IEC 60794 – 1 – 2 Method E19 or IEEE 1138-2009 clause 6.4.3.1
w. Galloping IEEE 1138 – 2009
x. Sheave Test IEC 60794 – 1 – 2 (2003) Method E18 B or IEEE 1138-2009 clause 6.4.2.1
y. Creep Test IEEE 1138 – 2009
z. Fibre Strain Test IEEE 1138 – 1994
aa. Strain Margin Test IEEE 1138 – 2009
bb. Stress Stain Test IEEE 1138 – 2009
cc. Cable cut off wavelength Test IEEE 1138 – 1994
dd. Fault current / Lightning Test IEC 60794 – 4 – 10 or IEC 60794 – 1-2 (2003)
ee. D.C. Resistance Test IEC 60228 or IEEE 1138-2009 clause 6.4.1.5
ff. Mechanical Strength Test for suspension Assembly IEC 61284: 1997

3. Functional Requirement

a) The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB/km. The attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB.

The overall optical fibre path attenuation shall not be more than calculated below:

Maximum attenuation @ 1550nm: 0.21 dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors

Maximum attenuation @ 1310nm: 0.35dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors.

b) All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply to ingress protection class IP 66 or better.

c) No more than 12 fibres shall be terminated in a single splice tray. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures.

d) All FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Ground lugs shall be provided on all FODPs and shall be properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.

SCHEDULE

Part – IV

Standards applicable to Power Line Carrier Communication (PLCC)

1. General Requirement

a) This mode of communication shall be used in the grid network between two consecutive substations as per requirement of Transmission Utility.

b) The PLCC system shall provide Speech, Data and Tele-protection requirements of the Power system. Protection coupler may be an internal module or external sub-rack.

c) Mode of communication shall be duplex, independent TX and RX channels, operating in the carrier frequency spectrum 40 to 500 kHz.

d) The PLCC terminal could be operated in APLC (Analogue), pure DPLC (Digital) or Mixed mode (combination of Analog and Digital), taking into consideration the Signal to Noise Ratio (SNR) of the link.

e) Supply voltage 48V DC +15%, –10%. (positive pole earthed). At least 10 hrs battery backup shall be provided, extended backup may be provided considering accessibility / remoteness of the node.

f) In the input circuit of the PLCC terminal protective devices shall be provided in the form of zener diodes or surge suppressers in order to eliminate any surge transfer through the coupling device or the surge induced in the connecting path of HF cable.

g) Companders and expanders shall be provided to improve voice transmission characteristics for the system. The companders shall have at least 2:1 compression ratio with a corresponding expansion ratio of 1:2. The operating range of compander shall be compatible with the audio power levels specified for 4 wire operation. The improvement gained by companders shall not be considered for power allocation and shall be in-hand reserve.

h) Speech plus Data channels shall independently fulfill the SNR requirements out of the power allocated to its channel from the total power of the PLCC terminals.

i) Fail safe devices shall be provided to avoid ~~a~~ malfunction in one unit or damage of any sub-assembly. All plug-in equipment shall be fitted with features to avoid improper insertion. The electrical cables shall not be routed across sharp edges or near sources

of high temperature. The adjustments, which are susceptible to maladjustment from accidental contact/ vibration shall be equipped with suitable locking devices.

j) The PLCC set shall be designed to give guaranteed performance from 0 to 50^0C. The thermal capability of the equipment shall be so designed to be operational up to 55^0C for 24 hours continuously.

k) The carrier set shall be provided with suitable supervision and alarm facilities. Individual parts of the carrier set should be accessible from front making it possible to place the carrier cabinets side-by-side. All components and parts of the carrier set shall be suitably tropicalised.

l) The type of PLCC and number of channels per line and number of codes per channel shall be as per prevalent CEA Regulations.

m) The responsibility of maintenance of communication system shall lies with the transmission licensee providing communication services.

n) The programmability of PLCC equipment shall be applicable for Digital PLCC only.

2. Standards and Codes of Practice

a) The equipment shall follow the industry best practices and applicable industry standards in respect of the equipment installation and its operation and maintenance.

b) IEC62488 Part-1, Part-2, Part-3: 2012 shall be considered while planning for Power Line Carrier Communication System in Power Utility, specifications for Analog and Digital terminals.

c) All the equipment shall comply with the relevant Standards like BIS, International Electro-Technical Commission (IEC) Standard, or International Telecommunications Union–Telecommunication Group (ITU–T), IEEE or any other equivalent International Standard:

Provided that whenever an International Standard or International Electro-Technical Commission Standard is followed, necessary corrections or modifications shall be made for ambient temperature, humidity and other conditions prevailing in India before actual adoption-of the said Standard.

