RFP of Fiber network management system

1. Introduction

Bhutan Telecom invites proposals from qualified and experienced vendors for the Design, supply, installation, integration, testing, commissioning, training, and support of a Comprehensive **Fiber Monitoring and Service Assurance System** on a turnkey basis for their **existing telecom access network**.

The selected bidder will be responsible for conducting a detailed site survey, supply all required hardware, carrying out installation and commissioning, performing acceptance testing, providing training for the operation and maintenance personnel, and post installation support and warranty services.

Proposed in-service fiber monitoring solution must enable Bhutan Telecom to gain complete visibility into PON networks and uplinks towards IP/MPLS network without use of any demarcation reflectors. It should be equipped with advanced deep PON assurance technology to enable precise, real-time event detection throughout the network beyond the splitter, facilitating cost-effective in-service fiber monitoring all the way to individual optical network terminals (ONTs).

2. Network Environment

The existing network environment includes: (please refer the topology/equipment details provided with this RFP for designing and submitting the suitable BOQ for monitoring of fiber links consisting of below equipment:

- Live GPON access network with active customers.
- Multi-generation OLTs, PONs, and ONTs deployed over multiple years currently from Nokia and Tejas currently consisting of:

#	OLT model	ONU	Vendor
1	7360FX4	G-2425G-A	Nokia
2	7362DF8		Nokia
3	TJ14001U	TJ2100N-14ET	Tejas
4	TJ1400_Type-13SR	TJ2100N-14B2	Tejas

The connector of OLT, splitter, Media Converter, PoP router & transport IP router is UPC, ONT is APC.

Sl.No	Technology	Optics type	Optical sensitivity range	Equipment optical throughput
1	Point of Presense(PoP)	Gigalight GBP-3524L-L2CD	(-3dBm to -23dBm)	(+3dBm)
2	Nokia GPON	Nokia GPON OLT SFP C+ Ctemp	(-8dBm to -27dBm)	(+3dBm)

3	Tejas GPON	Hisense CLASS B+	(-8dBm to -25dBm)	(+3dBm)
4	Tejas GPON	Hisense CLASS C++	(-8dBm to -28dBm)	(+5dBm)

We also plan to deploy GPON system from Huawei with latest models comprising of OLT, ONU, ONT, Splitters, etc.

- Ciena IP routers

#	Router spec
1	8110
2	5164
3	5144
4	3928

3. Objectives

The primary objectives of this RFP are to:

- Procure and install a proactive and scalable fiber monitoring system for our GPON access network and access transport networks (IP networks from Ciena).
- Early detection and localization of fiber faults/cuts.
- Centralized monitoring and Alarm management.
- Reduce **MTTR** through faster fault detection and localization and real time notification to relevant teams.
- Enhanced preventive maintenance capability
- Precise mapping of each subscriber ONT with each optical trace to identify and isolate fiber related faults from ONT power offs/cable disconnections etc. to achieve operational efficiency and cost reduction by avoiding sending repair teams for each generated ticket.
- Improve operational visibility without disturbing current operations during the Monitoring.
- Avoid vendor lock-in and support existing and future access vendors.
- Enable gradual adoption with phased deployment.
- Realtime monitoring of optical fiber infrastructure, the point-to-point across the access transport network & the multipoint, the GPON network monitoring up to ONU level beyond splitters up to 4th layer of the splitters.

- It is essential that FMS be provisioned with sufficient capacity to support future network expansion, inclusive of all critical components
- Integration with existing fiber network systems.

4. Scope of Work

The selected Vendor shall be responsible for the complete turnkey implementation of the Fiber Monitoring and Management System for GPON and IP router access network infrastructure. This includes, but is not limited to, end-to-end delivery, installation, integration, testing, commissioning, and operational handover of a fully functional system.

