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Bhutan Telecom Ltd.

REQUEST FOR PROPOSAL (RFP)

DWDM NETWORK MODERNIZATION

Supply, Installation, Testing, Commissioning and Migration of a Next-Generation Flex-Grid Coherent Optical Transport Network

Document Item	Details
Procuring Entity	Bhutan Telecom Limited
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2 INTRODUCTION, BACKGROUND AND OBJECTIVES

Bhutan Telecom Limited (BTL) invites proposals from qualified and experienced optical transport vendors for the design, supply, installation, testing, commissioning and end-to-end migration of a next-generation coherent DWDM network. The vendor must provide a complete node architecture showing client interfaces, OTN switching, transponder/muxponder, coherent line interface, ROADM/OXC, amplification, OCM/OSC, protection and NMS. Clearly identify which functions are integrated into the chassis and which require separate equipment. The project shall replace the existing legacy fixed-grid DWDM platform and establish a scalable, resilient and operationally efficient national optical backbone.

The current DWDM network was deployed approximately ten years ago and is based predominantly on 10G-per-channel fixed-grid technology. The platform is affected by capacity limitations, aging/obsolete equipment, limited protection on several routes, operational inflexibility and constraints in expanding services due to legacy filtering and hardware dependencies.

This is a full network modernization and replacement exercise. The awarded vendor shall take complete Turnkey responsibility for delivering a resilient, scalable and standards-based optical transport platform that serves as the foundation of Bhutan's national digital infrastructure for the next 15+ years.

1.1 Project Objectives

i. Increase capacity to coherent 100G/200G/400G services, with a credible roadmap to 800G+.
ii. Introduce Flex-Grid optical switching and ROADM-based wavelength routing.
iii. Replace obsolete/end-of-life equipment to reduce technology and support risks.
iv. Introduce centralized NMS/SDN-based control (zero-touch provisioning mandatory).
v. Enable a standards-based architecture that supports interoperability and minimizes avoidable vendor lock-in, including IP routers.
vi. Accommodate all the existing live services during migration with planned, controlled and minimal service interruption.
vii. Deliver layer-1 optical security (AES-256 encryption) on all critical paths as defined by BTL.

1.2 Existing Network and modernization Basis

The current DWDM network was deployed approximately 10 years ago and is based predominantly on 10G-per-channel fixed-grid technology over a transponder-based architecture across 31 sites. The platform suffers from:

i. Capacity saturation on backbone routes
ii. Aging and end-of-life hardware
iii. Limited or absent optical protection on several routes
iv. Fixed-grid spectral inflexibility
v. No centralised SDN or automation capability
vi. Sparse spare parts availability and unsustainable support costs

The modernization shall be treated as a FULL NETWORK REPLACEMENT. The existing network topology has been redesigned as per actual physical fiber availability, with some routes bypassed and

new connections established. The new topology along with site list and traffic matrices are provided in Annexes A, B and C The fiber plant is standard SSMF G.652.D. Measured span losses provided in Annex B range from approximately 5 dB (short urban hops) to 35.2 dB (End-of-Life margin included) on the most challenging mountain routes. The Bidder shall validate all fiber characterization through site surveys prior to design finalisation.

1.3 Scope of Work

i. Perform detailed site surveys at all 32 sites, fiber route assessment, span-loss verification and optical characterization as required.
ii. Prepare High-Level Design (HLD) and Low-Level Design (LLD) as per supported fiber SSMF G.652.D, including node architecture, degree design, wavelength plan, spectrum plan, protection/restoration plan and migration design.
iii. Perform optical link budget calculations for every span using EOL margins, and guarantee a minimum 3 dB margin across all deployed wavelengths.
iv. Supply all hardware, software, licenses, coherent optics, IP routers, patch cords, passive components, racks/sub-racks, power accessories, management servers and installation materials necessary for a complete solution.
v. Install, integrate, configure, test and commission the new DWDM system at all applicable sites.
vi. Provide a unified control plane (SDN/NETCONF/YANG) platforms in a highly available configuration and integrate agreed northbound interfaces with BTL operational systems.
vii. Migrate existing PTN, router, ISP, core and other identified services from the legacy system to the new platform through an approved phased migration plan.
viii. Execute Factory Acceptance Testing (FAT), pre-installation tests, Site Acceptance Testing (SAT), end-to-end service tests, protection/restoration tests and final acceptance tests.
ix. Provide comprehensive administrator, operations and maintenance training, including hands-on practical sessions.
x. Deliver full as-built documentation, operational procedures, configuration backups, licenses, network inventory, power budgets, test reports and lifecycle documentations.
xi. Provide warranty, spares, SLA-bound maintenance and lifecycle supports.