The details are given below:

- Line Trap: IEC-60353, IS-8792,
- Coupling Device: IEC 60481, IS-8997,
- Power Line Carrier Terminal: IEC60495,

- CVT: IS-3156,
- Coupling Capacitor & CVT: IEC60358,
- Coupling Capacitor: IS-9348,
- RF cables: IS-11967,
- Planning of SSB PLCC: IEC-663,
- Surge Arrestors: IEC-60099,
- HF Cable Testing: IEC-60096,
- Performance and testing of Teleprotection equipment: IEC-60834 Part-I,
- Characteristics values for inputs and outputs of single side band PLCC Terminals: IS-9428,
- Frequency planning of power Line carrier equipment: IS-9528/IC62488 Part-I.
- IEC 60255-27 for product safety requirements (Relays and Protection equipment)
- IEC 60834-1 for Command Systems (Tele Protection equipment)
- IEC 61000 Series for Electromagnetic compatibility (EMC)
- IEC 60950 Series for Electrical safety.
- IEC 60068 series for Environmental testing.
- Radiated Emissions as per CISPR 22
- Vibration as per EN60068 – 2 – 6
- Shocks parameter as per IEC 68 – 2- 27

d) The effects of wind, storms, floods, lightening, elevation, temperature extremes, icing, contamination, pollution and earthquakes shall be considered in the design and operation of the connected facilities.

3. Functional Requirement

a) PLCC equipment comprising of not limited to the following shall be provided:

i) Coupling devices (Line matching unit and protective devices).
ii) Coupling filters
iii) High frequency cable
iv) Power line carrier terminals
v) Tele Protection Equipment
vi) Private Automatic Exchange
vii) 48V DC power supply equipment
viii) Wave Trap for the above transmission lines

PLCC panels shall be located in the control room or in AC kiosks

b) PLCC link shall be provided with carrier protection of the transmission lines with tele-metering and speech communication in dialing mode or express communication.

c) Wave trap shall be inserted into the transmission lines to prevent undue loss of carrier signal for all power system conditions.

d) Coupling device (Line matching unit and protective devices) shall be interposed between the CVT and the connection line (co-axial cable) to the PLCC terminals to ensure:

   i) The efficient transmission of signals from the connection line to the high voltage line and vice versa.

   ii) The safety of personnel and protection of low voltage parts of the installation against the effects of power frequency voltage and over voltages. Phase-to-phase coupling is to be adopted.

e) Coupling filters in conjunction with the capacitor of CVT shall constitute a broadband pass filter. The characteristic impedance of the associated transmission line shall match with the impedance of the connection line for PLCC transmitter/ receiver.

f) The primary of the coupling unit shall have low impedance at the operating frequency of the transmission line (50Hz), so that the capacitor charging current (drainage of charging current) of the CVT is grounded.

g) The matching transformer of the coupling device shall be provided with galvanic isolation between input and output circuits and shall withstand a test voltage of at least $5kV_{rms}$ for 1 minute.

h) The coupling device shall be provided with a protective device to protect the carrier equipment against excess voltage on defective CVT.

i) A surge arrestor (SA) shall be connected directly between the primary and earth terminals to protect the coupling device and the carrier frequency connection. The surge arrestor shall have power frequency spark over voltage co-ordinated with the equipment ahead of it.

j) The coupling device shall conform to the following carrier frequency operating characteristics between phase to earth coupling units:

1)	Nominal impedance (equipment side)	Ω	150 (for balanced secondary circuit) 75 (for unbalanced secondary circuit)
2)	Maximum composite loss	dB	2
	Return Loss	dB	Equal to or greater than 12 dB
3)	Transmission band	kHz	40 to 500

k) The composite loss is the power loss in the carrier signal after passing through the coupling devices along with CVT's. Coupling unit shall be loaded with its primary and secondary impedance while capacitor is assumed to have no loss.

l) The capacitance of the CVTs with which the coupling unit is to be used for the above transmission band shall be provided by transmission utility/owner.

m) Two no. phase to earth coupling units shall be capable of inter-phase or inter-line coupling. In case any separate matching transformer or matching unit is required, the same shall be acceptable.

n) Suitable earth connecting switches for grounding the low voltage terminals of CVT for carrying out maintenance or any other works on coupling unit shall be provided.

o) The coupling device shall be suitable for outdoor mounting and shall be fitted on the steel structure. Temperature of metallic equipment mounted outdoor is expected to rise up to 65^0C with ambient temperature of 50^0C.

p) The connection between coupling device and CVT shall be with $6mm^2$ copper wire tapped with 11kV insulation tapes.

q) High frequency cable shall be provided to connect coupling unit installed in the switchyard to the PLCC terminals installed indoors.

r) The cable shall be lead sheathed and round steel wire armoured. The cable shall be insulated to withstand a test voltage of $4kV_{rms}$ for one minute between conductor and outer sheath. The high frequency co-axial cable with 75Ω impedance (unbalanced) shall also be acceptable.

