DESCRIPTION OF THE FTTH NETWORK

(CENTRALIZED SPLITTING ARCHITECTURE)

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

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INDEX

1. INTRODUCTION

This document aims to give a general view with the construction instructions that must be considered to make the different sections of the outside plant network needed for the FTTH deployment of UGG (Unsere Grüne Glasfaser) in Germany.

IMPORTANT NOTE: This document is only referring to the centralized splitting architecture that UGG 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 followed.

1.1 REVISIONS

EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
1st	MAY 2023			This document has been created, by modifying different chapters extracted from the original technical normative document "Construction Instruction for fiber deployment"
2nd	DECEMBER 2023	All	New codification of the document	The document is codified with the document code: TEF-NORM-00005. The logo of UGG is updated in the page header. References to other documents are included.
		3. Local Backbone Network	Mini-POP renamed as CDP	

2. BACKHAUL

2.1 BASIC DESCRIPTION OF THE BACKHAUL NETWORK

The backhaul is the network that aggregate all the traffic from the active POPs (Points of Presence) and that connect with interconnection points (aggregation switches, routers, etc) around the country.

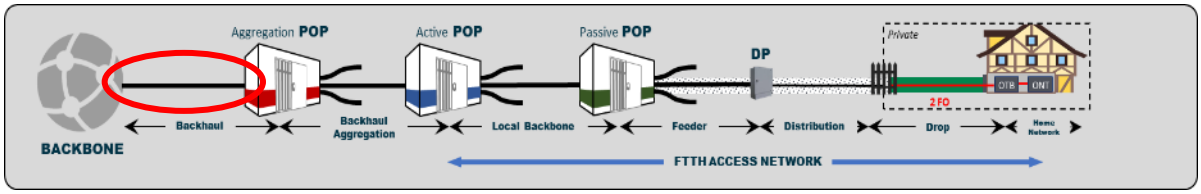


Figure 1. Network architecture scheme (Backhaul)

The backhaul network pipeline architecture normally is a simple line deployed close to a road, that is used to join different central offices, POPs, or any other singular point in a telecommunications network that are in different cities or villages.

In these backhaul paths, the number of fibers to be deployed normally is not so high, and the number of ducts to be deployed are few. But, to take advantage of the deployment made, for future extensions or needs, more than one duct or bundles or micro-ducts should be installed.

The distance to cover in the backhaul could be very large. In this part of the network, it will be necessary to make fusion splice between different cables to reach the destination.

There is a specific document to detail the different cases that we can find in the backhaul section in, the characteristics of the pipeline, and how must be terminated the network depending on the type of the point of interconnection (POIs): inside buildings, in the field (manholes), in the rooftop of a building, etc.

3. LOCAL BACKBONE NETWORK

3.1 BASIC DESCRIPTION OF THE LOCAL BACKBONE

The local backbone is the part of the FTTH network **between the actives POPs** (Points of Presence) **and the passives POPs.**

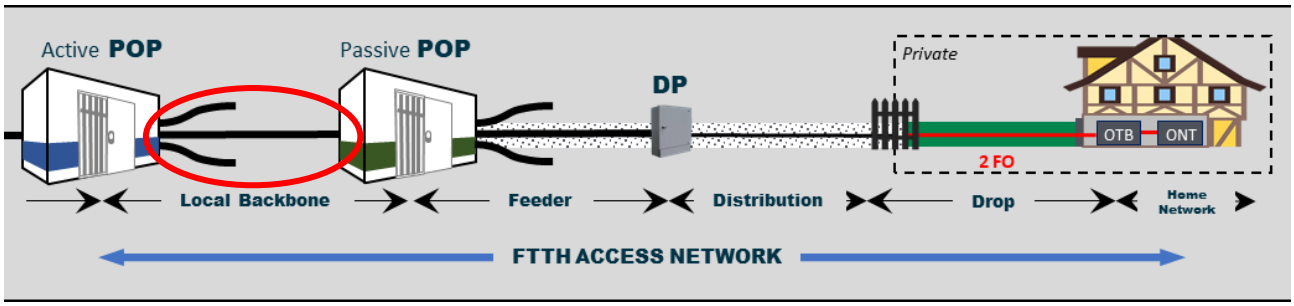


Figure 2. Network architecture scheme (Local backbone section)

The number of ducts that go out from the active POP (for the local backbone network) depends directly on **the number and the capacity of the passive POPs** that are served from the active POP.

