

## Attachment

### Technical Specifications

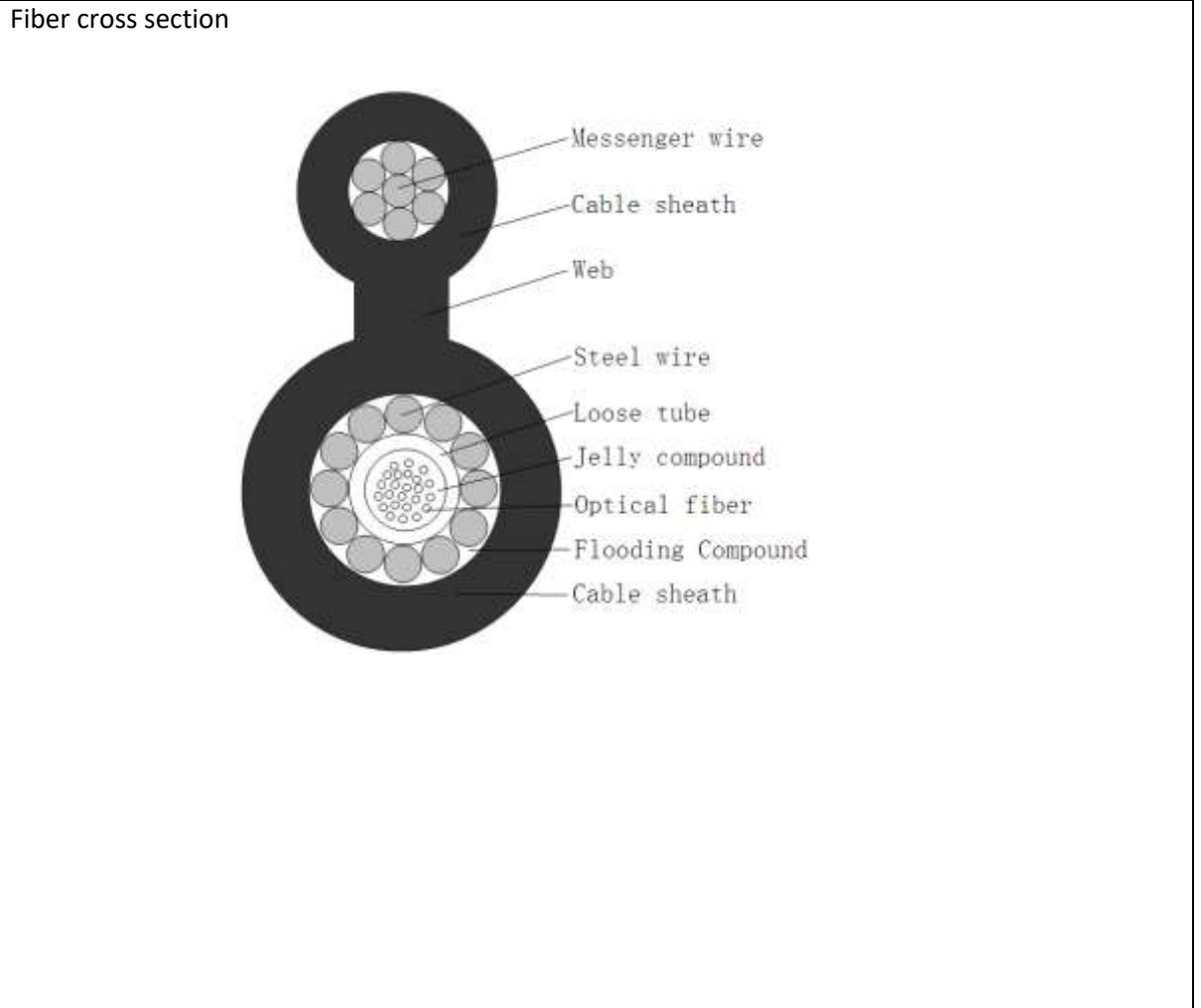
The Applicant shall install Broadband Network as specified in Request for Application.

The successful Applicant shall develop optical fiber network to use or rented/leased services from any other existing operators as applicable.