s) The values of attenuation per km of the cable at various values of carrier frequencies in the range of 40 KHz to 500 kHz shall be provided by the maximum attenuation at various frequencies shall be as follows:

Frequency (kHz)	**Attenuation (dB/km)**
10	0.8
60	1.4
300	3.3
500	4.7

The cable shall be supplied on drum lengths of 500 or 1000 meters.

t) Single side band PLCC terminals of latest version equipped for fixed frequency duplex system working shall be provided for superimposed channels (multipurpose) for speech and protection purpose. The PLCC terminals shall be provided with HF hybrid filters and shall have necessary frequency stability so that adjacent channel working is possible.

u) The PLCC terminals shall be provided with emergency call facilities from the carrier sets for point to point carrier communication with telephone set with suitable provision for keeping inside the cabinet.

4. Technical Requirement

a) Power line carrier communication (PLCC) conforming to latest IEC or equivalent standard shall be provided as per requirement of Transmission Utility. PLCC shall be suitable for use with the outdoor equipment viz. line traps, CVT, coupling device, HF cable.

b) PLCC will primarily be provided for speech, protection and data services. PLCC terminals shall be fully co-coordinated to match with the specific requirement for transmission/ reception.

c) Carrier frequency of PLCC terminal

i) The PLCC equipment shall support PLCC mode of operation and Transmission speed and spectral bandwidth shall be software programmable via PC/ Notebook.

ii) Modulation and coding shall be implemented as software functions in digital signal processing (DSP) technology. Transmission mode shall be of duplex working type.

iii) The nominal carrier frequency shall be programmable from 40 to 500kHz minimum.

iv) The carrier frequency stability shall be equal or better than ±1ppm over the operating temperature range.

v) The nominal bandwidth for transmitting or receiving shall be programmable from 4 to 8 kHz in steps of 4kHz. PLCC terminal at bandwidth of 4 kHz shall be suitable for following configuration:

- Speech + 4 x 1200 Baud Data (minimum)
- The data rates shall be selectable in steps, compliant with commonly used standardized data rates such as 200, 300, 600 and 1200 Bauds; and for digital PLCC 1200, 2400, 4800 and 9600 Bauds.
- The modems for the above requirement shall be supplied with DPLC and shall be an integral part of the equipment.
- The gross speed and transmission bandwidth shall be programmable for up to 28.800kbit/s in 4 kHz spectral bandwidth, up to 72 kbit/s in 8 kHz bandwidth.
- Transmit (Tx) and receive (Rx) bands shall be configurable for adjacent or non-adjacent operation.

- Transmit output power shall be user programmable for 10, 20 or 40W PEP (Peak Envelope Power). However, minimum 80W PEP transmit power shall be supplied for achieving desired SNR in 765kV long transmission lines (more than 300km) to overcome the noise.
- The nominal output impedance shall be programmable as 75 or 125Ω unbalanced, or 150 Ω balanced as an option.
- The return loss in the transmitter band shall be >10dB
- The tapping loss shall be <1.5dB (as per IEC:60495).
- The AGC range of the receiver shall be 40dB (minimum)

The system shall support automatic transmission speed adaptation (DSA- dynamic speed adaptation) in at least 2 user-defined steps, self-adapting to the prevailing line condition (noise and interference). In case of decrease of SNR, priority shall be given to data over voice. However uninterrupted flow of data shall be ensured even at a level of SNR =25dB.

The broadband modem shall provide a facility for automatic detection and suppression of narrowband interferers.

d) System operation

i) The PLCC equipment shall be programmable via Laptop PC/ Note book/ Human Machine Interface (HMI)/ Graphical User Interface (GUI) based on Windows OS.

ii) The PLCC system shall facilitate the programming and monitoring of the DPLC terminals in the standard GUI/ HMI (Human Machine Interface).

iii) Programming software shall be incorporated in the HMI for monitoring and programming of the PLCC terminals. One number Laptop PC with above programming software shall be provided.

iv) Potential free contact shall be made available for monitoring alarm/ link failure of the DPLC. The potential free contact shall be suitable for rated voltage of 0.1A, 220V DC.

e) Speech (voice signal) transmission

i) In digital telephony the data rate of compressed telephony shall be field programmable using PC/ Notebook for each telephony channel

ii) Speech interfaces shall be configurable as 4-wire E&M, 2-wire FXO or 2-wire FXS.

iii) Inter-channel crosstalk shall be compliant with IEC60495.

iv) A compander according to ITU-T G.162 shall be configurable via HMI for each speech channel. The digital PLCC shall be suitable for connection to PABX for speech requirement.

v) A service phone shall be provided with each PLCC terminal, multiplex with the main speech channel.

