IN-BUILDING NETWORK INSTALLATIONS

(CENTRALIZED SPLITTING ARCHITECTURE)

NOTE: This document is only referring to the centralized splitting architecture that UGG normally uses for rural areas.

IN-BUILDING NETWORK INSTALLATIONS

INDEX

1. INTRODUCTION

This document aims to give a general view with the construction instructions that must be considered to make the installations inside the buildings in the FTTH deployment of UGG (Unsere Grüne Glasfaser) in Germany.

NOTE: This document is only referring to the centralized splitting architecture that UGG normally uses for rural areas.

Other norms focussed on more detail for some parts of the network must prevail over the content of this document in case of conflict.

This document does not detail how must be carried out the civil works, or the cable installation in detail. For this purpose, there are available the norm "TEF-NORM-00001 - Civil Works for fiber deployment" and the norm "TEF-NORM-00002 - Blowing Procedure for Cables and Fiber Units" that should be follow.

1.1 REVISIONS

This document derogates the related parts of the "Construction Instruction for fiber deployment" document.

EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
1st	DECEMBER 2022			This document is extracted from the document "Construction Instruction for fiber deployment"
2nd	JANUARY 2024	All	New codification of the document	The document is codified with the document code: TEF-NORM-00010. The logo of UGG is updated in the page header. References to other documents are included.
		2.2 MDU scenario (up to 6 customers) 2.3 MDU scenario (from 7 to 12 customers)	Note with the possibility of more than 2 optical fibers per customer in the building optical network.	

2. IN-BUILDING OPTICAL FIBER TERMINATION

In this document, the different schemes for the in-building optical fiber termination will be explained.

There are 3 main scenarios to be covered:

- SFU scenario.
- MDU up to 12 HP scenario.
- MDU from 13 to 48 HP scenario.

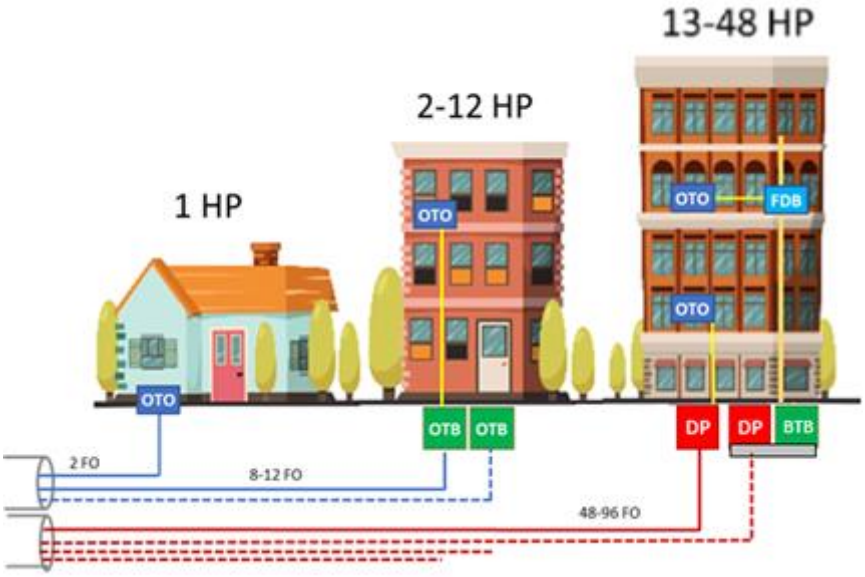


Figure 1. Limits for the different in-building optical fiber termination

2.1 SFU SCENARIO

In the SFU (Single Family Unit) scenario, the micro-duct will be finished in an OTB that only has the capacity to finish up to 2 optical fibers (the element is an Optical Outlet working as OTB).

In the SFU installation and depending on the customer preferences, could be 2 different options for the optical network termination:

- The optical network is finished in the OTB (in the basement of the building).
- The optical network is finished in the OTO (inside the customer home).

2.1.1 THE OPTICAL NETWORK IS FINISHED IN THE OTB (IN THE BASEMENT)

The optical network finishes in the OTB (in the basement of the building), and the ONT (if applicable) will be installed in the same room at less of 2 meters from the OTB. The connection between the router and the ONT is made with an UTP cable (ethernet), in an installation made by the client.

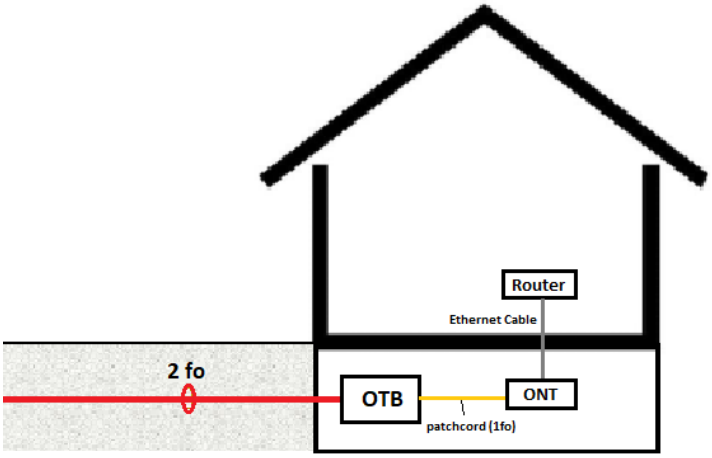


Figure 2. Customer house network termination scheme for SFU (Case in which the optical fiber network finish in the OTB)

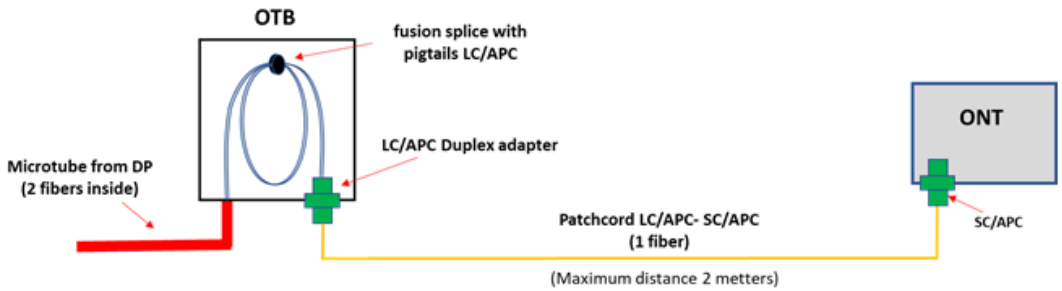


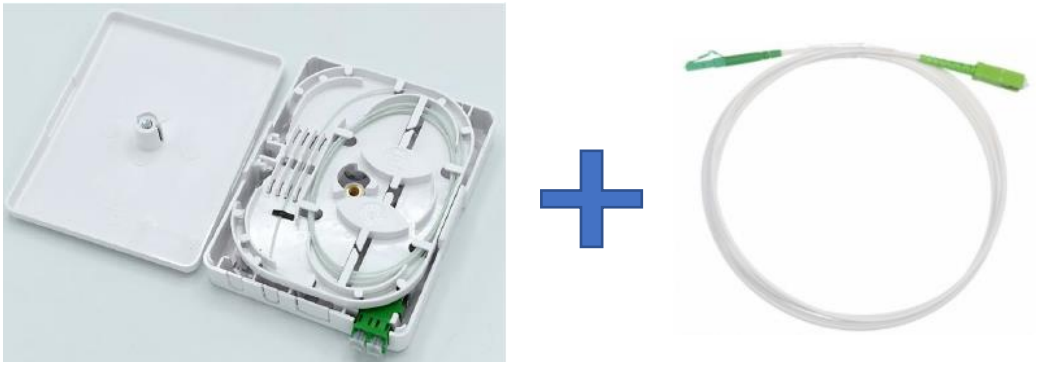
Figure 3. Basic scheme for SFU (Case in which the optical fiber network finishes in the OTB).

In this case, the ONT must be connected to the OTB using a simple patch-cord with a **length inferior to 2 meters.**

2.1.1.1 ELEMENTS NEEDED (FOR SFU FINISHING IN THE BASEMENT)

For this type of installation, the following elements are needed:

1. **OTB for SFU**. Optical plastic box, equipped with 1 splice tray, 1 adapter LC/APC duplex and 2 LC/APC pigtails.
2. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side**. To connect the OTB with the ONT equipment.



OTB for SFU | Patch-cord LC/APC – SC/APC

Figure 4. Elements needed for the in-building installation SFU (optical network finished in the OTB)

2.1.2 THE OPTICAL NETWORK IS FINISHED IN THE OTO (INSIDE THE CUSTOMER HOME)

The optical network will finish in the OTO (that will be installed inside the home of the customer, not in the basement). In this case, it will be necessary to install another cable to give continuity to the 2 optical fibers from the OTB to the OTO.

The maximum distance between the OTB and the OTO must be 60 meters.

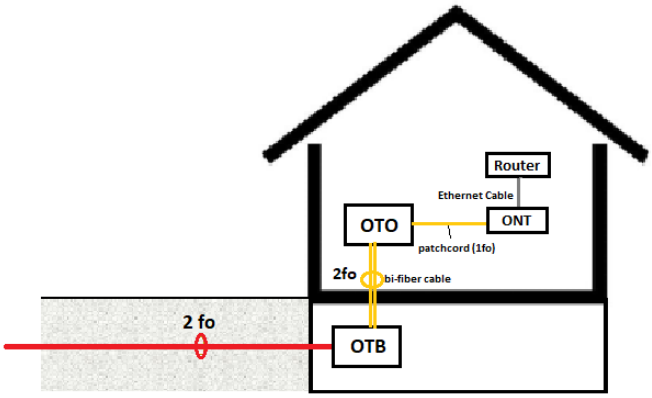


Figure 5. Customer House network termination scheme for SFU (Case in which the optical fiber network finishes in the OTO)

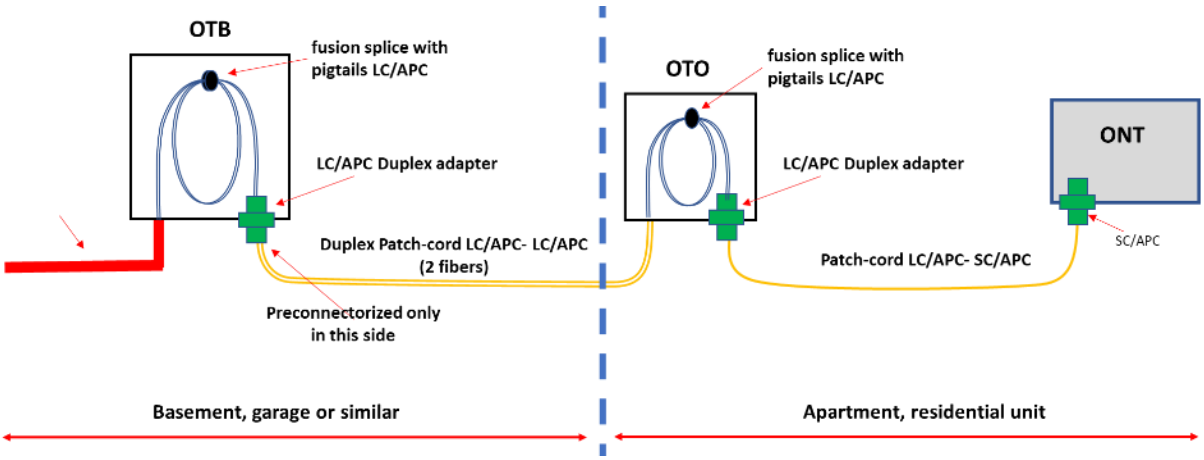


Figure 6. Basic scheme for SFU (Case in which the optical fiber network finishes in the OTO)

If there are no difficulties in passing connectors through walls or storing excesses, the pre-connectorized cable only at one end could be changed to a bi-fiber cable pre-connectorized in both sides, as in the following scheme:

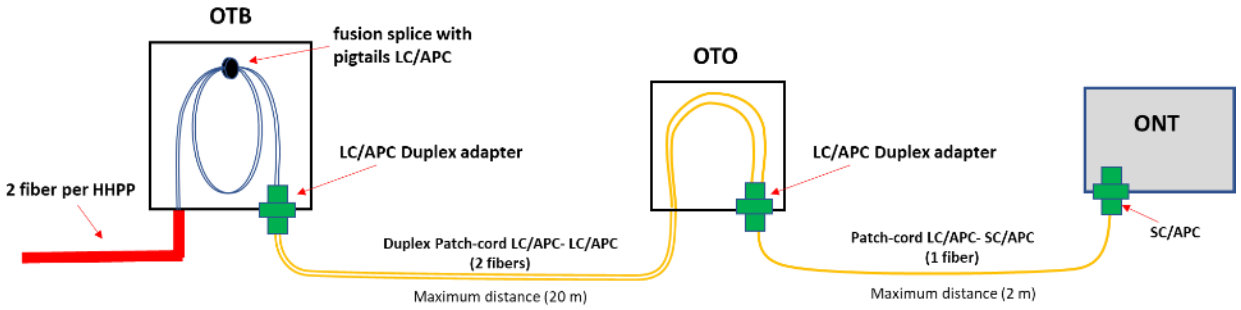


Figure 7. Basic scheme for SFU (the optical fiber network finishes in the OTO) with pre-connectorized fiber in both sides.