There are defined 6 main types of POPs, with different capacities and different functionalities:

- **POP type 1: Active standard:** in this type of POP up to 2 ODFs could be installed, with a capacity of 5376 fibers termination.
- **POP type 2 Active large:** in this type of POP up to 4 ODFs could be installed with a capacity of 10752 fibers termination.
- **POP type 3: Passive Standard:** in this type of POP up to 2 ODFs could be installed with a capacity of 5376 fibers termination.
- **POP type 4: Passive Large:** in this type of POP up to 4 ODFs could be installed with a capacity of 10752 fibers termination.
- **POP type 5: Active Small:** in this type of POP up to 1 ODFs could be installed with a capacity of 2688 fibers termination.
- **CDP (Centralized Distribution Point)*:** a reduced ODF with capacity for the termination of up to 1.152 fiber termination.

***NOTE:** New passive model recently authorized.

The needs in terms of the number of optical fibers necessary for the interconnection between an active POP and a passive POP are set by the passive POP due to the need to drag fibers that it requires to provide services (both types of services: point to multipoint and point-to-point) to its area of influence that finally must achieve the active POP.

More in detail, these needs are related with the number of ODFs installed inside the passive POP, and the capacity of fibers of the feeder network are expected to be finished on it.

The connection between POPs will be done with cables of different fiber counts, as can be cables with 96 fo, 192 fo or 288 fo maximum. If possible, there will not be optical fiber splices in the path between POPs (only if the distance is over the length of the cables available, or if the laying is very difficult should be planned splice points in this path).

Each ODF installed in a passive POP must be treated independently, and the fibers that need to be connected with the active POP must be independent from others ODFs installed in the same passive POP. That means, that it not possible to aggregate the necessity of one ODF with the necessity of other ODF installed in the same passive POP. The connection of the local backbone must be from ODF to ODF (one sited in the passive POP and the other one sited on the active POP).

The necessity of each ODF sited in a passive POP, must be aggregated in a maximum of two cables per ODF.

For each cable, it is needed a micro-duct between POPs, so this means that for each ODF in a passive POP, at least 2 micro-ducts are needed for the local backbone section. Considering the type of passive POPs, and adding a reserve of micro-ducts of 25 % the need for each type is the following:

- POP type 3 (Passive Standard – 2 ODFs): 5 micro-ducts needed. → (at least) 1 bundle of 7 micro-ducts.
- POP type 4 (Passive Large – 4 ODFs): 10 micro-ducts needed. → (at least) 2 bundles of 7 micro-ducts, or 1 bundle of 7 ducts and 1 bundle of 4 ducts.
- CDP (around 0,5 ODFs): 2 micro-ducts needed → (at least) 1 bundle of 4 microducts. Preferable 1 bundle of 7 microducts.

3.2 CHARACTERISTICS OF THE PIPELINE (LOCAL BACKBONE)

The pipelines in the local backbone network, will be installed **directly buried** into the ground. The ducts will be (normally) laid by the ploughing method. Other civil works technics can be used if needed (traditional trenching, mini-trenching, HDD, etc). The way in which the bundles or micro-ducts will be laid will follow the normative "TEF-NORM-00001 - Civil Works Normative for fiber deployment", and all the recommendations of the ducts manufacturers.

The microducts that must be used in this section of the network are **16/12 mm (outer/inner) diameter** and must be suitable for blowing optical fiber cables. The ducts must be deployed in bundles of 7 or 4 units each, depending on the necessity of each part of the local backbone network.