f) Broadband Data Transmission

i) The PLCC terminal shall be provided with an integrated modem for broadband/ high speed data transmission. Transmission speed and spectral bandwidth shall be programmable via PC/ Notebook.

ii) The gross speed and transmission bandwidth shall be programmable for up to 28.800kbit/s in 4kHz spectral bandwidth, up to 72kbit/s in 8kHz bandwidth.

iii) The data rates shall be selectable in steps, compliant with commonly used standardized data rates such as 1200, 2400, 4800 and 9600Bauds.

iv) The system shall support automatic transmission speed adaptation (DSA- dynamic speed adaptation) in at least 2 user-defined steps, self-adapting to the prevailing line condition (noise and interference). In case of decrease of SNR, priority shall be given to data over voice. However uninterrupted flow of data shall be ensured even at a level of SNR =25dB.

v) The broadband modem shall provide a facility for automatic detection and suppression of narrowband interferers.

g) Data multiplexing

i) The PLCC terminal shall be provided with an internal multiplexer for the time division multiplexing of up to 8 serial data channels which can be allocated individually to the internal modems.

ii) Data ports shall be compliant with V.24/V.28, RS232 and/ or V.11/ X.21/ X.24 s per functional requirement.

iii) All data ports shall be electrically isolated from ground and against each other.

iv) An Ethernet port shall be provided for equipment configuration via LAN, or for general IP forwarding. It shall have facility to operate @ 9600bits/s at good SNR of 35dB and above within the nominal Band width of 4kHz. The above functionality shall be possible for SNR of 25dB for Band width of 8kHz.

v) Ratings & requirements of PLCC terminals:

1)	Mode of transmission		Single side band amplitude modulation
2)	HF range	kHz	40 to 500
3)	Nominal carrier frequency band	kHz	1no.x 4 (for single channel sets) 2nos.x 4(for twin channel sets)
4)	- Effectively transmitted speech freq. band or signal freq. band when only speech or signal is transmitted	Hz	300 to 3400or more
5)	Effectively transmitted, speech plus signal freq band in case of multi-purpose air conditioned kiosks use	Hz	Speech: 300 to 2000 Signal: 2160 to 3400 or more
6)	Nominal Impedance: Carrier freq side: VF side:	 Ω Ω	 150 balanced or 75 unbalanced 600
7)	Nominal carrier freq power		Adequate to maintain prescribed S/N ratio under adverse conditions
8)	Supply voltage (DC)	V	48 (-10 to +15%)
9)	Freq difference between voice freq band transmitter and receiver in a pair of PLCC Terminals		As per relevant IEC/ IS
10)	Stability of carrier freq. from its nominal value	Hz	± 10
11)	Effectively transmitted speech and data signal freq. band	kHz	Within 0.3 to 3.7
12)	Relative level across 600Ω (VF side) - 4 wire transmit - 4 wire receive - 2 wire transmit - 2 wire receive	 dB dB dB dB	 0 to - 17 (-)3.5 to (+)8 0 (-)7
13)	Level regulations control (Automatic Gain Control)		In case of a 30dB change in the carrier frequency signal level within the regulation range, the change in voice frequency receiver levels of both speech & signals shall be less than 1dB

14)	Telephone signaling channel		Frequency shift keying (pulse distortions) of the tele-phonic signaling channel at signaling speed of 10 pulse per second shall be less than 5ms for one pair of terminals. The signaling channel shall be operated by a potential free open or closed contact at the transmit side and provide a potential free change over contact at the receiver side. All relays to be provided in the speech circuits shall be hermetically sealed.
15)	300 - 400Hz: -0.9 to +3.0dB 400 - 600 Hz: - 0.9 to +1.8 dB 600 - 1600 Hz.: - 0.9 to +0.9 dB 1600-2000 Hz. :- 0.9 to +1.8 dB	or	+1.5dB for the complete band of 300 to 2000Hz (without com-pander).
16)	- Permissible limits for variation of overall loss (attenuation) of the speech channel relative to 800Hz for back to back operation of one pair of terminals without com-pander		

SCHEDULE

Part – V

Standards applicable to Cellular Technology

1. General Requirement

a) This mode of communication shall be used below 132 kV / 110 kV system for low speed data acquisition system, where feasibility of access to wideband network is not possible.

b) Installation of this mode of communication shall be adopted after ensuring the available signal level up to the required strength and dual SIM with different service provider with automatic changeover to ensure 99.9 % link availability for interruption free operation of the communication system.

c) Shall be designed for satisfactory and continuous (24x7) operation in open environment with operating temperature range of -40 deg C to 60 deg C and 100% humidity with hot, tropical, dusty, humid, and conductive to rust and fungus growth.

d) Shall be designed for 230 volts +/- 30%, 50 Hz AC supply or 48 V DC or as specified. At least 10 hrs battery backup shall be provided, extended back-up may be provided considering accessibility/remoteness of the node.

e) Communication Service Provider shall be responsible for maintaining the communication link.