- Conduct a detailed survey of all designated sites and fiber routes.
- Assess existing infrastructure and environment conditions
- Submit a comprehensive site survey report
- Design of an overlay live in-service monitoring architecture for our end-to-end GPON Network along with 2 WAN fiber links at OLT location towards aggregation switches and IP router links as per the topology details provided in this RFP.
- Supply of monitoring software and hardware components
- Commissioning of monitoring software and hardware components
- Extended(5-years) free AMC support after completion of 1 year warranty
- With comprehensive training to our team on operational, maintenance at hardware, software level and the centralized NMS system, and **five years of comprehensive maintenance support**., documentation, and operational handover to Bhutan Telecom user team.

5. Functional Requirements

Live (In-service) GPON Network Monitoring

The offered system must:

- Monitor all live OLT PON ports and ONTs without any service interruption during monitoring. (as per details provided in this RFP).
- Monitor 2 WAN ports at each OLT location (uplinks towards aggregation switches). (as per details provided in this RFP).

6. Operational requirements

6.1 PON Link Monitoring

The solution must provide:

1. System should support complete end to end PON link monitoring without using any demarcation reflectors.
2. System shall be capable of detecting and determining fault location without the usage of handheld OTDR devices on the entire PON link from OLT to ONU.

3. System shall provide complete visibility of "conditions on the ground" to NOC and Customer Service about the GPON links from OLT to each ONT.
4. System shall be capable of differentiating and managing ONUs which are overlapping on the OTDR trace.
5. Automatic reference trace creation and update shall be supported upon provisioning, de-provisioning and migration of ONUs.
6. System shall be able to create logical tree view per RTU port.
7. System shall provide geographic localization of fiber faults correlated by "ONT missing, ONT moved events.
8. System shall be able to differentiate ONT power loss vs missing, removed or migrated vs. electronics failure conditions vs. fiber cuts.
9. System shall provide precise ONT location information by reconciling the calculated location information from the OLT and the "real world" location (optical distance) measured by the RTUs. It shall enter ONT type and ONT serial number into the RTU reference measurements (fingerprint) along with naming and remarks. This is required to greatly reduce documentation tasks and easy troubleshooting and repairs.
10. It shall provide a comprehensive Alarm dashboard for consolidated view of events and current status of links.
11. Offered monitoring system shall be vendor agnostic for optical monitoring and support all the deployed OLTs from different 3rd party vendors (currently deployed NOKIA &TEJAS OLTs).
12. System shall support open full REST API to enable easy installation across different GIS/work flow/trouble ticketing/work order/outage management system used in Bhutan Telecom network.
13. System shall provide access to historical information for performance and events.
14. System shall support inbuilt GIS maps with capability to create routes and access points, add devices (RTUs, OLTs ONTs) etc.
15. System shall pin point fiber fault locations between OLT and ONU on the GIS map.

6.2 Point to Point monitoring of fiber links towards aggregation switches/IP routers.

1. System shall continuously monitor all the designated in-service fiber (Please refer the topology/equipment link details provided with this RFP) links towards the aggregation switches/IP routers, connected to RTUs (Remote terminal units) using a monitoring wavelength of 1650 nm.
2. System shall be able to monitor dark fibers (if available) by inserting monitoring wavelength of 1650 nm into the connected fiber at RTU.
3. The system shall be able to detect and locate faults along the connected fibers and send Email alerts/alarms to designated authorities.
4. It shall support centralized view of all alarms, events reported through different RTUs connected through ethernet network.
5. It shall support centralized firmware/software upgrade, backup/restore of all connected RTUs.
6. It shall support Historical Fault logs and trends on the monitored fiber routes for proactive maintenance.
7. It shall support notification through email notifications for reporting of the faults/events to different field teams.
8. It shall support accurate documentation of fiber inventory (routes, nodes, joints, cabinets, etc.) by importing .kml/.kmz optical route survey files from different as-built systems/3rd party survey

