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OITDA Standard

TP

Technical Paper

Optical Fiber Distribution System for Detached Houses in FTTH

Third Version

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Coordination Committee
Fiber Optics Standardization Committee
Sub-committee on In-house optical fiber distribution system

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FOREWORD

This is a technical paper (TP) on the standardization published by Optoelectronic Industry and Technology Development Association (OITDA). TP is published to announce the proposed standards, provide technical materials on standardization, or to supplement the standards.

Figure 1 indicates the number of broadband service subscribers by type of access network such as FTTH, DSL, and CATV. Figure 2 shows the net increase/decrease of subscribers of FTTH and DSL on a quarterly basis (1). The number of broadband service subscribers has steadily increased, reaching 34,585 thousands at the end of 2010. In addition to the existing fixed-type services such as FTTH, DSL, CATV, and FWA, the number of broadband service subscribers using a mobile (wireless) communication system such as BWA (WiMAX) and the Long Term Evolution (LTE, 3.9-generation mobile phone packet telecommunication service) is also published. The number of FTTH subscribers has maintained its strong net increase of more than 650,000 per quarter and reached 19.77 million subscribers at the end of 2010. IT is expected that the number of subscribers will exceed 20 million by the end of March 2011

Based on the above facts, the optical fiber use of access network has expanded on a full-fledged basis in recent few years, and many general households now can use the optical triple-play service consisting of the Internet connection, IP Telephony service, and Video and TV service (IP TV service and Video On Demand service).

This TP systematically indicates the optical fiber distribution configuration and cabling method in detached houses in FTTH and composing parts and materials for FTTH. This is the update of the second version published in June 2009 to reflect the latest technological and product trend. Compared with the situation at the time of publishing the second version, as the use of FTTH service is more diversified, we have optical fiber distribution parts and materials and cabling methods for the detached house that can more fit the housing structure and the life environment the residents prefer such as increasing reliability of cabling facilities, simplified cable introduction parts and materials for detached houses, and more consideration on design of in-house equipment. In such background, for realizing the user environment the residents would like to have, it is important that the residents themselves in the case of already-built houses and the residents and house provider (such as housing maker, designer, and constructor) in the case of newly-built houses should understand the latest optical fiber distribution technical information on FTTH.

This TP is prepared as part of the information dissemination/provision activities to provide the latest optical fiber distribution technical information on FTTH. We expect that this TP is used as a guideline for the residents, developers, designers, and constructors who intend to introduce the optical fiber distribution system in detached houses as well as further accelerate the promotion and dissemination of FTTH service user environment.

Please note that part of the TP may infringe the patent right, patent application after the announcement of application, utility model right, or utility model application after the announcement of application. OITDA is not liable for confirming that the TP does not infringe such patent right, patent application after the announcement of application, utility model right, or utility model application after the announcement of application.

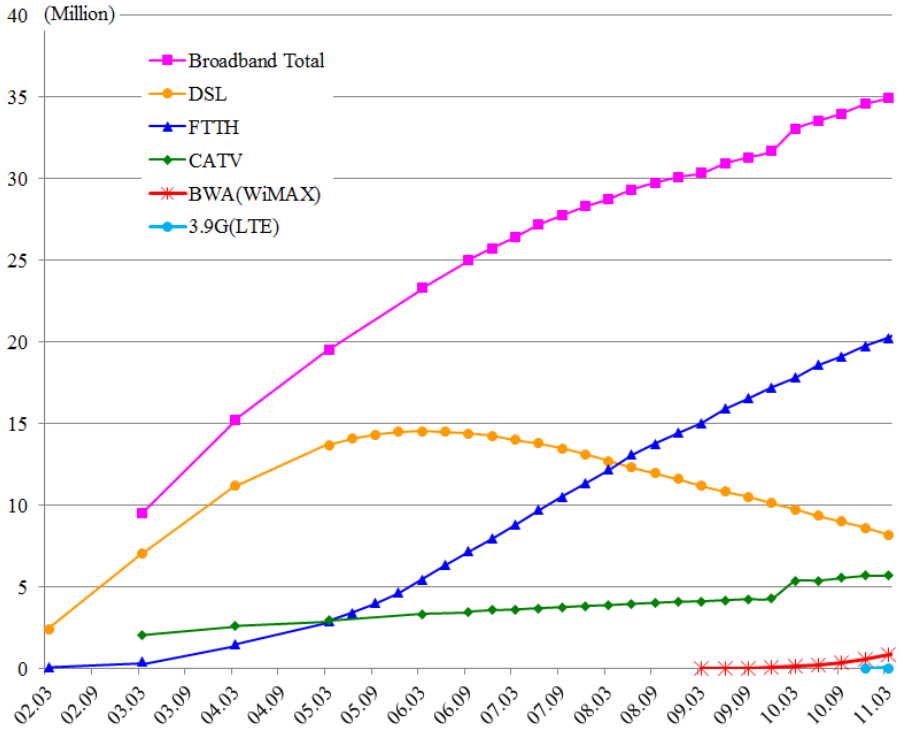

Figure 1: The number of broadband service subscribers

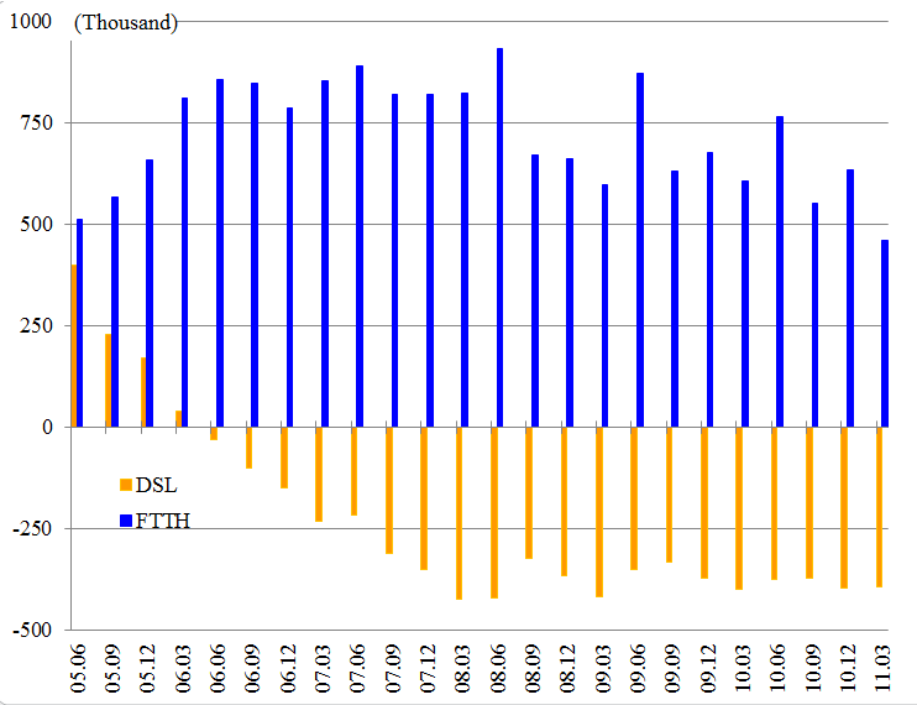

Figure 2: The net increase/decrease of subscribers of FTTH and DSL

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* Position of this TP

- It is revised from time to time to meet the technical advancement in optical fiber distribution system for detached houses in FTTH
- Please send your opinions and information to the following contact:

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TP 01/BW-2011

TP (Technical Paper)

Optical Fiber Distribution System for Detached Houses in FTTH

Introduction

This Technical Paper (TP) is a guideline based on the investigation and studies on optical fiber distribution system for detached houses in FTTH for the purpose of disseminating the optical fiber distribution system in a customer premise that has been promoted since 2003. It aims at summarizing technical information on optical fiber distribution system configuration, technical terms, and parts and materials that are important for the system configuration of optical fiber distribution system for detached houses, as well as provide useful information to users, designers, and constructors for the purpose of more introduction of optical fiber distribution system.

1. Scope

The TP refers to the introduction of silica glass optical fiber in a house and its connection to a generic cabling box, and installation, maintenance, management, and performance standard of its parts and materials regarding the optical fiber distribution system that enables to use FTTH service in a detached house.

We assume that the users of this TP include developers, house designers, housing makers, constructors, and residents (or owners) of the house who intend to install FTTH facilities in a detached house. The scope of facilities covers from a drop optical fiber cable dead-end hook and optical cabinet, indoor optical fiber cable that is distributed within a house, to an Optical network unit (hereinafter referred to as “ONU”) within a generic cabling box.

2. Definitions and Abbreviations

2.1 Definitions Definitions of terms used in this TP are as follows:

1）Dead-end hook

A metal hook using to hook an optical fiber cable, wiring from an aerial cable or an underground cable, on an external wall of the house by a telecommunication service provider

2）Optical cabinet

A junction box installed on an exterior wall of the house, in that there is splicing between a drop optical fiber cable owned by a telecommunication service provider and an indoor optical fiber cable distributed within a house. It means a junction box installed on an exterior wall of the house, in that there is splicing between a drop optical fiber cable owned by a telecommunication service provider and an indoor optical fiber cable distributed within a house. The optical cabinet is also used as a facility demarcation point that connects the drop optical fiber cable and the indoor optical fiber cable using an optical connector.

3）Through hole

A hole for introducing an optical fiber cable to the house. A duct for air conditioner can be used if it is located near the dead-end hook.

4）Drop optical fiber cable

A self-supporting type optical fiber cable that is led into a premise of the house from a dropping point (branch closure for dropping) near the house of the customer.

5）Indoor optical fiber cable

An optical fiber cable that connects the optical cabinet and ONU. It is exclusively for in-house distribution.

6）Optical network unit (ONU)

Equipment to mutually convert from/to optical signals to/from electric signals in FTTH. It is connected with an optical fiber cable and a LAN cable such as UTP.

7）Generic cabling box

A distributor that centralizes the input and output information (telephone, broadcasting, and telecommunications, etc.) line from outside of the house.

It houses not only the cabling but also a terminal component of cables, transmission equipment and a splitter, and can be used for checking, maintenance, update, and mutual switching.

8）Router

Equipment that relays and switches the packets in accordance with the protocol definition of the network layer.