The purpose of broadband network is to provide broadband connectivity service with minimum of 1 Mbps symmetric and dedicated bandwidth in each Rural Municipality (Gaun Palika), Wada Offices, health centers/health posts and public educational institutions (colleges and high schools) and residential household in the vicinity.

This Annex is prepared to provide minimum technical specification of different types of Access technology and media to provide broadband network. Each successful Applicant shall meet minimum of all the availability or key indicating parameters as listed in this Annex.

Clause No.	Particulars of Technical Requirements
1.0	Figure 8 Fiber specification
	12 Core G.652D Armored fiber shall be used to connect OLT GPON interfaces with Master Splitters
	6 core G.657A1 Armored shall be used to connect Master splitters to Distribution splitters



No. of cores		6	12	
Fiber Specification		6 core - G.657A1, 12 - G.652D		
Loose Tube	Material	Polybutylene Terephthalate (PBT)		
	Diameter ( $\pm 0.06$ ) mm		2.0	2.2
	Thickness ( $\pm 0.03$ ) mm		0.32	0.32
	The Max.Core NO./Tube		6	12
Water Blocking Layer( Material)		Flooding Compound		

Messenger wire	Material	Galvanized steel strand			
	Thickness ( $\pm 0.2$ ) mm	2.1(0.7mm*7)			
Armoring	Material	steel wire			
	Diameter*NO mm	0.7*12	0.7*12	0.8*12	0.9*12
Messenger Outer Sheath	Material	Medium Density Polyethylene (MDPE)			
	Thickness ( $\pm 0.2$ ) mm	1.3			
Cable Outer Sheath	Material	MDPE			
	Thickness ( $\pm 0.2$ ) mm	1.5			
Web	Material	MDPE			
	Size ( $\pm 0.5$ ) mm	3.0*2.0			
Cable Diameter ( $\pm 0.5$ ) mm (W×H)		6.4*13.1	6.4*13.1	6.8*13.5	7.6*14.3
Cable Weight ( $\pm 10$ ) kg/km		110	110	124	144
Attenuation	1310nm	0.35dB/ km			
	1550nm	0.21dB/ km			
Min. bending radius	Without Tension	10.0 × Cable- $\phi$			
	Under Maximum Tension	20.0 × Cable- $\phi$			
Temperature range (°C)	Installation	-20~+60			
	Transport & Storage	-40~+70			
	Operation	-40~+70			

Fiber core color codes:

No.	1	2	3	4	5	6
Color	Blue	Orange	Green	Brown	Gray	White
No.	7	8	9	10	11	12
Color	Red	Black	Yellow	Violet	Pink	Aqua
No.	13	14	15	16	17	18
Color	Blue+P	Orange+P	Green+P	Brown+P	Gray+P	White+P

No.	19	20	21	22	23	24
Color	Red+P	Natural+P	Yellow+P	Violet+P	Pink+P	Aqua+P

Item		Requirement
Allowable Tensile Strength	Short Term	3600 N
	Long Term	1500 N
Allowable Crush Resistance	Short Term	1500 (/100mm)
	Long Term	600 (/100mm)

#### Identification

Following information shall be embossed or printed or indented on the cable sheath at intervals of 1m throughout the whole length of the cable to enable the identification of cable. The embossed or printed or indented marking shall be distinct to naked eye from a distance of not less than 50 cm.

- (i) Type and size of cable
- (ii) Progressive length marking
- (iii) Year of manufacturing
- (iv) Manufacturer's name
- (v) NTA
- (vi) Laser symbol or text identifying the cable as optical fibre cables.

All Dielectric Self-Supporting Cable, (ADSS) Construction

Design of cable from core to skin shall be as follows:

Center strength member (CSM) shall be made from non-metallic materials.

Loose buffer tube filling compound to protect the fibers in the loose tube against water ingress and vibration, this compound must enable optical fibers move easily in the tube.

Loose buffer tube shall be made from Polypropylene (PP) or Polybutylene Terephthalate (PBT),

colored distinguished between loose buffer tubes and filled by filling compound or water swellable materials.