9. System shall provide localization and visualization of faults on a map (OTDR-based.)
10. It shall support alignment of OTDR trace events with GIS locations to enable highly precise fault localization.
11. It shall be possible for the operator to receive an email notification for the fault/event location.
12. System should enable full link characterization with a single click by using two different width pulses for faster characterization. This process should be fully automated and requiring no manual adjustments. There should be a provision for expert tweaking as well, only if needed by the user.
13. System should provide comprehensive long-term visibility into fiber link performance through Loss Tracking (storing of insertion loss data in every 5 minute), Data Optimization through compressing older data while preserving key insights.
14. System should support continuous monitoring of each connector and If insertion loss increases, this should be visible in the overall loss trend of the link or segment without storing the insertion loss for each individual connector so that excessive data is not generated in the database in long time monitoring operations.
15. Alarms generated in the system shall be routed based on geographical responsibility, not device location ensuring the right team is notified, even across regional boundaries.
16. Data backup and inventory management- System should support measurement data backup per unit or network wide, inventory management and reporting.
17. In built GIS should be able to convert optical distances measured by RTUs into geographical distance (geo coordinates) for the events for fast restoration and display these events on geographical map.
18. Embedded GIS GUI should be able to upload (KML/KMZ/JSON) and create routes.

7. Detail Technical Requirements for system Components

The solution must Include following key components: -

7.1 Hardware

7.1.A Remote Terminal Unit (RTU)- Remote Fiber Monitoring Device with up to 48 optical ports in 1RU size in a switch-less architecture to enables monitoring, fault detection, and fault localization of fiber links. This RTU should be independent of data rates, data formats, and protocols. The RTU will be using a test signal @ 1650 nm to actively monitor the fiber links without intruding on the data transport signals. The test signal will be transmitted down the fiber till ONT along with the data transport signals. By monitoring the reflected test signal from the Splitters/ONTs, the system should be able to determine the health and integrity of monitored fiber links. All these RTUs must be integrated with a centralized control and correlation software system, which can correlate the optical measurements performed by these RTUs with the ONT link performance data, extracted from the respective OLT. These RTUs must be provided as per the given OLT ports/WAN ports estimates in the RFP

Remote Terminal Unit (RTU)
Detail Technical characteristic

1. **Monitoring Ports:** minimum 48 integrated monitoring ports in the chassis without requiring the uses of port extension modules in 1RU size
2. **Connector Types:** LC APC.
3. **OTDR Module:**

- shall support remote fiber monitoring
- provide high accuracy fault localization
- support multi-wavelength of 1650 nm, 1310nm and 1650nm for dark and live fiber monitoring.

4. **Dynamic Range:** 42 dB or more.
5. **Pulse Width:** Selectable between 5 ns to 20,000 ns.
6. **Distance Uncertainty:** ± (0.8 + sampling resolution + 9.5 x 10-6 x distance)
7. **Data Sampling Points:** 256000 or more.
8. **Sampling Resolution:** 0.1 to 1.6 m
9. **Dead Zones:** Event dead zone 0.8 meter; attenuation dead zone 4 meters.
10. **Network Interfaces:** 1XSFP, 2x 10/100/1000 Base-T, 1X USB serial interface.
11. **USB Support :** 1X USB serial port, 4X UDB expansion ports.
12. **Power Input:** 1+1 fully redundant hot swapable power supply (-72VDC to -36VDC).
13. **Power Consumption:** Up to 20W typical.
14. **Operating Temperature** -40 to 65 degree centigrade.
15. **Storage Temperature**- -40 to 85 degrees centigrade.
16. **Compliance-**ETSI compliant/all electrical and optical connectors should be accessible through front panel.
17. **MTBF > 20 years**
18. **System Access:** Accessible locally or via IP connectivity for control and troubleshooting.
19. **Software Upgrades:** Remote upgrades from the centralized management server allowing bulk updates to remote test units (RTU).
20. RTU should be capable of making measurements/traces and storing results on its own during the event of disconnection/unavailability of centralized server. Alarms and performance data shall be synchronized after re-establishing the connection.

