# Overview of the Wujiang Metropolitan Wavelength Division and Data Exchange Platform (Postprint)

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## Abstract

In the era of media convergence, customer demands such as replay, fast-forward, rewind, and video-on-demand, together with business requirements including wireless internet access and data leased lines, have become the primary service demand drivers for cable operators. The metropolitan wavelength division multiplexing (WDM) and data exchange platform of Jiangsu Cable Wujiang Branch supports the transmission of multiple services including interactive on-demand television, broadband internet access, and data leased lines (for medical insurance, social security, and banking), providing fundamental infrastructure support for the construction of Wujiang Cable's cloud media platform. This paper introduces the metropolitan WDM and data exchange platform project of Jiangsu Cable Wujiang Branch and discusses the platform expansion and upgrade requirements necessitated by the anticipated increase in business volume.

## Full Text

## Preamble

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**Abstract:** In the era of media convergence, customer demands such as replay, fast-forward, rewind, and video-on-demand, together with services like wireless internet access and data dedicated lines, have become primary business drivers for cable operators. The metropolitan Wavelength Division Multiplexing (WDM) and data exchange platform of Jiangsu Cable Wujiang Branch carries multiple services including interactive on-demand television, broadband internet access, and data dedicated lines (for medical insurance, social security, and banking), providing fundamental support for the construction of Wujiang Cable's cloud media platform. This paper introduces the metropolitan WDM and

data exchange platform project of Jiangsu Cable Wujiang Branch and discusses the platform expansion and upgrade requirements necessitated by increasing business volumes.

**Keywords:** DWDM metropolitan WDM; OTN transmission network; cable data exchange platform; expansion

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## 1. Network Background Before Platform Establishment

Prior to the establishment of the metropolitan WDM and data exchange platform at Jiangsu Cable Wujiang Branch, the network architecture faced several limitations. The existing network situation is summarized below.

### 1.1 EPON Network

The EPON network was divided into east and west ring networks, as illustrated in [Figure 1: see original paper]. The east ring utilized four H3C S7506E switches as metropolitan core switches, with EPON OLT devices deployed at the central office and in the townships of Songling, Fenhu, Pingwang, and Tongli, using H3C S7503E switches. Songling and Tongli connected directly to the central office's S7506E via GE ports, while Pingwang and Fenhu formed a gigabit Ethernet ring with the central office's S7506E. The west ring employed Raisecom OLT equipment across five townships. Hengshan, Qidu, Zhenze, Taoyuan, and Shengze each housed one ISCOM5800 chassis OLT device, forming a gigabit Ethernet ring with a central H3C S7506E. Due to the lack of direct bare fiber between Shengze and the central office, connection was routed through the Pingwang office.

### 1.2 Interactive TV Streaming Network

A total of eleven IPQAM devices located in nine township broadcast stations connected via GE ports to a Cisco 3560 switch in the central office through direct fiber connections, forming a star network topology.

### 1.3 Data Dedicated Line Network

Before the WDM platform implementation, Wujiang's data dedicated line services primarily consisted of two types: SDH-based 2M services and MSTP services, and Ethernet dedicated line services. To transmit large volumes of data

including text, images, and video, a separate gigabit Ethernet network was constructed using switches, which significantly wasted fiber resources and resulted in redundant investment.

Overall, the pre-WDM platform network—whether EPON, interactive TV streaming, or data services—required numerous transmission channels between the central office and township sub-center offices, all structured as star topologies (central to sub-center). The bare fiber direct connection model for carrying GE and 10G services revealed increasing disadvantages as applications grew. First, fiber consumption was substantial, occupying large amounts of fiber resources with low utilization efficiency. Second, interface costs increased exponentially with transmission distance, a factor particularly pronounced for 10G interfaces. Third, manageability and security were relatively weak; long-distance fiber transmission was prone to cable breaks, and optical path troubleshooting was time-consuming and labor-intensive.

In response to these challenges, the metropolitan WDM and data exchange platform successfully established high-speed, stable, and reliable transmission pathways between the central and sub-center offices to carry multiple services.

## 2. WDM Platform Construction

The construction of the metropolitan WDM and data exchange platform significantly improved the network architecture of Jiangsu Cable Wujiang Branch. Serving as the core data transmission platform for external interconnection and internal connections with various broadcast station sub-center offices, the platform achieved a qualitative leap in both service carrying capacity and data transmission security and reliability. Post-construction, the platform conserved substantial city-to-township fiber resources, reducing construction and operational costs. The platform enhanced interactive TV video transmission capabilities, providing a foundation for interactive TV service expansion and local cable cloud media platform construction. Simultaneously, multiple services including broadband internet access and data dedicated lines carried on the platform generate direct economic benefits exceeding ten million yuan, representing a crucial driver for the company's value-added service growth.