Fillers and Loose tubes shall be arranged round CSM according to the reverse lay method (SZ).  
Fillers with neuter color shall be used to distinguish with loose buffer tubes.

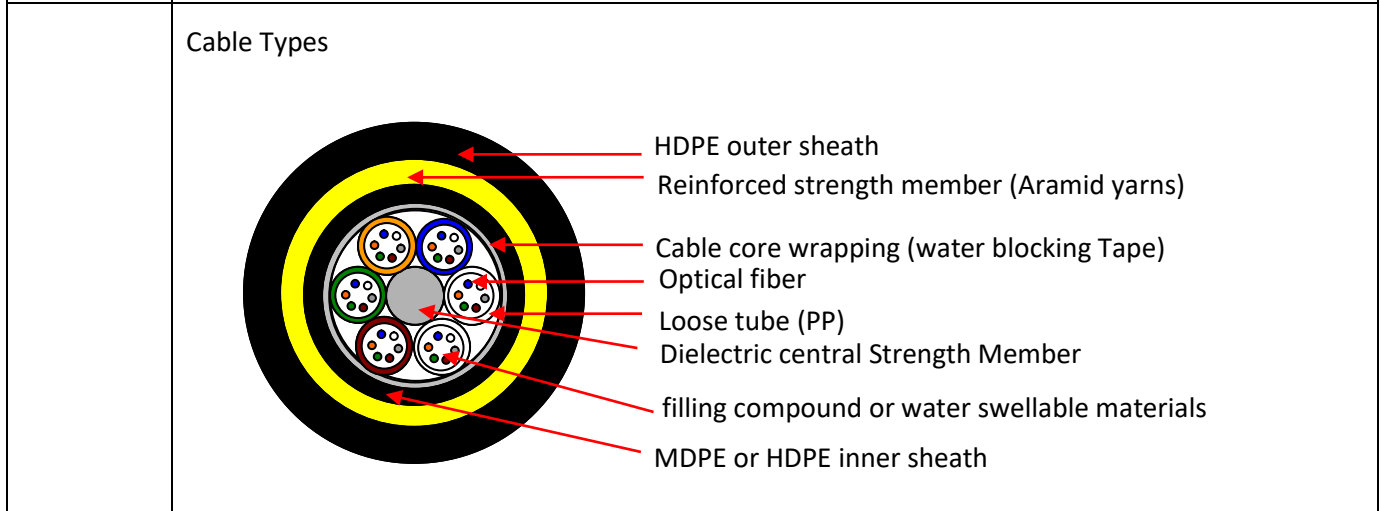
After application of fillers, at least one helical or longitudinal application of non-hygroscopic and non-wicking water blocking tape shall be applied over the cable core.

The inner jacket shall be of MDPE or HDPE as per the latest relevant BS standards.

Peripheral strength member shall be made from aramide yarns with high straining intensity and low stretching capacity.

HDPE outer jacket shall be able to sustain high electric field.

The Cable structure shall be as follows:



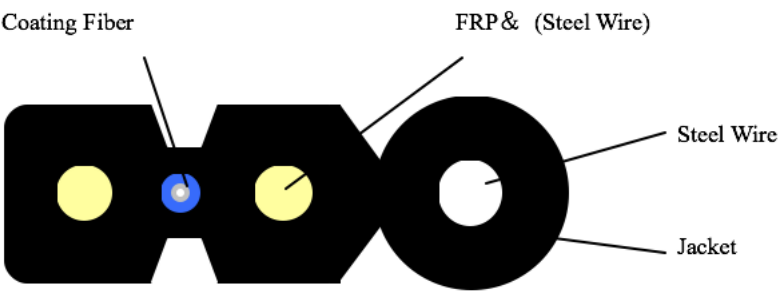
ADSS cable for 11/33KV 100m span 24 core