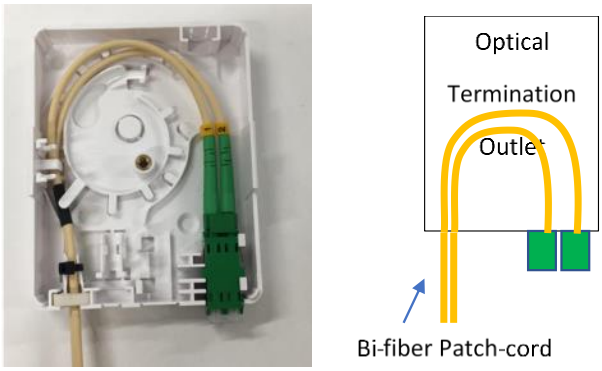


Figure 8. Termination of the bi-fiber patch-cord inside the OTO

In this case, the maximum distance between the OTB and the OTO must be 20 meters.

2.1.2.1 ELEMENTS NEEDED (FOR SFU FINISHING INSIDE THE HOME)

For this type of installation, the following elements are needed:

1. **OTB for SFU**. Optical plastic box, equipped with 1 splice tray, 1 adapter LC/APC duplex and 2 LC/APC pigtails.
2. **Bi-fiber or duplex patch-cord pre-connectorized LC/APC in one side.** To connect the OTB with the OTO
3. **OTO with pigtails.** Optical plastic box equipped with 1 adapter LC/APC duplex and 2 LC/APC pigtails.
4. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side.** To connect the OTO with the ONT equipment.

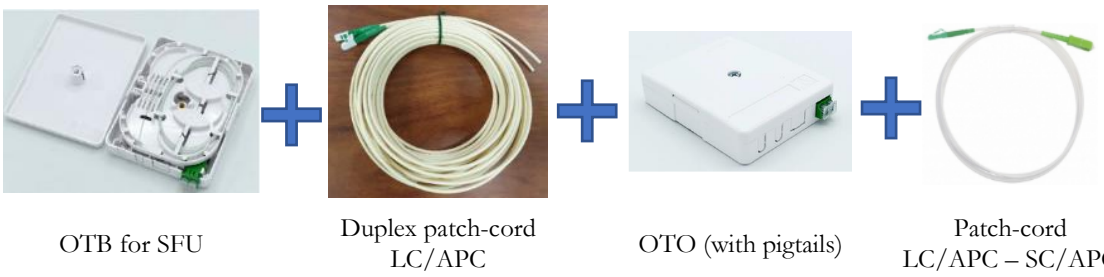


Figure 9. Elements needed for the in-building installation SFU (optical network finished in the OTO)

NOTE: The duplex patch-cord pre-connectorized only in one side, could be changed to the same duplex patch-cord pre-connectorized in both sides. In this case, in the OTO side is necessary to use the model without pigtails.

Figure 10. Bi-fiber patch-cord pre-connectorized LC/APC in both sides

2.2 MDU SCENARIO (UP TO 6 CUSTOMERS)

In the MDU scenario (up to 6 customers), the micro-duct will finish in an OTB with capacity to finish up to 12 fibers. In this scenario the optical fiber network doesn't finish in the OTB and continues until the OTO (Optical Termination Outlet) that will be installed inside each customer house.

A general scheme for this scenario could be seen in the following image:

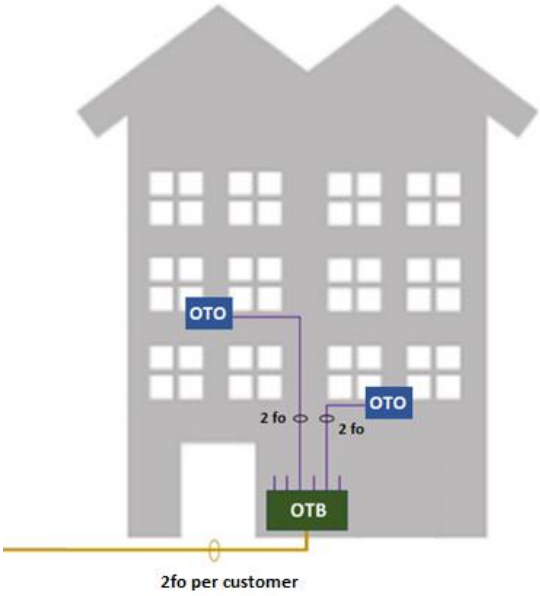


Figure 11. In-Building Termination Scheme (MDUs)

The cabling scheme:

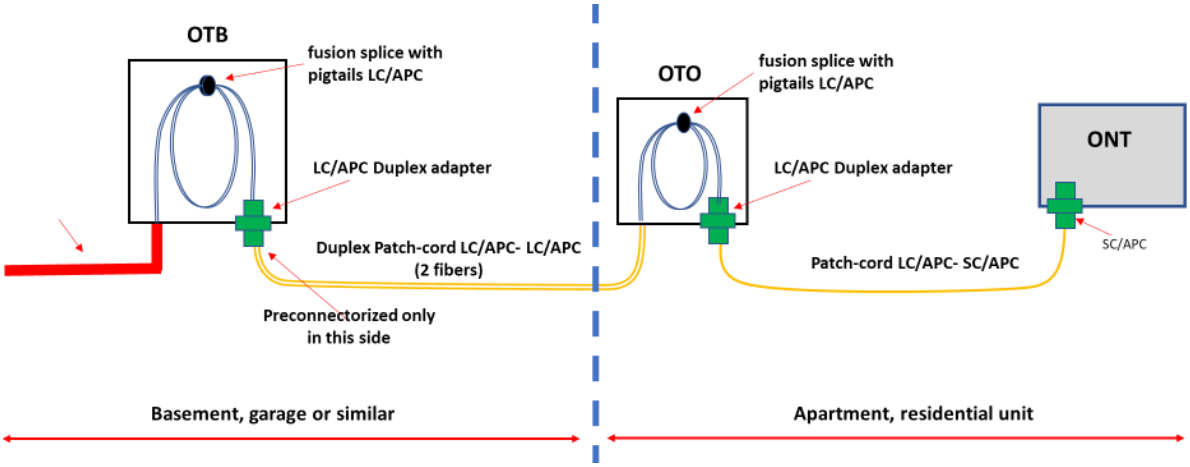


Figure 12. In-building Termination Scheme (MDUs up to 6 customers)

The connection between the OTB and the OTO in the MDU scenarios must be done with bi-fiber patch-cords pre-connectorized only in one side with LC/APC connectors.

Figure 13. Bi-fiber patch-cord pre-connectorized in LC/APC (ONLY 1 SIDE).

The maximum distance between the OTB and the OTO must be 60 meters.

The path to lay this bi-fiber patch-cord must be done by the customer, installing the appropriate gutter or similar that allow an easy and a safe installation for the patch-cord.

It is important that the property of the building prepares the ducts, gutters and registers, needed to allow the pass of the cables through different floors in the building.

If it is necessary to pass the patch cord through a wall, it is important to consider that the free space or the hole diameter must be enough to pass the cable without difficulties.

There are fusion splices inside the OTO, between the fibers of the bi-fiber cable coming from the OTB and 2 LC/APC pigtails.

The ONT (if applicable) will be connected directly to the OTO with a patch-cord of 2 meters.

NOTE: If the building optical network is going to be deployed with more than 2 optical fibers per customer, the building optical network must end in an interconnection box. This interconnexion box can be called Gf-Gv (Glasfaser-Gebäudeverteiler) or BTB (Building Termination Box).

In this case, the connection between the OTB and the BTB must be done using a single fiber patch-cord preconnectorized LC/APC in both ends.

2.2.1.1 ELEMENTS NEEDED (FOR MDU UP TO 6 CUSTOMERS)

For this type of installation, the following elements are needed:

1. **OTB for MDUs (Upgradable up to 6 customers).**
    - Optical plastic box, equipped with 1 splice tray, 4 adapters LC/APC duplex and 8 LC/APC pigtails.
    - **1 Upgrade Kit.** Formed by 2 adapters LC/APC duplex + 4 LC/APC pigtails.
2. **Bi-fiber or duplex patch-cord pre-connectorized LC/APC in one side.** To connect the OTB with the OTO
3. **OTO with pigtails.** Optical plastic box equipped with 1 adapter LC/APC duplex and 2 LC/APC pigtails.
4. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side**. To connect the OTO with the ONT equipment.

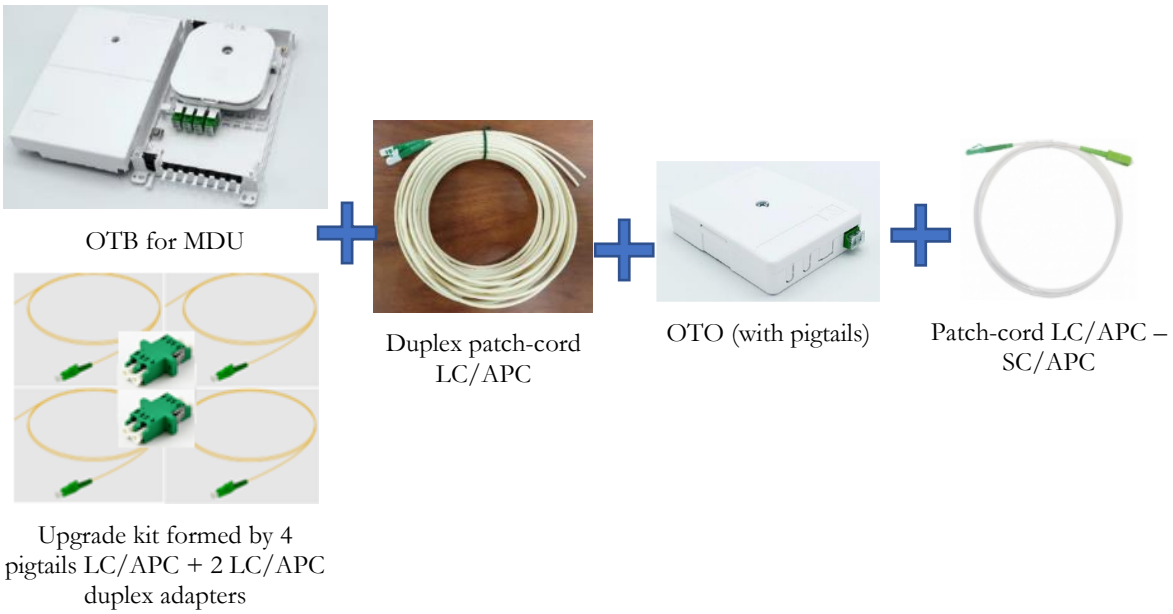


Figure 14. Elements needed for the in-building installation (for MDU up to 6 customers)

2.3 MDU SCENARIO (FROM 7 TO 12 CUSTOMERS)

The architecture for this MDU scenario is like the previous one (defined for up to 6 customers).

The difference is that, in this case, two OTBs are needed to serve the building. The OTBs, could be installed side by side, because the quantity of future cables going out from both boxes is reasonable and it could be managed easily.

If the architecture of the building requires, or if during the stakeout the contractor decide that is better to serve the building though 2 different points, it is possible to install the boxes in different points, in order to minimize the length of the cables that will connect the OTB with the OTOs. This could be done, installing in two different points in the basement.

Each OTB should be fed by an independent 7/4 micro-duct coming from the DP. Each micro-duct will have inside a fiber unit cable with up to 12 fibers count.

