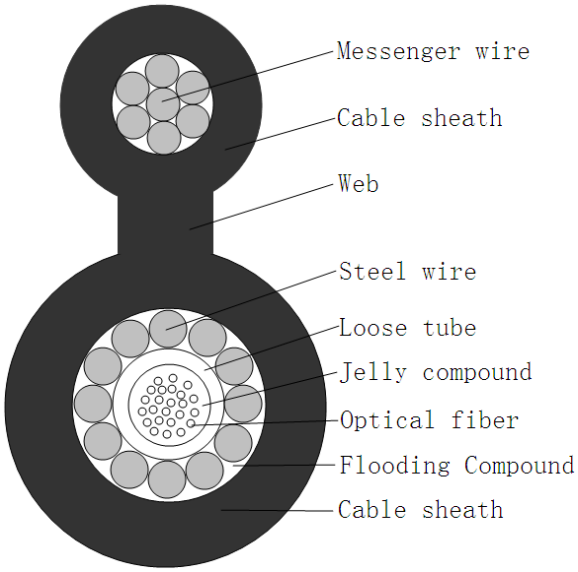
Annex-10

Technical Specifications

The Applicant shall install Broadband Network as specified in Request for Application.
The successful Applicant shall develop optical fiber network, wireless and/or VSAT to use or rented/leased services from any other existing operators.

The purpose of optical broadband network is to provide broadband connectivity service with minimum of 512Kbps symmetric and dedicated bandwidth in each Rural Muncipality (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 optical 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**
1.1	12 Core **G.652D** Armored fiber shall be used to connect OLT GPON interfaces with Master Splitters
1.2	6 core **G.657A1** Armored shall be used to connect Master splitters to Distribution splitters
1.3	Fiber cross section 
1.4	

No. of cores		**6**	**12**		
Fiber Specification		**6 core - G.657A1, 12 - G.652D**			
Loose Tube	Material	Polybutylene Terephthalate (PBT)			
	Diameter （±0.06） mm		2.0	2.2	
	Thickness （±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 （±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 （±0.2） mm	1.3			
Cable Outer Sheath	Material	MDPE			
	Thickness （±0.2） mm	1.5			
Web	Material	MDPE			
	Size （±0.5） mm	3.0*2.0			
Cable Diameter （±0.5） mm （W×H）		6.4*13.1	6.4*13.1	6.8*13.5	7.6*14.3
Cable Weight （±10） kg/km		110	110	124	144
Attenuation	1310nm	0.35dB/ km			

	1550nm	0.21dB/ km
Min. bending radius	Without Tension	10.0×Cable-φ
	Under Maximum Tension	20.0×Cable-φ
Temperature range (℃)	Installation	-20~+60
	Transport & Storage	-40~+70
	Operation	-40~+70

1.5

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

1.6

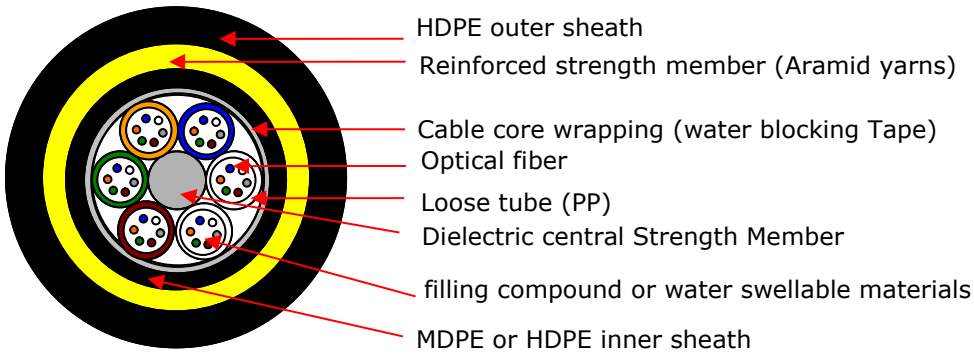
Item		**Requirement**
Allowable Tensile Strength	Short Term	3600 N
	Long Term	1500 N
Allowable Crush Resistance	Short Term	1500 (/100mm)
	Long Term	600 (/100mm)

1.7

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) NEPAL TELECOMMUNICATIONS AUTHORITY
(vi) Laser symbol or text identifying the cable as optical fibre cables.