9）Telecommunication outlet

Cabling equipment that centralizes telecommunication and broadcasting systems and power supply.

10）PT board

A distributor where a telecommunication service provider connects the optical fiber cable from the outside of the premise. It is usually placed in a MDF (main distribution frame) room.

11）PD board

A distributor at that the main cable connects to a horizontal cable.

It is usually placed within an EPS in a common space of residential premise. It is also called as a branching distributor or an optical connection box.

12）IP Telephony

A telephone system to convert voice into the data called as IP network packet for voice communications.

13）Terminal facility

A customer premise distribution and terminal equipment (such as ONU) after the demarcation point.

14）Demarcation point

A point of interface between the outdoor facility such as a transmission facility and customer-premise facility such as a terminal facility.

15）Termination

To put equipment such as a connector at the end of the cable. Termination makes various connecting equipment and facilities connectable.

16）Optical outlet

An interface used for the connection between the drop optical fiber cable or indoor optical fiber cable introduced in a customer premise and the in-house optical fiber distribution cord. In this TP, an optical wall outlet and an optical outlet are collectively referred to as an optical outlet.

17）Optical wall outlet

Optical outlet embedded within a wall of the house.

18）Optical exposed outlet

An exposed optical outlet placed in a house.

19）In-house optical fiber distribution cord

A cord with tensile strength yarn longitudinally attached around the optical fiber and covered by vinyl or polyethylene. And the cord has optical connecters on the both ends.

It is used to connect the optical outlet and ONU.

20）**HUB**

Integration equipment to mutually connect LAN equipment.

2.2 Abbreviations

CD Combined Duct
FTTH Fiber To The Home
LAN Local Area Network
ONU Optical network unit
V-ONU Video-Optical network unit
PD Premise Distributor
PT Premise Terminator
UTP Unshielded Twisted Pair cable
PLC Power Line Communications

3. Reference Standards

TS C 0017 Optical fiber distribution system for customer premises

4. Basic Configuration of Optical fiber distribution System

4.1 Summary

An optical fiber cable distributed from a building of telecommunication service provider is introduced to a house by a drop optical fiber cable, and the optical signal is converted into the electric signal by ONU. Then ONU is connected to a router or SW-HUB with a LAN cable such as UTP, and finally connected to telecommunication equipment such as an IP Telephony and information equipment such as PC in a house on a star-shaped network. In this chapter, we describe the summary of the connection from an optical fiber distribution service facility to an in-house cabling, and the facility conditions.

4.1.1 Facility for FTTH Optical fiber distribution Service Users

1) Image of facility for optical fiber distribution service

Figure 3 shows an image of facility for optical fiber distribution service. The building of telecommunication service provider and a place near the customer premise is connected through an optical fiber cable using an aerial distribution line or an underground conduit. If the user premise is a detached house, a drop optical fiber cable from the backbone optical fiber cable is introduced to the house. For apartment houses, please refer to “Optical fiber distribution System for Apartment Houses in FTTH”.

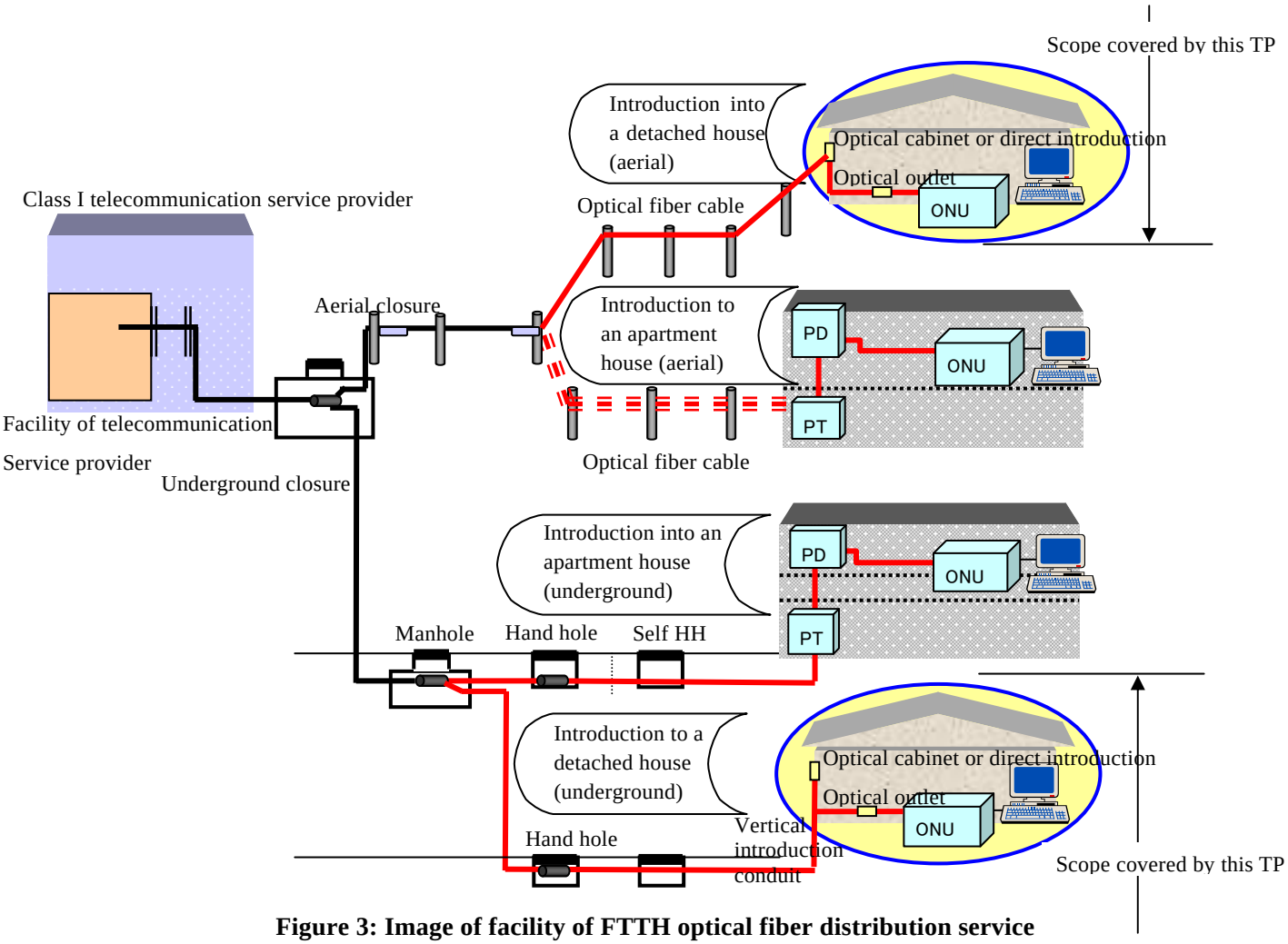


Figure 3: Image of facility of FTTH optical fiber distribution service

2） Selection of the number of optical fiber per house

The number of optical fiber introduced to a detached house is commonly one or two. As connection parts for optical outlet are usually for one or two optical fibers, it is reasonable to choose either of such parts.

(1) Introduction of optical fiber with one fiber

The optical fiber with one fiber is used for communication purpose. It is usually used for the data transmission and IP phone through the Internet connection. In some cases, video service data such as optical CATV is multiplexed in a different optical wave from the telecommunication one.

(2) Introduction of optical fiber with two fibers

One fiber is mainly used for the data transmission and telecommunication purpose such as IP phone. Another fiber is often used for a video service such as optical CATV or maintained as a spare fiber for future use.

4.1.2 Configuration of In-house Information Distribution system

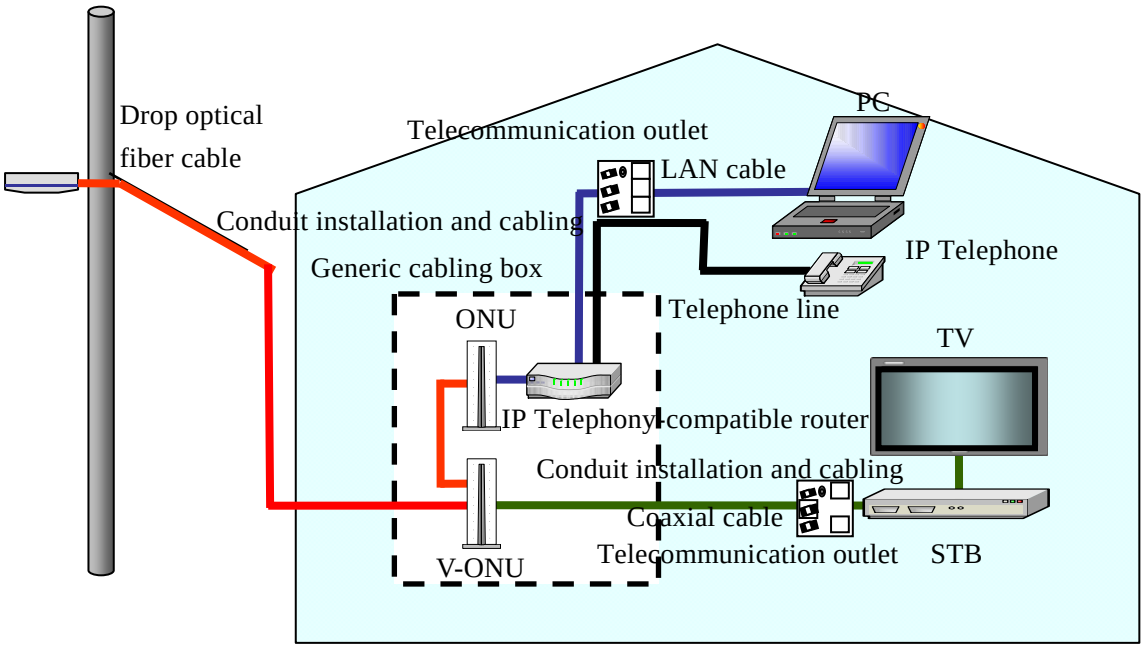
1) Basic configuration of in-house information distribution system

Figure 4 shows the basic configuration of information distribution for a detached house. Figure 4 (a) is an example of configuration for a newly-built house. It is an optical fiber distribution system characterized by a generic cabling box that integrates ONU and a router and placed near the introduction point of drop optical fiber cable, and LAN and coaxial cables that are connected from the generic cabling box to information outlets