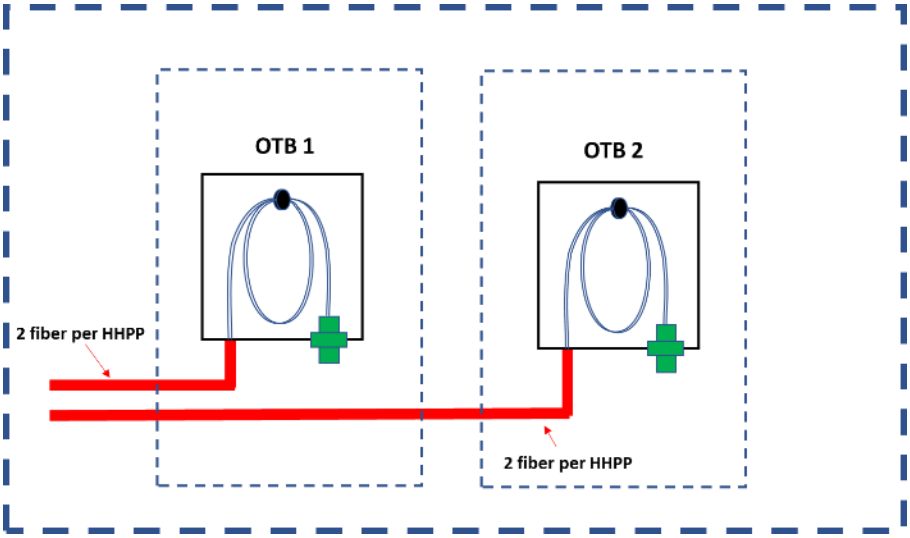


Figure 15. MDU scenario with 2 boxes to serve up to 12 customers.

The connection between the OTB and the several OTOs, will be based on the installation of dedicated bi-fiber cable per customer house. This architecture is based on the "drop on-demand" procedure. This bi-fibre cables will only be installed if the customer contract the service.

The vertical of the building used to pass the cables from the OTB to the OTOs, that will be installed in different customer houses, must be prepared to allow 12 bi-fiber cables to pass through. **Note:** if the OTBs are separated, this load could be divided in two different vertical paths.

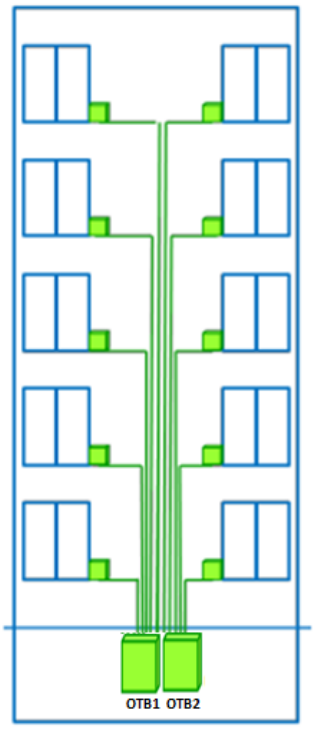


Figure 16. Scheme of the vertical (bi-fibre cable drops on demand)

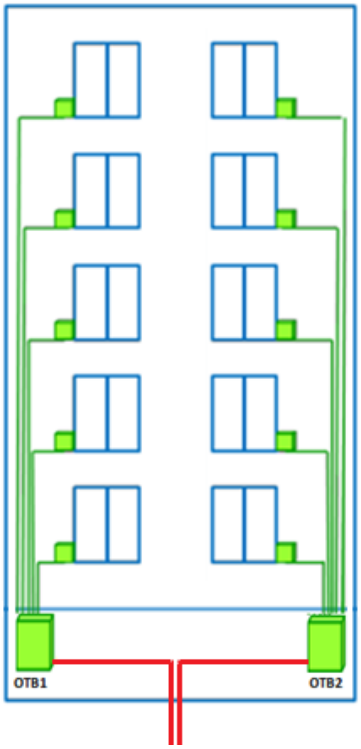


Figure 17. Alternative scheme with 2 verticals (bi-fibre cable drops on demand)

It is important that the property of the building prepares the ducts, gutters, and registers, needed to allow the pass of all the cables through different floors in the building.

The cabling scheme for each OTB is the same that in the MDU scenario for up to 6 customers:

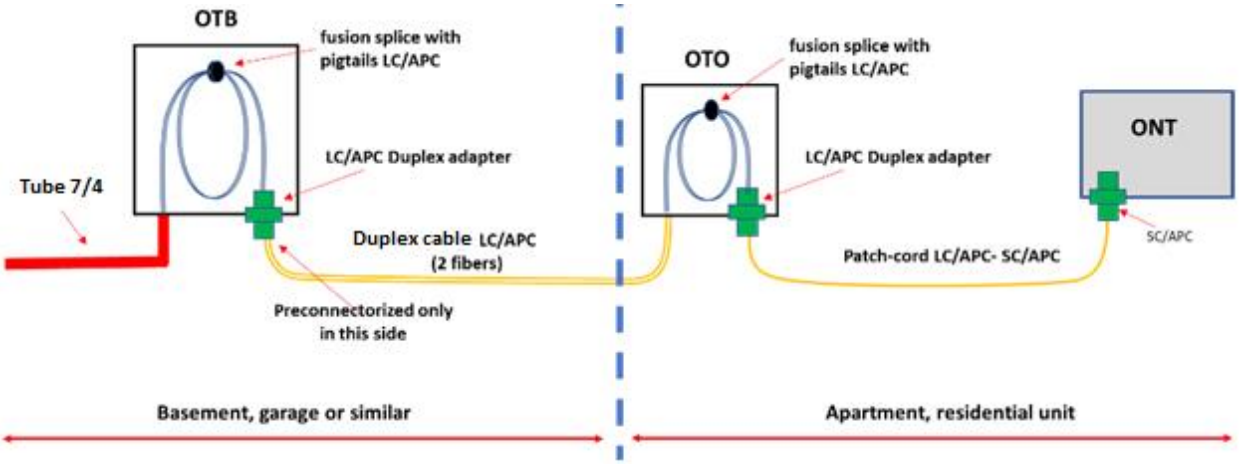


Figure 18. In-building Termination Scheme (MDUs 7-12 customers)

NOTE: The connection between the OTB and the OTO in the MDU scenarios must be done with bi-fiber cable pre-connectorized in one side ONLY with LC/APC connectors.

The maximum distance between the OTB and the OTO must be 60 meters.

The length of this bi-fiber cable must be adequate to the real distance between the OTB and the OTO, to not waste material unnecessarily.

NOTE: since one side is spliced, no overlength is needed to manage.

The path to lay this bi-fiber patch-cord must be done by the customer, installing the appropriate gutter or similar that allow an easy and a safe installation for the patch-cord.

If it is necessary to pass the patch cord through a wall, it is important to consider that the free space or the hole diameter must be enough to pass without difficulties the cable.

The ONT (if applicable) is connected directly to the OTO with a patch-cord of 2 meters.

NOTE: If the building optical network is going to be deployed with more than 2 optical fibers per customer, the building optical network must end in an interconnection box. This interconnexion box can be called Gf-Gv (Glasfaser-Gebäudeverteiler) or BTB (Building Termination Box).

In this case, the connection between the OTB and the BTB must be done using a single fiber patch-cord preconnectorized LC/APC in both ends.

2.3.1.1 ELEMENTS NEEDED (FOR MDU FROM 7 TO 12 CUSTOMERS)

For this type of installation, the following elements are needed:

1. **2 * OTB for MDUs (Upgradable up to 6 customers).**
    - Optical plastic box, equipped with 1 splice tray, 4 adapters LC/APC duplex and 8 LC/APC pigtails.
    - **1 Upgrade Kit.** Formed by 2 adapters LC/APC duplex + 4 LC/APC pigtails.
2. **Bi-fiber or duplex cable pre-connectorized LC/APC in one side.** To connect the OTB with the OTO.
3. **OTO with pigtails.** Optical plastic box equipped with 1 adapter LC/APC duplex and 2 LC/APC pigtails.
4. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side**. To connect the OTO with the ONT equipment.

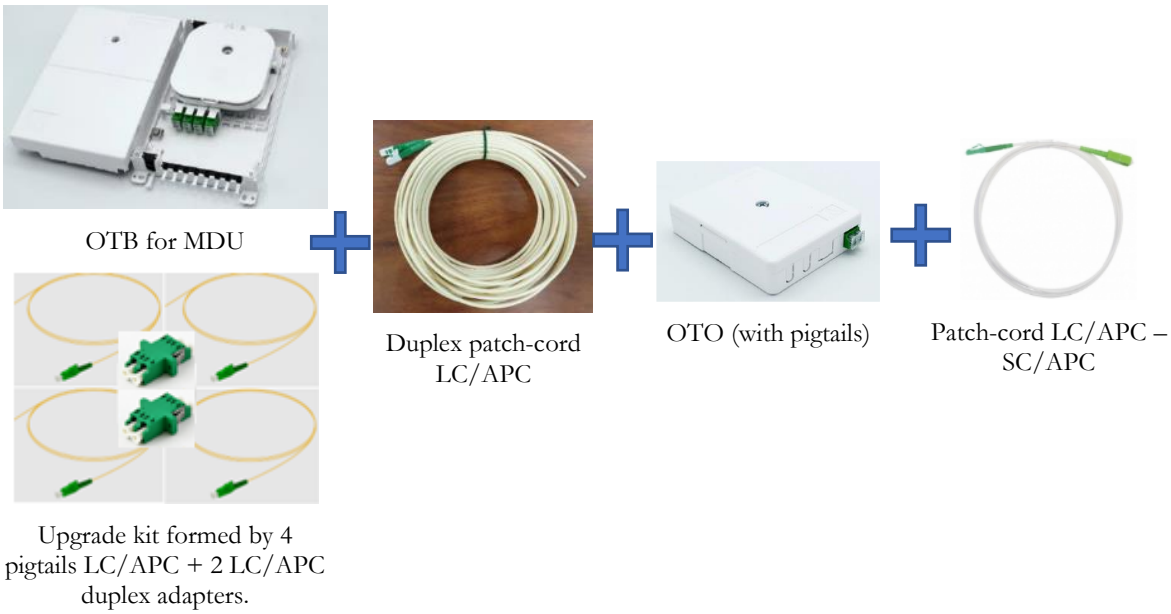


Figure 19. Elements needed for the in-house installation (for MDU from 7 to 12 customers)

2.4 MDU SCENARIO (FROM 13 TO 24 CUSTOMERS)

The architecture for this MDU scenario for more than 12 customers, **needs a different approach**, because the fibers needed to serve the building are too many to pass through a distribution point located in a street cabinet like in the other cases. In this case the approach will be the installation of a distribution point inside the building.

Since for this kind of installation are needed more fibers, it is needed to install a cable with 48 fibers (or more), instead a fiber unit like in other installations. Because of that, it is not possible to use a 7/4 micro-duct. For this purpose, the micro-duct that should be used is a 14/10.

Two 14/10 micro-ducts will be deployed to feed the indoor DP. One of the micro-ducts will have continuity to the POP. The other will be kept as a spare duct.

The UGG network and the building network must be clearly separated and independent, so always, will be at least an optical connector to join both networks.

NOTE: In MDU scenarios from 13 to 48 customers, it is necessary to use 2 indoor DPs with a 96 optical fiber cable pass through the first one. It could also be necessary to use two Gf-Gv elements.

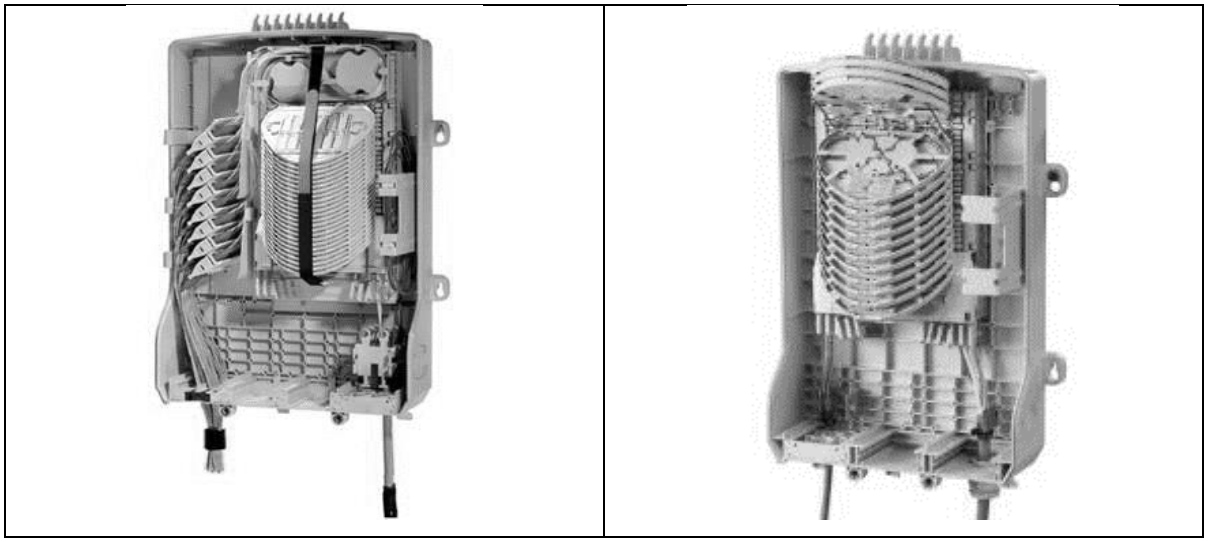


Figure 20. Example of the different elements that could be used as an indoor DP (with connectors and without connectors).

