Light ODN: Building a Visual, Manageable, and Easy-to-Maintain ODN

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As the deployment of fiber to the X (FTTx) network deployments continue to expand, the importance of the optical distribution network (ODN) as the “nerve endings of the optical network" connecting millions of households is becoming increasingly evident. Each year, a massive amount of optical fiber is deployed across the globe, resulting in significant amounts of dumb resources. Consequently, efficient network construction and management of dark fiber resources have become critical for operators in building a competitive optical network.

Operators need a centralized, standardized, and full-lifecycle system to perform fine-grained management of the dumb resources and dark pipes of the optical network. This system should serve as a real-time, accurate, and reliable intelligent management platform for network resources, and provide a scientific and rational basis for network planning.

The key requirements for the visual management of optical network resources are as follows:

- **Accurate data:** Data regarding optical network nodes, including site information, equipment information, network connections, equipment identifiers, and port occupation, should be accurately collected, transmitted, and recorded.
- **Accurate routes:** Information about network routes, including routing topology information, information about same-pipe or same-cable routes, and route change information, should be accurately collected, transmitted, and recorded.
- **Accurate predictions:** Network resource usage and network performance trends should be accurately analyzed. Strategies for network topology optimization and network capacity expansion should be accurately predicted.

Light ODN Offers Visual Management of ODNs

ZTE's Light ODN solution can help customers quickly create visual, manageable, and easy-to-maintain ODN networks for various application scenarios. It reduces the complexity of ODN operation and maintenance while also improving resource utilization efficiency to decrease redundant investments.

Light ODN comprises the FEB series pre-connectorized devices, prefabricated cables, and an intelligent management platform. A mobile app is used to scan the QR codes on the pre-connectorized devices and the barcodes of the optical cables to collect their information. The

network management system (NMS), digitally presents the optical link topology of the entire network. This process enables real-time collection and synchronization of ODN resources and make the optical link topology visible and manageable, with resource accuracy reaching 100%.

The visual management of the ODN encompasses the physical fiber network, the digital network, and intelligent management:

- **Physical fiber network:** Pre-connectorized boxes with QR codes and pre-connectorized optical cables with barcodes are used to build the physical optical network. The pre-connectorized connections outside the boxes and the point-to-point single-core connections of the cables make it easy to collect the optical link information.
- **Digital network:** The mobile app is used to scan and identify the connections of ODN materials such as boxes and optical cables based on image recognition technology. The results generated are transmitted in real time to the NMS, where they are electronically recorded and managed as the basic data of network topology. Based on the acquired information, the NMS presents a digital network topology that perfectly matches the physical fiber network.
- **Intelligent management:** With the accurate data from the digital network, optical link resources can be visualized on the NMS. A geographic information system (GIS) is employed to display the resource information on a map, thereby providing visual guidance for O&M. Additionally, optical link resource usage is intelligently analyzed to inform resource optimization strategies that guide network O&M and expansion to save time and reduce OPEX.
- **Efficient O&M:** When users report faults, automatic testing and diagnosis of faults are initiated for the point to multi point (P2MP) network. Faults of the fiber lines, such as breaks, bends, and connector contamination, are identified and accurately located. Based on the test and diagnosis results, maintenance personnel can perform troubleshooting quickly and easily.

ZTE's Light ODN solution can clearly present the following resource data on the logical view page of the NMS (Fig. 1):

