Optical Wiring Technology for Home Networks for a Service-ready and Low-cost FTTH Service

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Abstract

The rapid increase in demand for NTT's B-FLET'S service (high-speed Internet access via FTTH (fiber to the home)) has led to the need for rapid and inexpensive service construction. Therefore, we developed a cable sheath connector and a connector-based optical cabinet and connector-based optical rosette. We used a new optical fiber that can be bent with a small radius and cable sheath connector technology for these products to create a zero-storage optical fiber system.

1. Background

There are now more than 100 million broadband subscribers worldwide and Japan ranks second with over 15 million. Demand for broadband services has increased since 2001 and the market is now well established. Moreover, growth is expected to accelerate in the coming years. The majority of broadband users in Japan currently use DSL (digital subscriber line), which uses a DSL modem on a metallic telephone line. The number of ADSL (asymmetric DSL) lines has risen to more than 11.2 million because ADSL offers a high-speed access line service at a low cost. NTT offers not only ADSL service, but also an FTTH (fiber to the home) service called B-FLET'S [1], [2], which has a higher transmission speed than other broadband services. There were more than 1.14 million subscribers to the FTTH service at the end of 2003. This is four times the previous year's number (0.31 million), which shows that FTTH is achieving rapid market penetration. To ensure widespread availability of optical fiber services, we must construct an optical communications infrastructure and ensure that customers get a quick response to requests for service. Then, once the infrastructure is in place, we must be able to wire up subscribers' homes rapidly and inexpensively. To cope with these demands, we developed several key optical components to improve the efficiency of home optical networks.

2. Concept

To provide FTTH, we must deploy optical fiber up to and inside a customer's premises. However, there are several problems with the present FTTH wiring system (**Fig. 1**). One problem is that in the optical cabinet currently used to terminate an optical fiber drop cable, the jacket of the optical fiber must be removed because fiber connection is achieved by using a mechanical splice*1. This leaves the spare fiber in the bare state, so we must be very careful when we place it in the cabinet. Another problem is that when we want to find a disconnection, we must cut the connection in the cabinet and connect an SC connector pigtail to the fiber to test it. The situation is similar when we want to perform a test in an optical rosette*2. We have now developed optical components that eliminate the need to store surplus lengths of optical fiber, which may become required for repeated cutting and splicing, by using plug-and-socket connectors in the optical cabinet, rosette, and

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*1 splice: splice here means an optical joint of the fibers, which is achieved with a narrow gap between the facets of the fiber.

*2 rosette: a small terminal box for installing the connection part of an optical fiber in a customer's home.

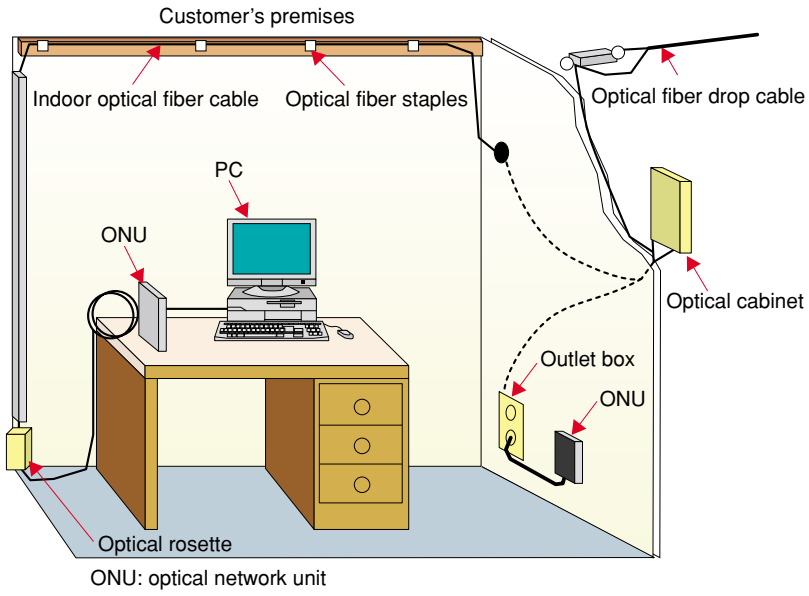

Fig. 1. Example of optical wiring on a customer's premises.

outlet box. Furthermore, we used a new optical fiber that can be bent with a small radius for the connector.

3. Outline of components

3.1 Cable sheath connector (FA connector)

Our cable sheath connector (called a field assembly (FA) connector) can be assembled simply. The FA connector can sheathe an optical fiber drop cable directly, so there is no need to remove the fiber cable jacket. A ferrule, a polished optical fiber, and a mechanical splice are installed in the FA connector in advance (**Fig. 2**).