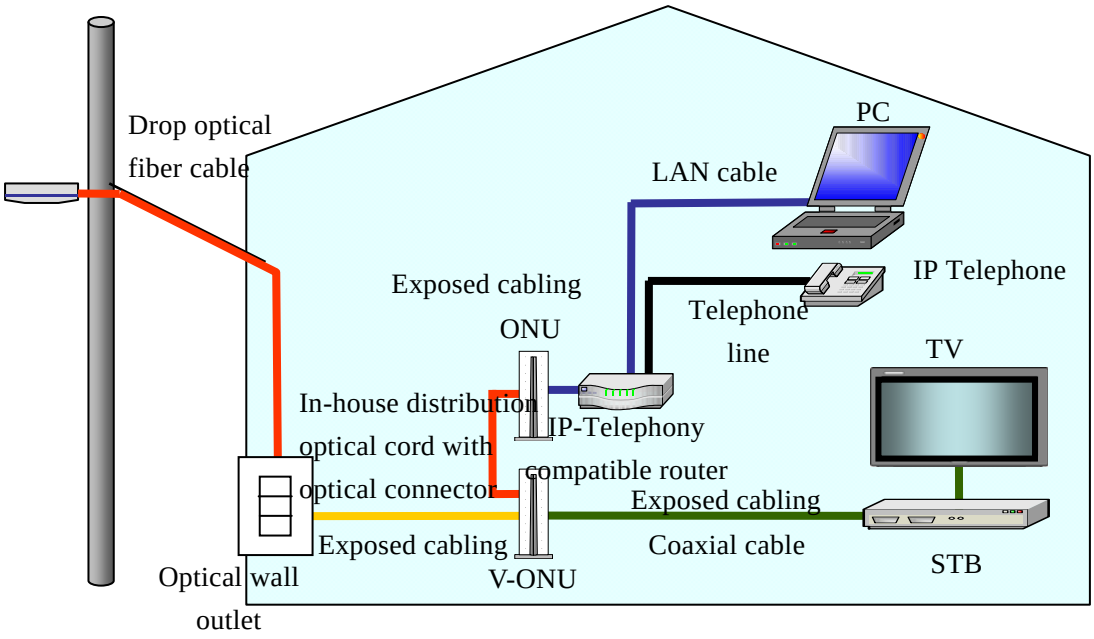
in each room through pre-installed conduits. The advantages of such configuration is that the residents can use PC and other IT terminal such as IT home appliances in any room and that, as the distribution system can easily be changed on the generic cabling box that enables the residents to change the purpose of the room or remodel the house, it comfortably matches the TV receiver system as well as has redundancy for future change. The disadvantages include that as conduit installation and placing a generic cabling box are required at the time of building a house, it costs much.

On the other hand, Figure 4 (b) shows an example of configuration in a house where there is no room for a generic cabling box (such as already-built houses). In this case, a drop optical fiber cable is directly introduced to a house and connected to ONU with an optical outlet and in-house optical fiber distribution cords.
While such configuration tends to be easily introduced in an already-built house which seems to have various housing environments and facility conditions, it is difficult to provide information distribution to several rooms if we cannot use existing conduits.

Figure 4 shows a configuration that enables to use the optical triple play that provides the Internet service, IP Telephony service and Video service such as the analogue/digital terrestrial broadcasting service, the BS (Broadcasting Satellite) analogue/digital broadcasting service and the CS (Communications Satellite) digital broadcasting service, in a detached house in FTTH. Recently, there are some cases that ONU that unifies ONU for data communications and V-ONU for video service, or an IP Telephony compatible-router that unifies all the functions of ONU, V-ONU, and router is installed. If the optical triple play service is not used, it is not necessary to place V-ONU and the optical fiber cable introduced in a house is directly connected to ONU.



(a) Placing a generic cabling box (mainly for newly-built houses)



(b) Not placing a generic cabling box (mainly for already-built houses)

Figure 4: Basic configuration of information distribution for detached house

2) Facility conditions

(**a)** For newly-built houses

(1) There is a through hole for introducing a drop optical fiber cable to a house;

(2) There is a conduit for drop optical fiber cables and indoor optical fiber cables from the through hole to the generic cabling box (2). The diameter of conduit is usually16 mm or 22 mm, and two conduits are needed including the one for broadcasting services.

(3) There is a space within a generic cabling box to place ONU, or there is a space in the premise to place the generic cabling box that has a room for ONU.

(4) There is power supply near the generic cabling box to operate ONU and a router.

(5) There are star-shaped conduits for information cabling from the generic cabling box to each room. The diameter of the conduit is usually 16 mm or 22 mm and two conduits are needed including the one for broadcasting services.

*If the star-shaped conduits from the generic cabling box to each room are available, it can flexibly handle the future cabling changes, as the optical fiber distribution system and the metal cabling system such as LAN cable and a coaxial cable for broadcasting are centralized in a generic cabling box. If there is no such conduit, there are some options: Installing a LAN cable within a wall in all the necessary rooms in advance and switching services in a generic cabling box, or using wireless LAN or PLC (Power line communication) system.

(**b)** For already-built houses

(1) There is a through hole on the external wall or an air-conditioner hole near the place where ONU is placed for introducing a drop optical fiber cable;

(2) There is power supply near the place installing ONU to operate ONU and a router.

4.2 Summary of Equipment and Materials Used for Optical fiber distribution System

4.2.1 Drop optical fiber cable dead-end hook and other related parts

These are metal parts that are used to introduce a drop optical fiber cable to a detached house. For a detached house, aerial introduction* is typical. Figure 5 shows the part attachd on the external wall of the house, and Figure 6 and 7 show the detailed of the parts.

A C type hook that hooks the drop optical fiber cable dead-end hook is fixed on the external wall of the house with screws. The supporting wire of the drop optical fiber cable is wounded and fixed on the drop optical fiber cable dead-end hook. The drop optical fiber cable is placed using optical cabling cleats in an appropriate interspace on the external wall. In the case where an optical cabinet is not used, the drop optical fiber cable is directly introduced to a house using an existing through hole for fixed-line telephone or a hole for air-conditioner. Generally, these steps are done by a telecommunication service provider.

*If the premise environment does not allow hooking the drop optical fiber cable that is extended from a drop point of an aerial line on the external wall of the house, a pole for cable introduction is installed within a premise.

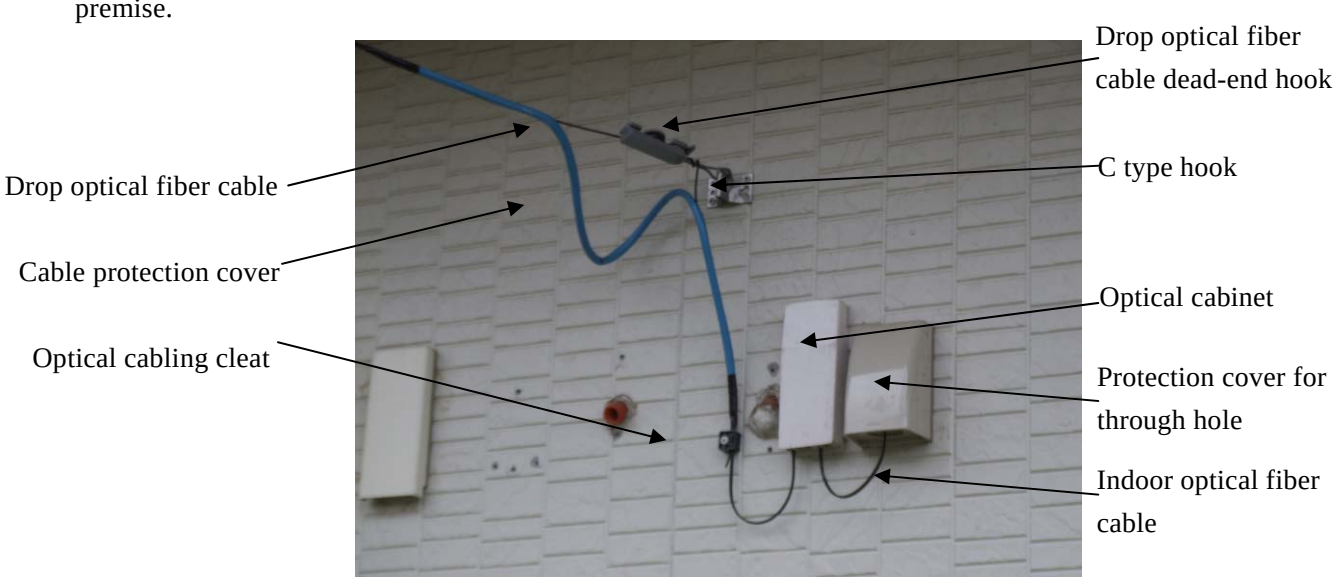


Figure 5: Example of installation of optical drop cable and optical cabinet on an external wall of the house (3)

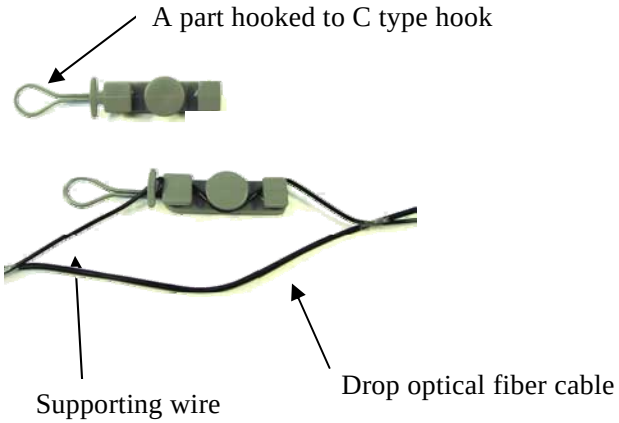


Figure 6: Example of drop optical fiber cable dead-end hook

Figure 7: Example of C type hook (3)