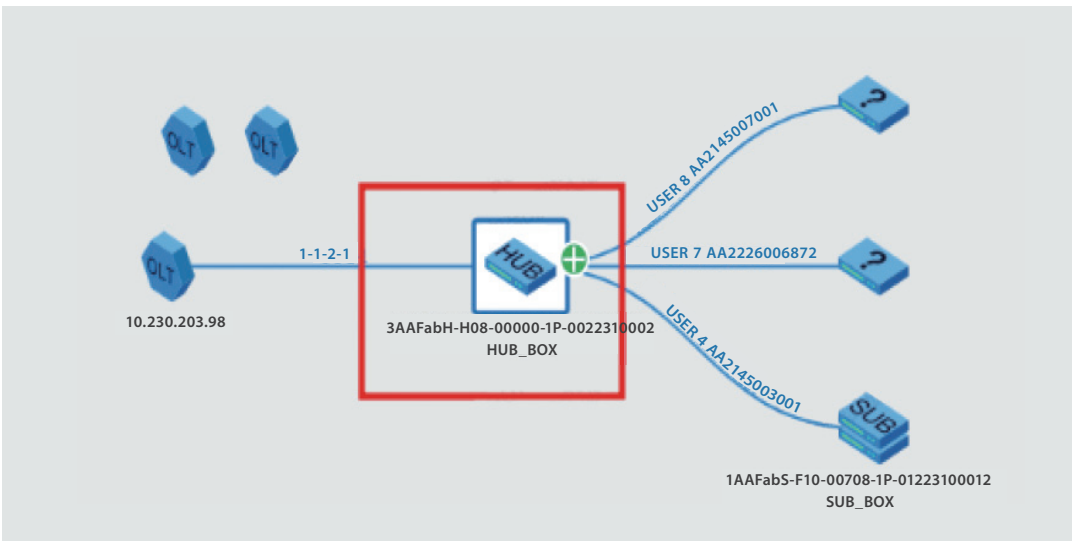

Fig. 1. Logical topology on the NMS.

- Basic view of the ODN, which shows information such as device types, device serial numbers (SNs), device names, and split ratios.
- Routing topology of the deployed devices, which is produced using AI-based analysis.
- Status information, including device alarms and fiber break alarms, of the optical links of optical network units (ONUs). The information is displayed in both images and text.

Light ODN is able to diagnose ODN links (Fig. 2). When an ONU goes offline, the NMS initiates diagnosis of the ONU's link and records the range of the fiber break in the topology view. This makes it easy to discover and troubleshoot the fault.

Light ODN Implements Real-Time Fault Location and Visualizes Fiber Health Status for Efficient O&M

Light ODN achieves remote, real-time, and automatic monitoring of the quality of fibers across the entire optical network, covering optical access networks, optical mobile backhaul networks, optical metropolitan area networks, optical backbone networks, and optical data centers. The monitoring encompasses detecting changes in the transmission characteristics of fibers and predicting the trends of the changes. After a fault is discovered, the NMS promptly issues an alarm and quickly and accurately locates the fault to facilitate troubleshooting and reduce the workload of maintenance personnel. This function offers reliable assurances for the maintenance of the optical network. Key features of Light ODN in fiber monitoring include:

- **Centralized fiber monitoring system:** The fiber monitoring system can monitor a greater quantity and a wider variety of fiber resources. Monitored device resources are shared to improve the utilization of the monitoring system.
- **Diverse detection methods:** To meet different scenarios and requirements, the monitoring system supports detection by different combinations of parameters like pulse width, dynamic range, resolution, and time.
- **Real-time fault monitoring:** Depending on the user's requirements, the monitoring system supports periodic or real-time fault monitoring using a polling mechanism. When a fault is detected in the optical network, the system promptly issues a fault alarm to speed up the O&M response.
- **Intelligent identification of fiber events:** Powerful algorithms are used to identify fiber events intelligently. The identification results are then compared against the fiber health database to accurately diagnose fiber events.
- **Visualized fault location:** Fault points detected by the monitoring system are displayed in real time on a GIS map, making it easy to quickly find the actual fault locations and troubleshoot the faults.
- **Extensive system interfaces:** The monitoring system supports functions such as northbound interfaces, southbound interfaces, and reports and statistics. It can seamlessly interconnect with the operation support system (OSS) to provide operators with more-intuitive monitoring results to facilitate O&M.