1.4 Turnkey Responsibility

The bidder shall be responsible for completeness of the offered solution. Any component, license, interface, cable, adapter, software feature or engineering service required for the solution to meet the RFP requirements and accepted design shall be deemed included even if not explicitly listed in the indicative BoQ, except where BTL has expressly identified an item as BTL-supplied.

1.5 Phased Execution Strategy

The project shall be executed in two distinct phases. Phase 1 (Target execution: 2027) shall cover all major Hubs and critical OLS backbone routes required to secure priority traffic. Phase 2 (Target execution: 2028) shall cover the remaining regional and less critical sites. The Bidder must ensure that

the optical line system (OLS) maintains end-to-end integrity. If a Phase 2 site is located on a fiber span between two Phase 1 sites, the Bidder shall include the required chassis, amplifiers, power supplies, and OSC at that Phase 2 site in the Phase 1 BoQ. The Phase 2 BoQ for that site shall only contain the add/drop components, transponders, and router pluggables.

Bidders shall provide separate Bill of Quantities (BoQ) for Phase 1 and Phase 2. The unit rates quoted for Phase 1 equipment, licenses, and services shall remain valid and binding for Phase 2 procurement. BTL reserves the right to adjust Phase 2 quantities based on 2028 network requirements using these locked-in unit prices.

3 ARCHITECTURE PHILOSOPHY AND DESIGN FREEDOM

BTL mandates the deployment of a robust, future-proof Open Line System (OLS) across all sites. The OLS must decouple the photonic line layer from the terminal transceiver layer. For the terminal transceiver layer, BTL is open to all architectural approaches. The Bidder is requested to analyze the provided network topology, traffic matrix, and fiber characteristics (SSMF G.652.D, noting severe span losses up to 36 dB) propose the optimal mix of:

i. Dedicated Transponder/Muxponder architectures
ii. Integrated IPoverWDM (IPoDWDM) relying on coherent router pluggables (400ZR/ZR+/OpenZR+).
iii. (IPoDWDM) relying on coherent router pluggables (400ZR/ZR+/OpenZR+).
iv. A hybrid approach combining both.
v. Any other coherent optical technology the bidder can technically demonstrate and commercially justify.

Regardless of the service layer technology chosen, the OLS shall natively support alien wavelengths coherent signals generated by third party transponders or router coherent pluggables without requiring proprietary signal conditioning. All proposed architectures shall maintain full optical interoperability and must not create proprietary dependencies that restrict BTL’s future flexibility to source service layer optics independently.

The Bidder must justify their proposed architecture based on physical link feasibility (maintaining a >= 3 dB End-of-Life OSNR margin on all paths), service criticality, traffic matrix, minimization of physical footprint/power, and the most favorable 5-Year Total Cost of Ownership (TCO). BTL reserves the right to evaluate and select the topology architecture that best aligns with its strategic and financial objectives.

BTL reserves the sole right to select, modify or combine proposed architectures during the evaluation and negotiation phase.

