NETWORK DESIGN GUIDELINES

INDEX

1. OBJECT

1.1 OBJECT

This document sets out the **technical requirements for the design of the outside plant of UGG's FTTH network.**

In the event of any conflicts when interpreting documents and requirements, the following **order of precedence** shall be observed:

1) Germany law and statutory requirements
2) Local regulations (at the Municipality, District or State level)
3) Third party network requirements, where third party infrastructure is utilised or crossed underground
4) Technical briefings and amendments issued subsequently to the issue of this document, in order of date issued.
5) This document
6) Other applicable UGG Technical Schedules

1.2 REVISIONS

EDITION	DATE	REVISED SECTIONS	MAIN CHANGES	OBSERVATIONS
1.0	30/01/2021	All	Document structure reformatted from previous versions 0.x	New document
1.1	10/02/2021	All	Major changes in chapters POP design criteria (3.1) and Naming convention (4). Minor corrections in all the rest.	First revision.
1.2	26/02/2021	All	Added chapters 5, 6 and Annex 3. Minor changes and updates in chapters 2 to 5.	Second revision.
1.3	13/04/2021	2,3,4,5, Annex B	Document updated with clarifications and new design criteria	Third revision
2.0	29/06/2021	All	Added new UGG IT Systems & deliverables, in-building vertical infrastructure and interconnection to other providers. Minor changes in other sections.	Major release
2.1	15/07/2021	3.7, 4.1, Annex B	New handhole models, splicing guidelines for indoor DP, removed GIS-based design deliverables	Maintenance version
2.2	22/10/2021	See highlighted sections	Indoor DPs, explanations added to civil works, spare infrastructures, labels changes, design deliveries, POI handhole, order in ODF, Backbone and Backhaul cables	Maintenance version
2.3	21/12/2021	See highlighted sections	DP extension, lots recount, trays balance in ODF, cluster scheme, DOMA, VH labelling, spare bundles, microducts order segregation, design splitting	Maintenance version

3	18/03/2022	See highlighted sections	Major changes in all the document	Major release
4	15/12/2022	All	New LLD deliverables, information before starting the LLD, no FTTF to empty lots, use of bundles in Backbone, Backhaul and Backup line, Redundancy BackHaul, Other Services, labelling, POP type 6 (CDP-512), DP-96 HPs	Major release
4.1	03/04/2023	See highlighted sections	New Access and BH/LB projects, use of 50/40mm bundle, use of depth and rocky supplements, documents codification, LLD folder structure, use of point object in Keycom, VH Fence for accesses through private areas	Maintenance version
5	28/06/2023	See highlighted sections	New Distributed Splitting Architecture with new elements and labelling, change in Indoor DP label, change in the assignment of empty lots microducts in distribution bundles, small changes in documentation structure, change in home-assignment to administrative buildings in LOMA, clarification about rolling surface…	Major release
5.1	08/08/2023	See highlighted sections	Change of name from Traditional Architecture to Splitting in POP Architecture. Updating Bundles schematics in LBB and Feeder. Others	Maintenance version
5.2	25/09/2023	See highlighted sections	Options for Vacant Lot microduts. Specify connection details in Distributed Splitting Architecture. New element table update for Distributed Splitting Architecture.	Maintenance version
6	20/11/2023	See highlighted sections	All: Naming and Contracting Architectures Section 3: DS Arq. Indications for non-dense areas Section 3: Prohibition of Configuration 1 in UDP Section 3: Reduction of Bundle usage types Section 5: Design Help outside of KeyCom All: Other small modifications	Medium release

1.3 REFERENCES

[1] Network deployment process and tools – Technical Schedule

[2] Optical Distribution Frame allocation and layout configurations – Technical Normative

[3] Installation criteria on Active POP – Technical Normative

[4] Civil Works for fiber deployment – Technical Normative

[5] MDU Design Technical Ammendment

[6] UGG Design Manual – KeyCom

[7] LOMA Manual – LOMA

[8] Annex for Urban DP-96 (with splitters)

2. INTRODUCTION

2.1 UGG NETWORK ARCHITECTURE

The UGG network Architecture with Centralized Splitting consists of five sections: backhaul, local backbone, feeder network, distribution network and customer drop. The last three on the list make up the FTTH access network.