Light ODN Guarantees Sustainable Development of ODN Networks

The Light ODN solution is designed in light of the development trends and key requirements of optical network construction. It aims to enable the efficient and fast building of secure, reliable, and fully visible optical networks. Leveraging innovative AI technology, Light ODN

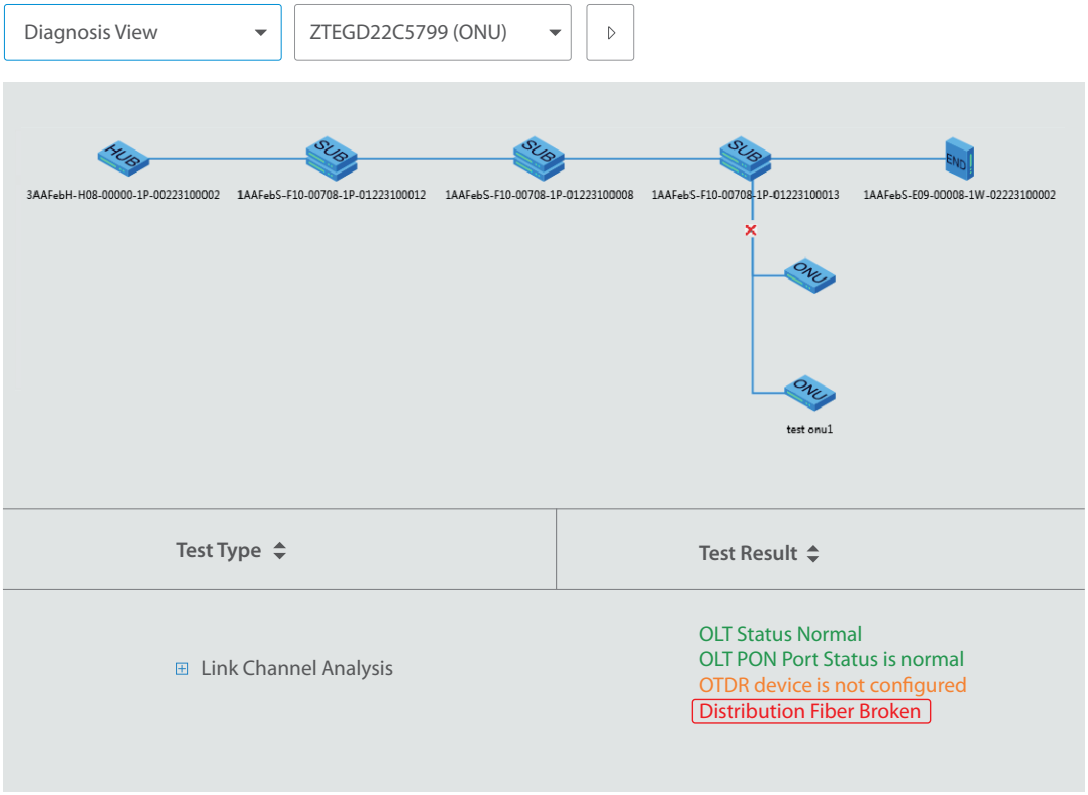

Fig. 2. Link diagnosis results page.

renders ODN topology and links visible and manageable and makes resource statistics constantly accurate. On that basis, it constructs an intelligent, real-time, and accurate optical network monitoring system, thereby enhancing operational efficiencies and reducing operational costs.

In addition to enabling rapid network construction, Light ODN allows for the optimization of ODNs and the visualization of dumb resources. It advances the application of PON technology in enterprise, campus, and home scenarios like fiber to the room (FTTR). By combining the NMS of the ODN with the element management system (EMS) of the OLT, Light ODN creates an end-to-end fully visualized PON network that serves as an intelligent foundation of all-optical access.

On top of its existing features like pre-connectorization, image recognition, automatic data synchronization, and network topology restoration, Light ODN will incorporate research results in areas such as fiber sensing and intelligent analysis and prediction. It will combine AI analysis and prediction applications, and integrate key technologies such as all-parameter perception of optical networks, automatic topology discovery, real-time link monitoring, fault location and delineation, and risk prediction and warning to help operators build digitalized, intelligent FTTx networks with integrated sensing and communication capabilities.

ZTE's Light ODN solution has been deployed in multiple countries including Peru and Indonesia. In addition to helping operators rapidly build ODNs, it also makes optical network topologies visible and optical network resources manageable, enhancing the utilization efficiency of optical infrastructure and achieving a win-win with the customers. ZTE TECHNOLOGIES