Description	Technical Requirement
ADSS cable	
Span length	100m
Lifetime	≥ 30 years
Dielectric central strength member diameter	≥ 2.0 mm
Minimum Quantity (or Amount) of Aramid Yarn	> 34,000 den
Rated Tensile Strength	≥ 9 kN
Maximum allowable Tension	≥ 3.6 kN
Every day Stress	≥ 2.25 kN
Applied Load Crush Resistance	≥ 2 kN/100mm

	Allowed Bending Radius	20 times of diameter of cable
	Inner jacket thickness	≥ 1.0 mm
	Outer jacket thickness	≥ 1.5 mm
	Cable weight	120 -160 kg/km
	Fiber length in the cable compared to the cable length	≥ 1%
	ADSS cable for 11/33KV 200m span 24 core	
	Description	Technical Requirement
	ADSS cable	
	Span length	200m
	Lifetime	≥ 30 years
	Dielectric central strength member diameter	≥ 2.0 mm
	Minimum Quantity (or Amount) of Aramid Yarn	> 79,600 den
	Rated Tensile Strength	≥ 15 kN
	Maximum allowable Tension	≥ 6 kN
	Every day Stress	≥ 3.5 kN
	Applied Load Crush Resistance	≥ 2 kN/100mm
	Allowed Bending Radius	20 times of cable diameter
	Inner jacket thickness	≥ 1.0 mm
	Outer jacket thickness	≥ 1.5 mm
	Cable weight	140 -180 kg/km
	Fiber length in the cable compare with the cable length	≥ 1%
	ADSS cable for 11/33KV 300m span 24 core	
	Description	Technical Requirement
	ADSS cable	
	Span length	300m

	Lifetime	≥ 30 years
	Dielectric central strength member diameter	≥ 2.0 mm
	Minimum Quantity (or Amount) of Aramid Yarn	> 137,600 den
	Rated Tensile Strength	≥ 18 kN
	Maximum allowable Tension	≥ 7 kN
	Every day Stress	≥ 4.5 kN
	Applied Load Crush Resistance	≥ 2 kN/100mm
	Allowed Bending Radius	20 times of cable diameter
	Inner jacket thickness	≥ 1.0 mm
	Outer jacket thickness	≥ 1.5 mm
	Cable weight	150 -190 kg/km
	Fiber length in the cable compare with the cable length	≥ 1%

## 2.0 Underground Optical Fiber Cables

2.0	Last Mile Fiber Drop Wire Specification
2.1	Two core G.647A1 outdoor black fiber should be used to provide last mile connection from Distribution splitter to ONT
2.2	<p>Fiber cross section:</p>  <p>The diagram illustrates the cross-section of a fiber optic cable. It features two yellow circular cores positioned symmetrically. Between these cores is a blue circular coating fiber. Surrounding the cores and coating fiber is a black layer labeled 'FRP &amp; (Steel Wire)'. The entire assembly is enclosed within a larger black circular 'Jacket'. Labels with leader lines point to 'Coating Fiber', 'FRP &amp; (Steel Wire)', 'Steel Wire', and 'Jacket'.</p>

2.3	Items		Unit	Specification
			G.657A1	
	Mode Field Diameter	1310nm		9.0±0.4
		1550nm		10.1±0.5
	Cladding Diameter		μm	124.8±0.7
	Cladding Non-Circularity		%	≤0.7
	Core-Cladding Concentricity Error		μm	≤0.5
	Coating Diameter		μm	245±5
	Coating Non-Circularity		%	≤6.0
	Cladding-Coating Concentricity Error		μm	≤12.0
	Cable Cutoff Wavelength		nm	$\lambda_{cc} \leq 1260$
	Tension (Long Term)		N	300
	Tension (Short Term)		N	600
	Crush (Long Term)		N/10cm	1000
	Crush (Short Term)		N/10cm	2200
	Min. Bend Radius (Dynamic)		mm	30
	Min. Bend Radius (Static)		mm	15
	Operating Temperature		°C	-20~+70
	Storage Temperature		°C	-20~+70
	Attenuation(max.)	1310nm	dB/km	≤0.35
		1550nm	dB/km	≤0.21
	Macro-Bending Loss	1turn×10mm radius @1550nm	dB	≤0.75
		1turn×10mm radius @1625nm	dB	≤1.5
3.0	GPON Optical Line Terminal (OLT)			