All the connections needed to give continuity between ducts should be done with the corresponding connectors and the duct joint will be left directly buried. **All the joints between ducts must be registered in the inventory system with GPS coordinates with a precision of centimetres (tolerance: 2 cm max),** to know in the future the exactly point of the singularity for maintenance purposes or networks upgrades.

Each 1500 meters a manhole must be installed to facilitate cable installation and subsequent maintenance of the network.

When a fusion splice between cables is needed to give continuity, it will be done with a splice closure that will be installed inside the manhole. **The manholes and the splice closures must be registered in the inventory system with GPS coordinates (2 cm tolerance).**

4. FEEDER NETWORK

4.1 DESCRIPTION OF THE FEEDER NETWORK

The feeder network is the part of the FTTH network between the POP (Point of Presence) and the distribution points (DPs).

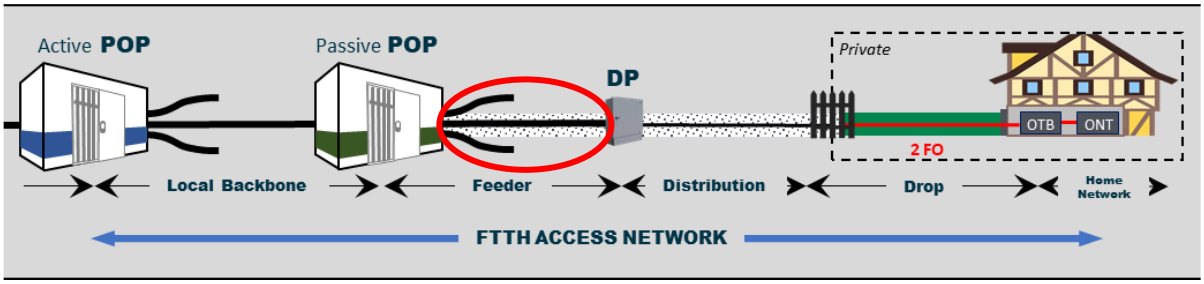


Figure 3. Network architecture scheme (Feeder network section)

From the point of presence (PoP), an important number of ducts will go out to the Distribution Points. The number of ducts that go out from the POP depends directly on the number of DPs, that are served from the POP. At least one duct per DP and an additional reserve of spare ducts of 25% is needed to be laid in the pipeline for the feeder network in the POPs output.

In terms of bundles, 25% vacancy must be respected (without requiring all of them to have a continuity connection between DP and POP)

- 1 vacancy on Bundle of 2
- 2 vacancies on Bundle of 4
- 2 vacancies on Bundle of 7

The use of the bundles will be reducing the capacity to the necessary (and complying with the previous point), not prolonging the maximum capacity beyond what is necessary. With this, we always get to the ends of each branch with:

- Bundle of 2 for 1 DP
- Bundle of 4 for 2 DPs
- Bundle of 7 for 3-5 DPs

Depending on the type of POP (the capacity), the first part of the feeder network could have a big number of bundles of ducts, which translates into the need to use wider trenches than in other sections. Also, this can generate the necessity of divide the bundles in several trenches to simplify the civil works execution.