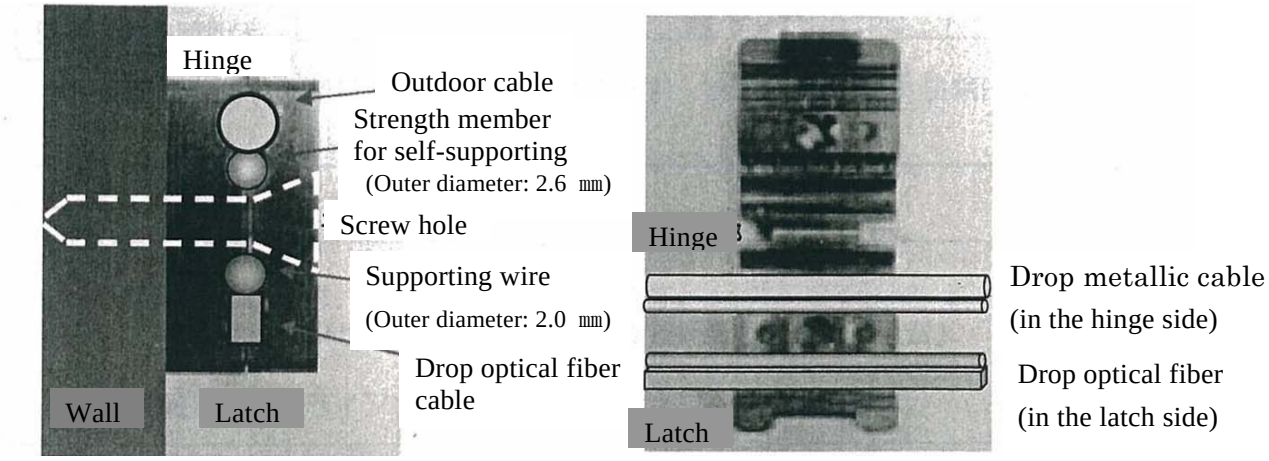


Figure 8: Example of Optical Cabling Cleats

4.2.2 Optical Cabinet

An optical cabinet is a connection box within which the connection parts of a drop optical fiber cable service provider and an indoor optical fiber cable (for the introduction to the house) (such as fusion splicer, mechanical splicer, and connector connection) are placed and which is usually a small, light and water-proof made of plastic. The example is shown in Figure 9.

Generally, the optical cabinet is placed on an external wall of the house near the through hole. A drop optical fiber cable and an indoor optical fiber cable are mated with connectors in the optical cabinet and such connector is sometimes used as a demarcation point. The optical cabinet is usually installed by a telecommunication service provider.
If a drop optical fiber cable is directly introduced to a house, the optical cabinet is not required.

Size: H183 x W77 x D37 (mm)
Weight: Approximately 0.2 Kg

Figure 9: Example of optical cabinet (3)

4.2.3 Generic Cabling Box

In order to prepare an environment where telephone, TV and an information terminal such as PC can be used in any room including a living room, library, bed room, and kid's room, it is necessary to distribute a coaxial cable for TV and a LAN cable in each room in advance. The generic cabling box is a distribution box to unify the optical fiber cable introduced from a transmission facility of a telecommunication service provider, a telephone line, and a TV line from a receiver antenna, and to provide a star-shaped distribution network in the house.

ONU and a router are placed in a free space in the generic cabling box with which each cable is connected. The generic cabling box should be placed in a place where the residents can easily check. If there is no place for the generic cabling box, it is sometimes placed in a wall of a corridor, under the roof, a wall of stairs, or inside a shoe cupboard. Figure 10 shows an example.

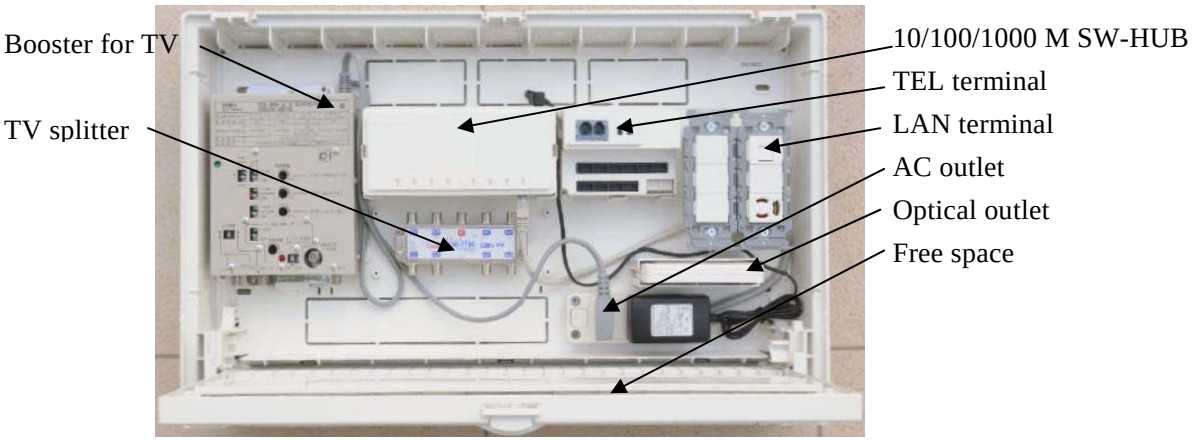


Figure 10: Example of generic cabling box (4)

4.2.4 In-house Conduit installation

It is a conduit inside of the wall of the house to distribute an indoor optical fiber cable, a LAN cable, and a coaxial cable for TV broadcasting. It usually uses a flexible synthetic resin conduit such as flexible Combined Duct (CD) and its inner diameter is usually 16 mm or 22 mm. Figure 11 shows an example of CD.

It is difficult to set conduits in an already-built house. If the conduits are placed to each room at the time of building a house, such conduits enable the residents to change the distribution or cables when a purpose of the room is changed or the house is reformed as well as to maintain the beauty of room interior by avoiding exposed cabling.

If the conduits have too many curves, it is difficult to draw a cable. Therefore, it is recommended to have the right angle turning per section less than three and to place a box if the number of turning exceeds three. The recommended radius of curvature of the conduit is 6 times or more of the inside diameter of the conduit .

*Flexible synthetic resin cable conduit has two types: Plastic Flexible (PF) conduit and Combined Duct (CD). While PF conduit has burning resistance self-extinguishable

, CD has no burning resistance (non self-extinction). CD is colored with orange for identification.

Figure 11: Example of CD (5)

4.2.5 Optical fiber cable

Optical fiber cables used for a detached house in FTTH have two types: A drop optical fiber cable used for introducing the line to the house and an indoor optical fiber cable for in-house distribution. These optical fiber cables have silica glass single-mode (SM) optical fibers.

1) Drop optical fiber cable

Figure 12 shows an example of structure of drop optical fiber cable. The number of optical fiber is usually one or two. Strength members are allocated in parallel at the both sides of optical fiber, and coated with black flame retardant polyethylene resin, which compose the cable part. The cable part and the supporting wire part are unified through the thin bridge and can be separated easily. As shown in Figure 5, the supporting wire part is cut after hooking to the dead-end hook of drop optical fiber cable, and only the cable part is introduced to an optical cabinet or to the house.

Recently, for the purpose of avoiding an accident of in-house equipment damage due to the falling of a thunderbolt, a strength member is usually made of non-conductor materials such as fiberglass reinforced plastic (FRP). In many cases, an optical fiber with low bending loss type is used to reduce the permissible bending radius to one-half (15mm) of the previous ones for the purpose of reducing the permissible cable bending radius.

In the Western area of Japan, there are some cases that the fiber in drop optical fiber cable is cut by cicada attack. We recommend using an optical fiber that has protective measures against cicadas in the area where such damage occurs.

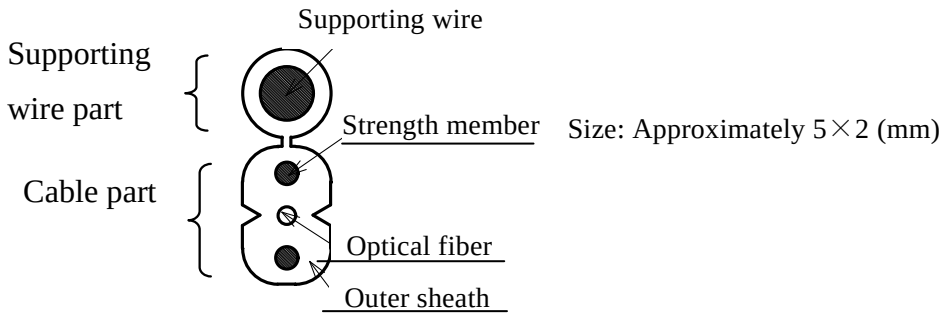
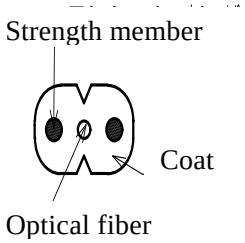


Figure 12: Example of configuration of drop optical fiber cable

2）Indoor optical fiber cable

Figure 13 shows an example of structure of indoor optical fiber cable. Strength members are allocated in parallel at the both sides of optical fiber, and coated with fire-resistance polyethylene resin. For maintaining the beauty of room interior in the case of exposed cabling, the cover is often colored with ivory.

Recently in many cases, an optical fiber with low bending loss type is used to reduce the permissible bending radius to one-half (15mm) of the previous ones for the purpose of reducing the permissible cabe bending radius.



Size: Approximately 2×3 (㎜)

Figure 13: Example of configuration of indoor optical fiber cable

3）Precautions for using optical fiber cables

When installing an optical fiber cable, it is necessary to comply with the permissible tension and permissible bending radius of the cable. Especially as an optical fiber cable for in-house use such as an indoor optical fiber cable has smaller permissible tension, it is necessary that excessive tension should not be imposed when wiring it from a through hole to a generic cabling box. Generally, the permissible tension is approximately 150 N for indoor optical fiber cables (if its strength member is a steel wire. If it uses induction free material such as fiberglass reinforced plastics, the permissible tension is approximately 35N), and 700 N for drop optical fiber cables.

(For reference, the permissible tension of UTP 0.5-4P cable is 110 N).

4.2.6 In-house Optical fiber distribution Cord

It is used to connect an optical outlet with ONU, and is an optical cord that enables the free cabling in a house. Generally, an optical fiber that significantly reduces the bending loss caused by bending is more frequently used than the one used for a drop optical fiber cable and indoor optical fiber cable for the purpose of coping with sharper bending of the cord. It has a dust-shutter function or a simple clearing function for the purpose of protecting the end face of the connector from dust and dirt of the house.