4 DETAILED TECHNICAL REQUIREMENTS

4.1 Optical Line System (OLS)

Sl.No	Parameter	Mandatory Requirement
1	Grid	The OLS shall operate on ITU-T G.694.1 Flex-Grid with a minimum channel spacing granularity of 12.5GHz.
2	Spectrum	C-band mandatory. Bidder shall provide a documented, technically feasible path for future spectrum expansion, including C+L-band were supported by the proposed platform.
3	Architecture	ROADM-based coherent optical line system suitable for multi-degree national backbone deployment & the OLS shall support native Alien Wavelength (open channel) operation with no proprietary conditioning at add/drop ports. Add/drop ports shall accept input power from -14 dBm to 0dBm to accommodate diverse pluggable form factors.
4	Fiber compatibility	Support standard single-mode fiber and existing deployed fiber types subject to survey/characterization.
5	Optical monitoring/Performance	The OLS should support Optical Time Domain Reflectometry (OTDR) integration or built-in fiber monitoring capability for span fault localization. It shall include Optical Channel Monitoring (OCM) with per-channel OSNR, power and wavelength visibility at every ROADM
6	OSC	The OLS shall include an Optical Supervisory Channel (OSC) operating outside the signal band (e.g., 1510 nm or 1625nm for inter-node communication and management.
7	Automatic control	All OLS amplifier modules shall be hot-swappable with automatic power equalization and safe restart capability.
8	Engineering margin	The OLS shall achieve a Maximum Span Loss Support of at least 36dB (EOL) using EDFA technology with optional Raman Amplification configurable on spans exceeding 30dB

4.2 ROADM Architecture

i. All 32 sites shall be equipped with ROADM-capable optical nodes providing full Colorless, Directionless (CD) add/drop capability as a minimum & flex grid capability to allow dynamic wavelength routing without blocking.

ii. The ROADM degree shall support a minimum of 2 directions at terminal sites and upto 8 directions at major hub sites. The chassis shall support degree expansion without full hardware replacement.

iii. The ROADM switching fabric shall be based on Wavelength Selective Switch (WSS) technology with fast switching speed capable of supporting less than sub-50ms path restoration.

iv. The ROADM shall support both fixed and flex-grid channel plans simultaneously to accommodate any legacy services during migration.

v. The architecture shall support remote wavelength provisioning without manual optical patching for normal service turn-up at ROADM-equipped nodes.

4.3 Amplification and Optical Reach

i. Standard EDFA modules shall provide a configurable output power range of +13 dBm to +23 dBm with noise figure <= 5 dB.
ii. Variable Gain Amplifiers (VGAs) shall support gain tilt correction and dynamic gain equalization to maintain flat spectral response across the full loaded spectrum.
iii. For spans exceeding 30dB insertion loss, the Bidder shall propose either Distributed Raman Amplification (DRA), higher-gain EDFAs, or optical regeneration. BTL mandates that a 3 dB EOL margin is maintained regardless of the amplification approach chosen.
iv. Regeneration shall be minimized through coherent reach optimization, but any required regenerator sites shall be included and clearly identified.
v. All amplifier modules shall include automatic laser shutdown (ALS) and automatic power reduction (APR) per ITU-T G.664 for personnel safety.
vi. The system shall support in-line amplifiers (ILA) at intermediate sites where span distances exceed single-span reach capability.
vii. Booster, pre-amplifier and in-line amplifier placement shall be based on verified span loss, nonlinear limits, OSNR and OEM design rules.
viii. Bidder shall submit end-to-end optical design calculations for each route including launch power, span loss, OSNR, residual margin and expected performance.

4.4 Coherent Optical Interfaces

i. All coherent interfaces shall be software-configurable for multi-rate and multi-modulation operation: minimum 100G (QPSK), 200G (8-QAM or 16-QAM), 400G (16-QAM) and a credible roadmap to 800G per wavelength.
ii. All coherent interfaces shall implement Advanced Soft-Decision Forward Error Correction (SD-FEC) with a minimum Net Coding Gain (NCG) of 11 dB.
iii. Coherent DSP shall provide full electronic dispersion compensation for a minimum of 40,000 ps/nm of Chromatic Dispersion (CD) without requiring external DCM modules.
iv. Polarization Mode Dispersion (PMD) tolerance shall be a minimum of 30 ps at all line rates.
v. Where dedicated transponder/muxponder platforms are proposed, they shall include:
    a. Wire-speed Layer-1 AES-256 optical encryption (FIPS 140-2 Level 2 minimum) on all critical paths
    b. OTN (G.709) framing and switching capability
    c. multi-service client interface support (1GE, 10GE, 100GE, STM-N, OTU-k)
vi. Where coherent router pluggables are proposed as part of the solution (e.g., 400ZR, OpenZR+), the Bidder shall:
    a. Demonstrate full OIF 400ZR / OpenZR+ / OpenROADM MSA standards compliance