7.1.B WDM Coupler-. The WDM Coupler is used to combine a 1650 nm test signal and the OLT Downlink signal towards Splitters/ONTs so that this OLT-ONT link can be continuously monitored without interfering with the GPON services. These couplers must be provided as per the given OLT/RTU port estimates in the RFP with a minimum 20% spare port capacity.

7.1.C Port Extenders – When number of OLT ports (to be monitored at a site) are higher than the physical optical ports available on RTU than extenders need to be provided. These extenders shall fit into 1RU size for offering 96 additional optical ports to utilize the 1650 nm signal from base RTU unit installed at that location by connecting 2 RTU ports into their respective input ports.

Following are key technical requirements for port extenders:

- 96-port extension
- LC-APC based
- 1-RU compact design
- Powered by RTU unit.

7.1.D Server for Central Orchestrator Software – Central **Orchestrator Software** will reside on a Linux (Ubuntu/Debian or similar that can run docker) server in our environment (virtual or physical) to serve as PON monitoring centrepiece. This system will be provided access to/from RTU(OTDR) using SSH, SNMP, HTTP,

or HTTPS and outbound to the Cloud via Internet. The **server will be allowed to make outbound HTTP, HTTPS and DNS to be able to send REST requests the Cloud to be able to get equipment information.**

7.1.E- Optical patch cords- Suitable patch cords to connect the RTU monitoring ports and OLTs PON ports with WDM couplers.

Notes: All devices (passive & active) must fit in 19-inch rack size

7.2 Software

7.2.A -Central Orchestrator Software System Deep PON Monitoring

This is centre piece of the entire PON monitoring system. This software shall be managing all RTUs deployed at OLT sites to perform desired optical measurements on connected fiber ports. This system will responsible for ONT data correlation based on combined readouts from OLT and RTU (OTDR) reference measurements. Using sophisticated algorithms, it shall be capable to detect each ONT location with carrier grade precision. This will help our team to ensure physical layer connectivity up to each ONT in the PON link to provide proactive 24/7 fiber monitoring for each subscriber. This software will assemble data in our environment from OLTs and other access equipment's, subscriber records, customer database records, radius accounting/DHCP lease info, and NetFlow data sets. This system is required for critical insight into subscribers and intelligence gathering for accurate and flaw less troubleshooting including 24/7 proactive fiber monitoring across all subscriber accounts. This software shall use reverse SSH tunnels between the Cloud nodes and our local proxy server. The reverse SSH tunnels shall be initiated from the proxy server to the Cloud nodes so there is no need for the proxy server to have a public IP address or be accessible from the Internet. The OS should be the latest available and secured using our company's security policy. The proxy server must be running sshd and allow ssh connections to the localhost. The **server shall be allowed to make outbound SSH, HTTP, HTTPS, DNS, and TCP Port 9229 connections to the Internet**. The proxy server shall communicate with access devices like OLT using SSH, SNMP, HTTP, or HTTPS, as applicable. If we require to pull subscriber and or customer records from a billing system, the proxy server will also be allowed to communicate with the billing server API or database depending on our billing platform. It is important to note that the proxy server will be on a private network and not directly accessible from the Internet. This proxy agent shall reside on a Linux (Ubuntu or Debian) proxy server in our environment (virtual or physical) to serve as the hub for collecting required data. This proxy will be provided access to/from network equipment (such as OLTs) and Central Correlation Software System. The latest release Ubuntu 24.04 LTS shall be supported.