With this quantity of HHPP, different approaches are considered to solve the different cases that could be found in the buildings.

- **On-demand network (Building without optical network deployed).** The same architecture proposed for other MDU scenarios with less customers. A dedicated bi-fiber patch-cord from the indoor DP (connectorized) to each the OTO, deployed in the moment in which the client contracts the service.
- **Building with network deployed.** The building has a network deployed (or is going to have it) between the interconnection point Gf-GV, installed in the basement of the building, to all the homes. At least 2 fibers per home comprised this building network (from Gf-GV to OTO). The interconnection point Gf-Gv, has connectorized all the fibers of the building. UGG install its indoor distribution point (fusion splice type) near the Gf-Gv and makes patching between the boxes.

2.4.1 ON-DEMAND NETWORK (FROM 13 TO 24 CUSTOMERS)

The architecture of the connection between the indoor-DP (connectorized) and the several OTOs, will be based on the installation of a dedicated bi-fiber patch-cords per customer house. This architecture is based on the "drop on demand" procedure. This bi-fibre patch-cords will only be installed if the customer contract the service.

The day of the installation of the drop patch-cord, it is necessary to open the indoor DP and connect with the correct connectors in which the feeder network is terminated.

NOTE: The indoor DP (connectorized) will have 48 optical connectors inside. Also, the box used as indoor DP (connectorized) will have a splice tray per customer (at least 24 splice trays). This is very important for this type of architecture since this feature will reduce the risk of fiber damage during maintenance tasks.

In the other side, in the OTO inside the customer house, it is necessary to make 2 splices between the bi-fiber cable and the 2 pigtails.

The vertical infrastructure of the building used to pass the cables from the indoor-DP to the OTOs, must be prepared to allow 24 bi-fiber cables to pass through. Different vertical paths could be chosen (if the building has them) to minimize the size of the ducts and registers of the building.

A general scheme for this scenario could be seen in the following image:

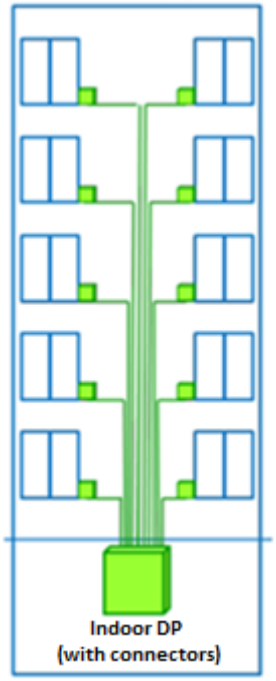


Figure 21. Scheme of the (On demand network)

NOTE: It is important that the building have been prepared with empty ducts, gutters and registers, needed to allow the pass of all the cables through different floors in the building.

NOTE: In MDU scenarios from 13 to 48 customers, it is necessary to use 2 indoor DPs with a 96 optical fiber cable pass through the first one.

The Cabling scheme for the (on-demand network) could be seen in the next picture:

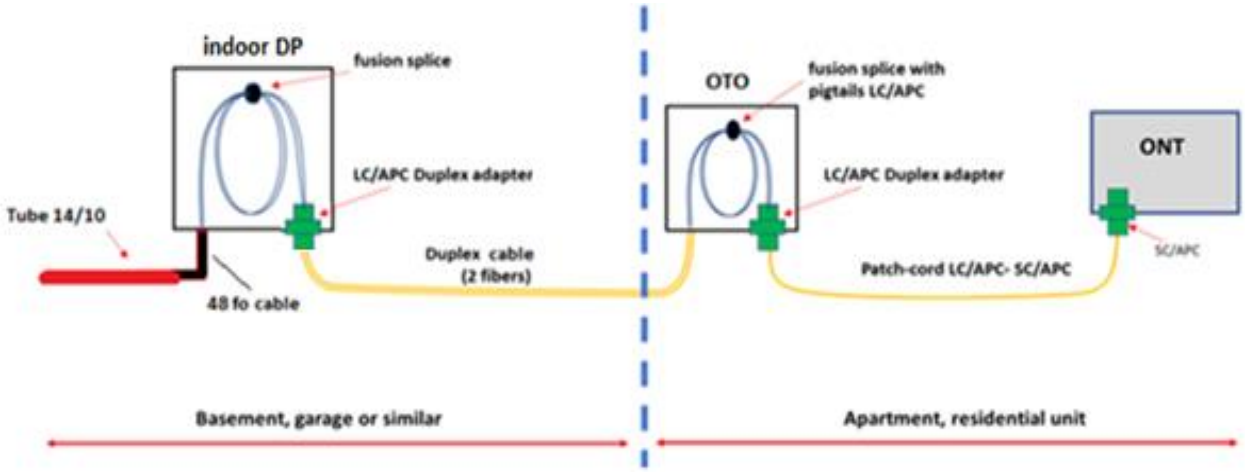


Figure 22. Scheme of connections between indoor-DP and OTO the bi-fiber duplex cable is pre-connectorized.

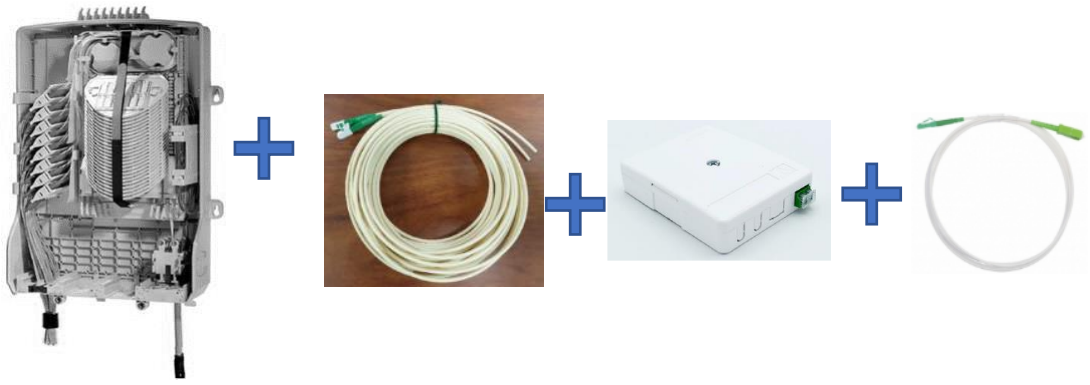
NOTE: the cable used between the indoor-DP (connectorized), and the OTO is pre-connectorized. The cable will be splice only in the OTO side.

The maximum distance between the indoor-DP and the OTO must be 60 meters.

2.4.1.1 ELEMENTS NEEDED (FROM 13 TO 24 CUSTOMERS WITH ON-DEMAND NETWORK)

For this type of installation, the following elements are needed:

1. **Indoor Distribution Point Connectorized (Indoor DP-Connectorized).**
    - Optical plastic box, equipped with 48 LC/APC connectors, 24 LC/APC duplex adapters. 28 splice trays (24+4 splice trays, 1 per customer plus 4 as reserve), output space for up to 24 duplex patch-cords and 2 entries for feeder cables.
2. **Bi-fiber or duplex patch-cords pre-connectorized LC/APC in one side.** To connect the indoor DP (connectorized) with the OTO.
3. **OTO with pigtails.** Optical plastic box equipped with 1 adapter LC/APC duplex and 2 LC/APC pigtails.
4. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side**. To connect the OTO with the ONT equipment.



Indoor DP-connectorized | Duplex patch-cord LC/APC | OTO (with pigtails) | Patch-cord LC/APC – SC/APC

Figure 23. Elements needed for the in-building installation (on-demand network)

2.4.2 BUILDING WITH NETWORK DEPLOYED (FROM 13 TO 24 CUSTOMERS)

In this case, UGG must finish his network in an indoor DP (fusion type) that allows the connection with the Building Termination Box (BTB) or the Gf-Gv (*Glasfaser-Gebäudeverteiler*,).

The network of the building must comply with the following characteristics:

- The Gf-Gv must be installed in the basement of the building.
- From the Gf-Gv to each home, a minimum of 2 fibers must be deployed (point to point).
- All the fibers of the building network must be terminated in LC/APC 8º connectors in both sides (Gf-Gv), and in the OTO (inside each house).
- The total attenuation of the network must be less than 1.5 dB for each fiber.
- The in-building network must be done with G.657.A2 fiber.

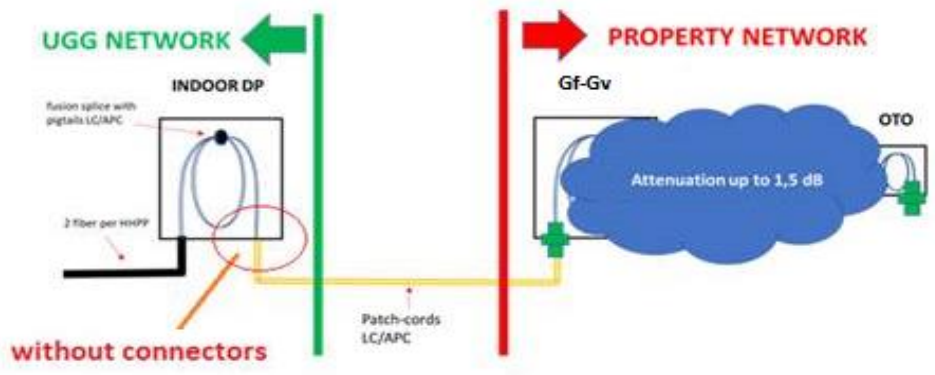


Figure 24. Interconnection scheme between the UGG indoorDP and the Gf-Gv.

To make a connection between the UGG indoor-DP and the fibers of the property network (inside the Gf-Gv box) it is necessary the following:

- Use a bi-fiber pigtail patchcords with connectors in the Gf-Gv side.
- Open the indoorDP (fusion type), and fusion the pigtail fibers with the feeder cable fibers.
- Open the Gf-Gv box (connectorized) and connect with the correct fibers (connectors) of the building network.

NOTE: In MDU scenarios from 13 to 48 customers, it is necessary to use 2 indoor DPs with a 96 optical fiber cable pass through the first one. It could also be necessary to use two Gf-Gv elements.

2.4.2.1 ELEMENTS NEEDED (FOR THE TERMINATION OF THE UGG NETWORK IN BUILDINGS WITH INTERCONECTION POINT (GF-GV))

For the termination of the UGG network and the interconnection with the GF-GV interconnection point with the building network, the following elements are needed:

1. **Indoor Distribution Point (fusion type) (Indoor DP-fusion type).**
    - Optical plastic box, equipped with 28 fusion splice trays (24+4 splice trays, 1 per customer plus 4 as reserve), output space for up to 24 duplex patch-cords and 2 entries for feeder cables.
2. **Bi-fiber or duplex patch-cords pre-connectorized LC/APC in one side only.** To connect the indoor DP (fusión) with the Gf-Gv (connectorized).
3. **Gf-Gv. Interconnection box of the building.**

Indoor DP-fusion | Duplex patch-cord LC/APC | Gf-Gv. Building termination box.

Figure 25. Elements needed for the interconnection in buildings with network deployed

2.4.2.2 BUILDING NETWORK ARCHITECTURES

The architecture of the building network can vary depending on the building type, the size and other circumstances.

In the next paragraphs will be shows different options for the building network if UGG is in charge to do it for the property.

Two main architectures will be covered: riser architecture, and dedicated drops architecture (star topology).

If the building network is not deployed by UGG, different architectures, elements and configurations are possible.

2.4.2.2.1 RISER ARCHITECTURE

The architecture of the connection between the Gf-Gv and the OTOs, will be based on two sections. The first section is formed by a riser cable (shared by all the customers) that will be installed running along the vertical of the building, and the second section dedicated for each customer, that will connect the riser to the customer house.