b. Provide optical link budget simulations confirming 3 dB EOL margin across every proposed pluggable span
c. Specify supported launch power range and DSP capability relevant to the specific span loss profiles

vii. Bidder shall clearly identify in the architecture proposal which sites are served by dedicated transponders and which are served by coherent pluggables, with full technical and commercial justification for each classification.

4.5 OTN / Client Interface Requirements

i. The system shall support full ITU-T G.709 OTN framing, mapping, multiplexing and switching at applicable nodes.
ii. Supported OTN rates shall include OTU1, OTU2, OTU2e, OTU4 and FlexO (Flexible OTN) as a minimum.
iii. Client interfaces shall support: 100GE, 400GE, OTU-1/2/3/4, FC100/200/400/800 and any other relevant service types.
iv. OTN switching capacity shall be stated clearly in the proposal (in Tbit/s) with a clear upgrade path.

4.6 IP routers

The proposed Core Router shall provide a minimum hardware-based forwarding capacity of 800 Mpps, measured with 64-byte packets, and shall be capable of maintaining line-rate forwarding simultaneously across all populated and active interfaces/ports.

The forwarding performance shall not be dependent on software-based forwarding. The bidder shall submit manufacturer-certified technical documentation confirming the stated forwarding capacity, including the applicable packet size, interface/port configuration, duplex configuration, and test methodology.

The quoted forwarding capacity shall represent the actual forwarding capability of the proposed hardware configuration, without requiring additional optional hardware, licenses, or performance-enhancement modules unless explicitly identified and included in the bid.

The interface ports should be capable of 400G, 100G & 10G/1G ports with minimum of 48 ports.

4.7 Protection and Restoration

i. The system shall support Optical Channel Protection (OChP) including 1+1 dedicated path protection and shared mesh restoration.
ii. Optical restoration time for protected wavelengths shall be <= 50 ms from detection of failure to traffic restoration.
iii. The system shall support Optical Multiplex Section Protection (OMSP) at the line level.
iv. The system shall support GMPLS/ASON/WSON-based automated path computation and rerouting & should support L0 control plane.

v. BTL requires protection to be configurable per wavelength (some traffic unprotected, some 1+1 protected, some shared mesh) based on service SLA class.
vi. Failure scenarios, restoration times and service impact shall be demonstrated during acceptance testing.

4.8 Network Management, SDN and Automation

i. A dedicated Network Management System (NMS) shall be provided with a graphical user interface (GUI) displaying full optical layer topology, alarm management, performance monitoring and configuration management.
ii. The NMS/SDN Controller shall support OpenConfig data models with NETCONF/YANG protocol for all device configuration, telemetry streaming and state monitoring.
iii. The controller shall provide open northbound REST/RESTCONF APIs for integration with BTL's existing OSS/BSS platforms.
iv. Zero-Touch Provisioning (ZTP) shall be supported for all network elements.
v. The system shall support per-channel optical performance monitoring including OSNR, BER pre-FEC and post-FEC, transmit/receive power, CD, PMD and Q-factor.
vi. Streaming telemetry shall be supported with data exportable to standard data platforms (e.g., InfluxDB, Kafka, gRPC dial-out) for integration with external analytics tools.
vii. The NMS shall support multi-layer correlation between the optical layer and the IP/MPLS layer for root-cause fault analysis.
viii. Alien wavelength provisioning and monitoring (for third-party coherent pluggables) shall be supported natively within the NMS without requiring a separate management domain.