7.2.B- P2P monitoring (uplinks towards aggregation switch/IP routers)

1. System shall support centralized view of all alarms, events reported through different RTUs connected through ethernet network.
2. System shall support centralized firmware/software upgrade, backup/restore of all connected RTUs.
3. System shall support Historical Fault logs and trends on the monitored fiber routes for proactive maintenance.
4. System shall support centralized notification through email notifications and north bound API for reporting of the faults/events to different field teams.
5. System shall support centralized north-bound interface for integrating with 3rd party OSS systems.
6. System shall support accurate documentation of fiber inventory (routes, nodes, joints, cabinets, etc.) by importing .kml/.kmz optical route survey files from different as-built systems/3rd party survey

7. System shall provide localization and visualization of faults on a map (OTDR-based) and geospatial visualization of network health.
8. System shall provide layered map views (e.g., ducting, fiber, POP, etc). Events and faults should be comprehensively described in centralized management system and accurately pinpointed on a geographical map.
9. It shall support alignment of OTDR trace events with GIS locations to enable highly precise fault localization. These reference points should be actively incorporated by the software to optimize correlation accuracy.
10. It shall be possible for the operator to receive an email, in case a fiber cut is detected with a direct link to Google Maps, to allow users to view the exact geographical position of any fault or event.
11. Alarms generated in the system shall be routed based on geographical responsibility, not device location, ensuring the right team is notified, even across regional boundaries.

8. Future-Proofing & Migration

- The hardware must be **wavelength-agnostic** to support upgrade from GPON to XGS-PON or 50G-PON without replacement.
- Provide a committed roadmap for software updates to support new ONU chipsets (Broadcom, Realtek, etc.).
- 20 to 30% of growth in GPON network are expected as GPON team is studying the decentralized OLT devices to avoid single point of failure & fiber dropping. Solution must support all dynamic shifts and changes within GPON and router networks seamlessly in future.

9. Timeline

The entire turnkey project should be completed by **October 31st 2026 & handover to Bhutan Telecom Ltd.** from the starts of awarding the PO to selected vendor. OEM must confirm their ability to meet this deadline proposal. The bidders shall provide a detailed implementable schedule:

Indicative timeline as below:

Activity	Timeline
Contract Award	May
Site survey	May
Design submission	May
Supply of equipment	August
Installation and intergration	September
Testing and Commissioning	October
Training	October
Final Acceptance	November

10. Deliverables

The successful bidder shall deliver:

- Site Survey Report
- Approved System Design
- All hardware and software
- Installed and commissioned system
- Acceptance test reports
- Training completion report
- Complete documentation set
- Warranty and support documents

11. Acceptance Criteria

The system shall be considered accepted upon:

- Successful completion of installation
- Successful acceptance testing
- Resolution of all identified issues
- Submission of complete documentation
- Successful training completion
- Formal acceptance by the purchaser

12. Pricing Format

The bidder shall provide itemized pricing including:

Item Description	Quantity	Unit Price	Total Price
Site Survey			
FMS Hardware			
Software & Licenses			
Installation & Integration			
Testing & Commissioning			
Training			
Warranty & Support			
Taxes			
Grand Total			

13. Proposal Submission requirements

The proposal shall contain:

13.1 Technical Proposal

Executive Summary

Technical Compliance Statement

System Architecture

Product Datasheets

Implementation Methodology

Project Schedule

Team Composition

Training Plan

Support and Warranty Plan

Compliance Matrix

13.2 Financial Proposal

Detailed pricing

Payment terms

Commercial conditions

14. Evaluation Criteria

Proposals shall be evaluated based on:

Criterion	Weight
Technical compliance & solution architecture	40%
Demonstrated experience (references for GPON-to-ONU monitoring & IP routers)	15%
Financial proposal (Capex + 5-year Opex)	30%
Project delivery plan & training	10%
Support & Warranty	5%

15. Expression of Interest

The OEM/Bidder must submit the expression of interest from potential firm for verification on the proposed solutions. The bidder must also mention the list of at least three live deployments where the proposed solution monitors GPON/FTTH fibres from the OLT to the individual ONU (through splitters) and monitors IP-router uplinks. If necessary, Bhutan Telecom will make site visit for live demo & verifications.