4.2.7 Telecommunication Outlet

Figure 14 shows an example of information outlet. The information outlet has modular jacks for LAN (RS-12) and for telephone (RJ-11) and information distribution terminals such as coaxial cable connectors in addition to AC power source that enables to provide connection and power supply to TV set, telephone, and various information terminals such as PC. The information outlet provides smart and smooth information distribution in a house.

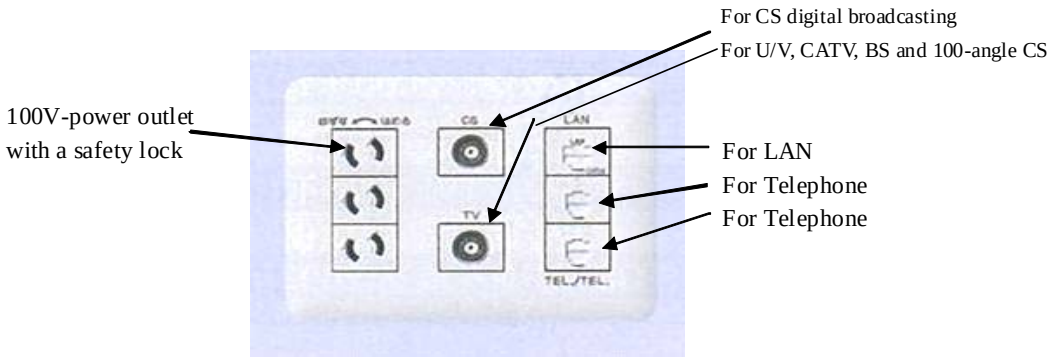


Figure 14: Example of information outlet (6)

4.2.8 Optical Outlet

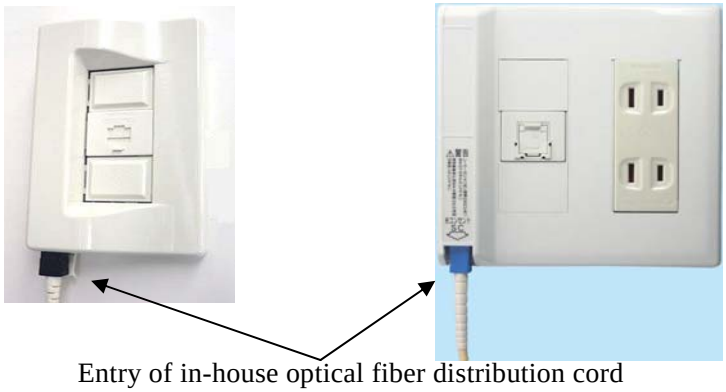
It is an interface to connect a drop optical fiber cable introduced from outside of the house with an in-house optical fiber distribution cord. The top end of the drop optical fiber cable terminated by optical connector (generally Type SC optical connector) with optical connector adaptor is attached.

An in-house optical fiber distribution cord is inserted into the room-side plug-in. In this TP, we call an optical wall l outlet and an optical exposed outlet to explain below optical outlet generally.

The optical outlet allows connecting a drop optical fiber cable and ONU in a room using an in-house optical fiber distribution cord in one action. As watching the end face of optical connector in the optical outlet may damage eyes due to laser beam, it is usual to have a safety measure such as a light shield shutter to prevent laser beam from leaking when the optical connector is plugged out.

1）Optical wall outlet

The optical wall outlet is installed on a wall of the room like a household wall socket and can be used in a newly-built house or an already-built house which can use existing ducts. Figure 15 shows an example of optical wall outlet.



(a) Single column type (7)　　(b) Double column type (8)

Figure 15: Example of optical wall outlet

2）Optical exposed outlet

The optical outlet is an optical outlet installed and exposed in a room. It is mainly used for an already-built house where ONU is placed in a place with no duct hole and for rented accommodation where the installation of an optical outlet is not allowed. Figure 16 shows an example of optical outlet.

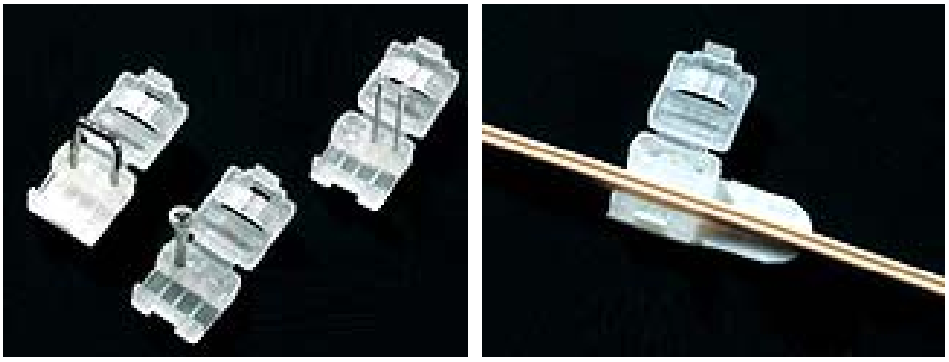
Figure 16: Example of optical outlet (9)

4.2.9 Field assemble-type optical connector

For the optical connector that is housed within an optical outlet, we usually use an on-site assemble-type optical connector that can be directly attached to an optical drop/indoor cable in the working site (generally SC-Type optical connector).

4.2.10 Optical Staple

The optical staple is used to fix a drop optical fiber cable and an indoor optical fiber cable exposed on a wall of the room. There are two types of optical staple: One is to be fixed using nail and rivets, and the other is to be fixed using a double-stick tape. Figure 17 shows an example of optical staples.



(a) Nail type (b) Double stick tape with tabs

Figure 17: Example of optical staple (11)

5. Example of Optical fiber distribution Installation in Detached House

5.1 Types and Characteristics of Optical Fiber Introduction Methods

In a case of newly-built house, as it is possible to prepare a through hole for introducing the optical fiber cable and an in-house conduit from the through hole at exterior wall to a generic cabling box or an optical outlet at the stage of designing the house, the following description assumes that the in-house conduit for optical fibers is available. Under such facility conditions, as the through hole is placed on an exterior wall of the house in advance, the "Method of introducing an optical fiber cable to an in-house conduit" is used.

In case of already-built house, if there is a through hole for introducing an optical fiber cable and conduits are available for in-house distribution of optical fibers (the same applies in the case of using the existing duct for telephone line), the same method for a newly-built house can be used.

In an already-built house, if use of existing conduits or through hole at exterior wall is impossible, generally the "Method of air conditioner conduits" or "Method of new through hole at exterior wall at external wall" is used.

In the following sections, we describe the types and characteristics of the above-mentioned typical methods for introducing an optical fiber cable by showing concrete execution steps with pictures.

1) Method of introducing an optical fiber cable to a conduit

In the method of introducing an optical fiber cable to a conduit, there are two ways: directly introducing a drop optical fiber cable to the house, or introducing an indoor optical fiber cable through an optical cabinet.

Figure 18 shows an example of execution of a drop optical fiber cable distributed from a utility pole is fixed on a hook on the exterior wall, and directly introduced to the house. As it is not necessary to open a new through hole on the exterior wall for introducing the drop optical fiber cable, it does not spoil the beauty of the house.

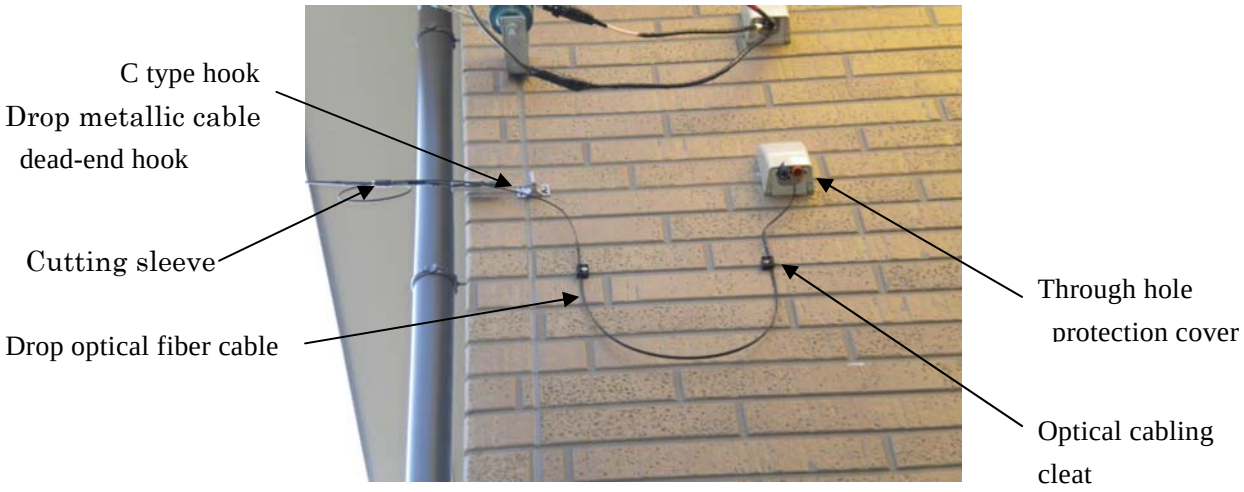


Figure 18: Execution example of introducing an optical fiber cable using a direct introduction method (exterior wall of the house)

Another method is to place an optical cabinet near the through hole at the exterior wall and connect a drop optical fiber cable and an indoor optical fiber cable inside of the optical cabinet (see Figure 5). In this case, the indoor optical fiber cable is introduced to the house. As in the case of "1) Method of introducing an optical fiber cable to a conduit", it is not necessary to open a new through hole at the exterior wall, it does not spoil the beauty of the house.

2) Method of using an air conditioner conduit

Figure 19 shows an execution example. It is a method of using an air conditioner duct for directly introducing a drop optical fiber cable into a house. It does not require a new through hole at the exterior wall and therefore, it is frequently used for already-built houses that cannot use existing ducts. If ONU is placed not near the room where the air-conditioner duct is available, as it would require long in-house cabling distance that spoils the beauty of the house. Therefore, it is desirable to place ONU near the air-conditioner duct.