2. Standards and Codes of Practice

a) EMI / EMC requirements

i) Electrostatic Discharge as per IEC 61000 – 4 -2

ii) Fast transient Burst as per IEC 61000 – 4 – 4

iii) Surges immunity as per IEC 61000 – 4 – 5

iv) Conducted Emissions as per IEC 61000 – 3 – 2 and CISPR 22

v) Radiated Emissions as per CISPR 22

vi) Radiate Immunity as per IEC 61000 – 4 – 3

vii) Vibration as per EN600068 – 2 – 6

viii) Shocks parameter as per IEC 68 – 2- 27

b) The modem shall be compliant with ETSI GSM Phase 2+ standards

c) The receiving device shall have IPSec, PPTP, and L2TP VPN support up to 8 concurrent tunnels with max 70Mbps throughput

d) The communication equipment / modem shall comply with IP 65 rating.

3. Functional Requirement

a) Field interface shall be optical port / RS 232 / RS 485 / any other suitable port

b) Data received shall be automatically validated by validation rules

c) The modem shall support dual SIM cards

d) The receiving device shall support IEC - 60870 -5- 101 & IEC - 60870 -5-104 protocol & DLMS (IS15959/IEC 62056), MODBUS for interfacing

e) The receiving end shall have multi WAN VPN Concentrator shall have built in facility to manage at least 250 remote nodes for a fixed IP provided.

f) The receiving end shall have redundant Multi WAN VPN Concentrator with a fail over – fall back feature for uninterrupted data communication

g) Gate way level security through appliance like Unified Threat Management (UTM) comprising of firewall, Antivirus, Intrusion Prevention system (IPS), Intrusion Detection system (IDS), etc. shall be adopted to ensure Cyber Security.

h) The router shall be capable of handling VPN based security by assuming a fixed IP issued by the Multi-AN VPN Concentrator at the SCADA end

i) Shall have the capability of data encryption with 3DES to ensure secured communication network over GPRS (3G/4G), Broadband or latest.

j) Device can decide and act according to the best available link in redundant mode configuration with automatic switchover.

k) QoS (Quality of Service) and Bandwidth management for optimal bandwidth usage.

l) Centralized Monitoring at Control Centre shall be available.

SCHEDULE

Part – VI

Standards applicable to VSAT

1. General Requirement

a) This type of communication shall not be used for primary protection function of Power system and can be used for SCADA control functions of power system equipment as Geo-Stationery Satellite hop delay is 240 ms.

b) This mode of communication shall be used for remote locations where access to wideband network is not possible

c) The VSAT terminal shall be able to work with all geostationary satellites visible from India and work efficiently from all parts of India.

d) The VSAT terminal shall work either on KU or C-band or extended C band for interruption free 24 X 7 operation in extremely rainy (more than 10mm/hour intensity) and cloudy conditions. At least 10 hrs battery backup shall be provided, extended back-up may be provided considering accessibility/remoteness of the node.

e) This mode of communication shall be adopted after ensuring the available signal level up to the required level by the service provider and link availability (99.9 percent) for interruption free operation of the communication system. NMS should be having facility of maintaining link status along with signal strength of the nodes.

f) This mode of communication shall not be connected to the National wideband network.

g) The size of the antenna should be as per WPC/DOT guidelines. All regulatory clearance from various regulatory bodies like DOT / WPC etc. shall be taken to operate the VSAT communication as its guidelines.

h) The VSAT Service Provider shall have redundant configuration enabled in Network Management System (NMS).

i) Pull Band width feature shall be adopted for the VSAT Network.

2. Standards and Codes of Practice

The equipment shall be conforming to latest revision of ITU-R recommendation S.580-6

3. Functional Requirement

a) Uplink and down link configuration shall be redundant (1 + 1)

b) The network shall be designed based on FTDMA / MFTDAM / SCPC DAMA technology or any other proven future technology with configurable data rate as per data communication requirement.

c) Bit error rate shall be lesser than 1×10^{-7} (data) to 1×10^{-4} (Voice)

d) Shall support Broadcast, Unicast, Multicast, TCP spoofing

e) Shall support IP RJ-45 (IP and E&M),

f) Receiving device should support IEC - 60870 -5-104 protocols for interfacing data as well as to IPv4, IPv6, RIP v1 , v2, ARP, ICMP, TCP, UDP, Telnet, IGMP, v1, v2, SNMP for networking Utilities.

g) Necessary protection / Firewall with IPS shall be provided to ensure Cyber Security.

h) Shall be designed for 230 V +/- 30% AC power supply at 50 Hz.