4.9 Standards and Interoperability

The proposed solution shall comply with the following standards applicable:

##	**Standard**	**Scope**
1	ITU-T G.694.1	Flex-Grid channel plan
2	ITU-T G.652.D	Single-mode fiber characteristics (existing plant)
3	ITU-T G.709	OTN framing and interfaces
4	ITU-T G.664	Optical safety (ALS/APR)
5	ITU-T G.826/G.829	Error performance objectives
6	ITU-T G.8080	ASON architecture
7	ITU-T G.7712	DCN management

8	OIF 400ZR	400G coherent pluggable interoperability
9	OpenZR+ MSA	Extended-reach ZR+ pluggable interoperability
10	OpenROADM MSA	Open ROADM interoperability framework
11	OpenConfig	Network element configuration models
12	NETCONF RFC 6241	Network configuration protocol
13	YANG RFC 7950	Data modeling language
14	FIPS 140-2 Level 2	Cryptographic module security (encryption)
15	IEC 60950 / 62368	Equipment safety
16	ETSI EN 300 019	Environmental conditions

4.10 Physical, Environmental and Power Requirements

i. Equipment shall be carrier-grade, modular and suitable for telecom equipment rooms used by BTL.
ii. Dual/redundant DC power feeds shall be supported for critical chassis. Bidder shall state nominal and maximum power consumption per equipped node.
iii. Bidders shall provide rack-unit (RU) usage, heat dissipation and power consumption per site and demonstrate material improvement in Watts/Gbps and rack utilization compared with the legacy platform.
iv. All cables, patch cords and interfaces shall be labeled and documented. Proper grounding/earthing and cable management shall be included.
v. Operating temperature, humidity, altitude and other environmental limits shall be disclosed and must be suitable for the intended Bhutan deployment sites.
vi. All equipment shall be designed for 19-inch or 21-inch rack mounting as appropriate. Bidder to specify both options where available.
vii. Equipment shall operate within the following environmental envelope without performance degradation:
    i. Operating Temperature: 0°C to +55°C
    ii. Storage Temperature: -40°C to +70°C
    iii. Relative Humidity: 5% to 95% non-condensing

viii. Altitude: up to 3,500 m above sea level (Critical for high-altitude Bhutan sites)
ix. All sites shall be powered via -48V DC with hot-swappable 1+1 redundant power supply modules. AC/DC conversion modules shall be provided where mains AC is the only available source.
x. The Bidder shall provide a per-site power consumption estimate (W) for initial deployment and at full system loading.
xi. All chassis and modules shall support hot-swap replacement without interruption to live traffic on unaffected channels.
xii. Equipment shall comply with applicable RoHS and WEEE environmental directives.

4.11 Performance and Engineering Requirements

i. The Bidder shall provide system-level optical link budget simulations for every span using the fiber loss data provided in Annex B, demonstrating an End-of-Life (EOL) margin of >= 3 dB for every deployed wavelength.
ii. The system shall guarantee a BER floor of 1E-15 post-FEC under nominal operating conditions.
iii. The Bidder shall demonstrate the system's OSNR performance model including amplifier noise accumulation across the longest multi-span path in the proposed topology.
iv. The Bidder shall provide a five-year capacity growth roadmap demonstrating how additional wavelengths, higher line rates and potential C+L band expansion can be accommodated without forklift hardware upgrades.

4.12 Synchronization and Timing Requirements

The system MUST fully support IEEE 1588v2 Precision Time Protocol (PTP) and natively support Telecom Boundary Clock (T-BC) functionality. To ensure highly accurate phase and time synchronization required for 5G mobile backhaul and latency-sensitive deployments, the proposed solution shall:

- ✓ Support Synchronous Ethernet (SyncE) on relevant client and line interfaces.
- ✓ Support full PTP timing distribution conforming to applicable ITU-T telecom profiles (e.g., G.8275.1).
- ✓ Maintain strict timing accuracy across the network without relying exclusively on external GPS/GNSS at every node.