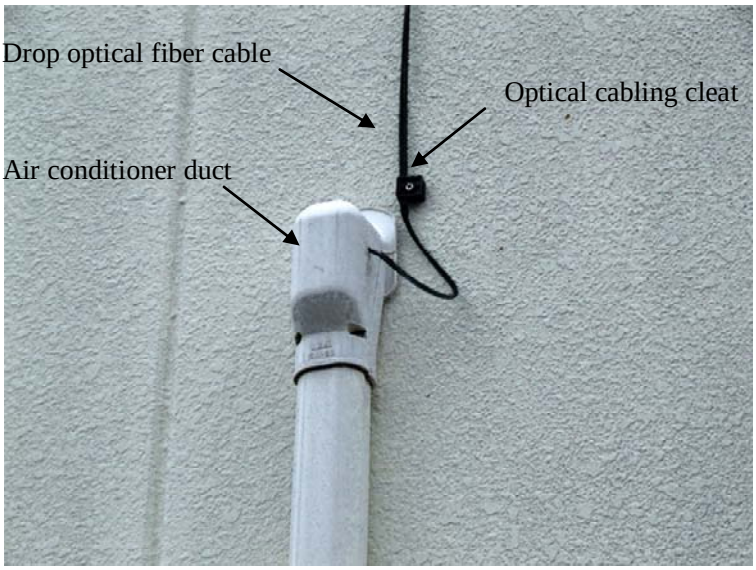


Figure 19: Execution example of introducing optical fiber cable using air-conditioner duct (external wall of the house)

3）Method of opening a new through hole at the external wall

Figure 20 shows an execution example. It requires opening a new through hole with 1 cm-diameter at the external wall and introducing a drop optical fiber cable to the house. This method is usually used for a room where there is no through hole such as an air-conditioner duct. While it is possible to open a new hole near the ONU placed inside of the house and it allows to minimize the in-house distribution cabling distance, many residents do not prefer this method as it requires newly opening a through hole at the external wall of house.

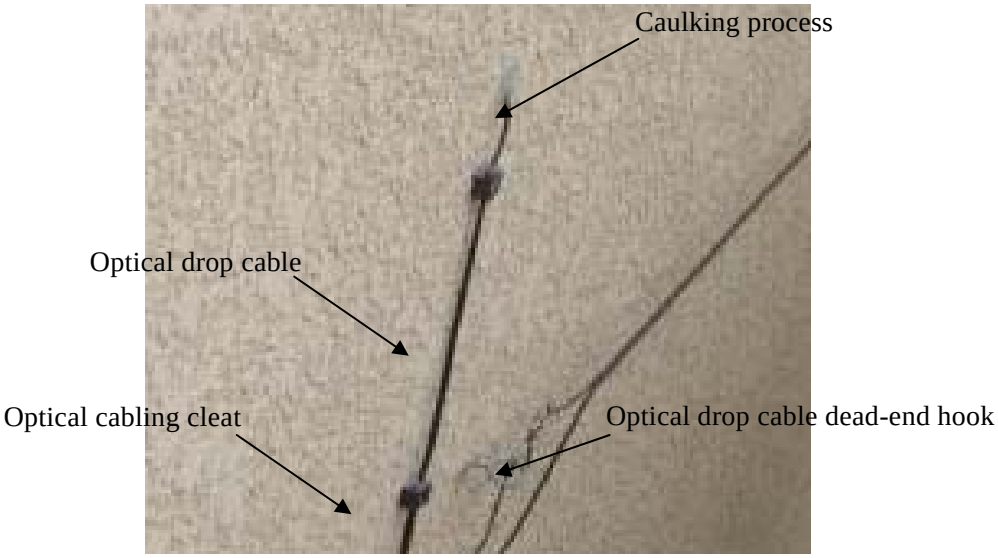


Figure 20: Method of introducing an optical fiber cable using a through hole (exterior wall of the house)

In the case of optical fiber cable introduction methods in the above 2) and 3), it is usual to directly introduce a drop optical fiber cable distributed from a utility pole to the house. However, there is the case of an indoor optical fiber cable introduced through an optical cabinet depending on the housing environment or telecommunication service providers, too.

5.2 Types and Characteristics of In-house Optical Cabling Methods

In a newly-built house, “Cabling using conduits” is adopted using in-house conduits that have already been placed. On the other hand, for an already-built house where we cannot use the in-house existing conduits, an optical fiber cable is wired along with the internal wall of the house from an introduction point to ONU. In this case, there are broadly three in-house cabling methods: “Exposed cabling using optical staples”, “Cabling with cable protector”, or “free cabling“.

In this section, we describe the types and characteristics of the in-house optical cabling methods mentioned above by showing concrete execution steps with pictures.

1) Cabling using conduit

This method has almost no exposed optical fiber cable and thus, is the most beautiful one. It is possible to wire several different types of cables in one conduit depending on the diameter of the conduit.

In the case of using in-house conduits, the optical wall outlet is p embedded in the internal wall of house at the exit point of the in-house conduit, and a drop optical fiber cable or an indoor optical fiber cable introduced into the house is directly connected to ONU.
Recently, we can use new cabling parts, materials and style that considers the needs of residents such as external beauty or moving of ONU after the initial placement. An example of such execution is shown in Figure 21. A drop optical fiber cable or an indoor optical fiber cable introduced to a house is terminated with connecter at the point of backside of the optical wall outlet embedded in the internal wall of the house at the exit point of the in-house conduit. The optical wall outlet and ONU is connected by an in-house optical fiber distribution cord. The optical wall outlet and the connector of in-house optical fiber distribution cord generally have a shutter for light shield to prevent the laser beam from leaking and a dust protection to protect the end face of the optical connector from dust and dirt of the house.

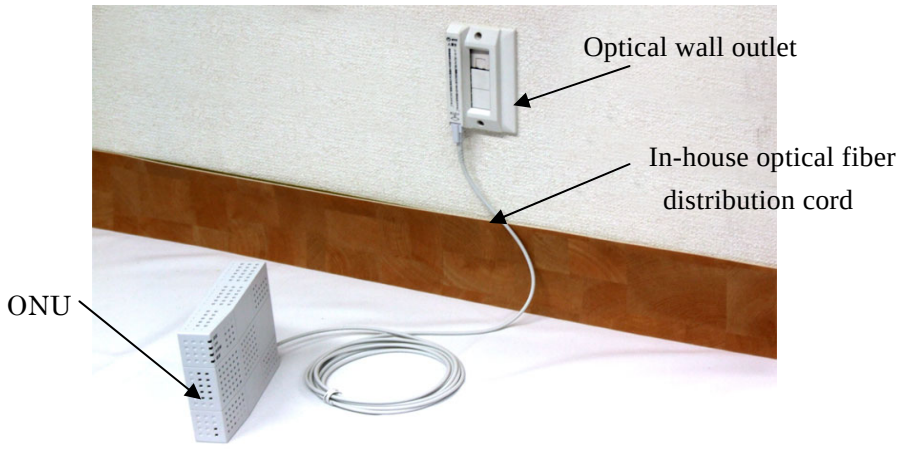


Figure 21; Execution example of in-house optical cabling using optical outlet

2) Exposed cabling

Figure 22 shows an execution example. The exposed cabling means a cabling method to use optical staples and installing optical fiber cables on the internal wall of the house. The required time for the installation is short

and it is the most popular cabling method. However, as the cables are exposed, it is not recommended to use this method in a place where the cable is easily tucked or pulled. The wall remains damaged after displacing the cable due to a room remodeling or change of the purpose of the room. Currently, we can use optical staples of double-stick tape type in addition to those fixed with nails or rivets.

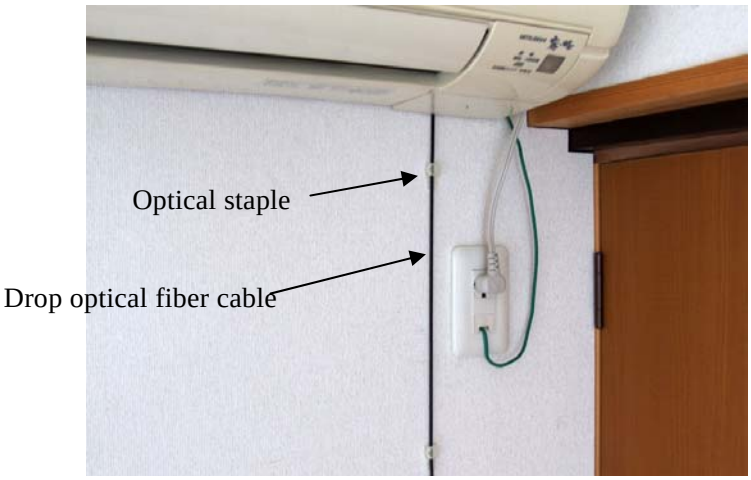


Figure 22: Execution example of exposed cabling using optical staples

3) Cabling with cable protector

Figure 33 shows an execution example. The cabling with cable protector is to use a cable protector that protects an optical fiber cable and do cabling inside of the protector. This method can be used for the place where the cable is easily tucked or pulled. As in the case of exposed cabling, it is also a general method. However, whether the user chooses this method or not depends on their beauty preference such as shape and color of the protector.

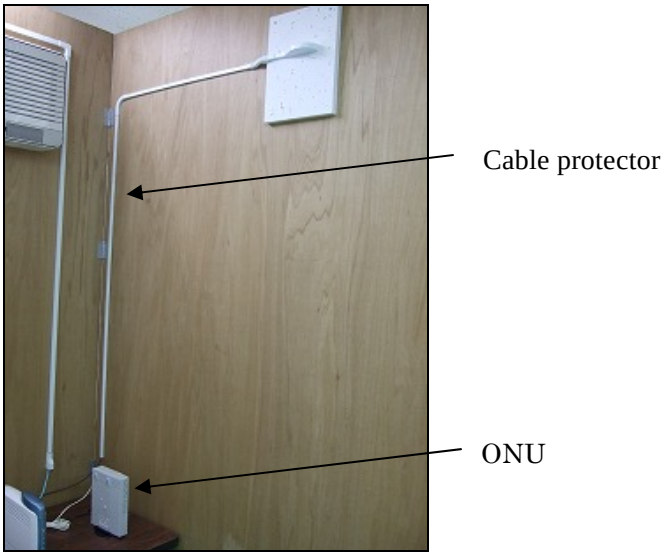


Figure 23: Execution example of cable protector cabling

4) Free cabling

The free cabling means not to fix all the optical drop or optical indoor optical fiber cables in the house. It is also used in combination with the above two methods. As shown in Figure 24, as cables are not fixed and an optical fiber cable surplus after the cabling is left and coiled, it is easy to move terminal equipment. However, the risk

of damaging or bending a cable by tucking or pulling is high, thus this method should be avoided in general. If this method is adopted due to an unavoidable reason, residents of the house should be careful for not damaging the cable.