The first section (the riser cable) must be deployed passing all the different floors of the building, a floor distribution box (FDB) should be installed to reserve fibers in this points to serve some part of the apartments of the same floor, or adjacent also.

The second section will be deploying individually from the floor distribution box to each house. This will be done with a bi-fibre patch-cord that will connect the riser cable (in the FDB) with the OTO that must be installed inside the customer house.

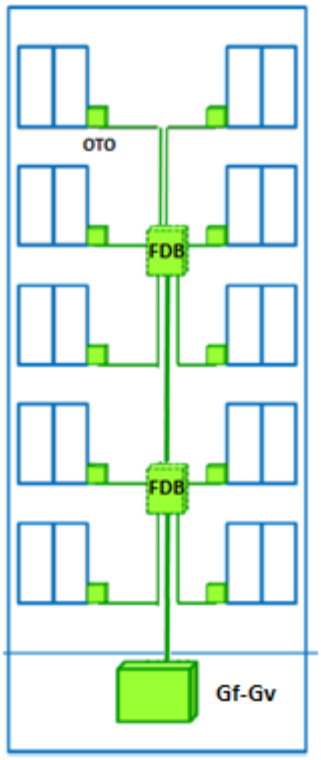


Figure 26. Riser cable architecture

NOTE: It is important that the building prepare the ducts, gutters, and registers, needed to allow the pass of all the cables through different floors in the building and from the different floors to each apartment.

The riser cable is spliced with the LC/APC pigtails included in the box used as Gf-Gv that must be installed in the basement.

The riser cable runs the vertical of the building. The cable riser pass through all the "fiber distribution box" (FDB) that are deployed in the vertical. The riser cable fibers that serve FDBs sited in upper floors pass through each FDB without splices. The fibers that are reserved in each FDB to serve their own floor (or adjacent if the project indicates this) are spliced inside the FDB with pigtails and are finished into connectors (LC/APC type).

From the FDB to the OTO a duplex cable pre-connectorized LC/APC (only in one side), will be installed.

The Cabling scheme for the building network with riser cable architecture could be seen in the next picture:

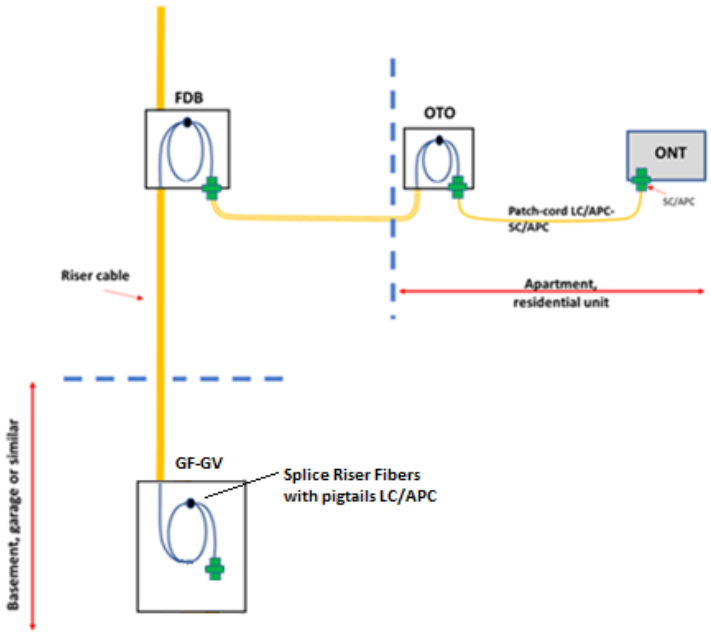


Figure 27. Scheme of a Building network with riser cable architecture

2.4.2.2.1.1 ELEMENTS NEEDED (FOR BUILDING NETWORK WITH RISER CABLE ARCHITECTURE)

For this type of installation, the following elements are needed:

1. **Building interconnection box pre-connectorized (Gf-Gv).**
    - Optical plastic box, equipped with 48 LC/APC connectors, 24 LC/APC duplex adapters. 28 fusion splice trays (24+4 splice trays, 1 per customer plus 4 as reserve), output space for up to 24 duplex patch-cords and 4 entries for riser cables.

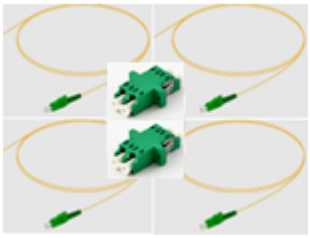
    NOTE: the box proposed to be used as building interconnection box (Gf-Gv) is the same element that is indicated as indoor DP connectorized.

2. **Riser Cables.** Riser cables to serve the building and to create all the verticals that could be needed.
5. **FDBs.** Optical plastic box Upgradable up to 8 duplex connectors. Equipped with 1 splice tray, 4 adapters LC/APC duplex and 8 LC/APC pigtails.
    - **1 Upgrade Kit.** Formed by 2 adapter LC/APC duplex + 4 LC/APC pigtails.

    NOTE: The FDB is the same element that the OTB for MDUs and it could be upgraded up to 8 duplex connectors if it is needed. In this case, there are no limitation related with the cable that serves the box (in the OTB is limited by the FU with 12 fibers).

3. **Bi-fiber or duplex cable pre-connectorized LC/APC (only 1 side).** To connect the indoor FDB with the OTO.
4. **OTO with pigtails.** Optical plastic box equipped with 1 adapter LC/APC duplex and 2 LC/APC pigtails.
5. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side**. To connect the OTO with the ONT equipment.

FDB

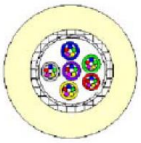


Upgrade kit formed by 4 pigtails LC/APC + 2 LC/APC duplex adapters

Duplex patch-cord LC/APC

OTO (with pigtails)

Patch-cord LC/APC – SC/APC



Riser Cable

Building interconnection box with connectors **(Gf-Gv)**

Figure 28. Elements needed for the in-house installation with the riser architecture

2.4.2.2.2 DEDICATED DROPS ARCHITECTURE (STAR TOPOLOGY)

The connection between the Gf-Gv (connectorized) and the several OTOs, will be based on the installation of a dedicated duplex cables or microducts with fibers inside (star topology).

All the infrastructure and the cables are installed the day 1. It is different from the on-demand network mentioned before in the document.

NOTE: The Gf-Gv will have 48 optical connectors inside. Also, the box used as Gf-Gv (connectorized) will have a splice tray per customer (at least 24 splice trays).

In the other side, in the OTO inside the customer house, it is necessary to make 2 splices between the fibers of the drop cable and the 2 pigtails included in the OTO.

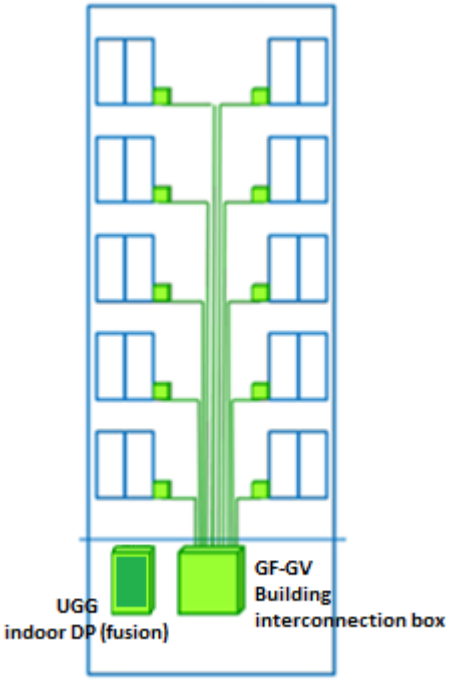


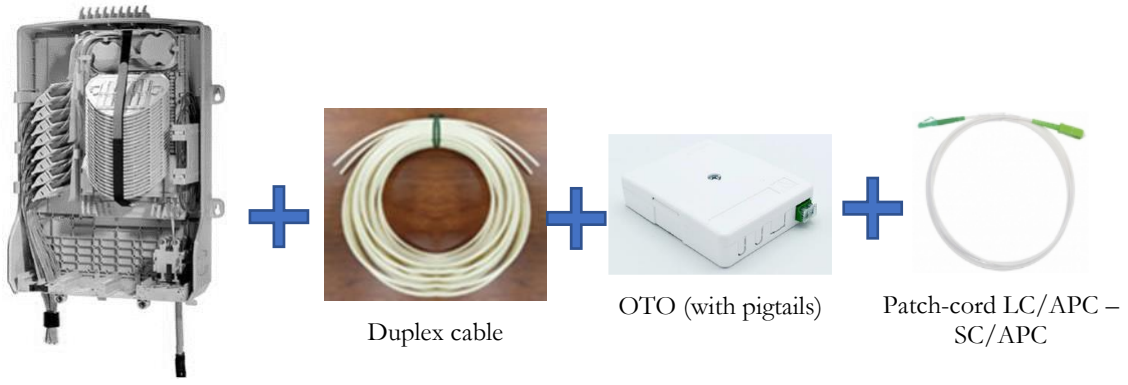
Figure 29. Dedicated drops architecture

2.4.2.2.2.1 ELEMENTS NEEDED (FOR BUILDING NETWORK WITH DEDICATED DROPS ARCHITECTURE)

For this type of installation, the following elements are needed:

1. **Building interconnection box pre-connectorized (Gf-Gv).**
    - Optical plastic box, equipped with 48 LC/APC connectors, 24 LC/APC duplex adapters. 28 fusion splice trays (24+4 splice trays, 1 per customer plus 4 as reserve), output space for up to 24 duplex patch-cords and 24 entries for duplex cables or microducts 7/4.

    NOTE: the box proposed to be used as building interconnection box (Gf-Gv) is the same element that is indicated as indoor DP connectorized.
2. **Drop fiber cables (2 options):**
    - **Bi-fiber or duplex cable:** direct install inside empty ducts, to connect the Gf-Gv with the OTOs.
    - **Indoor microduct 7/4 + FU (2 fibers):** dedicated microduct for each house, connecting the Gf-Gv with the OTOs + blowing of FU of 2 fibers inside each microduct.
3. **OTO with pigtails.** Optical plastic box equipped with 1 adapter LC/APC duplex and 2 LC/APC pigtails.
4. **Single fiber patch-cord pre-connectorized LC/APC in one side and SC/APC in the other side**. To connect the OTO with the ONT equipment.



Building interconnection box with connectors **(Gf-Gv)**

Duplex cable

OTO (with pigtails)

Patch-cord LC/APC – SC/APC

Figure 30. Elements needed for the in-building installation (dedicated drops architecture) – option 1

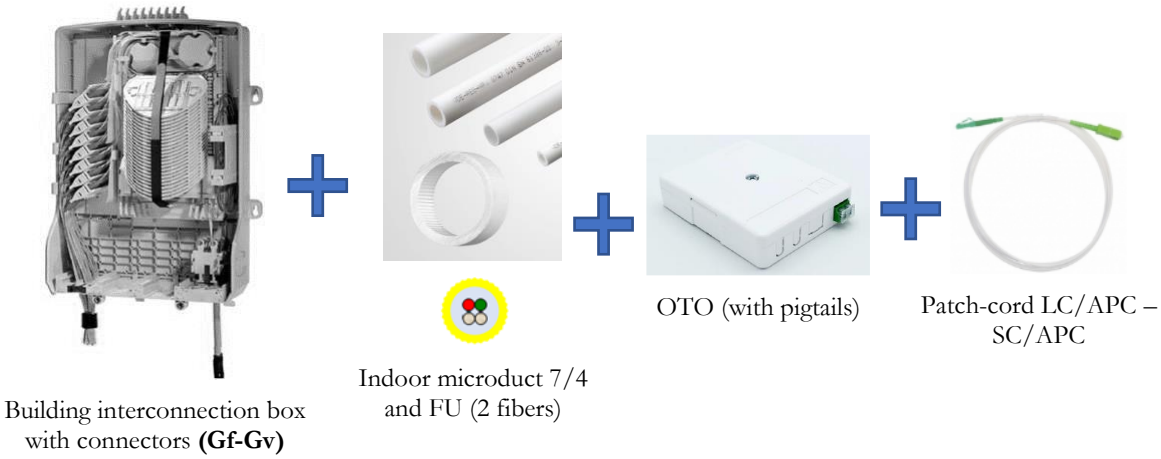


Figure 31. Elements needed for the in-building installation (dedicated drops architecture) – option 2

2.5 TYPE OF IN-BUILDING INSTALLATION DEPENDING OF HHPP

This table resume the type of installation and the cables that should be used in each case.