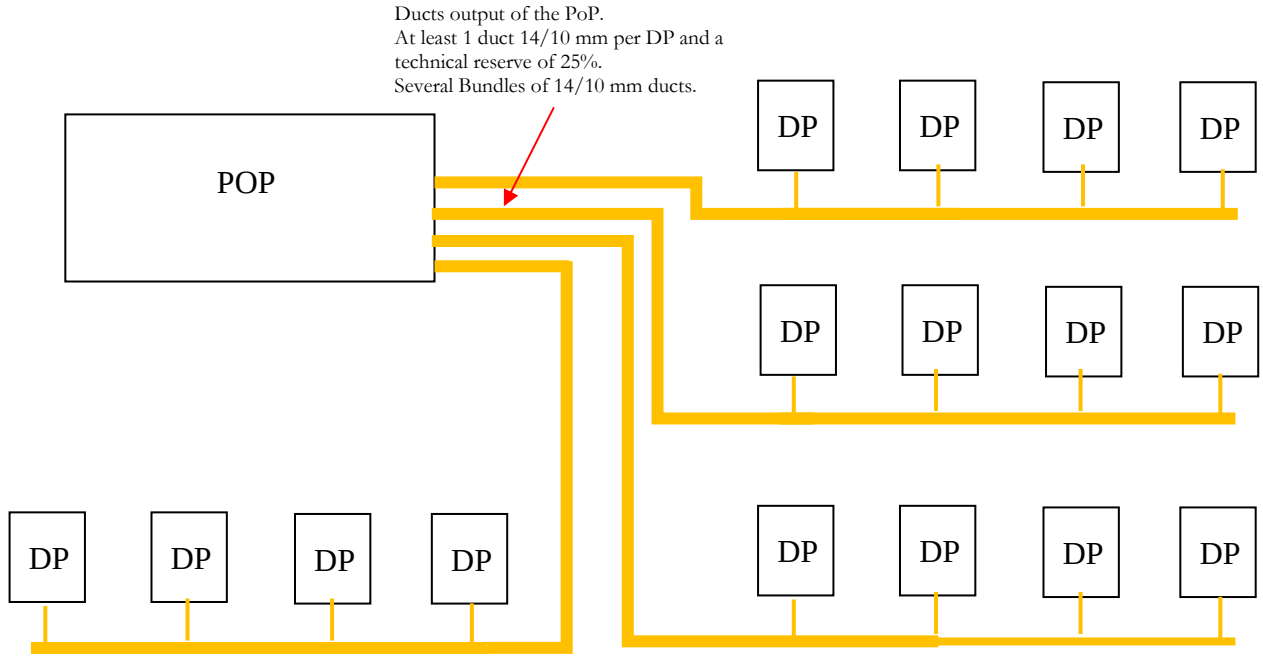


Figure 4. Feeder network pipeline scheme

That means that bundles of ducts with more ducts count should be used in the proximity to the POP, and as the pipelines go away from it and closer to the DPs, transitions to bundles with fewer ducts can be done if needed.

To each DP, 2 micro-ducts of 14/10 will arrive. One of them will have continuity to reach the POP, and the other will remain as a spare duct. The spare duct associated to the DP, will be finished with an end cap, and must be sited near (but not connected) the main pipeline with more duct reserves (reserves aggregated with the necessities of more DPs that share the same path of the pipeline), to permit if it's needed the connection in the future to a spare duct of the main pipeline.

An optical cable with 96 fo, will connect each DP with the POP. So, in the POP, (at least) one 96fo cable per DP will enter in its area of influence. **NOTE:** normally the DPs deployed have a maximum capacity of up to 48 HP. Nevertheless, a new type of DP with double capacity (for 96 HP) to be used in areas with more building density. For those cases, the associated cable will change to 192 fo. The microduct type 14/10 will be maintained for this situation also.

There will not be intermediate optical fiber splices in the path between the POP and the DP.

4.2 CHARACTERISTICS OF THE PIPELINE (FEEDER NETWORK)

The pipelines in the feeder network, **will be installed directly buried into the ground**, without the use of concrete prism.

The ducts will be (normally) laid into mini-trenches or traditional trenches. Preferably, the ducts will be laid into mini-trenches (if possible), and only in cases where the number of ducts to be deployed does not fit the size of the mini-trench, the traditional trench will be used.

The way in which the bundles or micro-ducts will be laid will follow the normative "TEF-NORM-00001 - Civil Works Normative for fiber deployment", and all the recommendations of the micro-ducts manufacturers.

The ducts that must be used in this section of the network are **14/10 mm (outer/inner) diameter ducts** and must be suitable for blowing optical fiber cables.

The ducts must be deployed in bundles of 7, 4 or 2 ducts units each, depending on the necessity of each part of the feeder network.