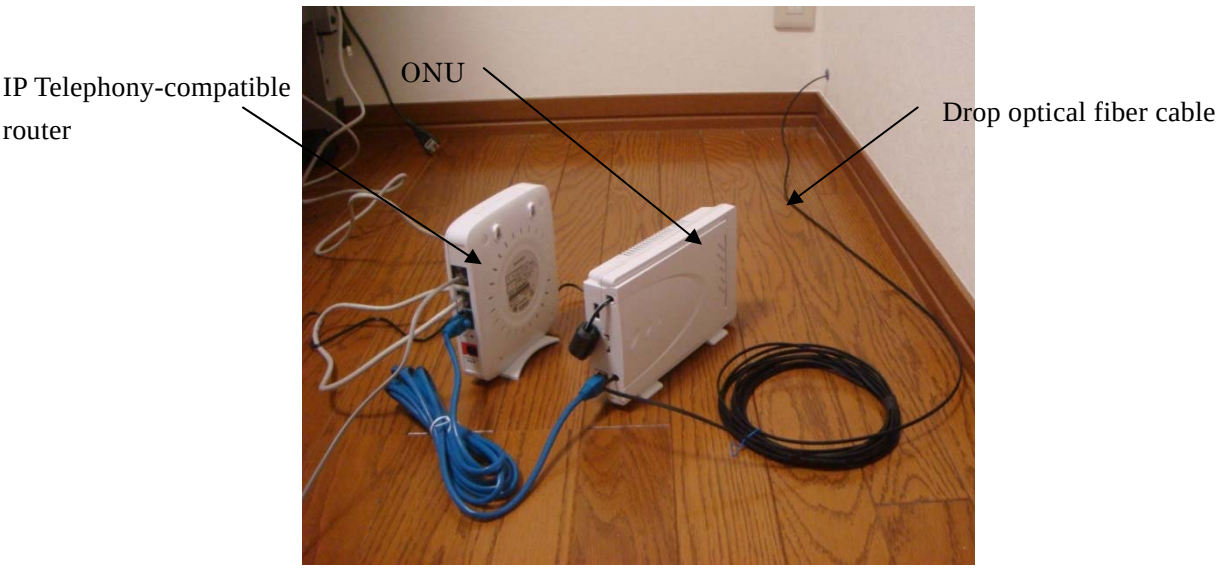


Figure 24; Execution example of free cabling

An optical fiber cable wired with the either of method 2), 3) or 4) mentioned above is directly connected to ONU. However, recently, we can choose a new cabling style where, as shown in Figure 25, an optical outlet that can be placed with exposed setting in the house is used and is connected to ONU using an in-house optical fiber distribution cord as in the case of optical outlet using the in-house conduits.

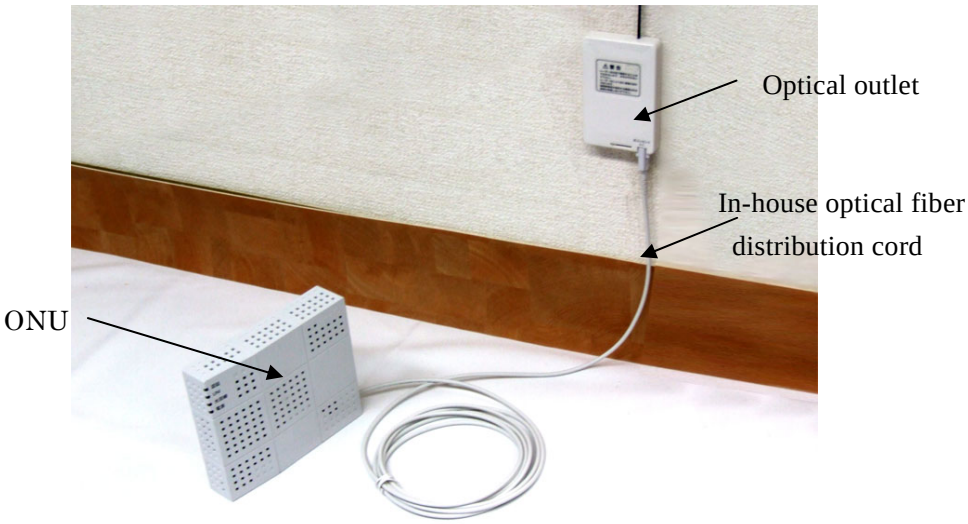


Figure 25: In-house optical cabling using optical outlet

Table 1: Types and characteristics of optical fiber distribution method for detached house

Purpose	House where conduits are available (Newly-built house, already-built house)	Other already-built house	
Optical fiber cable introduction method	Introduction using conduits	Air conditioner duct	Opening a new through hole at exterior wall
Advantages	No need to open a new through hole at the external wall. Almost no exposed cabling that does not spoil the appearance of the house	No need to open a new through hole at the external wall	Can open a new through hole in a room where ONU is placed that can shorten the in-house cabling.
Disadvantages	The initial investment is required to install in-house conduits	The cabling in the house is longer if ONU is distant.	Need to open a new through hole at the external wall.
Corresponding in-house optical cabling method	Cabling using conduit	Exposed cabling/cabling with cable protection /free cabling	
Distribution to ONU*	Optical wall outlet In-house optical fiber distribution cord	Optical outlet In-house optical fiber distribution cord	

*In some cases, a drop optical fiber cable or an indoor optical fiber cable is directly connected to ONU.

5.3 Points to be checked **by the Residents before the Construction**

In order to realize the service environment the residents wish, it is desirable that the residents themselves clearly identify what they want for the construction in advance. In this section, we assume the residents of already-built house, and describe points to be explained to the residents in advance such as the request by the residents and the housing environment of already-built house. More concretely, it is recommended to check and explain the following issues:

1) Where to place ONU
2) In-house conduits are available or not
3) In-house optical fiber cable cabling method (what is chosen)

1) Where to place ONU

Generally, the most important point to choose where to place ONU seems the location of PC. Other issues that should be checked in advance are as follows:

The place of ONU
- has commercial power supply;
- does not have a risk of high temperature/humid, or getting water;
- does not have a direct sunlight;

- is stable;
- Whether the residents prefer desktop-type or wall-hung type.

2) Availability of in-house conduit

It is necessary to check whether an in-house conduit is available to a room where ONU is placed. If there is a conduit to the room where ONU is placed (usually used an existing in-house duct for telephone line), it is desirable to check whether the optical wall outlet should be placed (including the change of modular plate) or not. If a conduit to each room can be used and the residents would like to place a generic cabling box, it is better to check the starting point of distribution to each room for smooth progress of works.

On the other hand, if there is no in-house conduit it is necessary to check whether there is a through hole in a room where ONU is placed (including the existing hole for telephone line) or an air conductor duct that can be used as a through hole.

3) In-house optical cabling method (what is chosen)

It is necessary to check which in-house optical cabling method from a through hole to ONU the residents prefer. For the methods of in-house optical cabling, please refer to Section 5.2. Please also check if the residents have a preferable cabling route from the through hole to ONU.

6. Cabling and Connection

Generally, a telecommunication service provider is responsible for cabling, fixing, and connecting a drop optical fiber cable from the utility pole to the exterior wall of the house.
It is also responsible for in-house cabling of indoor optical fiber cable and setting ONU.
We work to comply with TS C 0017 “Optical fiber distribution system for customer premises”. Refer to “Cabling in conduit tube” (6.3.2 d) and
“Laying of floor optical fiber cables” (Chapter 6.3) for more information.

As mentioned above, when setting an optical fiber cable, it is necessary
to comply with permissible tension and permissible bending radius.
The optical fiber dust generated at the time of connecting the optical fibers should be disposed separately from general waste.

7. Maintenance and Management

Maintenance and management should be done in accordance with TS C 0017 “Optical fiber distribution system for customer premises” as well as the following points.

1) Record of newly or additional cabling and equipment setting
As the record of cabling and equipment used is useful for investigation at the time of trouble or changing cabling or adding equipment, the records should be recorded and maintained.

2） Dissemination of cautions about in-house optical facilities
- Do not touch the end face of the connector in the optical outlet. If the end face of the connector is soiled or the end face is damaged, the connection loss increases and the telecommunications may disable.
- Do not watch the end face of optical connector connected to ONU or an adaptor end face of optical outlet.

Laser beam may damage eyes.
- When moving furniture, be careful to do not damage the optical fiber cable (do not cut the fiber) by pushing or stamping the cable.
- Caution about optical fiber
The optical fiber is made of glass with a diameter of 0.125 mm. If the indoor optical fiber cable is cut by mistake, do not touch the end of optical fiber. The optical fiber may cause a wound by piercing on a hand or foot, or eyes.

8. Test and Performance Standards

After setting and connecting an optical fiber cable, it is necessary to conduct a test of optical loss or optical power level at ONU from the facility of telecommunication service provider to the input point of ONU, and have a result that meet the performance standard. The test method and performance standard differ depending on each telecommunication service provider.