The Wujiang Branch local network metropolitan WDM project established two 40$×$10G WDM rings with the data center at the head office as the core node. The east ring passes through five OTM stations: central office, Songling office, Tongli office, Xinta office, and Pingwang office. The west ring passes through six OTM stations: central office, Hengshan office, Qidu office, Zhenze office, Taoyuan office, and Shengze office. Both rings intersect at the data center located at the head office [Figure 2: see original paper].

The project selected Huawei's OptiX OSN 6800 series equipment, which enables dynamic optical layer scheduling and flexible electrical layer scheduling. The network element management software, OptiX iManager U2000 (EM), provides unified management of IP, transmission, and access equipment. The platform

employs ODUK SNCP protection with backup for critical cards such as TOM and TDX boards. ODUK SNCP protection enables protection of line boards and subsequent units with switching times under 50ms.

### 3.1 Wavelength Channel Allocation

**East Ring:** Waves 1, 2, 5, 6, 7, 8, 11, and 12 (totaling 8 waves) are configured for 10G services, with each of the four townships utilizing 2 waves. The central office is equipped with four TDX boards, with each township office equipped with one TDX board. Waves 3, 4, 9, and 10 (totaling 4 waves) are configured for GE services, with each township using one wave carrying eight GE services. The central office is equipped with four TOM boards, with each township office equipped with one TOM board [Figure 4: see original paper].

**West Ring:** Waves 1, 2, 5, 6, 7, 8, 11, 12, 13, and 14 (totaling 10 waves) are configured for 10G services, with each of the five townships utilizing 2 waves. The central office is equipped with five TDX boards, with each township office equipped with one TDX board. Waves 3, 4, 9, 10, and 15 (totaling 5 waves) are configured for 8 GE services, with each township using one wave carrying eight GE services. The central office is equipped with five TOM boards, with each township office equipped with one TOM board [Figure 3: see original paper].

## 4. Upgraded Network Structure

To maximize the WDM platform's capabilities, data exchange equipment was simultaneously upgraded. The central office deployed two egress routers and two core switches, with each township office deploying one aggregation switch (Songling, Tongli, Fenhu, and Pingwang utilized existing H3C S7506E switches with additional cards). Core equipment deployed the H3C high-end routing switching system S12500, aggregation switches adopted H3C multi-service core switches S7600 (S7500), and egress routers used H3C terabit core routers SR88. The two core switches employ IRF2 technology, virtualizing into a single device [Figure 5: see original paper].

Each aggregation switch uses six GE ports, which via WDM transmission equipment, uplink to the two core switches (three GE ports per core switch). Through IRF2 technology, the six GE ports achieve cross-device link bundling. The upgraded data exchange platform forms a star network (central to sub-center), simplifying the overall network structure and preventing various faults associated with ring networks. Although the data exchange platform is star-shaped, the central and sub-center connections utilize WDM ring transmission channels, creating a structure where the network topology is star-shaped while the transmission channels form a ring.

The EPON network dismantled the original two OLT rings. Songling, Tongli, Fenhu, and Pingwang connected directly to WDM transmission equipment, while Raisecom OLT devices in Shengze, Taoyuan, Zhenze, Qidu, and Hengshan were connected under corresponding township office S7600 switches. This

transformed interactive TV, broadband internet, and financial private network services into a protected star transmission structure. Meanwhile, switches from the original data dedicated line network and discrete education network switches were also connected under S7600 and S7500 switches, achieving unified aggregation and upload at sub-center offices. Through configuration, unified network management from the central office was implemented for each downstream switch. The upgraded data exchange platform not only improved original network quality but also significantly expanded uplink bandwidth (currently 6G, upgradeable to 26G), fully meeting current bandwidth requirements while providing carrying capacity for future high-traffic, high-bandwidth services such as video monitoring.

During the data network upgrade, business development between Wujiang and Suzhou was also considered. In addition to using the SDH network for MSTP services, the current data exchange platform supports Layer 2 VPN and Layer 3 VPN networking across the entire network, enabling future high-bandwidth, low-cost VPN services.

## 5. Future Expansion Directions

As a technical platform carrying interactive TV video streaming, media streaming, and broadband internet services, WDM technology and the corresponding data exchange platform will become increasingly critical. We will continue adapting configurations and optimizing structures to meet the evolving business demands of the media convergence era, ensuring increasingly rational and secure business operations.

The existing east and west ring services cannot meet growing business requirements and require expansion of two additional waves per township node to transmit 2$×$10GE. Post-expansion, each site will increase to five waves.

Each site will expand with two 10GE ports, requiring the following expansion cards: ND2*2, TDX*1. The central east ring requires ND2*8, TDX*4. The central west ring requires ND2*10, TDX*5. Based on actual slot positions and expansion board quantities, township stations require no additional electrical layer subracks, while the central east ring requires one additional subrack and the central west ring requires two additional subracks.

Post-expansion, the IP metropolitan network bandwidth can reach 10GE, and streaming switches can also add a 10GE path, laying the foundation for future business development.

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*Note: Figure translations are in progress. See original paper for figures.*