Figure 5. Different shapes of the micro-ducts bundles for the feeder network

If possible, no manholes or handholes will be installed in this section of the network. If the distance between the POP and the DP is more than 1500 meters, manholes will be installed in the path, to assist the blowing task and to make easy the management of the network in the future.

When a duct joint is necessary to be done (to give continuity between ducts), it will be done with the corresponding connectors and the duct joint will be left directly buried.

All the joints or connection between ducts must be registered in the inventory system with GPS coordinates, to know in the future, the exactly point of the joint or segregation of ducts for maintenance purposes or networks upgrades.

The joints between ducts, must be done according to the recommendations of the manufacturer of the ducts. For example, the joint of the seven ducts of a bundle, must be done in a staggered manner, avoiding that all the connectors coincide in the same position.

The connectors used to make the duct joint must allow an installation directly buried. **NOTE**: Connectors designed for not buried applications with another protection cover are not allowed.

For all the DP (48 HP and 96 HP capacity), 2 ducts of 14/10 mm will be deployed and connected to them. One of the ducts must be connected to one duct of the main pipeline section to have continuity from the DP to the POP. The other duct, will remain as a spare duct, finished close to the main pipeline section, and finished with the appropriate end-cap.

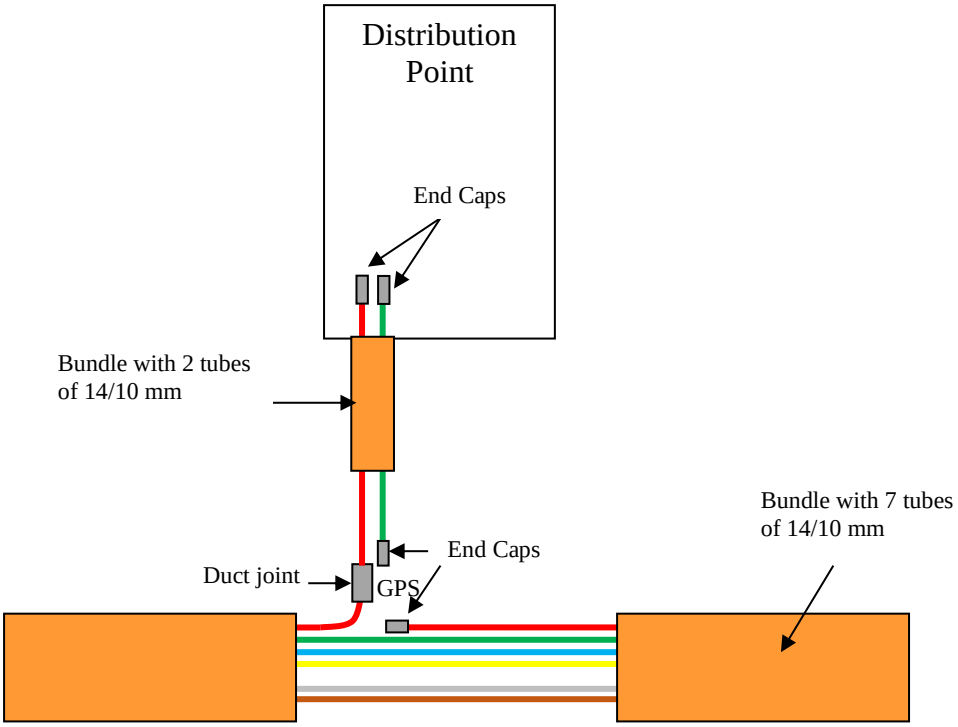


Figure 6. Scheme of the feeder network near the distribution point

The point of the branch of to the Distribution Point (DP), must be registered in the inventory system with GPS coordinates. It is absolutely needed, to know exactly the point to dig in the future for networks upgrades, or maintenance purposes, if for example it is needed to use the vacancy duct of the DP and connect with one of the vacancy ducts of the main pipeline bundle.