The FA connector can be assembled very simply by a service engineer visiting the customer's home. To assemble an FA connector, the end of the jacket of the

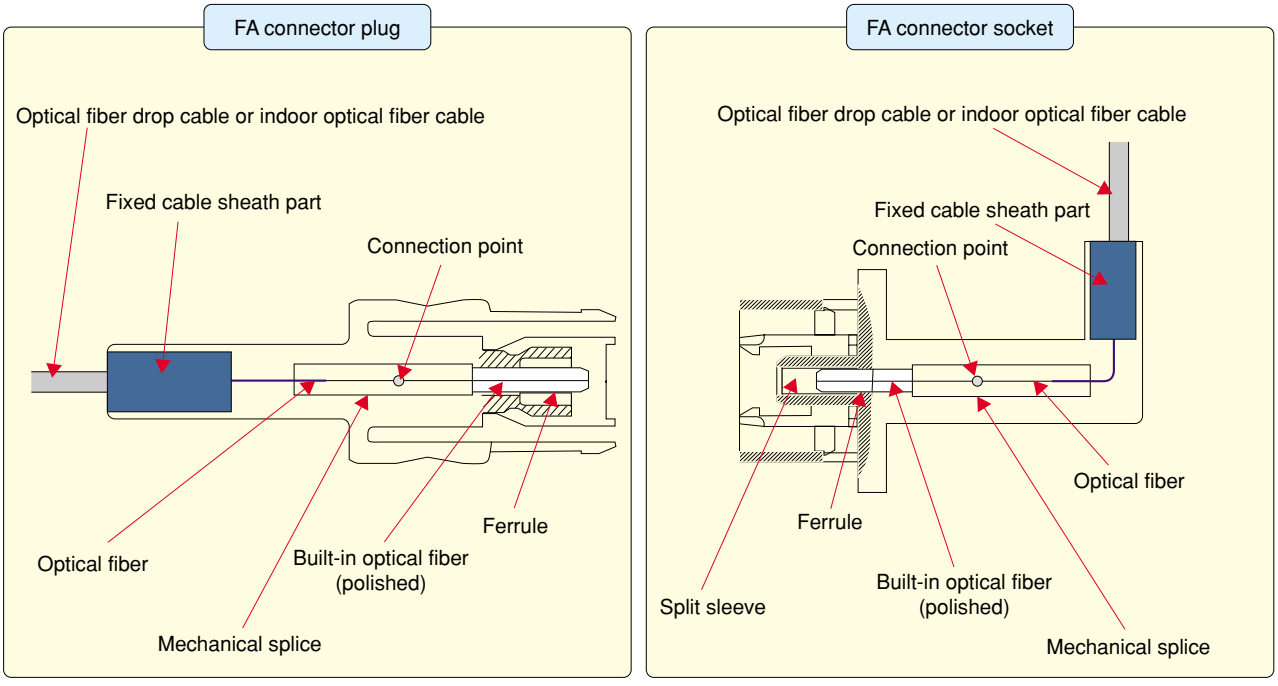

Fig. 2. Basic structure of FA connector.

optical fiber drop cable is attached to the fixed cable sheath part and then installed in a holder. Then the fiber is cut to a regulation length with a stripper and a fiber cutter. After that, the fiber is inserted into the main part of the FA connector and fibers are connected with the installed mechanical splice. Finally, the cable sheath part is fixed in the main FA connector part. The mechanical splice is a conventional technology, so we did not have to develop any new tools for connection and could make a simple assembly technique with low loss and high reliability.

The FA connector consists of a plug and a socket (FA connector plug and FA connector socket), which can be connected directly to each other (**Fig. 3**). The FA connector socket can also be connected to an SC connector plug, which conforms to JIS C 5973, directly without an adapter. Furthermore, because its structure is designed to bend the optical fiber drop cable by 90°, which reduces its size, it will fit in the most commonly used outlet box (conforming to JIS C 8435) and can also be used in the B-FLET'S service for condominium network systems (**Fig. 4**).