1.8	**All Dielectric Self-Supporting Cable, (ADSS) Construction**
	Design of cable from core to skin shall be as follows: a) Center strength member (CSM) shall be made from non-metallic materials. b) 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. c) 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. d) 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. **e)** 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. f) The inner jacket shall be of MDPE or HDPE as per the latest relevant BS standards. g) Peripheral strength member shall be made from aramide yarns with high straining intensity and low stretching capacity. h) HDPE outer jacket shall be able to sustain high electric field.
1.9	The Cable structure shall be as follows:
	Cable Types 

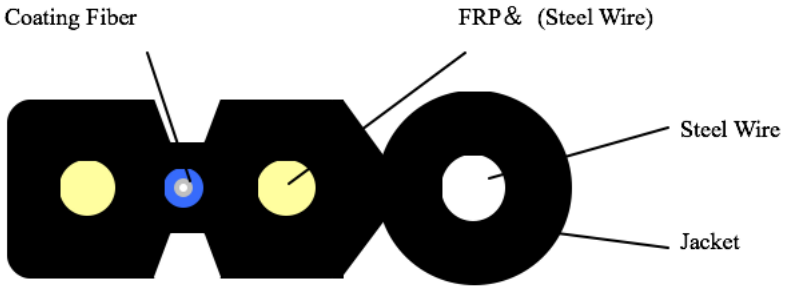
a) ADSS cable for 11/33KV 100m span 24 core

	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 Outer jacket thickness	≥ 1.0 mm ≥ 1.5 mm
	Cable weight	120 -160 kg/km
	Fiber length in the cable compared to the cable length	≥ 1%
	(b) 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 Outer jacket thickness	≥ 1.0 mm ≥ 1.5 mm
	Cable weight	140 -180 kg/km
	Fiber length in the cable compare with the cable length	≥ 1%
	(c) 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 Outer jacket thickness	≥ 1.0 mm ≥ 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	Fiber cross section: 
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	λ_{cc}≤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		℃	-20～+70
Storage Temperature		℃	-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)**				
3.1	OLT must comply with ITU-T recommendations G.984.1 , the G.984.2, G.984.5 and G.988.				
3.2	The GPON operating wavelengths shall be bidirectional 1490nm downstream and 1310nm upstream.				
3.3	The bitrate of the GPON system shall be 2488.32 Mbit downstream and 1244.16 Mbit/ upstream, as defined in G.984.2				
3.4	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+				
3.5	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				
3.6	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.				
3.7	The OLT shall automatically discovered ONT registration.				
3.8	The OLT MUST support the pre-provisioning of ONT serial numbers and registration IDs and their associated ONT IDs.				
3.9	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.				
3.10	The proposed equipment shall support complete all T-CONT types according to ITU-T G.983.4				
3.11	Support Advanced Encryption Standard (AES),Forward error correction (FEC), Dynamic bandwidth allocation (DBA) & Configurable delay tolerance				
3.12	The proposed equipment must comply with the ITU-T G.988 ONT management and control interface specification (OMCI)				
3.13	OMCI transport mechanism compliance based on ITU-G 984.3.				
3.14	GEM Port IDs MUST be assigned automatically by the OLT				
3.15	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)				
3.16	The proposed equipment shall be able to detect and isolate the rogue ONTs.				
3.17	The proposed OLT must have at least one year of commercial application.				
3.18	The vendor should implement his OMCI stack in accordance to OMCI Implementer's Study Guide, ITU-T G.988 for OMCI interoperability				
3.19	The proposed equipment must be compliant to ONT management and control protocol as defined in G.988				
3.20	The GPON OLT should be modular chassis based with small, medium and high-density various slots options				
3.21	The OLT optical connections to the GPON must be based on SC/UPC				
3.22	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.				
3.23	The proposed product should support an operating temperature of -25C to +60C				

