Light ODN Enables Rapid FTTx Deployment

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In the past decade, the share of fiber to the x (FTTx) in fixed broadband (FBB) deployment has been climbing every year. By the end of 2021, FTTx had accounted for at least 66% of FBB networks and become the primary mode of FBB construction. As the underlying technology of FTTx, passive optical networking (PON) has also seen fast development in this process. In an FTTx deployment, especially in a fiber to the home (FTTH) network, the optical distribution network (ODN) makes up 50% to 70% of the total cost. That makes the ODN the most important part of FTTH deployment as it is directly linked to the operation and maintenance (O&M) of the optical access network, the implementation of the FTTH solutions by equipment vendors, and the development of the optical cable systems integration market. For all its importance to FTTH deployment, however, the ODN still presents pressing problems for operators, including poor construction efficiencies, large investments and management difficulties.

Future-Proof Light ODN Solution Helps Operators Rapidly Build Intelligent ODN Networks

An FTTH network involves a long construction period, a high cost, and a long time to market (TTM). To help operators solve these problems, ZTE has developed its Light ODN solution, which innovates the technical features of ODN products and creates value for operators by slashing the cost of ODN construction. On the one hand, the solution makes the ODN lightweight, including making it pre-connetorized and eliminating the need for splicing throughout the installation process. On the other hand, it changes ODN resources from a dumb to a manageable and visual status. With these capabilities, the solution can help operators rapidly build premium ODNs and precisely manage the network resources. Operators can use the solution to rapidly build a visual, manageable and controllable all-fiber infrastructure network that can accelerate their transformation into all-optical operations.

Traditionally, ODN construction involves many steps, requires engineers with fusion skills, and is therefore inefficient. Light ODN employs single-core and multi-core pre-connectorization technology to replace the traditional splicing technique. Thanks to the modular pre-connectorized products used by the solution, it takes only ten minutes for one engineer to complete installation at one site. A key component of the solution is ZTE's patented pre-connectorized optical connectors that support blind-mating and self-locking. The blind-mating mechanism uses a unique mechanical design of the connectors to automatically align them, thereby reducing the operation difficulty, completely preventing connector damage caused by misoperations, and shortening the connection time from nine to five seconds. With the self-locking mechanism, the latches of the connectors automatically rotate and lock after the insertion operation is completed. This prevents connection failure and connector detachment and reduces the connection time per port from ten to three seconds. The enhanced connection reliability and installation efficiency resulting from the self-locking mechanism cuts the deployment cost by 30% and the construction time by 50%.

Light ODN supports flexible networking, and a typical four-level cascading scheme uses one-core optical cable to save fiber cores. The solution can adapt to different application scenarios, including medium- and low-density areas, far-flung places, office buildings, and fixed-mobile convergence scenarios.

Light ODN uses a combination of fiber link sensing and artificial intelligence (AI) technologies to realize a digital and intelligent ODN with capabilities like resource management, visual topology, fault location, and fault early warning. These functions together serve as a foundational platform for accurate O&M of the ODN. Light ODN employs intelligent image scanning technology that lets engineers use an app to scan the quick response (QR) code or barcode on pre-connectorized products. By combining the product information obtained from the scan with the geographic information system (GIS) information of the products, the port connection relationships of the ODN can be quickly established. With all this connection relationship information, the network topology can be instantly presented after ODN construction is completed. This method of visualization ensures a 100% accuracy of network resource information and helps to boost network O&M efficiency.