Reference

(1) “The number of broadband service subscribers” (as of the end of June 2008; by Ministry of Public Management, Home Affairs, Posts and Telecommunications):
http://www.soumu.go.jp/menu_news/s-news/2008/080917_2.html （2009.3.25）
(2) In-house information telecommunication/broadcasting advancement forum: Basic Execution Specifications
(3) Fujikura Ltd. “Optical cabling solution catalogue: 2008 No.1”:
http://www.fujikura.co.jp/catalog/hikari/book43.html （2009.3.25）
(4) Sekisui Chemical Co., Ltd “Hybrid Cabling System”:
http://www.hybrid-system.jp/ （2009.3.25）
NTT-Neomeit Co., Ltd. “Multi Home Net”:
http://www.ntt-neo.com/service/multihomenet/index.html (2011.2.1)
(5) Furukawa Electric Co., Ltd. “Electric Facility Material Guide: 2008 - 2009”:
http://www.furukawa.co.jp/tukuru/pdf/densetu/densetu_index.htm （2009.3.25）
(6) Panasonic Electric Works Co., Ltd “Multimedia-compatible cabling system”:
http://denko.panasonic.biz/Ebox/multimedia/mms_08_top.html （2009.3.25）
(7) Sumitomo Electric Industries Ltd. “Optigate”:
http://www.optigate.jp/ （2009.3.25）
(8) Sanwa Denki Kogyo Co., Ltd. Product Information:
http://www.snwd.co.jp/japanese/04product/new/index.html （2009.3.25）
(9) Hakko Electric Machine Works Co., Ltd. Product Information
http://www.hachiko-denki.co.jp/html/product_24.html （2009.3.25）
(10) Zentsukyo:
http://www.zentsukyo.or.jp/products/hikari-b/hikaristaple/index.html （2009.3.25）

Description of Optical fiber distribution System for Detached House in FTTH

This description is to explain matters that are described in the body text and Annex and other relevant matters, and not a part of the technical paper (TP).

I. History

Sub-committee on In-house optical fiber distribution system under Fiber Optics Standardization Committee of Optoelectronic Industry and Technology Development Association has prepared the standard information on optical fiber distribution for customer premise, "Optical fiber distribution system for customer premises" (TS C 0017, in 1999) and standardized the optical fiber distribution system configuration, cabling method, connecting method, and testing/management method. The updated version was issued in January 2002. ("Optical fiber distribution system for customer premises" was also updated as standard specifications to include the latest information and republished as TS C 0017 in January 2006)
On the other hand, there is no progress on the latest information and standardization for optical fiber distribution system for detached houses.

Under such circumstances, the sub-committee started the investigation of detached house structure, examination of silicon glass/plastic optical fiber and peripheral technology, collection of execution example of optical cabling, and identification of problems in 2003.

For the purpose of preparing the guideline for promoting the optical fiber distribution to detached houses, the sub-committee examined the latest technical trend and discussed about what the guideline should be. For newly-built/already-built houses, it investigated the actual condition of optical fiber distribution, made a hearing from optical fiber execution makers, and gathered information on the use of optical cabling parts and materials. As a result of collecting the information, we firstly prepared the technical material for newly-built house as the first version, as it is difficult to establish a general technical material for already-built house due to the fact that the introduction and in-house cabling differ in each case for already-built houses, and placing ONU in a generic cabling box is ideal for the in-house optical fiber distribution system. During the period from 2005 to 2006, we developed the technical material and published “Optical fiber distribution system for detached houses in FTTH” in 2007 as the first version.

In 2007, given the fact that the majority of optical fiber distribution was for already-built houses in Japan, we mainly investigated the latest trend of execution examples of optical fiber distribution for already-built houses. As a result, compared with the timing we prepared the first version, we found that various optical cabling methods and cabling parts and materials were used depending on the housing structure and the life environment the residents preferred, we started revising the first version to prepare the second version to reflect the facts mentioned above.

In the second version, we mainly added the types and characteristics of optical fiber distribution methods and in-house optical cabling methods the residents are interested in and new cabling parts and materials as the latest execution examples that can apply to newly-built houses and already-built houses in different environments.

In 2011, the number of FTTH subscribers reached 15 million households and has increased steadily. Under such circumstances, we changed points for technical trend research on FTTH and optical fiber distribution in

premise, and conducted the research in each technical area such as (i) Optical fiber cable technology, (ii) Connection technology, (iii) Execution technology, and (iv) Optical network systems. As a result, we found that more new applicable optical fiber cables, connection connectors, and other cabling parts and materials are available for detached houses that have new technology. To reflect the new information, the sub-committee started the preparation of version 3 in 2010.
In the version 3, the description on optical fiber cables, connection connectors and other cabling equipment and parts that are newly used for detached houses is added. We also changed pictures of examples of execution and cabling parts and materials to the latest ones as much as possible.

II. Description of Major Items

1. Scope

The scope of this technical paper is from the introduction of drop optical fiber cable to a detached house to ONU of generic cabling box in each house.

2. Definitions and Abbreviations

The TP defines equipment and cabling parts and materials that are main components of optical fiber distribution system.

3. Referenced Standards

The TP indicates the standard described in TS C 0017 “Optical fiber distribution system for customer premises”

4. Basic Configuration of Optical fiber distribution System

We expect that the digital TV broadcasting service increases as an optical service that can be used in a detached house in FTTH in addition to the Internet service and IP Telephony service. Thus, we defines that the basic configuration is from the introduction of drop optical fiber cable to the detached house to ONU placed within the house as the optical fiber distribution system for optical services.

As the number of optical fiber introduced to a detached house is generally one or two, we set one or two fibers as a standard. Additionally, as the optical triple play services are now widely available, we also set the distribution style that includes V-ONU and IP Telephony-compatible router in the standard configuration.

The optical fiber cable distributed from a telecommunication service provider is introduced to a house through a drop optical fiber cable. At that point, there are two methods: directly introducing the drop optical fiber cable to the house or introducing an indoor optical fiber cable through an optical cabinet. Then, the introduced drop/indoor optical fiber cable is connected with the optical outlet. Regarding an optical outlet, we can choose an optical outlet or an optical exposed outlet depending on the newly- or already-built house or whether a conduit is available within the wall. We use an in-house optical fiber cord from the optical wall outlet to ONU. The optical signals for Video and for the Internet data are respectively split into V-ONU and ONU. And both signals are converted into electric signals in V-ONU and ONU. V-ONU is connected with TV set using a coaxial cable. And ONU is connected with information terminal such as PC using a LAN cable, and also connected with a telephone terminal. For newly-built houses or already-built houses that can use conduits, LAN cables and coaxial cables are basically distributed in a star-shaped network through the conduit to each room. However, if we cannot use the conduits, as it is difficult to distribute the signal to several rooms, the distribution using a LAN cable and a coaxial cable is provided from the room where ONU is placed.

5. Cabling, connection, maintenance, management, testing, and performance standard

Cabling, connection, maintenance, management, and testing are conducted in accordance with TS C 0017 "Optical fiber distribution system for customer premises". As people have more chance to touch the optical connectors and optical fiber cables in detached houses, we added cautions about handling the optical connectors.

III. Standardization Progress in foreign countries and other domestic organizations

Regarding the standardization of distribution in premises, the international standardization process is in progress in ISO/IEC JTC1 SC25/WG3 to prepare ISO/IEC 11801 "Generic Cabling for Customer Premises" (2002). On the other hand, regarding the distribution in private houses, ISO/IEC 15018 "Generic Cabling for Homes" is developed as a standard. However, as ISO/IEC 15018 is mainly for SOHO environment using multimode optical fiber and plastic optical fiber as a media, it does not specify the standards for of distribution system for detached houses in FTTH as covered in this TP. Standardization of optical fiber introduction standards for detached houses has not been progressed both domestically and internationally.

For optical fiber distribution parts and materials used for apartment houses, the Center for Better Living (established in 1973) established the standards for better housing parts and materials for optical fiber distribution system equipment for apartment houses in December 2008 (1). It describes premise terminator (PT) boards, premise distributor (PD) boards, and optical outlets. As the optical outlet can also be used in a detached house, we should refer to this standard.

Optical Fiber Promotion Association (non-profit organization authorized in May 2003) has promoted the enlightenment and dissemination of informatization and assisted the introduction optical fiber for small and medium sized building owners, and plans to prepare a guidebook for advanced information distribution facilities. It aims at providing the standards for cabling facilities for each of apartment houses, office buildings, and detached houses as well as newly- and already-built premises. As this guidebook is closely related to this technical paper, we will carefully watch the progress of this guidebook.

As domestic promotion activities of optical fiber, Advanced Info-Communications Promotion Community (NPO authorized in January 2004) has actively worked and promoted the information distribution technologies and human resources through holding a competition of information distribution work technique and seminars and providing the technical authorization system. The Community is deeply involved in "Information network works" in the International Vocational Training Competition; Olympics in Technology and has taken various actions in accordance with TS C 0017 "Optical fiber distribution system for customer premises". As the Community has a close relationship with the sub-committee, we also carefully watch their development.

IV. Reference Materials

1) BLS OC: 2008 "Good housing parts authorization standard - optical fiber distribution system equipment" by the Center for Better Living, published and effective on December 1, 2008

V. Draft Preparation Committee

The draft of this technical paper (TP) was prepared by Sub-committee on In-house optical fiber distribution system of Fiber Optics Standardization Committee in 2009 to 2010. The members who participated in preparing the draft are as follows:

Chairman: Shin-ichi Furukawa (Yazaki Corporation) (Chairman in 2009; Member in 2010)
Chairman: Toshihiko Sekiguchi (Nippon Telegraph and Telephone Corporation) (Member in 2009; Chairman in 2010)
Member: Katsuyuki Ishibashi (Kinden Corporation)
Member: Daisuke Iwakura (Furukawa Electric Co., Ltd.)
Member: Shinji Ogawa (Sumitomo Electric Industries Ltd.) (until March 2010)
Member: Toshiaki Takahashi (Sumitomo Electric Industries Ltd.) (from April 2010)
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Member: Akihiro Kimura (Nippon Comsys Corporation)
Member: Teruo Koyama (Mitsubishi Cable Industries Ltd.)
Member: Satoshi Takahashi (Japan Science and Technology Agency)
Member: Katsunori Tanaka (Urban Renaissance Agency) (until March 2010)
Member: Kazuhiko Tanaami (Urban Renaissance Agency) (until March 2010)
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Member: Tomohiro Murakawa (Kyowa Exeo Corporation) (until June 2009)
Member: Kouji Yosida (Kyowa Exeo Corporation) (from July 2009)
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Observer: Shigeyasu Hatsuyama ((Industrial Science and Technology Policy and Environment Bureau, Ministry of Economy, Trade and Industry) (from April 2010)
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This Technical Paper (TP) for OITDA Standards was discussed, reviewed and prepared by Technical-committee on In-house optical fiber distribution system under Fiber Optics Standardization Committee of Optoelectronic Industry and Technology Development Association.
Please contact below for your opinions and questions.

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