	OLT must comply with ITU-T recommendations G.984.1 , the G.984.2, G.984.5 and G.988.
	The GPON operating wavelengths shall be bidirectional 1490nm downstream and 1310nm upstream.
	The bitrate of the GPON system shall be 2488.32 Mbit downstream and 1244.16 Mbit/ upstream, as defined in G.984.2
	The optical power levels for the 2.4 Gbit/s downstream and 1.2 Gbit/s upstream system and the optical power budget shall be compliant to Class B+ and Class C+
	It should provide Optical Line Supervision capabilities as defined in G.984.2, with compliancy to measurement specifications G.984.2 like Transceiver temperature, voltage , Laser bias current , Optical transmit power and receive power
	The GTC parameters shall be compliant to support the following GPON system, as defined in G.984.3 with Logical split ratio of up to 1:128 or Higher and Fiber distance of up to 20km or Higher.
	The OLT shall automatically discovered ONT registration.
	The OLT MUST support the pre-provisioning of ONT serial numbers and registration IDs and their associated ONT IDs.
	The OLT must support DBA method and be capable of accommodating on the same PON a mix of status-reporting and non-status-reporting ONT.
	The proposed equipment shall support complete all T-CONT types according to ITU-T G.983.4
	Support Advanced Encryption Standard (AES),Forward error correction (FEC), Dynamic bandwidth allocation (DBA) & Configurable delay tolerance
	The proposed equipment must comply with the ITU-T G.988 ONT management and control interface specification (OMCI)
	OMCI transport mechanism compliance based on ITU-G 984.3.
	GEM Port IDs MUST be assigned automatically by the OLT
	The management specification must allow the OLT to establish and release connections across the ONT, manage the UNIs at the ONT, request configuration information and performance statistics and autonomously inform the system operator of an event (e.g. link failure)
	The proposed equipment shall be able to detect and isolate the rogue ONTs.
	The proposed OLT must have at least one year of commercial application.
	The vendor should implement his OMCI stack in accordance to OMCI Implementer’s Study Guide, ITU-T G.988 for OMCI interoperability
	The proposed equipment must be compliant to ONT management and control protocol as defined in G.988

	The GPON OLT should be modular chassis based with small, medium and high-density various slots options
	The OLT optical connections to the GPON must be based on SC/UPC
	The same GPON service board should support mixing of B+ and C+ pluggable transceivers. There should be no restriction on the number of pluggable SFP of each flavor (B+ or C+) that could be inserted.
	The proposed product should support an operating temperature of -25C to +60C
	Field replaceable Fan Frame and Dust Filter
	The Equipment should support redundant -48VDC power supply
	Should support Redundant Controller Card
	The offered product must provide a support for 10GPON in future
	The OLT must support 1/10G SFP+ port for uplink connectivity towards network
	IEEE 802.3ad Link Aggregation must be supported on OLT uplink network interfaces for link protection/redundancy
	The SFP+ uplink interfaces on the OLT must support transceiver monitoring DDMI monitoring like temperature, voltage, lazer bias current, RX and TX power
	Out of Band Management support in the control card
	Should Support L2, L3, IP/MPLS, VPWS, VPLS, Layer 3 routing protocols OSPF,IS-IS,BGP
	Protection against malicious media access control (MAC) move, proxy ARP, IP spoofing, L2/L3/L4 ACL including MAC ACL and Traffic rates controls, DHCP snooping
	Should support or have clear roadmap to support SDN and NFV
	Support Fequency and timing protocol such as ToD, 1588v2, SyncE & BITS for mobile backhaul
	The OLT should be able to support IEEE802.1Q Vlan 1-4094, QinQ tagging, Vlan translation, N:1 Vlan, S-Tag, C-Tag, 1:1 Vlan
	Should support IGMPv2, IGMPv3 for multicast traffic with IGMP Snooping
	Should support SNMP v1, 2 and 3
3.39	Minimum 2 x service slots or higher
3.40	1 x Control Card with provision to add another for redundancy in future
	2 x 1/10Gbps or higher SFP+ uplink interfaces with optics based on proposed network design
	The power card should be physically separated from control card;
6.0	GPON Service Interface Card