3.24	Field replaceable Fan Frame and Dust Filter
3.25	The Equipment should support redundant -48VDC power supply
3.26	Should support Redundant Controller Card
3.27	The offered product must provide a support for 10GPON in future
3.28	The OLT must support 1/10G SFP+ port for uplink connectivity towards network
3.29	IEEE 802.3ad Link Aggregation must be supported on OLT uplink network interfaces for link protection/redundancy
3.30	The SFP+ uplink interfaces on the OLT must support transceiver monitoring DDMI monitoring like temperature, voltage, lazer bias current, RX and TX power
3.31	Out of Band Management support in the control card
3.32	Should Support L2, L3, IP/MPLS, VPWS, VPLS, Layer 3 routing protocols OSPF,IS-IS,BGP
3.33	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
3.34	Should support or have clear roadmap to support SDN and NFV
3.35	Support Fequency and timing protocol such as ToD, 1588v2, SyncE & BITS for mobile backhaul
3.36	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
3.37	Should support IGMPv2, IGMPv3 for multicast traffic with IGMP Snooping
3.38	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
5.1	2 x 1/10Gbps or higher SFP+ uplink interfaces with optics based on proposed network design
5.2	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)**
8.1	The ONT should belongs to proposed Vendor's of OLT
8.2	The ONT should support 4 x 10/100/1000 Mbps interface over RJ45
8.3	The ONT should support Wi-Fi capability such as b/g/n
8.4	Should support Bridge/Routed
8.5	IP-v4 and IP-v6 support
8.6	The throughput of the Ethernet port shall be wire speed for different frame size
8.7	The ONT should support Bridging of 802.1q tagged Ethernet frames between its LAN and WAN interfaces
8.8	The ONT should have local LAN DHCP server to provide IP assignment to end device
8.9	The ONT should support remote software download and upgrade
8.10	The ONT should support Bridging of 802.1q tagged Ethernet frames between its LAN and WAN interfaces
8.11	The ONT should support PPPoE over the encapsulated Ethernet , Bridge IP over Ethernet
8.12	Should support Multiple WAN interfaces for Internet, IPTV, including TR069 for Management
8.13	The ONT should support NAT/Firewall/DMZ with port forwarding
8.14	The ONT shall support smart public Wi-Fi hotspot for public usage over different VLAN, and invisible for family users (Hidden SSID).
8.15	The ONT should support Wi-Fi user security such as WPA-PSK/WPA2
8.16	The ONT should support IEEE 802.1q virtual LAN (VLAN)
8.17	The ONT should support Class of Service (CoS) based on VLAN-ID, IEEE 802.1p bit

8.18	ONT must be manageable through Network Element manager of OLT
8.19	ONT must be zero touch auto provisioning through TR069 using DHCP options from ACS
8.20	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
8.21	Should support the AES security mechanism defined in G.984.3
8.22	Fully manageable from NMS using OMCI from OLT
8.23	Must support L2 loop detection feature on the LAN side with auto port shut feature upon loop detection as an action
9.0	**Routers**
9.1	The router must have 2 or higher service slots
9.2	The router have 20x1Gbps Ethernet ports
9.3	The router have 4x10Gbps SFP+ Ethernet ports
9.4	
9.5	The Router should support 1 Million IPv4 and 512K IPv6 routes
9.6	Minimum Switching Capacity: 80Gbps
9.7	Packet Forwarding Capacity per service slot (at least): 50 Mpps
9.8	Packet Forwarding Performance for Chassis (at least): 500 Mpps
9.9	Router shall be equipped with redundant route processor card
9.10	Upgradation and down gradation of software in the standby processor should not affect traffic switching in the main processor.
9.11	Shall support on line hot insertion and removal of cards without service hit.
9.12	Should have redundant -48VDC power supply and 220VAC
9.13	Operating Temperature: -5°C to 40° C nominal
9.14	Should support all Metro and Carrier Ethernet Services and L2 protocols like 802.1Q VLAN, Q-in-Q, VLAN Translation, EFM, CFM, Link Aggregation
9.15	Should support all L3 functionality Static Route, RIP, OSPF, ISIS, BGP, GRE, MP-BGP, uRPF,
9.16	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.
9.17	Supports Multicasting PIM-DM, PIM-SM, IGMP v1, IGMP v2, IGMP Snooping, MLD, MSDP,
9.18	The router shall support the dual stack with all IPv6 related features