4.3 OPTICAL CABLES (FEEDER NETWORK)

A 96-fiber optic cable will be installed to connect the POP and each DP, using the duct that has continuity between the POP and the DP. This cable will be finish directly in the ODF (Optical Distribution Frame), in the POP side, and in the splice tray system of the street cabinet in the DP side.

The cable of 96 fo, has a diameter of 6,3 mm (approximately).

NOTE: for the DP with double capacity (DP-96) the cable will have 192 fo. This cable has a diameter of 8 mm (approximately).

5. DISTRIBUTION NETWORK

5.1 DESCRIPTION OF THE DISTRIBUTION NETWORK

The distribution network is the part of the FTTH network between the Distribution Point (DPs) and the customer premises and finish just before the last drop section that enters to the customer premises.

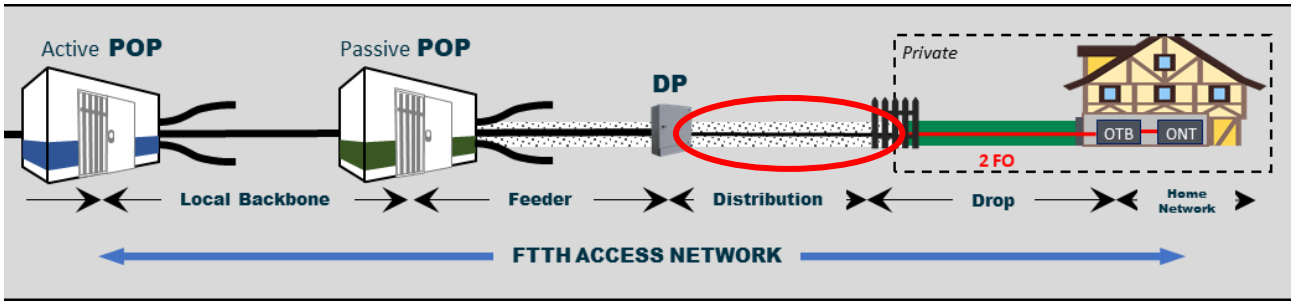


Figure 7. Network architecture scheme (Distribution network section)

Each DP serves up to 42 homes passed (HPs). But, from the distribution point, up to 48 micro-ducts 7/4 mm will go out to passing in front all the customer premises through the sidewalk until the end of the street, making up the distribution network section.

NOTE: 48 micro-ducts is the maximum capacity of the DP48 *(standard capacity)*. The DP96 will have the capacity doubled: up to 96 microducts and HPs.

The micro-ducts will be deployed in bundles with 7, 12 or 24 with a diameter 7/4 mm. At the end of the bundles, all the micro-ducts will end sealed in a gastight and a watertight manner with the appropriated end cap.

Figure 8. Scheme of pipelines for Distribution Network

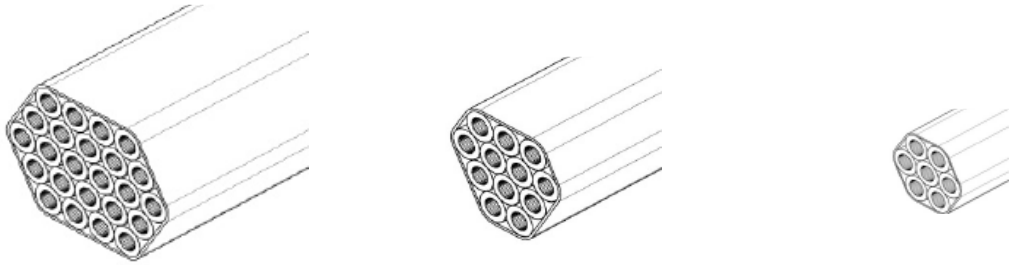
5.2 CHARACTERISTICS OF THE PIPELINE (DISTRIBUTION NETWORK)

The pipelines between the Distribution Points (DPs) and the customer premises or sidewalk, will be installed directly buried into the ground, without the use of concrete prism.