6.1	16 x GPON Ports with class B+ or C+ optics based on proposed network design
8.0	GPON Optical Network Terminal (ONT)
	The ONT should belongs to proposed Vendor's of OLT
	The ONT should support 4 x 10/100/1000 Mbps interface over RJ45
	The ONT should support Wi-Fi capability such as b/g/n
	Should support Bridge/Routed
	IP-v4 and IP-v6 support
	The throughput of the Ethernet port shall be wire speed for different frame size
	The ONT should support Bridging of 802.1q tagged Ethernet frames between its LAN and WAN interfaces
	The ONT should have local LAN DHCP server to provide IP assignment to end device
	The ONT should support remote software download and upgrade
	The ONT should support Bridging of 802.1q tagged Ethernet frames between its LAN and WAN interfaces
	The ONT should support PPPoE over the encapsulated Ethernet , Bridge IP over Ethernet
	Should support Multiple WAN interfaces for Internet, IPTV, including TR069 for Management
	The ONT should support NAT/Firewall/DMZ with port forwarding
	The ONT shall support smart public Wi-Fi hotspot for public usage over different VLAN, and invisible for family users (Hidden SSID).
	The ONT should support Wi-Fi user security such as WPA-PSK/WPA2
	The ONT should support IEEE 802.1q virtual LAN (VLAN)
	The ONT should support Class of Service (CoS) based on VLAN-ID, IEEE 802.1p bit
	ONT must be manageable through Network Element manager of OLT
	ONT must be zero touch auto provisioning through TR069 using DHCP options from ACS
	Remotely software image download over OMCI, as well as activation and reboot/reset functionality along with auto re-provisioning in case of factory reset by customer
	Should support the AES security mechanism defined in G.984.3
	Fully manageable from NMS using OMCI from OLT
	Must support L2 loop detection feature on the LAN side with auto port shut feature upon loop detection as an action

9.0	Routers
	The router must have 2 or higher service slots
	The router have 20x1Gbps Ethernet ports
	The router have 4x10Gbps SFP+ Ethernet ports
	The Router should support 1 Million IPv4 and 512K IPv6 routes
	Minimum Switching Capacity: 80Gbps
	Packet Forwarding Capacity per service slot (at least): 50 Mpps
	Packet Forwarding Performance for Chassis (at least): 500 Mpps
	Router shall be equipped with redundant route processor card
	Upgradation and down gradation of software in the standby processor should not affect traffic switching in the main processor.
	Shall support on line hot insertion and removal of cards without service hit.
	Should have redundant -48VDC power supply and 220VAC
	Operating Temperature: -5°C to 40° C nominal
	Should support all Metro and Carrier Ethernet Services and L2 protocols like 802.1Q VLAN, Q-in-Q, VLAN Translation, EFM, CFM, Link Aggregation
	Should support all L3 functionality Static Route, RIP, OSPF, ISIS, BGP, GRE, MP-BGP, uRPF,

	The router should support IP/MPLS features LDP based MPLS, BGP based MPLS, L2VPN (EoMPLS) , L3VPN, VPLS, EVPN, RSVP, RSVP-TE, MPLS-TE, MPLS-FRR, VRF.
	Supports Multicasting PIM-DM, PIM-SM, IGMP v1, IGMP v2, IGMP Snooping, MLD, MSDP,
	The router shall support the dual stack with all IPv6 related features
	The proposed router shall support defend against TCP SYN flood attack
	The router must support QoS features to allocate network resources on application needs and QoS priorities. Such ass, traffic shaping, queueing, Classifications for DiffServ, Marking, Round Robin, RED, WRED
	Should support SNMP v1, v2 and v3 along with Radius, Tacacs+, SSH and Telnet
	Switch
	The manageable switch musth have minimum 8x100Mbps Ethernet and two Gigabit Ethernet port
	Should operate in either -48VDC power supply and 220VAC
	Operating Temperature: -5°C to 40° C nominal
	Should support all Metro and Carrier Ethernet Services and L2 protocols like 802.1Q VLAN, Q-in-Q, VLAN Translation, EFM,Link Aggregation, STP, RSTP, MSTP, Port Loopback detection.
	Should support SNMP v1, v2 along with Radius, Tacacs+, SSH and Telnet
	PLC Splitter is based on the Planar Waveguide Technology (Planar Lightwave Circuit Splitter)
	Must be SC/APC connector
	Splitter could be 1:2,1:4, 1:8, 1:16 or 1:32 based on network design
	The splitter should have Low PDL, Insertion and high return loss
	Should have uniform power splitting, wide operating wavelength
	Should have compact design that can be easily fitted in the pole mount outdoor enclosures
	Should be Qualified Under Telcordia GR-1221 and GR-1209
	Excellent Environmental & Mechanical Stability