Digital and Intelligent ODN Management Enables Efficient network O&M

ZTE's Light ODN solution provides digital and intelligence ODN management that involves visual network topology, digital network resources, visual network status, and digital and intelligent network O&M (Fig. 1).
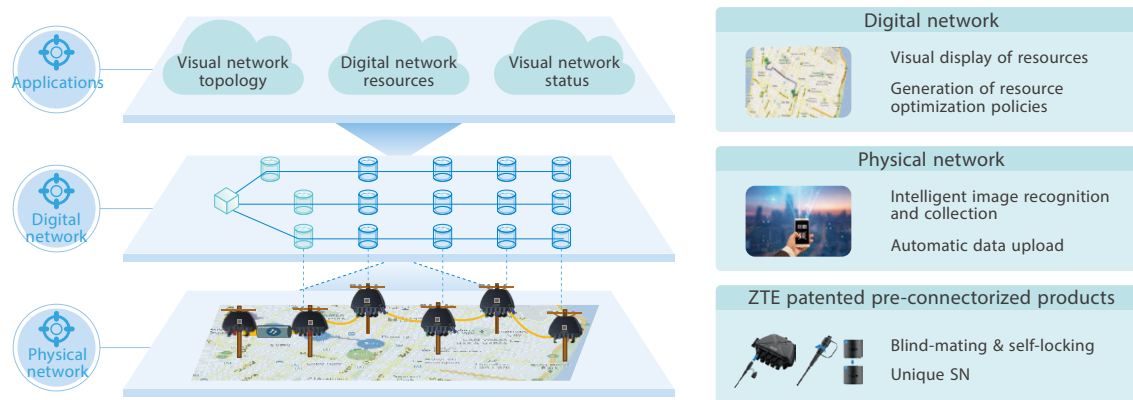
Visual Network Topology

The ODN network topology can be identified and obtained digitally.

Digital Network Resources

- **Equipment resources:** The equipment types in the network can be digitally obtained and entered into the resource system.
- **Line resources:** The connection relationships of network equipment are automatically obtained by AI analyzing resource data.
- **Link resources:** By using AI to analyze resource data and link sensing metrics, a connection relationship comprising a PON port of the optical line terminal (OLT), a port of an optical splitter, and an optical network unit (ONU) can be identified.

Visual Network Status

- **Changes in network topology:** The solution uses fiber link monitoring technology to discover changes in network topology, user, and ODN connection relationships.
- **Changes in network performance:** By collecting such performance data as link attenuation, reflection, and return loss, the

◀ Fig. 1. ZTE's Light ODN solution.

solution can detect end-to-end performance changes, perform comprehensive analysis, and give early warnings.

Digital and Intelligent Network O&M

- **Network acceptance:** Engineers can remotely detect and discover network topology, collect network performance data, and digitally enter the data into the ODN management system.
- **Topology presentation:** The network topology can be presented based on the ODN resource database and the link sensing technology. End-to-end topology information can be automatically displayed and updated.
- **Network monitoring and early-warning:** The network and resource status can be monitored in real time or periodically so that faults can be located, responsibilities can be assigned, and fault early-warnings can be issued.

The Light ODN solution is designed to provide customers with services covering the full lifecycle of a premium intelligent ODN, including fast deployment and accurate O&M. By significantly simplifying ODN construction, the solution improves deployment efficiency by 50%, shortens TTM by 30% and reduces the total cost of ownership (TCO) by 20%.

Light ODN Solution Ensures Sustainable Development of Optical Networks

While optical fiber has long been the "blood vessel" for transmitting signals, now it also functions as a "nerve" that monitors signals. Armed with AI, the Light ODN solution is becoming the key to improving the deployment, operation and monitoring of optical networks. Using the big data generated from long-time monitoring, the network management system can make a comparative analysis against the network health database and diagnose network faults. Big data modeling and analysis are carried out on the network management

platform. Innovative AI technology makes ODN topology and link loss visual and manageable while also producing resource statistics that are always accurate. Consequently, an intelligent, real-time, and accurate optical network monitoring system can be built to improve O&M efficiency, reduce O&M costs, and help operators cut expenditure on ODN construction.

Light ODN Solution Evolves to Meet Customer Requirements

The following features and capabilities of the Light ODN solution have been planned:
- An intelligent management architecture with a built-in O&M system that can automatically identify changes to passive network equipment and topology. The architecture can implement automatic discovery and acceptance of end-to-end ODN topology.
- Automatic issuance of work orders and identification of node equipment. The entire process is managed as a closed loop.
- Real-time connection identification and topology management.
- Capability to detect multiple parameters of an optical network. Compatibility between fixed and 5G networks.
- Physical link monitoring, real-time prediction and alerting, and proactive O&M.
- Intelligent end-to-end ODN O&M to meet dynamic changes in physical resources.

ZTE's Light ODN solution has been deployed in countries including Colombia, Peru, Argentina and Spain to help operators economically construct ODNs and accurately manage network resources. The solution realizes automatic sensing of resource information and intelligent management of networks, thus turning the traditional optical network into an intelligent infrastructure network characterized by transparent management, fast service provisioning, and quick troubleshooting. This brings significant reductions in O&M costs and creates sustainable business value for operators. **ZTE TECHNOLOGIES**