Another feature of the FA connector is that it satisfies outdoor environment condition requirements

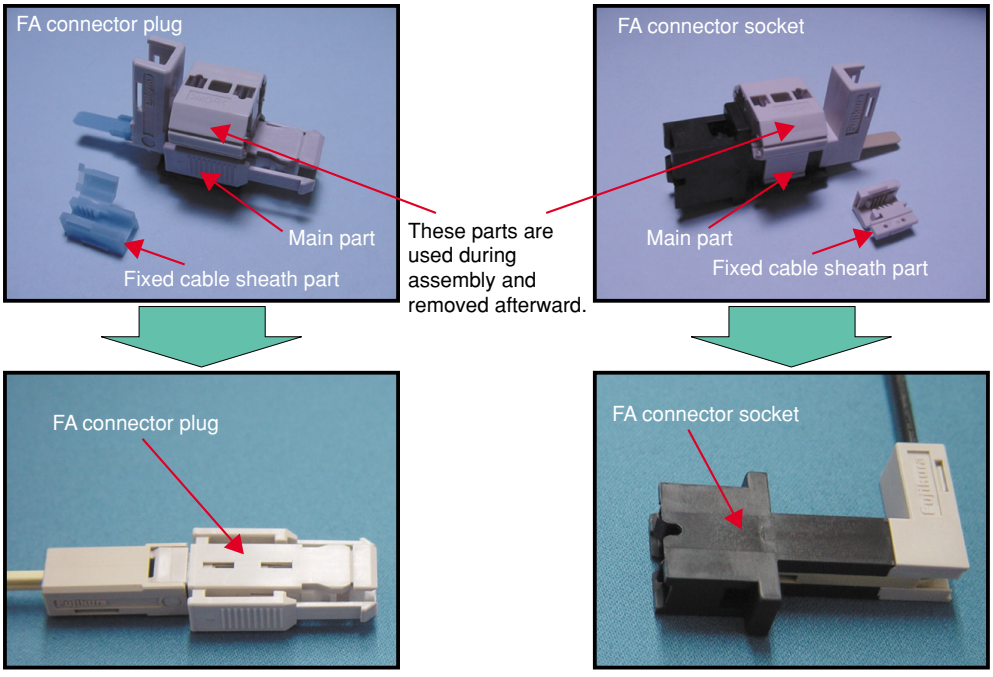

Fig. 3. Constituent elements and completed FA connector plug and socket.

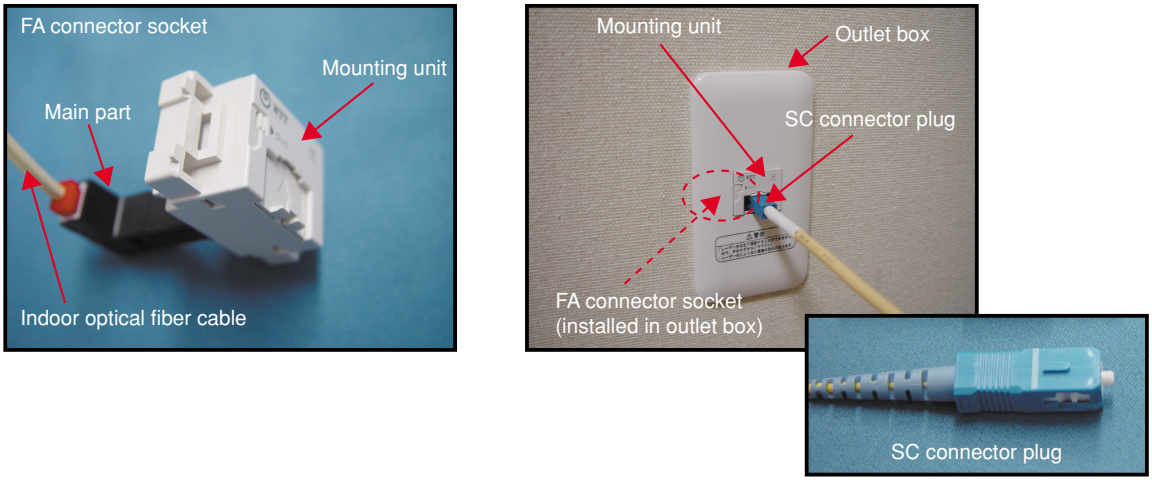

Fig. 4. Example of structure of FA connector socket (outlet type).

related to temperature characteristics and continuous temperature/humidity cycle characteristics. This will enable it to be used in outdoor optical cabinets as well with long-term reliability.

3.2 Optical cabinet and optical rosette

Our new optical cabinet (**Fig. 5**) and optical rosette (**Fig. 6**) are based on a common design that uses the FA connector.

The existing optical cabinet must provide storage space for surplus optical fiber to allow repeated cutting and splicing. The new optical cabinet accommodates the FA connector, so there is no need to store bare optical fiber. This allows easy connection between an optical fiber drop cable and an indoor optical fiber cable. It can be used as a connection point for testing because the FA connector socket allows connection/disconnection to/from an SC connector plug, so it improves testing efficiency and lets us make a compact outdoor optical cabinet. The new optical cabinet thus provides easier maintenance than the existing one and its volume is 65% smaller. This will reduce the cost of the B-FLET'S service system.