Number of HP in the building	**Micro-ducts**	**Fiber Unit/Cable**	**Type of in-house fiber termination**	**Architecture**
1	1 x 7/4	1 x 2 fo	OTB or OTB + OTO	Drop on demand
2-4	1 x 7/4	1 x 8 fo	OTB + OTO	Drop on demand or Building network
5-6	1 x 7/4	1 x 12 fo	OTB + OTO	Drop on demand or Building network
7-12	2 x 7/4	2 x 8 fo or 1 x 12 fo + 1 x 8 fo or 2 x 12 fo	OTB + OTO	Drop on demand or Building network
13-24	2 x 14/10	1 x 48 fo	IndoorDP Connectorized + OTO or IndoorDP (fusion) + Gf-Gv	Drop on demand or Building network
25-48	2 x 14/10	1 x 96 fo (Pass through)	2 x IndoorDP Connectorized + OTO or 2 x IndoorDP (fusion) + 2 x Gf-Gv	Drop on demand or Building network

3. IN-BUILDING INSTALLATIONS REQUIREMENTS

In the previous chapters, different architectures for the in-building optical network termination have been presented, based mainly in the quantity of potential customers that has the building and the physical infrastructure available to do the installation.

Nevertheless, other aspects must also be considered as can be the compliance with the fire prevention regulations.

To understand well this, it is necessary to include some information about the German regulation regarding the building classifications, the different network parts, and the main fire regulations applicable.

3.1 TYPES OF BUILDINGS AND IN-BUILDING FIBER NETWORK

The Federal Building Regulations (MBO, *Musterbauordnung*) and the Regional Technical Building Regulations (LBO, *Landesbauordnung*) define **6 different building classes** based on the dimensions -height and area-, number of house units and the primary usage.

For the purposes of this building classification:

- **Height** is the measurement of the upper edge of the floor (UFE) of the highest storey in which an occupied room is possible, above the ground surface on average.
- The **floor areas** of the units of use are the gross floor areas; areas in basements are not considered when calculating the total gross floor areas.

The six building classes are:

- **Building Class 1**

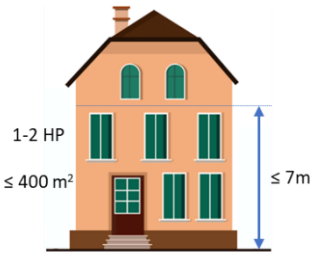
  a) Free-standing buildings with a height of up to 7 m. and no more than two homes, totalling not more than 400 m²,

  b) Free-standing buildings used for agriculture or forestry

CLASS 1: Free-standing building

- **Building Class 2**

  Buildings with a height of up to 7 m. and not more than two homes, with no more than 400 m² in total



CLASS 2: Small single or dual home

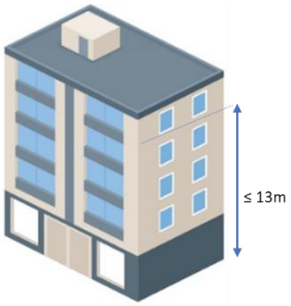
- **Building Class 3**

Other buildings (with more than 2 homes or 400 m²) but with a height of up to 7 m.

CLASS 3: Small multi-dwelling building

- **Building Class 4**

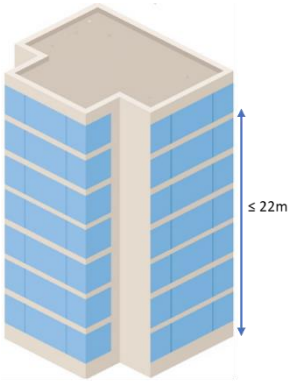
Buildings with a height of up to 13 m. and use units with no more than 400 m² each



CLASS 4: Medium size multi-dwelling unit

- **Building Class 5**

Oher buildings, including underground buildings, with a height of up to 22 m. and not included in the category of 'Special Buildings' or Classes 1 to 4.



CLASS 5: Other multi-dwelling buildings

- **Special Buildings**

Special Buildings include, but are not limited to, the following facilities and spaces:

a) High-rise buildings (residential buildings exceeding 22 m),

b) Structures exceeding 30 m,

c) Buildings with more than 1.600 m² of floor area of the floor with the largest extension, excluding residential buildings and garages and rooms and buildings for bicycle storage,


SPECIAL BUILDINGS

d) Sales outlets whose salesrooms and shopping streets have a total floor area of more than 800 m²,

e) Buildings with rooms that serve an office or administrative use and individually have a floor area of more than 400 m²,

f) Buildings with rooms which are individually intended for use by more than 100 persons,

g) Places of assembly

h) Pubs and restaurants with more than 40 seats indoors or more than 1000 seats outdoors, lodging establishments with more than 12 beds and amusement arcades with more than 150 m² floor space,

i) Buildings with use units for the purpose of care or support of persons in need of care or with disabilities,

j) Hospitals,

k) Installations and premises not listed in these specifications but whose nature or use is associated with comparable hazards.

3.2 FIRE PROTECTION REQUIREMENTS

For years, the requirements for building safety and fire protection in buildings have increased continuously.

Network planners, surveyors and construction teams must have a good knowledge of fire protection regulation and techniques and follow periodic refresh courses to be permanently updated. This is critical to achieving safe and quality in-building fiber network designs installed on fully qualified infrastructures.

Fire protection requirements apply to materials, infrastructure elements and installation procedures. The following paragraphs provide an overview of the applicable regulations. The list is not exhaustive and is constantly updated, so it is the reader's responsibility to complement it by reading the Normative in full, through the links provided at the end of this section and other specific links available for each region or locality.

3.2.1 FIRE PROTECTION REQUIREMENTS FOR THE INSTALLATION OF FIBRE IN MDUs

As per the Federal Building Regulations (MBO, *Musterbauordnung*), special legal requirements for the installation of fibre optic in buildings apply **in escape routes and through room-enclosing building components**. According to MBO Section 3, the regulations serve to avoid dangers to public safety and order, in particular to life and health, caused by fire or smoke.

Fire protection regulations are specific for each building class. The following paragraphs provide a summary of the general regulations applicable to each building class. Depending on the location of the building, additional Regional Technical Building Regulations (LBO, *Landesbauordnung*) or also Local Regulations can apply.

MLAR (Model Guideline on Fire Protection Requirements for Line Installations) is a building code for fire protection for pipelines and electrical installations issued by the German construction minister conference. The code is applicable in conjunction with MBO and LBO to the construction of in-building fiber networks and infrastructure.

In general, MBO stipulates that structural installations must be arranged, erected, modified and maintained in such a way that **the development of a fire and the spread of fire and smoke is prevented**, and in the event of a fire the rescue of people and animals and effective extinguishing work is possible.

1. Building Class 1 and 2.

No fire protection regulations apply to installations through room-enclosing building components. Fibre optic cables may also be laid openly in escape routes.

Rating: Fire-retardant for Class 2, no requirements for Class 1

Standards: MBO Sec. 40 (1) No. 1, MLAR Sec. 3.2.1 c)

2. Building Class 3, 4 and 5. Special buildings.

There are special regulations on the permissibility of laying cables with regard to:

- **Laying in escape routes** (MBO Sec. 40(2))

  To lay cables in escape routes (necessary stairwells and rooms, and required corridors) the cables must be relocated:

  - Individually or arranged next to each other fully plastered.
  - In slots in solid building components sealed with mineral plaster at least 15 mm thickness on a non-combustible plaster base or with boards of mineral building materials at least 15 mm thickness.
  - Within at least fire-resistant walls of lightweight construction, but only cables which serve exclusively to supply the electrical equipment located in and on the wall.
  - In installation shafts and ducts according to MLAR Sec. 3.5 (in general I30 cable ducts).
  - Above suspended ceilings.
  - In underfloor ducts.
  - In system floors (special requirements apply)

  The above-mentioned restrictions are only applicable to buildings Class 4, 5 and Special Buildings.

- **Laying through room-enclosing building components** (MBO Sec. 40(1)).

If possible, separate openings in accordance with MLAR Sec. 4.3.2 must always be made to pass fibre optic through room-enclosing building components, bypassing existing bulkheads. Openings must not be larger than necessary. The annular gap between cable and component must not be wider than 15 mm. After occupancy, the openings must be sealed with approved materials.

Within this framework, empty conduits with/without occupancy may also be passed through components with fire resistance requirements and sealed off as described. The ends of the empty conduits must be sealed on both sides with loose mineral wool, to prevent smoke transmission.

Rating: Fire-retardant for Class 3, Highly fire-retardant for Class 4, Fire-resistant for Class 5.

Standards: MBO 27-31, 35f & 40. MLAR Sec. 4.1, 4.2 and 4.3.

Concluding from the regulations, **all fiber optic in-building networks** (including cables and passive components) **may be installed openly** in buildings of building Classes 1 to 5 and in Special Buildings in the following areas without restriction.

- In all apartments/utility units.
- In all cellar rooms/adjoining rooms.
- In all basement corridors that are not necessary corridors (necessary corridors are only required for connected recreation rooms.
- In decommissioned fire-resistant chimneys (further requirements to be observed).
- In installation shafts with fire resistance requirements.
- In elevator shafts that form their own fire compartments (not in connection with fire brigade elevators). The installation must always be carried out in sheet metal ducts.
- On exterior walls.
- In the case of penetration through third-party dwellings/occupancy units, if the partitioning takes place in the partition walls and story ceilings.
- Garages.
- In connection with concealed electrical conduits / micro conduits, the installation of fiber optic cables is always permitted.

Finally, the laying of fibre optic cables is **always prohibited** in:

- Elevator systems and their anterooms.
- Safety stairwells and their anterooms.

3.2.2 FIRE PROTECTION AND BUILDING REGULATIONS

Some recommendations and normative to be complied with according to current regulations (as per the document edition date) are compiled in the table below. The list is not exhaustive, other regional or local regulations may be applicable as well to each specific building location. Check always for specific regulations that may apply on each case.

MBO - 2002 version, last amended by the Buildings Supervisory Commission in 2019
LBO - *Landesbauordnungen* based on the MBO, published by the Länder
MVV TB - Model Administration Regulations Technical Construction Regulation 2019/1 incl. of the relevant Annexes
VV TB - Administrative Regulations Technical Building Regulation based on MVV TB 2017/1 or 2019/1, as announced in countries
MLAR - Pipeline Directive Model 2016
LAR - Pipeline Directive based on MLAR 2005/2016, published in countries
Model Special Building Ordinances/Special Building Guidelines, for example. B. for sales, hosting and Event Venues Ordinance, Garage, Skyscraper Ordinance, School Construction and Industrial Construction Directive

Model special building regulations/special building guidelines, as before, but in published versions
MFeuV - Model Combustion Ordinance
FeuV - Combustion Ordinance, announced by the Länder
MEltbauVO - Model Ordinance on the Construction of Electric Operating Rooms
EltbauVO - Ordinance on the construction of electric operating theatres, announced by the Länder
DIN 4102-1:1998 Reaction to fire of building materials and components - Part 1: Building materials; Terms, requirements and tests
VDE 800 - Telecommunications technology, construction and operation of plants
DIN 50174 (VDE 0800-174) - Information technology - Installation of communication wiring (moving from external cables to internal cables)

The following links to the main German telecommunications actors and entities can be consulted for other specific information and further details:

- Federal Ministry of Transport and Digital Infrastructure (*Bundesministerium für Verkehr und digitale Infrastruktur*, BMVI). Responsible for broadband development and implementation of the Federal Government's broadband strategy.
- Federal Ministry of Economics and Energy (*Bundesministerium für Wirtschaft und Energie*, BMWi). Promotes the main areas of digital infrastructure and transport infrastructure.
- Federal Agency for Electricity, Gas, Telecommunications, Post and Rail Networks (*Bundesnetzagentur*). Part of the Federal Ministry of Economics and Energy, it is responsible for implementing the regulatory framework laid down in national and EU legislation.
- Federal Gigabit Office (*Gigabitbüro des Bundes*), part of the Federal Ministry of Transport and Digital Infrastructure, has been designated the national broadband authority. It liaises with the competent broadband centres in the Länder.
- Network Alliance for a Digital Germany (*Netzallianz Digitales Deutschland*) represents a network of leading telecommunications companies willing to invest and innovate. It is expected to invest more than ten billion euros in broadband deployment in Germany by 2021.