i) Shall be designed for trouble free operation at temperature range -10 deg C to 55 deg C and humidity up to 95% non-condensing. Shall be designed for wind speed of minimum 80 kmph (Operational)

j) Shall be able to deliver bidirectional composite data traffic.

k) Round trip delay shall be less than 600 ms

l) The VSAT IDU (for remote sites) shall support TCP/IP without the need of an external router.

m) The VSAT terminal shall have separate storage banks for software and firmware, to enable configuration changes pertaining to either the terminal (firmware) or the overall system architecture (software), without affecting the other.

n) The terminals should be able to take the software and firmware downloads from the hub over the air, without any disturbance to the online user traffic while in operation on per terminal (Unicast), per group (Multicast) or entire network (Broadcast) basis.

SCHEDULE

Part – VII

Standards Applicable to Microwave RF

1. General Requirement

i. It shall be designed for satisfactory and continuous (24 X 7) operation in open environment with operating temperature range of -40 deg C to 60 deg C and 100% humidity with hot, tropical, dusty, humid, and conductive to rust and fungus growth. At least 10 hrs battery backup shall be provided, extended back-up may be provided considering accessibility/remoteness of the node.

ii. The system shall remain fully operational for at least 7 years post commissioning.

iii. The solution shall utilize a license/unlicensed radio spectrum (subject to WPC/ DOT Authority requirements).

iv. It shall be capable of delivering data, voice and video traffic (video conferencing, multicasting) over the radio network.

v. It shall be error free transmission of all types of traffic in the proposed network.

vi. All the base locations will be inter-connected and all remote locations to its based stations in a Point to Multi-point architecture

vii. Shall provide all services for running of all the traffic between point-to-point and point to multipoint links.

viii. It shall have connection to all the given sites in the proposed network with clear line of site.

2. Standards and Codes of Practice

Radio technology:	TDD OFDM
Safety:	UL 60950-1, EN 60950-1
Frequency band:	As per WPC
LAN Data entry compliance:	IEEE 802.3

Latency:	<5mSec
Radio regulations:	FCC, WPC
Safety:	FCC/IC
EMC:	FCC

3. Functional Requirement

(i) Each set shall comprise of two independent Radios with antenna, cables, IDU, ODU

(ii) The individual system shall comprise of outdoor & indoor equipment, antenna, cables (RF/IF) with connectors, system software required for operation, monitoring & configuration of the link

(iii) It shall be a carrier type Point-to-Point Broadband Wireless Access radio system, with 99.9% reliability

(iv) The system shall be of reliable and field proven design and suitable for harsh environmental conditions. Outdoor Radio equipment must be IP-67 compliant & certified

(v) The system shall support Flexible Quality of Services and concurrent use of IP, VoIP & Video

(vi) Capable of suitable Channel Bandwidth selection with 5 MHz steps

(vii) EIRP shall be as per WPC norms

(viii) Shall have a support for dual pole (MIMO) External Antenna to provide higher capacity. Shall support Antenna diversity in order to Run the link under frequency interference environment

(ix) Flexible symmetric link supporting up to 50:50% UL/DL in either direction for enabling different applications like voice, video and data

(x) Modulation Schemes shall be with Forward Error Correction (FEC)

(xi) Transmit power control- within allowable EIRP as per WPC regulations

(xii) Radio shall be capable to capture both side (local and remote) spectrum view. Radio equipment shall have site management and link management facility (software) for initial configuration. Installation and maintenance using single computer/LCT for a complete link.

(xiii) Shall support TELNET/SNMP based / NMS with SNMP Agent: SNMP VI/V2/V3 client, MIB II, Bridge MIB.

(xiv) Security: Atleast AES-128-bit authentication. The radios shall have the capability for locking MAC address. System shall be conforming to the relevant standards

(xv) Shall have facility to upgrade Software/Firmware over the air

(xvi) Radio shall support and store performance logs for and up one month

(xvii) Operating temperature

(a) Outdoor Unit- -40°C to 60°C

(b) Indoor Unit- 0°C to 40°C

SCHEDULE

Part – VIII

Standards Applicable to Radio Frequency Canopy based Communication

The primary function of the communication network is to provide a highly reliable bidirectional data communication system.

1. General Requirement

(a) This mode of communication may be used in implementation of Smart Grid Applications.

(b) It shall be designed for satisfactory and continuous (24 X 7) operation in open environment with operating temperature range of -40 deg C to 60 deg C and 100% humidity with hot, tropical, dusty, humid, and conductive to rust and fungus growth.

(c) The system shall remain fully operational for at least 7 years post commissioning.

(d) The solution shall utilize a license/unlicensed radio spectrum (subject to WPC/ DOT Authority requirements).

(e) All RF canopy elements are required to adhere to the Wireless Planning Commission, India (WPC) latest guidelines.