5 NETWORK DESIGN AND ENGINEERING DELIVERABLES

The Bidder shall submit the following as part of the technical proposal:

i. Network Architecture Overview Document clearly describing the proposed solution, architecture rationale per site category and comparison against alternatives considered.
ii. High-Level Design (HLD) including network topology diagram, node architecture diagram per site type, degree design, wavelength/spectrum plan and protection plan.

iii. Optical Link Budget Calculations for every span in the network using the measured fiber loss data from Annex B, demonstrating >= 3 dB EOL margin.
iv. Per-site equipment list (BOM extract) identifying chassis, amplifiers, ROADM degrees, transponders/pluggables, client interfaces, management hardware, passive components and licensing.
v. Migration Plan overview covering phasing strategy, service migration sequence, rollback procedures and estimated downtime per service.
vi. Five-Year TCO Model covering CAPEX, licensing, & per hops power, spares and operational support costs.
vii. The vendor shall provide a transparent breakdown of all licensing costs, including **per-port, per-hop, per-terminal/site, and capacity-based licenses as applicable, for accurate TCO assessment.**
viii. Project Implementation Schedule (Gantt Chart) from contract award to final acceptance.

6 MIGRATION AND SERVICE CONTINUITY

i. The Bidder shall develop and execute a phased migration strategy that ensures ALL existing live services are migrated to the new platform with the shortest possible planned outage per service.
ii. Maximum permitted planned outage per service during migration shall be <= 30 minutes per affected circuit.
iii. The migration plan shall include:
    a. Service inventory and pre-migration characterization
    b. Parallel running / hitless migration where technically feasible
    c. A rollback procedure for each migration phase
    d. A Communication Plan to notify affected stakeholders
    e. Post-migration service verification test plan
iv. The Bidder shall be solely responsible for any unplanned service degradation or outage caused by migration activities and shall compensate BTL in accordance with Liquidated Damages clauses in the contract.

7 PROJECT IMPLEMENTATION AND MANAGEMENT

i. The Bidder shall nominate a dedicated Project Manager as the primary point of contact for BTL throughout the project lifecycle.
ii. The Bidder shall submit a Project Execution Plan (PEP) within 4weeks of contract award, covering:
    a. Project governance structure and escalation matrix
    b. Detailed implementation schedule (Gantt Chart)
    c. Resource plan (local and expatriate staff)
    d. Risk register with mitigation actions
    e. Quality assurance and HSE plan

iii. Weekly progress reports shall be submitted during implementation, and monthly reports during the warranty period.
iv. The project shall be completed within 6 months from the date of contract award/purchase order.

8 TESTING AND ACCEPTANCE

8.1 Factory Acceptance Test (FAT)

A Factory Acceptance Test shall be conducted at the Bidder's or OEM's manufacturing/integration facility prior to shipment, witnessed by BTL's nominated representatives.

The FAT shall verify:

i. Hardware identity and build standard against BoQ
ii. Software version and feature license verification
iii. ROADM switching, amplifier performance and coherent transponder/pluggable turn-up
iv. Alien wavelength interoperability test (third-party coherent pluggable transmitted through OLS)
v. NMS/SDN controller connectivity and OpenConfig interface
vi. Encryption functionality (AES-256) on applicable interfaces
vii. Protection switching time measurement (<= 50 ms)
viii. Demonstrate on NMS, channel provisioning of 100G and 400G channels and 1+1 protection.

FAT test procedures shall be submitted to BTL for review and approval at least 4 weeks before the scheduled FAT date.

8.2 Site Acceptance Test (SAT)

SAT shall be performed at every site following installation and commissioning.

The SAT shall verify as a minimum:

i. Physical installation compliance with BTL standards
ii. Optical power levels and OSNR measurements per span
iii. Optical link budget verification against design predictions
iv. Per-channel BER test over a minimum 24-hour soak period
v. Alarm and event reporting via NMS
vi. Protection switching test on all protected paths
vii. Service-level verification of all migrated circuits
viii. ZTP and SDN API functional test

9 TRAINING AND KNOWLEDGE TRANSFER

The Bidder shall provide a structured Training Programme covering:

i. System Architecture and Design Principles (Engineering Team)
ii. NMS / SDN Controller Operation and Administration
iii. Optical Layer Troubleshooting and Maintenance

iv. Coherent Transponder / Pluggable Configuration and Diagnostics
v. Protection and Restoration Procedures
vi. Security and Encryption Management

A minimum of 10 BTL staff shall receive training. Training shall be conducted in-country (Thimphu) or at an agreed regional training centre. All training material shall be submitted to BTL in English and in editable softcopy format.