Marking and Labeling of individual ports												
Parameter	Unit	Specification										
Operation Wavelength	nm	1260~1650										
Channel Number		1X2	1x3	1X4	1x6	1X8	1x12	1X16	1x24	1X32	1X64	1x128
Insertion Loss (Max.)	dB	4.3	6.2	7.4	9.8	10.7	12.5	13.9	16.5	17.2	21.5	25.5
Uniformity (Max.)	dB	0.5	0.6	0.8	0.8	1.0	1.0	1.4	1.5	1.6	2.0	2.6
Polarization Dependent Loss	dB	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.8
Return Loss	dB	≥50										
Directivity	dB	≥50										
		Connector IL Loss of 0.3dB on APC not included										
12.0	Outdoor Enclosures Specification											
	The box should have International Protection rating : IP55											
	The Material should be sheet molding compound (SMC)											
	The Seal material should be Ethylene Propylene Diene Monomer (EPDM)											
	The Sealing of the ports should be Rubber											
	It should have key locks door											
	Operating temperature - 40 degree to +70											
	The installation type should be Pole mounted											
	The clamps for mounting the splitters enclosures in the poles shall be made up of “stainless steel” for superior durability, corrosion and red rust resistance.											
	The Box should have marking as below:											

	Nepal Telecom Authority, Provider assigned Splitter name or number
13.0	<p>Power supply</p> <p>All the offered equipment shall work on -48V DC dual-power supply systems.</p> <p>All the offered equipment shall have 1+1 power supply redundancy protection mechanism.</p> <p>Adequate protective devices and alarms shall be provided to protect the system from any damage caused due to surge, high voltage, and high current or overheating.</p>

	Power Supply System (PSS)
	<p>The Applicant shall provide complete power systems for all the stations of the network having two types:</p> <p>a)Site with AC power supply system: City Supply with 48 hours of battery backup</p> <p>b)Site without AC power supply system: Solar power system with 76 hours of battery backup</p> <p>All power systems must have IP remote management capability</p> <p>Earthing, Lighting and Surge Suppression System:</p> <p>The Applicant shall provide the complete earthing system for each site under this project. Suitable design and materials shall be used to maintain the Earth Resistance to less than 5 ohms even in dry season for the supplied earthing system.</p> <p>The Application shall provide complete details of Lighting protection system of each sites. All equipment must be installed with surge suppression system</p>
16.0	FTTH Guidelines
16.1	Operators are free to rollout the network using any split ratio and combination of splitter however it is advised to use max two level split as per standard industry practice for class B+ and max three level split if class C+ or C++ optics used
16.2	The max attenuation at ONT GPON port should not be higher 26dB for Class B+ optics and 29dB for Class C+ and 31 dB for Class C++ optics keeping safety margin of 2-3dB at each site.
16.3	ADSS/UG 24 Core fiber should be used to connect The Routers and interconnection of OLT
16.4	12 core Fiber should be used to connect OLT with 1st level Master splitters
16.5	6 core fiber should be used to connect 2nd level Distribution splitters with Master splitter
16.6	All necessary subscription Licenses, Support and comprehensive Warranty for 2 years should be backed by proposed OEM along with manufacture authorization letter