(f) The Communication Service Provider (CSP) shall ensure that their devices and installations are within the acceptable human exposure limits per international standards/WPC norms and as required for the utility service territory.

(g) All elements of communication canopy should be interoperable with elements of any other alliance member and in case if there is any version upgrade or change in standard for the applicable products, the CSP should accommodate all such changes.

(h) The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP65). The mounting provision shall be for either pole mounting or mounting brackets for flat surfaces.

(i) Enclosure Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be of weather and aging resistant material made of neoprene or equivalent.

(j) Operating Voltage shall be with 50% tolerance. The single phase auxiliary power supply should operate in the range 95 V - 270 V. At least 10 hrs battery backup shall be provided, extended back-up may be provided considering accessibility/remoteness of the node.

(k) It is required that the network conforms to relevant DOT standards.

2. Design Requirements

a) Radio Frequency Canopy shall be deployed on IPv6 based 6LoWPAN RF mesh network technology.

b) It shall provide scalability, interoperability and certain level of future proofing to remain usable for life span.

c) The Design shall be reliable, immune to interference and provide robust communication network keeping in view the site conditions. It shall be flexible in terms of providing communication in variable terrain & urban density.

d) The communication network shall have facility for auto registration and self-healing. It should be fault tolerant & “sleepy” in nature to optimize on resources.

e) All Network element shall

   i. Be of industrial grade construction
   ii. Be certified by competent authority for use in India.
   iii. Be Mountable as pole top devices
   iv. Have a lifespan of at least 10 years post go live.

f) Communication canopy solution shall have necessary Disaster Recovery (DR) & security mechanisms in place and also shall guarantee performance of the entire system in quantifiable terms, for all conceivable parameters for entire life cycle.

g) The solution should conform/ comply to both IPv6 and IPv4 network protocols with backward compatibility feature.

h) RF canopy shall be designed to operate at minimum 50 % of designed capacity (peak data requirement with guaranteed performance) for full scale deployment and balance capacity shall cater to performance expectations during difficult & challenging times and also for meeting future applications.

i) CSP may also utilize third party mobile towers for creating RF canopy, for that CSP should have back to back arrangement with tower owner for minimum of 10 years.

j) Last mile mesh network must support auto-registration and self-healing feature to continue operation using easiest possible available route in case of failure of any communication device in the mesh.

k) Communication network should be immune with any external Magnetic field/ESD/Jammer/HV voltage influence such that it shall not affect the normal overall functionality.

l) Last mile communication infrastructure created shall be scalable over the air for supporting more end-point deployments and other applications in future.

m) Design the complete solution for minimum availability of 99.5% at any point of time.

n) The necessary power backup facility shall be available in all the communication devices.

o) Communication network should be reliable, scalable, not impacted by noise.

p) Communication network shall support up-gradation of the Firmware / software in the communication modules/devices and smart meters from remote over-the-air (OTA) from time to time to meet the increasing demand of the system in operation / overcoming system limitations / bugs.

3. Functional Requirements

a) The communication canopy should be capable to integrate with multiple types of field devices.

b) RF canopy should support multiple applications data and all end-points should be able to be connect to either the AMI Head End System and/or to the respective control & monitoring system

c) Be capable of communicating with large numbers of end points simultaneously over the same network at the same time maintaining prioritization (quality of service) as required for operational applications

d) Have the capability to use an external antenna to extend communication range

e) Have the ability to support multiple communication protocols to provide flexibility to cover existing and future protocols as per different applications as mentioned in the scope.

f) The data flow design between the DCU and HES should be attempted with redundant nodes on Cellular (3G & 4GLTE) or MPLS, Fibre etc.

g) Communication canopy should support data rate of 100 kbps or more or as per requirements of different applications as mentioned in the scope.

h) Phase reversal & phase natural interchange shall not affect the gateway/router functionality in any manner.

i) Network should support traffic prioritization, filtering, shaping etc. Data traffic/ congestion measures are required so that communication canopy elements can efficiently handle the volumes of asynchronous or synchronous data that will potentially be routed through their hardware.

j) Each mesh network device/ endpoints must be able to connect to at least two peers/base stations for redundancy.

k) Each meter should be able to access minimum of 2 routers address/ endpoints dynamically.

l) Communication Network should have minimum following Functionality:

i. Automatic Node Discovery
ii. Dynamic Re-routing
iii. Self-Healing mechanism through re-routing and built-in network redundancy
iv. Downloading configuration data to field devices/ meters
v. Supervision and optimization of the Communication Canopy network by computing performance statistics to achieve maximal channel capacity
vi. Troubleshooting of devices from field, reading of data from end devices with portable tools, detection and reporting of trouble conditions such as link breaks and device failures
vii. Support for IPv6 with backward compatibility to IPv4 is a must
viii. Each gateway device should have 10BASE-T/100BASE-TX Ethernet Port to connect to any Circuit switched / packet switched network such as SDH / MPLS

4. Network Management System

Suitable network management system (NMS) shall be provided to monitor the performance of the communication canopy round the clock from the Control Centre of respective DISCOMs. The NMS shall provide view of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes over the air. The NMS shall be capable to provide Bandwidth Utilization, Latency, Link Health and Signal Strength of the network under observation.