These sections are separated by two network elements: The Point of Presence (POP), between backhaul and feeder sections, and the Distribution Point (DP), between feeder and distribution sections.

The access network starts on the OLT at the Aggregator or Active POP and ends at the ONT, installed at customer premises.

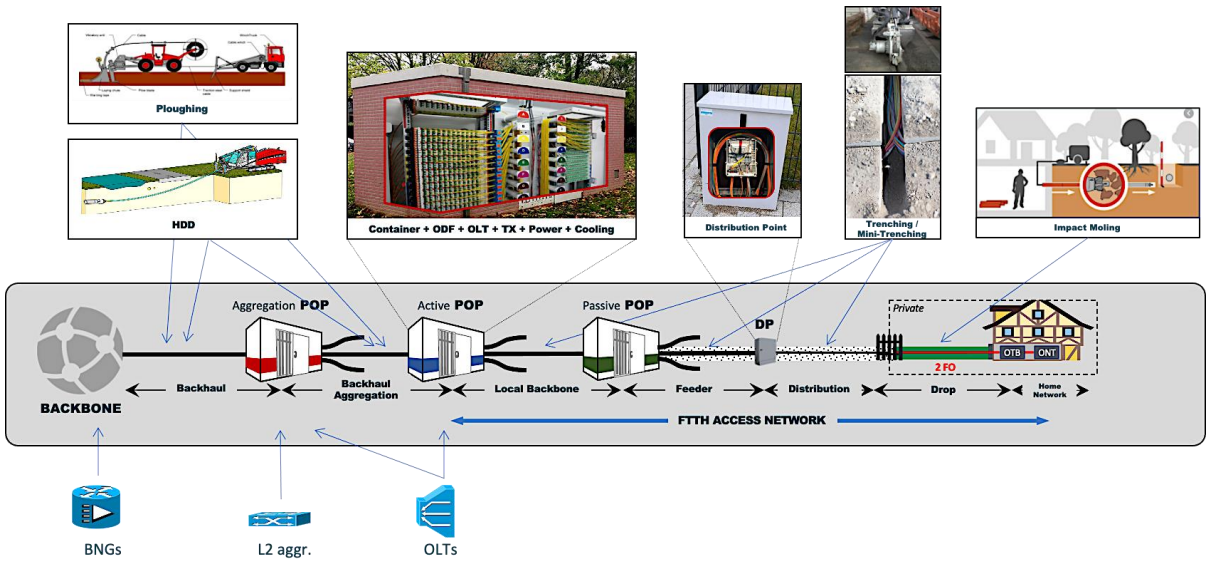


Figure 1.- UGG Centralized Splitting network Architecture (CS Arch.)

From now on, **UGG starts to deploy in variety of urban areas**. To do that, the network architecture changes, placing the 1:64 splitting level outside the POP. This splitting level is moved to intermediate equipments giving rise to a Distributed Splitting Architecture of 2 levels (1:4 and 1:16). This new architecture consists of five sections: Backhaul (from Headend POP to SWD or other Headend POPs), Local Backbone, Feeder Network, Distribution Network and Customer Drop.