3.3 INFRASTRUCTURE REQUIREMENTS FOR "ON-DEMAND" SCENARIOS

For the cases of SFU, MDU up to 12 customers, and in some cases for the MDU up to 24 customers, the preferred architecture is based in a star shape topology.

As was mentioned before, the idea is deploying a bi-fiber pre-connectorized cable to each home in the moment in which the customer signs the contract. **To do that, it is necessary to have empty infrastructure (corrugated ducts, gutters, etc) already available in the building joining the OTB/indoorDP room with each home of the building.**

If there is no availability of this basic infrastructure, will be needed to install by the owner following the indications or specifications of UGG complying with all the standards and regulations applicable (specially the fire protection requirements).

3.3.1 CONSIDERATIONS FOR SFU AND MDU UP TO 2 HOMES

Generally, for the SFU and the MDU up to 2 homes, there is no special requirements to the indoor fiber deployment, due to the building classification and the fire protection requirements applicable. So, for these cases, the cables can be laid without a specific infrastructure, and can be installed openly attached to the walls, covered (just in case) by tubes or gutter channels according to the owner preferences. Only special attention to the ceiling/floor openings must be considered (that should be closed professionally with fire-approved products after the installation). The owner should prepare the paths to deploy the fiber from the OTB to the OTO easily.

3.3.2 CONSIDERATIONS FOR MDU FROM 3 TO 24 HOMES

The MDU scenarios between 3 and 24 homes, are more complex due to the quantity of cables to be deployed and to the fire protection requirements applicable.

In these cases, UGG will install the OTB or the indoorDP in the basement. Generally, the OTB or the indoorDP will be installed at a maximum distance of 2 meters to the point through the fiber came into the building (the entry drilling).

From the point of installation of the OTB or the indoorDP, it should be available a channel (a plastic gutter, or also protection tubes are valid: corrugated or rigid) to reach the empty corrugated ducts of the vertical of the building. **NOTE:** generally, there is no special fire prevention requirements in the basement but this fact must be assured case by case.

This gutter can be a standard one, with a dimension that allow the installation of all the cables comfortably inside (for example 45x100 mm or bigger dimensions).

Figure 32. Example of a standard gutter channel

In the next image an example of gutter joining the OTB/indoorDP with the register that has access to the building vertical.

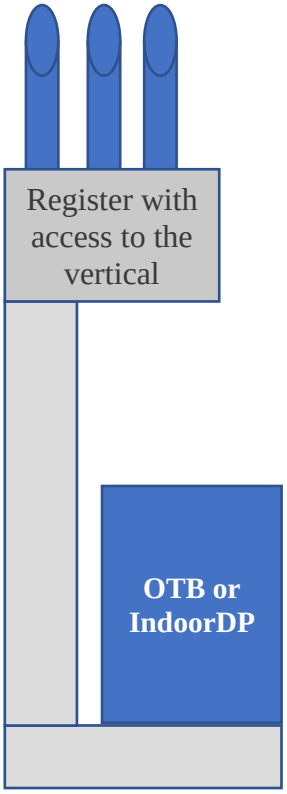


Figure 33. Example of gutter path to join the OTB/indoorDP with the register to access to the vertical.

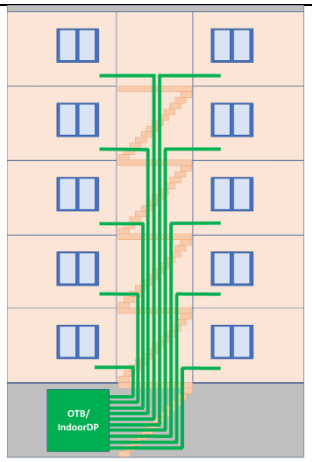
If the vertical has empty ducts, or ducts with enough space to deploy the fiber cables, the preference is to use it (with the previous consent of the owner).

If there is no free space in the vertical ducts or even there is no ducts in the building, the owner must install the infrastructure according to the UGG requirements and complying with all the fire prevention regulations applicable.

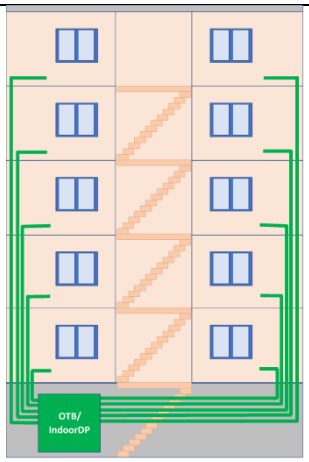
Considering the fire requirements, different paths with different requirements could be considered to deploy the basic infrastructure in the building. Depending on the complexity to execute each solution (this should be evaluated with a previous inspection) and taking into consideration the time and the cost, the most benefit solution should be selected.

There are two main approaches to deploy the infrastructure paths needed once the basement is passed:

- Deployment through escape routes
- Deployment through room-enclosing building components



Deployment throught escape routes



Deployment through room-enclosing building compo-nents

Figure 34. Infrastructure examples layout for "on demand" scenarios

3.3.3 DEPLOYMENT THROUGH SCAPE ROOMS

In this scenario, there is a huge limitation to deploy the cables and the ducts due to the fire prevention regulation. As was mentioned before in the chapter 3.2, it is not permitted the installation of the cables or the conduits openly.

The cables or ducts must be installed inside the walls (in appropriate channels, or recessed), covered always with at least 15 mm of plaster.

An alternative is to install metallic ducts or channels that are incombustibles on the wall.

Figure 35. Example of metallic channel/duct

These metallic channels can be installed openly on the walls, and inside can be installed, corrugated tubes or directly the optical fiber cables.

Both options could be valid, if there is enough space to deploy all the drops cables needed.

The corrugated tube recommended is the M25 (25/17 mm, outer/inner diameter). Bigger dimensions are also valid.

Figure 36. Example of corrugated tube

The deployment of these types of corrugated tubes must avoid curves with less radius than 60 mm.

In the different plants, registers must be created (if there are not available) to join the vertical trunk with the horizontal paths needed to reach each apartment.

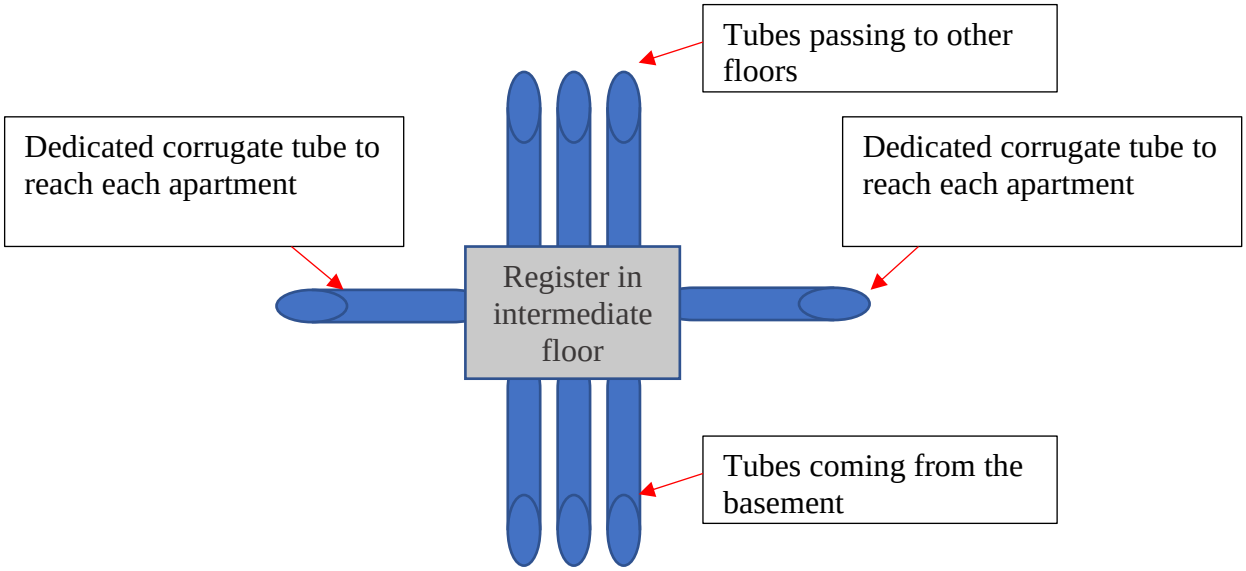


Figure 37. Example of register in intermediate floor to distribute the paths to each apartment.

IMPORTANT: All the dedicated corrugate tubes, and the registers must be installed inside the walls (recessed covered by 15 mm thickness plaster or similar) or inside false ceiling (if it is available).

3.3.3.1 REQUIREMENTS INSIDE THE HOMES

Once the network reaches the inner part of the apartment, the installation can change to standard gutter channels, installed openly on the surface walls if necessary.

The gutter that can be used to guide the fiber inside the house could be an auto-adhesive standard gutter channel with a dimension of 30x15 mm. **NOTE:** a bi-fiber cable with figure 8 section and dimension of 3x6 mm must pass through.

The channel gutter can be installed following the baseboard of the wall to the position desired by the customer. **NOTE:** The path should avoid as much as possible the corners.

3.3.4 DEPLOYMENT THROUGH ROOM-ENCLOSING BUILDING COMPONENTS

In this scenario, the limitation due to the fire prevention normative is different and less restrictive than in the previous case. The main difficulty for these cases is to have the permits of all the owners of the apartments affected for the installation of the infrastructure.

The preferred solution is to install individual corrugated tubes for each apartment, passing through one apartment to the other from the basement of the building to the last flat of the building.

The tubes should be installed inside channels if they are available. New channels can be created with standard channel gutters with the previous consent of the owner. These channels should be installed in corners, and in places without transit if it is possible.

The pass from one floor to other must be sealed according to the fire prevention normative.

The recommended corrugated tube is the M25 (25/17 mm, outer/inner diameter).

3.3.4.1 REQUIREMENTS INSIDE THE HOMES

Once the ducts reach the desired apartment, the corrugate tubes can be changed to a standard gutter channel, installed openly on the surface walls.

The gutter that can be used to guide the fiber inside the house could be an auto-adhesive standard gutter channel with a dimension of 30x15 mm. **NOTE:** a bi-fiber cable with figure 8 section and dimension of 3x6 mm must pass through.

The channel gutter can be installed following the baseboard of the wall to the position desired by the customer. **NOTE:** The path should avoid as much as possible the corners.

3.4 INFRASTRUCTURE REQUIREMENTS FOR NOT ON-DEMAND SCENARIOS

As was mentioned before, other MDU situation is a building that has a complete network deployed (NE 4), from the Gf-Gv or Building Terminal Box, to each apartment (to each OTO) with at least 2 fibers per each.

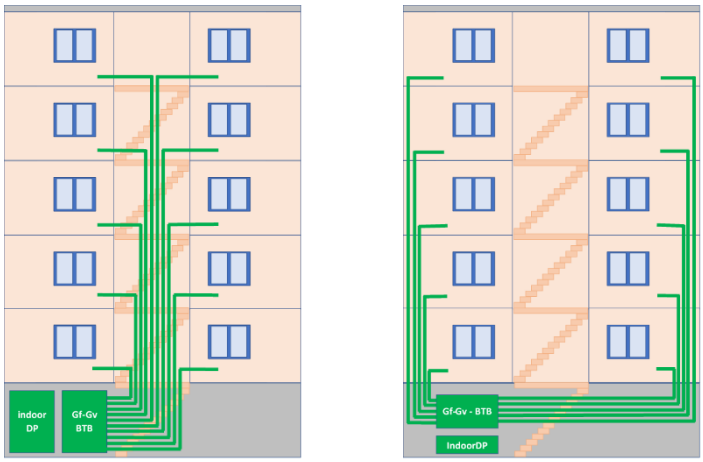
In this case the network is finished in both sides (Gf-Gv, and OTO) in LC/APC connectors.

There are a lot of alternatives to deploy the network in the building. It is possible to deploy a star shape topology (similar to the on-demand scenarios presented before, but installing the fiber the day one, and finishing the network in the Gf-Gv or BTB), or a riser architecture topology, using riser cables and FDBs (fiber distribution boxes) in some floors, and drop cables to each apartment.

Depending on the architecture selected to do the NE4, different physical infrastructure will be needed to deploy previously.

3.4.1 DEDICATED DROPS ARCHITECTURE - STAR TOPOLOGY

If the star shape topology is selected, basically the same schemed presented before for the "on demand" scenario almost valid. The only change is that in the basement the box in which the infrastructure is finished is the Gf-Gv instead of the OTB or indoorDP.