The pipeline path must be registered in the inventory system with GPS coordinates, every 5 meters, to know in the future, the exact path of the pipeline for maintenance purposes or networks upgrades.

The ducts that must be used in this section of the network are **7/4 mm (outer/inner diameter) ducts** and must be suitable for blowing optical fiber units inside.

The ducts must be deployed in bundles of 24, 12 or 7 units each. Also, for the final customer connection an individual duct of 7/4 mm will be used (but this is part or the drop section).



Bundle of 24 ducts (7/4 mm) Bundle of 12 ducts (7/4 mm) Bundle of 7 ducts (7/4 mm)

Figure 9. Different bundles for the Distribution Network

No manholes or handholes will be installed in this section of the network. When necessary to make a joint to give continuity between ducts or make a segregation, it will be done with the corresponding connectors and the duct joint will be left directly buried.

All the joints or connection between ducts must be registered in the inventory system with GPS coordinates, to know in the future, the exactly point of the joint or segregation of ducts for maintenance purposes or networks upgrades.

The joints between ducts, must be done according to the recommendations of the manufacturer of the ducts, and according to the instructions of UGG.

The connectors used to make the duct joint must allow an installation directly buried. Also, all the end caps used must be valid for direct buried installations.

The termination of the distribution network can be ambiguous to define, as could be considered that the distribution bundle is the last part of this network section (considering that the individual segregation form part of the drop section) or in the fence limit of each property (FTTF – Fiber to the fence) if these few meters are not considered as drop section.

In the different technical normative that cover these singular points (the transition of distribution to drop section), it is considered that once the tube is segregated individually, this form part of the drop section and not distribution. There are 2 specific normative covering deeply these topics: "TEF-NORM-00008 - FTTF construction guidelines", and "TEF-NORM-00007 – Drop Section".

6. DROP SECTION

6.1 DESCRIPTION OF THE DROP SECTION

The drop section is the last part of the FTTH network between the distribution network (at the customer premises) and the optical termination point of the network inside the home of the client in the OTB (Optical Termination Box).

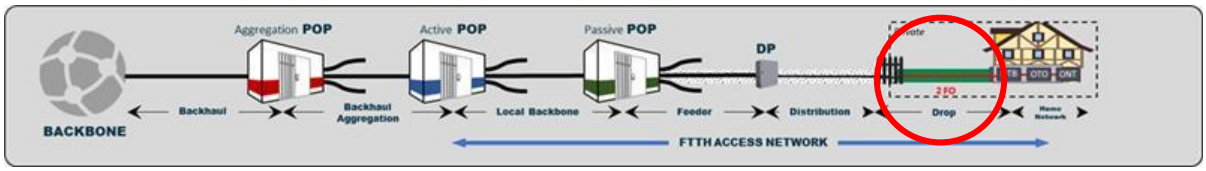


Figure 10. Network architecture scheme (Drop section)

All the houses connected, will have an individual duct of 7/4 mm (outer/inner diameter), from the sidewalk until the Optical Termination Box (in case of SFU could be OTB/OTO), installed inside the house.

NOTE Exception: for MDU scenarios with more than 12 houses in the building, the micro-ducts that will be laid to connect the building will be a 14/10 mm (outer/inner diameter). These ducts will not pass through the distribution point like in other cases. For these cases, the OTB has enough entity to be considered as an indoor DP, with direct connection to the POP. 2 micro-ducts 14/10 will be installed (like other DPs).

This individual duct must be connected to one duct of the bundle of ducts that pass in front of the house (in the sidewalk, for example). Once make the connection of this last drop section, the house will have an individual duct path from the house to the distribution point (DP) that is a street cabinet.

The connection or joint between the individual duct, and the ducts of the bundles must be done with the adequate connector or "duct joint".

In the bundle, the duct must be used, must be selected according to the colour code and the project instructions.

The duct selected inside the bundle, must be cut, and connected (with and appropriated connector or joint) to the individual duct for the customer. The other end of the duct selected, that continue inside the bundle and could be used in the future in maintenance tasks, must be sealed in a water and a gastight manner with an appropriated end cap.