The new optical rosette is similar to the optical cab-

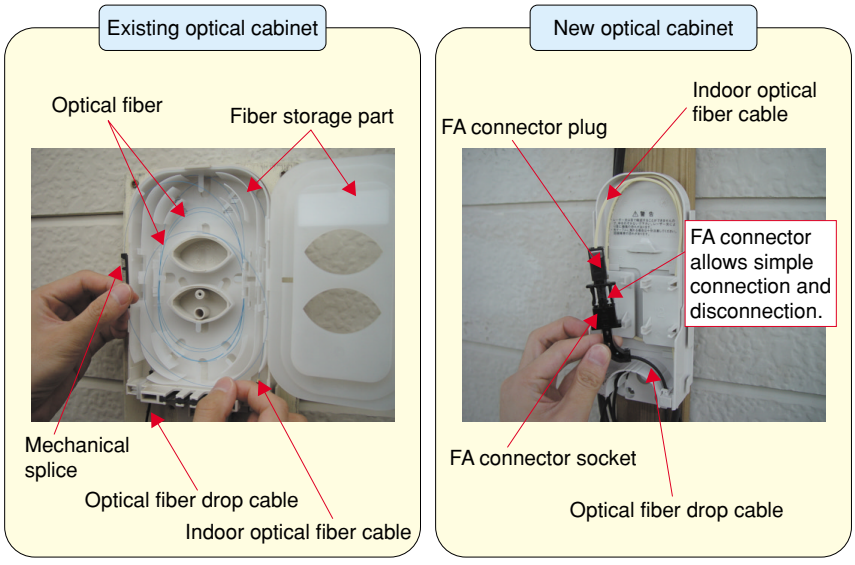

Fig. 5. Comparison of existing and new optical cabinets.

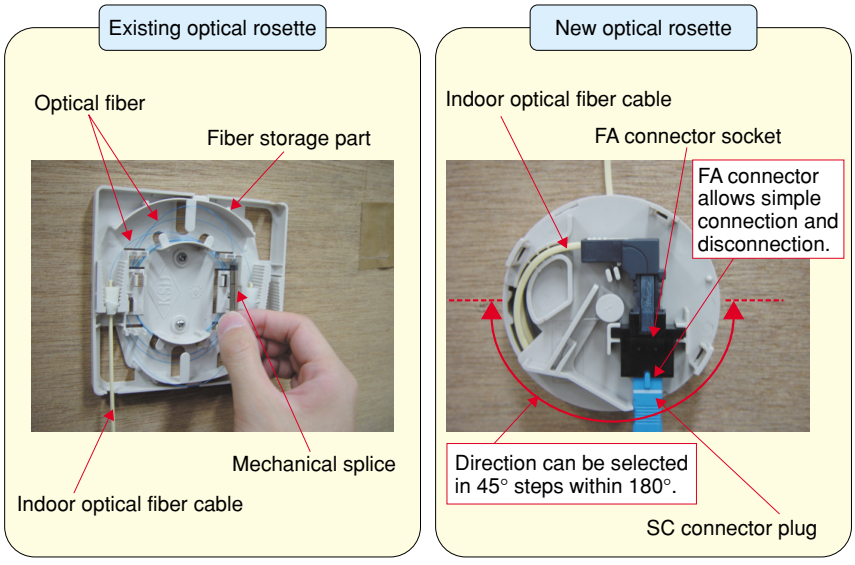

Fig. 6. Comparison between existing and new optical rosettes.

inet. By using the FA connector, we reduced the system's volume by 60% and reduced the system cost and increased the efficiency for finding disconnection points and performing maintenance. The rosette allows a choice of five exit directions for the indoor optical fiber cable because the FA connector orientation in the optical rosette can be changed in 45° steps to suit the installation conditions.

4. Conclusion

We improved the efficiency of the construction and maintenance of an optical network on a customer's premises and made a compact low-cost system by using cable sheath connector technology. In future, we will attempt to use a free-bend optical fiber that enables a smaller bending radius and employ it in our products. This should make optical network construction as efficient as metallic network construction and will strongly support the B-FLET'S service strategy.

References

[1] http://www.ntt-east.co.jp/product_e/05/index.html
[2] http://www.ntt-west.co.jp/service_guide/5great/great02.html

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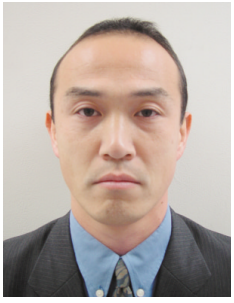

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