Deployment throught escape rooms (neccesary stairways)

Deployment throught room-enclosing building components

Figure 38. Infrastructure examples layout for dedicated drops architecture (star topology

The Gf-Gv or BTB should be installed in a position that can be easily reachable for the operators with their networks. It must be installed with enough space around to allow the installation of the operator box, and in the case of UGG, the OTB or the indoorDP box.

The distance between the Gf-Gv or BTB, and the operator box (OTB or indoorDP), should be less than 2 meters (if possible).

The path to join both boxes should be prepared for the installation of different patch-cords with a gutter channel.

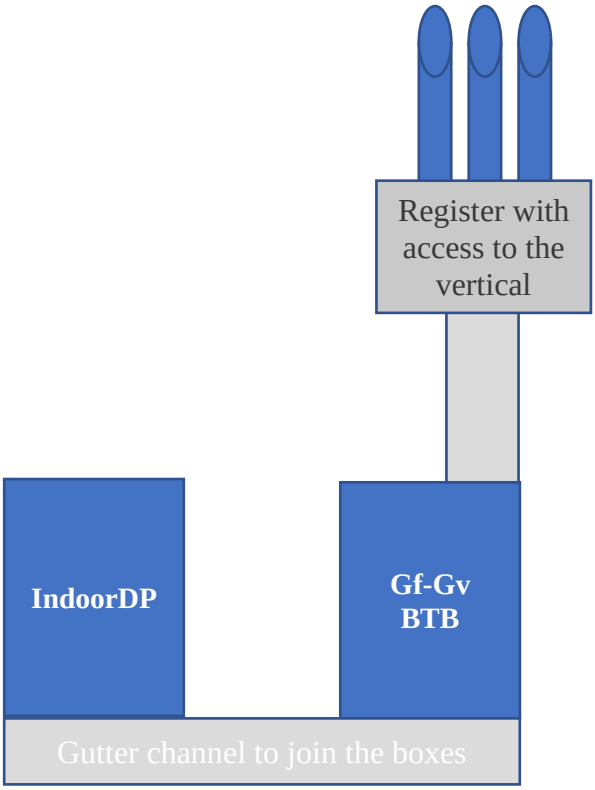


Figure 39. Scheme for indoorDP and BTB interconnection

The in-building network must be finished inside the BTB into connectors LC/APC, so the fibers of the vertical should be spliced inside. As it is no need to use pre-connectorized drop cables (as in the "on demand" cases), the infrastructure to be deployed through the vertical can be different.

The ducts to be deployed to each home, can be the same as presented before (the corrugated tubes M25), but also LSZH microducts 7/4 for indoor applications can be used.

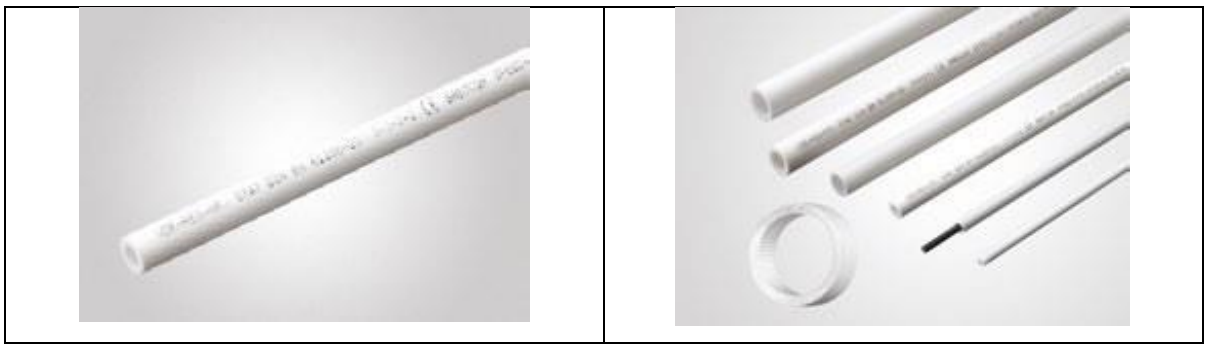


Figure 40. Example of indoor LSZH microducts.

NOTE: In the case of use microducts LSZH, the installation must be individually from the BTB to each home (there is not possibility to use this kind of microducts as a trunk shared tubes as the corrugates). After the installation of the microducts the fiber must be blown inside.

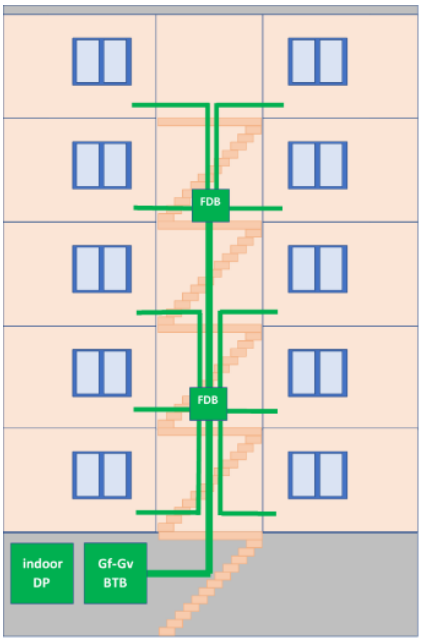
In terms of fire prevention regulation, is the same as presented before depending on the path in which they are installed, through scape rooms (necessary stairways and corridors) or through room-enclosing building components (apartments, etc).

3.4.2 RISER ARCHITECTURE

In this case, instead to deploy individual tubes or microducts for each customer from the Gf-Gv (or BTB building terminal box) to each house, a riser cable will be installed as a trunk and shared cable through the vertical. In some of the floors, a FDB (Floor Distribution Box) will be installed, to make the transition from the vertical riser cable to individual drop cables to serve the different apartments of the same floor or adjacent.

In general, this kind of architecture is deployed in common spaces of the building with easy access to all the houses (most of the cases, escape rooms, as can be stairways and corridors).

The scheme of the infrastructure is as follows:



Riser deployment throught scape rooms (staiways and corridors)

The infrastructure requirements for this type or installation are like other solutions presented before, but for the vertical riser deployment, generally less ducts are needed, because only a few riser cables (shared by several apartments) are needed to deploy.

The M25 corrugated tubes, can be used to deploy the different cables needed. It is important to not exceed the 40% of occupation of the cross section of the tube.

In terms of fire prevention, the same requirements as presented before, to deploy cables through necessary stairways and corridors (basically need to be recessed into the walls, or inside metallic conduits).

For this architecture, in some floors will be needed to have some space to install the FDBs, preferable inside registers recessed into the wall. From these registers should be access to the different dedicated tubes to reach each apartment.

NOTE: there are some exceptions deviations that could allow the installation of the FDB on the wall (openly), but not the cables that are connected to them (the pipeline must be recessed). To do that is needed to install the FDB close to a register, or partially over a register. Exception due to deviation on construction normative MBO and MLAR. The FDB are components totally passives, without possibility of autoinflammation.

Figure 41. Installation example of a FDB installed on the wall (in a necessary stairway).

4. ON-DEMAND DROP CABLE INSTALLATION AND CUSTOMER CONNECTION

The drop cables must be installed in compliance with the "In-building fiber termination schemes" presented before and with the applicable technical standards and regulations, such as DIN EN 50173, DIN EN 50173-1 and DIN EN 50174. The latest versions of the respective standards apply.

4.1 PREPARATORY MEASURES

An inventory of the objects to be built must be carried out by means of a site inspection, tensile tests must be carried out on any existing empty conduit system and a development concept must be drawn up.

Already during the site inspection, attention shall be paid to possible structural defects, especially in fire protection. If necessary, any defects found are to be recorded and the client is to be informed immediately.

The coordination of the preparatory measures and the dates of execution shall be coordinated with the respective flat owner, tenant and/or administrator. After the site inspection, the client shall receive a detailed inspection report, which shall be signed by the respective condominium owner, tenant and/or administrator.

4.2 INSTALLATION ROUTES – DROP CABLE LAYING

The listed installation options are mandatory and must be implemented according to the following prioritisation:

1. The building has been prepared by the owner with a closed empty conduit or cable duct system. The contractor checks the installation path, installs the OTO in the flat and lays the fibres to join the OTB or IndoorDP with the OTO. Any excess fibre lengths must be shortened.

2. The contractor installs the OTO in the residential unit with the aid of an already installed telephone and coaxial cable (parallel laying). The fibre is laid from the OTB/indoorDP to the existing empty conduit system in a closed empty conduit or cable duct system. Any excess fibre lengths must be shortened.

3. The contractor installs a self-sufficient, closed empty conduit or cable duct system from the OTB or indoor DP to the OTO and installs the OTO in the flat. Any excess fibre lengths must be shortened. The empty conduit or cable duct system can be installed as an internal riser through the staircase or through the living areas.

The respective cable duct cross-section is to be minimised. The cables in the basement area must be laid in closed pipe/duct systems. Laying in private basement rooms is not permitted. In the building, the necessary wall and ceiling penetrations for laying the fibre optic cables must be made in such a way that no load-bearing components are damaged. All wall openings in and on the building must be professionally closed again.

Other installation routes, such as disused chimneys, may be used, if available and usable, after consultation with the client and approval by the owner/chimney sweep, provided this does not result in any technical or economic disadvantages. The contractor is responsible for checking and obtaining approval for the installation routes. Deviations are only possible in consultation with the client and after approval by the owner.

4.3 COMPLIANCE WITH FIRE SAFETY REGULATIONS

In the context of a required new installation of the PON distribution network, it is expressly pointed out that the legal framework conditions resulting from the respective building construction ordinance and the applicable DIN and VDE standards must be observed. When leaving fire compartments, certified use fire bulkheads in accordance with the fire resistance classes of the ceiling and wall penetrations. The contractor bears full responsibility for compliance with all related legal regulations.

All the ducts used, must be sealed after the cable installation with rock wool to prevent the spread of smoke in the event of a fire.

4.4 TERMINATION INSIDE THE RESIDENTIAL UNIT

The drop cable will be finished inside each residential unit, in a passive plastic box (the OTO – Optical Terminal Outlet) equipped with 2 ports or connectors LC/APC. The OTO must be installed professionally, and it must be labelled according to the UGG's specifications with a sticker label on the cover.

The OTO must be installed considering that:

- The ONT shall be installed at a maximum distance of 2 metres and the customer connection shall be activated.
- The ONT shall be installed at a maximum distance of 1.20m from a 230V socket.

An OTDR measurement must be performed on both fibres at 1310 and 1550nm (from the OTO to towards the POP). For this purpose, the measurement must be carried out with a OTDR launching coil. This means that the launching coil fibres have the same fibre properties as the fibre to be measured (G.657.A2).

The ONT must be installed in an accessible place to allow the easy connection of the router as well as an easy maintenance work on the ONT itself.

The ONT that have been mounted, must be installed in a well-protected manner in order to prevent them from being damaged and their usability from being impacted by normally occurring exposure to dust, humidity, dirt, being touched by persons or falling objects (vacuum cleaner, broom, etc.).

The fibers termination in the OTO will be made respecting the following order:

- Fiber 1 (the left position),
- Fiber 2 (the right position).

Note: looking at the OTB or OTO frontally.

The required splicing work shall comply with the following requirements:

- Attenuation (1,550 nm): ≤ 0.1 dB
- Return loss: > 65 dB
- Splicing must be carried out by carrying out fusion splices.
- A splice protection must be installed to protect the fibre optic cable.

Note: ANT protectors are not allowed. Only shrink type protectors are allowed.

The OTB as well as the incoming micro-duct / fibre optic cable from the DP must be labelled with the cable ID, the line path from the OTB to the OTO, and the ONT must be labelled.

At the end of the installation work, the room where the OTO and the ONT are mounted, must be left in the same state as it was before the beginning of work. During the laying of cables between the OTB and the OTO and ONT it must be ensured that the prescribed bending radius and the maximum traction limits, in accordance with the manufacturer's specifications, are observed.

A customer connection can be handed over only once the connection with the POP has been checked by means of an optical power meter, an OTDR measurement and the services have been properly activated and tested on the ONT.

4.5 DOCUMENTATION

After completion of the construction measures, all FTTH system components installed shall be documented in accordance with the respective current documentation specifications of UGG by means of documentation software or as a drawing of the cable routes in/on the building, provided with photos of the installation measures and handed over or transmitted to the Client on data carriers or electronically.

Furthermore, the corresponding protocols of the OTDR measurements carried out as well as an acceptance protocol signed by the flat owner, tenant and/or administrator shall be provided.