9.19	The proposed router shall support defend against TCP SYN flood attack
9.20	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
9.21	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
10.1	Should operate in either -48VDC power supply and 220VAC
10.2	Operating Temperature: -5°C to 40° C nominal
10.3	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
11.1	PLC Splitter is based on the Planar Waveguide Technology (Planar Lightwave Circuit Splitter)
11.2	Must be SC/APC connector
11.3	Splitter could be 1:2,1:4, 1:8, 1:16 or 1:32 based on network design
11.4	The splitter should have Low PDL, Insertion and high return loss
11.5	Should have uniform power splitting, wide operating wavelength
11.6	Should have compact design that can be easily fitted in the pole mount outdoor enclosures
11.7	Should be Qualified Under Telcordia GR-1221 and GR-1209
11.8	Excellent Environmental & Mechanical Stability
11.9	Marking and Labeling of individual ports

11.10

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**

12.1 The box should have International Protection rating : IP55

12.2 The Material should be *sheet molding compound* (SMC)

12.3 The Seal material should be Ethylene Propylene Diene Monomer (EPDM)

12.4 The Sealing of the ports should be Rubber

12.5 It should have key locks door

12.6 Operating temperature - 40 degree to +70

12.7 The installation type should be Pole mounted

12.8 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.

12.9 The Box should have marking as below:
Nepal Telecom Authority, Provider assigned Splitter name or number

13.0 **Power supply**

- All the offered equipment shall work on -48V DC dual-power supply systems.
- All the offered equipment shall have 1+1 power supply redundancy protection mechanism.
- 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.

14.0	Wireless
14.1	**Point-to-Multipoint Radio - Base station & CPE Specification**

14.2

Features	Description
Frequency	Frequency supported should be according to unlicensed frequency band approved by WPC - 5.825 GHz to 5.875 GHz
Frequency Band Support	Should support multiband in 5 GHz - in case Govt. releases new frequency under unlicensed band in future, hardware should not be changed
NLOS, nLOS operation	Should support *near Line of sight* / *Non Line of sight*
Channel Bandwidth	5 MHz, 10 MHz, 20 MHz & 40 MHz
Channel spacing	Should be 5 MHz or better
Max Output Power at Antenna port	Should support 25 dBm or better; user configurable in 1 dBm steps
Modulation	OFDM, MIMO supported with QPSK, 16-QAM, 64-QAM with Forward Error Correction (FEC)
	Should support automatic adaptive modulation
Architecture	Base Station: 90^o / 120^o Dual polarized sectoral antenna
	Single CAT5e / CAT6 Cable between IDU & ODU
Radio	Quoted Radio should not be based on WiFi CSMA CA based 802.11a/b/g/n/ac standards
Distance Coverage	Product should be capable of providing communication to minimum 15 KMs
CPE supported per Base station	Should support at least 50 CPEs
Transmit Power	Should support Automatic Transmit Power Control (ATPC) by Base Station
Bandwidth restriction	Should support the MIR/CIR configuration to ensure SLA
Ethernet Latency	Should be less than 20 ms
DHCP	Should support DHCP client
Protocol Filtering	System should support the protocol filtering based on interface

		Broadcast Rate Limit	System must be able to limit broadcast rate
		Link Test Utility	Should support the inbuilt link test utility to calculate the throughout and efficiency of link
		Security	Should support 128 bit AES encryption
			Should support Layer 2 firewall to allow/deny based on VLAN, Ethertype, Source and Destination MAC address in wireless/Ethernet port
			Should support Layer 3 firewall to allow/deny based on IP address, Network and DSCP/TOS.
			System should have option to use RADIUS authentication for better security and protection from intruder
		Throughput	Should provide up to 200 Mbps aggregate Ethernet throughput
		Spectral Efficiency	Minimum 5 bps/Hz or better
		Bandwidth allocation	System should be able to configure symmetric & asymmetric bandwidth
		Interference mitigation techniques	System should have dynamic filters to block adjacent / alternate channels to help mitigate interference
			System should support beamforming to avoid co-channel interference to improve the performance - Enabling Beamforming feature may be optional, wherever required it should be enabled by attaching the beamforming antenna
			System should support GPS synchronization technique to eliminate interference in colocated scenario
		Interfaces	Should support 100/1000Base(T) Full Duplex, rate auto negotiated, 802.3at compliant
		Management	System should have support of protocols: IPv4, UDP, TCP, IP, ICMP, SSH, SNMPv2c, HTTPs, FTP, IGMP Snooping, LLDP, DHCP, RADIUS, NTP
			System should have support of Network Management with HTTPs, SSH, SNMPv2c