5. Standards and Codes of Practice

a. The Communication Canopy shall comply to the following standards: EEE 802.15.4 – IEEE standard for Information Technology –Telecommunications and Information Exchange between Systems – Local and Metropolitan Area Networks –Wireless Medium Access Control (MAC) and Physical layer (PHY); IEEE 802.15.4g – IEEE Standard for Smart Utility Networks or any other equivalent standard /alliance and Relevant Indian Standards.
b. The communication network shall support multiple protocols including DLMS/COSEM, IEC 60870-5-104, DNP3 for transfer of data to HES and ensure secure communication to HES.
c. Interoperability: IEEE 802.15.4 and IEEE 802.15.4g or equivalent implementations.

6. Data Security and Encryption Protocols

It is required that the solution adheres to following security protocols and practice:

a) Certificate/RSA based identities user names and passwords
b) Role based access control
c) Link-layer encryption
d) Group based key generation and management
e) Network layer encryption
f) 802.1x based access control for meters, routers, grid devices
g) Data encryption applied on all data following through the communication channel through Asymmetric encryption between Smart Meter and HES
h) Sensitive information must be encrypted in the database
i) Preference is for user access to be managed in a central area using Role Base Security
j) Password policy to enforce password rules
k) Manage the length of active sessions, and retries
l) The use of Digital certificates
m) Audit logs to track user changes (Audit trails)

SCHEDULE

Part – IX

Narrow Band Power Line Communication

The primary function of the Narrow Band Power Line Communication is to provide a highly reliable bidirectional data communication system.

1. General Requirement

a) This type of communication may be used where no protection function is envisaged and are not proposed to be used in protection of power system equipment.
b) This mode of communication may be used in implementation of Smart Grid Applications.
c) It Shall be designed for satisfactory and continuous (24 X 7) operation in open environment with operating temperature range of -40 deg C to 60 deg C and 100% humidity with hot, tropical, dusty, humid, and conductive to rust and fungus growth. At least 10 hrs battery backup shall be provided, extended back-up may be provided considering accessibility/remoteness of the node.
d) The system shall remain fully operational for at least 7 years post commissioning.
e) It is required that the network conforms to DOT privacy standards.

2. Design Requirements

a) Narrow Band Power Line Communication shall be deployed on IPv6 based 6LoPLC network technology.
b) It should provide scalability, interoperability and future proofing so as to remain usable for life span.
c) Design a reliable, interference free & robust communication network keeping in view the site conditions. It shall be flexible in terms of providing communication in variable terrain & urban density.
d) All Network element must:

i. Be of industrial grade construction
ii. All network elements should be certified by competent authority for use in India.

e) The solution shall conform/ comply to both IPv6 and IPv4 network protocols with backward compatibility feature.
f) PLC Communication network shall not be impacted by noise

3. Functional Requirements

a) PLC technology shall enable convenient two-way communications for home users and utility companies to monitor and control electric plugged devices such as electricity meters and street lights etc.
b) The Narrow Band Power Line Communication (NB-PLC) shall be capable to integrate with multiple types of field devices.
c) The Narrow Band Power Line Communication shall support multiple applications data and all end-points shall be able to be connect to either the AMI Head End System AND/OR to the respective control & monitoring system
d) Network should support traffic prioritization, filtering, shaping etc. Data traffic/ congestion measures are required so that NB-PLC elements can efficiently handle the volumes of asynchronous or synchronous data that will potentially be routed through their hardware.

4. Network Management System

Suitable Network Management System (NMS) shall be provided to monitor the performance of the communication canopy round the clock from the Control Centre of DISCOM. The NMS shall provide view of all the networking elements deployed at site and enable configuration, parameterization of the networking devices from the control center.

5. Standards and Codes of Practice

1. The Narrow Band Power Line Communication shall comply with the following standards: IEEE 1901.2, ITU-T G.9902 (G.hnem), ITU-T G.9901, ITU-T G.9903 (G3-PLC) and ITU-T G.9904 (PRIME).
2. The communication network shall support multiple protocols including DLMS/COSEM, IEC 60870-5-104, DNP3 for transfer of data to HES and ensure secure communication to HES.

3. Narrow Band Power Line Communication devices shall comply Equipment Electromagnetic Compatibility (EMC) standards: IEEE 1775 for Power Line Communication Equipment (EMC) Requirements.