10 DOCUMENTATION REQUIREMENTS

The Bidder shall deliver the following documentation:

i. As-Built Network Design (HLD and LLD) in editable format
ii. Equipment Installation Manuals and Configuration Guides
iii. Optical Link Budget Workbooks (per span) in Excel/PDF
iv. NMS/SDN Administration and User Manuals
v. Fault Management and Troubleshooting Guides
vi. Spares and Maintenance Manuals
vii. FAT and SAT Test Reports
viii. Training Materials
ix. Software and Firmware Version Records
x. Warranty and Support Agreement Documents

All documentation shall be delivered in English in both softcopy (PDF and editable source) and a minimum of two hardcopy sets.

11 WARRANTY, SUPPORT, SPARES AND LIFECYCLE

Warranty Period: A minimum of 1 year from Final Acceptance Date for all hardware and software. Bidder to offer optional 5-year warranty as an alternative priced line item.

The Bidder shall provide 24x7x365 NOC-level technical support with defined response SLAs:

i. Critical (P1): Response within 2 hours, resolution within 4 hours
ii. Major (P2): Response within 4 hours, resolution within 8 hours
iii. Minor (P3): Response within 8 hours, resolution within 48 hours

The Bidder shall provide a recommended spare parts list covering a minimum 5-year operational period, with in-country or regional spares depot options clearly priced.

i. Software maintenance, including feature updates and security patches, shall be included throughout the warranty period at no additional cost.
ii. The Bidder shall declare the committed End-of-Sale (EoS) and End-of-Life (EoL) dates for all proposed equipment.
iii. The Bidder shall provide a Technology Roadmap demonstrating the OEM's committed investment path for the proposed platform over a minimum 10-year horizon.

12 BILL OF QUANTITIES (BOQ) AND COMMERCIAL RESPONSE

The Bidder shall submit a complete and itemised Bill of Quantities (BoQ) covering every hardware, software, license, service, separate line items of NMS application and support element of the proposed solution. Pricing shall explicitly identify all applicable taxes, freight, insurance, installation charges, licenses and optional items as separate line items.

The Bidder shall submit a Five-Year TCO model covering:

i. Year 1 CAPEX (hardware, software, installation, commissioning)
ii. Annual OPEX (maintenance, support, licensing, power)
iii. Spares provisioning cost
iv. Optional upgrade paths (C+L, 800G, additional sites)

All mandatory software licenses required for contracted functionality shall be included in the base price and shall not expire during the warranty period unless explicitly identified as subscription-based and separately priced. Unit rates for future expansion (additional transponders, amplifiers, ROADM degrees, wavelengths) shall be provided and held firm for 3 years from contract date.

13 EVALUATION METHODOLOGY

Proposals will be evaluated on a Quality-and-Cost based scoring model:

#	**Evaluation Area**	**Weight**	**Indicative Considerations**
1	Technical compliance & architecture	50%	High level & low level design, OLS design, ROADM/CD-F architecture, coherent interface standards, OTN/IPoWDM, protection/restoration, SDN/NMS, margin engineering, interoperability, 800G+ roadmap Credibility of Phase 1 (2027)/Phase 2 (2028) schedule, mountain-site/monsoon logistics plan, migration & cutover methodology, international gateway coordination plan, risk register quality, rollback plan
2	Financial Proposal	50%	Total CapEx, software/license costs, power/space efficiency, spares pricing, AMC/support costs & complete 5-year Total Cost of Ownership (TCO).
	Total Marking	100%	

BTL reserves the right to request clarifications, technical demonstrations, or proof-of-concept testing during the evaluation process.

14 ANNEXURES

i. Annex A: Network Topology Map (Attached)
ii. Annex B: Fiber Route Data and Measured Span Loss Table (Attached)
iii. Annex C: Traffic Matrix and Node Criticality Index (Attached)

iv. Annex D: Technical Compliance sheet (Attached)