VLAN	System should have the support of VLAN based on IEEE 802.1Q with 802.1p priority
Priority Management	System should provide option to define priority for management and data traffic
QoS	Should support at least 3 queues or better with packet classification by DSCP, COS, VLAN ID, IP & MAC address, Broadcast, Multicast and CPE Priority
Error Correction	Forward Error Correction coding and ARQ should be supported
Performance Statistics	System should provide detailed statistics of Wireless and LAN Interface
	System should have the option of uploading syslog data to Syslog Server
Tools	Should support Spectrum scanner / monitor to analyze the interference
	Should have inbuilt tools like Ping, Traceroute to get help in troubleshooting
Power Consumption	Should not exceed 20W
Surge Suppression	Should have inbuilt surge protection
Operation Temperature	-25°c to 55°C
Enclosure	IP55 or better
WPC Approval	System must be approved from WPC - ETA certificate to be submitted

Point-to-Point Radio Specification		
1	**Frequency**	Radio should opreate in ISM Band (5.8GHz) as per WPC Regulation
2	**Band Support**	Radio Must support 5.8GHz Multi-Band
3	**NLOS, nLOS operation**	Must support 512 subcarrier to support superior performance in NLOS ,nLOS conditions
4	**Channel Bandwidth**	5 / 10 / 15 / 20 / 30 or 40 MHz with 2.5 MHz steps
5	**Max Output Power at Antenna port**	Subscriber Module: up to 27 dBm automatically adjustable by ATPC controlled by AP
6	**Modulation**	QPSK, 16-QAM, 64-QAM, 256-QAM, MIMO-B, with Forward Error Correction (FEC)

			Should support automatic adaptive modulation, separated per CPE per direction for maximum performance
	7	**Architecture**	Quoted Radio should not be based on “WiFi CSMA CA based 802.11a/b/g/n/ac standards
			Integrated, minimum 23 dBi, Must support H and V polarization patch or Connectorized
			Single Cable between IDU & ODU
	8	**Distance Coverage**	Minimum 15 Km with suitable antenna
	9	**Transmit Power**	Automatic transmit power control (ATPC)
	10	**MIR/CIR**	Should support the MIR/CIR configuration to ensure SLA
	11	**Maximum Burst Size**	System must support the Bursting of more than 2 Gbits to manitain Voice/Video/Data Quality
	12	**Ethernet Latency**	Average latency of a heavily loaded (85% of link capacity) one way trip must not exceed 7 ms (regardless of packet size)
	13	**DHCP**	System should be able to serve as DHCP Server and DHCP client
	14	**Protocol Filtering**	System should support the protocol filtering based on port
	15	**Broadcast Rate Limit**	System must be able to limit broadcast rate
	16	**AAA Authentication**	System should have the support for AAA authentication support for better security and protect from intruder
	17	**Support feature like NAT,L2TP,PPPoE,DHCP option 82**	System should support features like NAT and L2TP, DHCP option 82 to enhance security and prevent broadcast
	18	**Management of Video Traffic**	Please describe how your radio system is designed to accommodate traffic of burst nature, such as real time video surveillance traffic
	19	**Link Test Utility**	Should support the inbuilt link test utility to calculate the throughout and efficiency of link
	20	**VLAN Support**	VLAN support based on IEEE 802.1Q
	21	**Security**	128 bit AES authentication, accepted by NIST and passed the CAVP & CMVP testing
	22	**Throughput**	Should support 300 Mbps aggregate Ethernet throughput