The duct joint will be installed and left directly buried. The point in which the connection between ducts must be registered as a "Virtual Handhole" in the inventory system with GPS coordinates, to know in the future, the exactly point of the joint of ducts for maintenance purposes. A photo will also be registered on the IT systems.

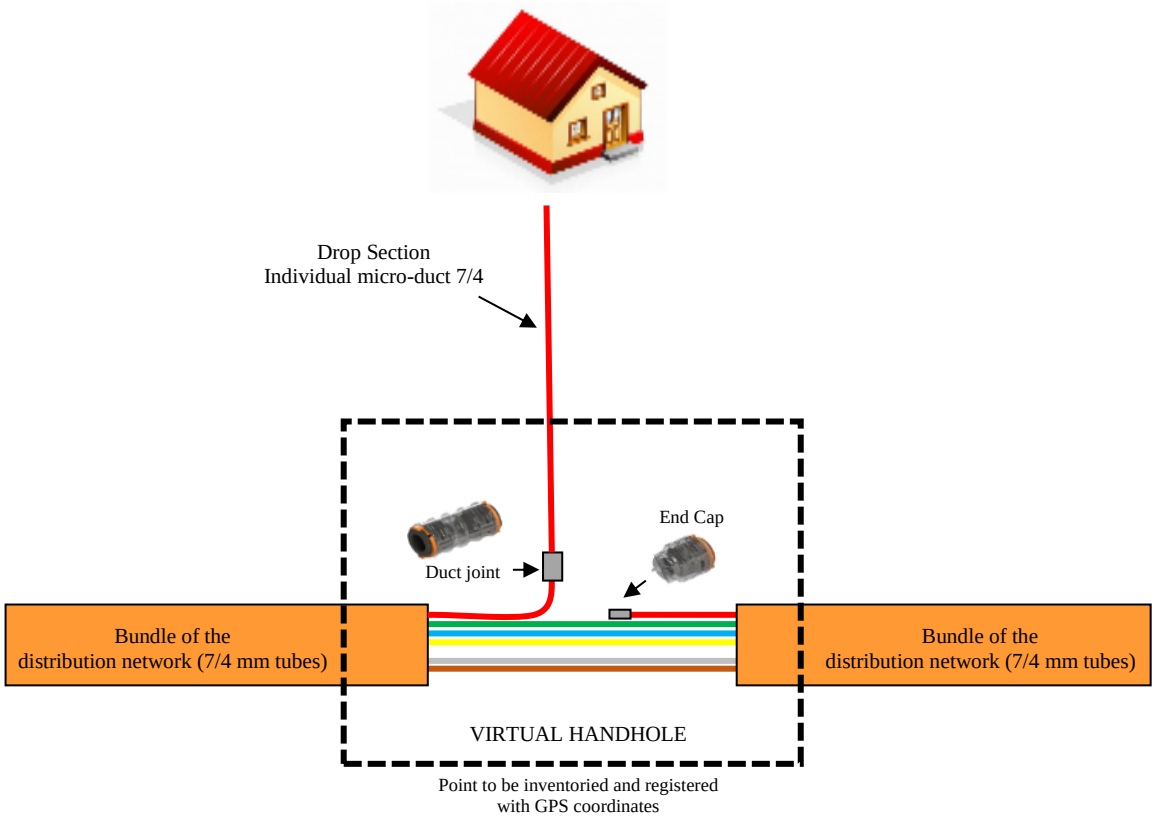


Figure 11. Scheme of pipelines connection for the final drop section (home connected)

There are 2 specific documents that cover the explanation of how must be executed the drop section: "TEF-NORM-00008 - FTTF construction guidelines", and "TEF-NORM-00007 - Drop Section". Those documents cover all the situations depending on the moment in which must be done (during the deployment phase or later), and from which point it should start (from the bundle of the distribution network, or from the FTTF point).