	23	**Bandwidth**	System should be able to configure symmetric & asymmetric bandwidth. Upload and download percentage should be user configurable
	24	**MIMO-B**	System must have the support for 2 x 2 MIMO-B technology to increase the throughput
	25	**Avoid Collision**	System should support scheduled access rather than CSMA to avoid collision
	26	**Interference mitigation**	System should have dynamic filters to mitigate interference from alternate frequency channels
			System carry small Radio data packet to combat interference without impacting performance
	27	**Interfaces**	LAN Interface: System must have 100/1000Base(T) Full Duplex, rate auto negotiated (802.3 compliant)
			Should have POE Output interface in the ODU to power up camera, WiFi Hotspot or other POE directly
	28	**Management**	System should have support of IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
			System should have support of Network Management with HTTP, Telnet, FTP, SNMP v2c
	29	**Management VLAN**	System should have the support of VLAN 802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
	30	**QoS**	Must support 802.1P and Diffserve QoS
	31	**Error Correction**	3/4 Reed Solomon Forward Error Correction coding and ARQ
	32	**Alignment**	SNR bar or beeper based alignment option on outdoor radio unit for antenna alignment
	33	**Antenna Gain**	Should support integrated 23 dBi gain flat panel antenna or connectorized to use with external antenna
	34	**Antenna Beamwidth**	Antenna Beam width should be at least 10° azimuth
	35	**Input Voltage**	802.3at compliant
	36	**Surge Suppression**	EN61000-4-5: 1.2us/50us, 500 V voltage waveform
	37	**Operation Temp.**	40°c to 60°C Outdoor

				20°c to 40°C Indoor
	38	**Protection**	IP66 & IP67	
	39	**WPC Approval**	System must be approved from WPC	
15.0	**Aggregation Wireless Backhaul**			
	An all outdoor radio offering point to point backhaul solution shall be carrier grade and robust performance with a highly efficient operation and having excellent QoS			
15.1	Radio Capacity: 250Mbps or Higher			
15.2	Latency: 5ms Max			
15.3	Modulation: to 256QAM, MIMO, OFDM			
15.4	Synchronization: GPS with frequency reuse and scalability			
15.5	Channel Width: 5Mhz up to 40Mhz			
15.6	Configuration: PTP or P2M			
15.7	Security: AES, HTTPS, SNMP, Radius Authentication			
15.8	Reliability: MTBF 25yrs of higher			
15.9	Interfaces: Gigabit Ethernet			
15.10	Power Supply: 48VDC/ 220VAC or POE			
15.11	Ruggedized: IP66/67,IEC60529, ESD Higher than 8kV contact / 15kV air ESD discharges per EN61000			
15.12	Operating Temperature: -30°C to +55°C			
	Very Small Aperture Terminal (VSAT)			
15.13	The offered VSAT terminals shall be either it's own or rented or leased from any one or multiple of NTA licensed ISP(s)/operator.			
15.14	**Capacity of each terminal port:** 512Kbps to 2 Mbps or higher Symmetric and Dedicated			
15.15	**Bands**: Ku or Ka or other available bands			
15.16	**Antenna**: 0.6m to 1.2m or Higher			
15.17	**LNB**: up to 500 MHz range			
15.18	**BUC**: up to 1 W or higher			
15.19	**Satellite location**: Any			
	WiFi Router			

15.20	Wireless: 5dB External Antenna
15.21	Ports: 4 x 10/100 Ethernet LAN and 1 x 10/100 WAN
15.22	Standard: 802.11a/b/g/n, 2x2 MIMO 300Mbps
15.23	Protocols: NAT, DHCP/PPPOE,DNS, VLAN, QoS, TFTP/HTTP/TR069 Firmware upload and Remote Management
15.24	**Security:** WEP/AES, WEP, WPA2, WDS,WPS
15.25	SSID: 4 with Hidden SSID support
15.26	Power Supply System (PSS)
	The Applicant shall provide complete power systems for all the stations of the network having two types: a)Site with AC power supply system: City Supply with 48 hours of battery backup b)Site without AC power supply system: Solar power system with 76 hours of battery backup All power systems must have IP remote management capability Earthing, Lighting and Surge Suppression System: 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. The Application shall provide complete details of Lighting protection system of each sites. All equipment must be installed with surge suppression system
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