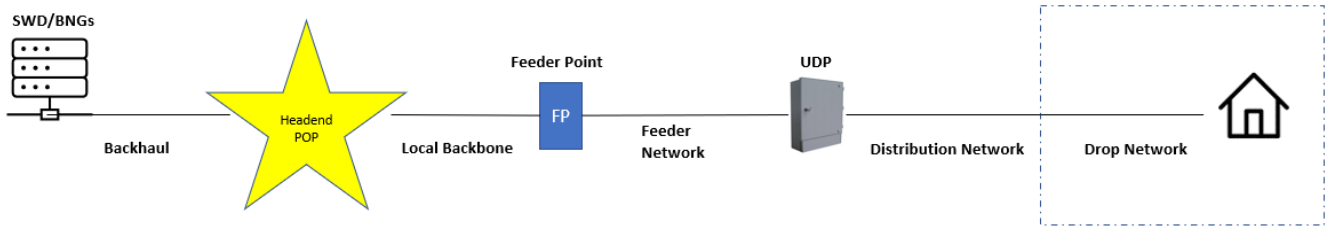


Figure 2.- UGG Distributed Splitting network Architecture (DS Arch.)

2.1.1 NETWORK ELEMENTS

2.1.1.1 POINT OF PRESENCE (POP)

The POP is a container-size cabinet including space for the active equipment (OLT, transmission nodes, console routers, etc.), passive optical elements (ODF - optical distribution frame equipped with splitters, patch-panels, splice and connector modules), AC and DC power equipment, cooling systems, security systems (fire protection, electronic access door), raised flooring and suspended structures for cabling system.

POPs can have active equipment (including the OLT and all the other active equipment required): Active, Aggregator, subtended Aggregation POP, Aggregator Headend POP and Active Headend POP, or passive equipment (without OLT, connected remotely to an Active POP): Passive POP.

An Aggregator POP has an aggregation switch that aggregates the traffic of multiple OLTs from other active POPs, sharing the backhaul section connecting to the Backbone. On the other hand, a subtended Aggregation POP is an Aggregator POP not connected directly to the SWD. It is hierarchically located between an Aggregator POP and an Active POP. The Headend POP has an aggregation switch and 2 or 3 OLTs. It does not have splitters and UDPs are not connected to it; it is the POP used for the DS Arch. In this architecture the Active Headend POP (with 1 OLT and without splitters) is always connected to the Aggregator Headend POP as it does not have aggregation.

2.1.1.2 FEEDER POINT (FP)

The Feeder point (FP) is a fully passive splice enclosure used in the DS Arch. where Local Backbone cables (coming from the Headend POP) are spliced to Feeder cables fibers. Initially, they will be installed in TC Manholes. Feeder cables have 24 fibers and Local Backbone cables may have 96 or 192 fibers.

The fibers are classified according to their use: for UGG BSA service, for future Passive services, and reserve fibers.

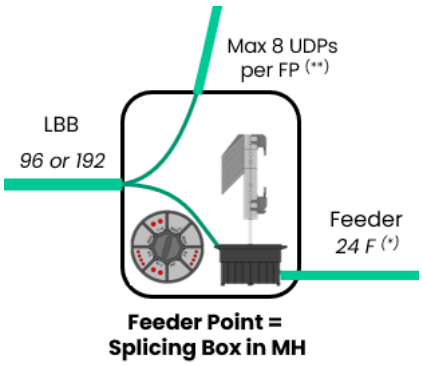


Figure 3.- Feeder Point

2.1.1.3 URBAN DISTRIBUTION POINT (UDP)

The Urban Distribution Point is a medium-size passive street cabinet located on street-level pedestals (it is similar to the DP-96). It receives the feeder cable from the Feeder Point and, through internal splitters, delivers the necessary fibers to households via the distribution network.

Currently, there is only one type defined: Type A, equipped with 2 splitters 1:4 and 6 splitters 1:16 preinstalled from factory. This Urban DP has 7 different configurations depending on the number and type of addresses/homes to serve; however the 6th configuration is not allowed by technical reasons (it will not appear in this document) and it will be covered by the 7th configuration, solving the SDUs cases by installing OTB-4 with splitter as Network termination equipment at the client. Configuration 1 will also be disallowed starting with the 6th edition of this document.

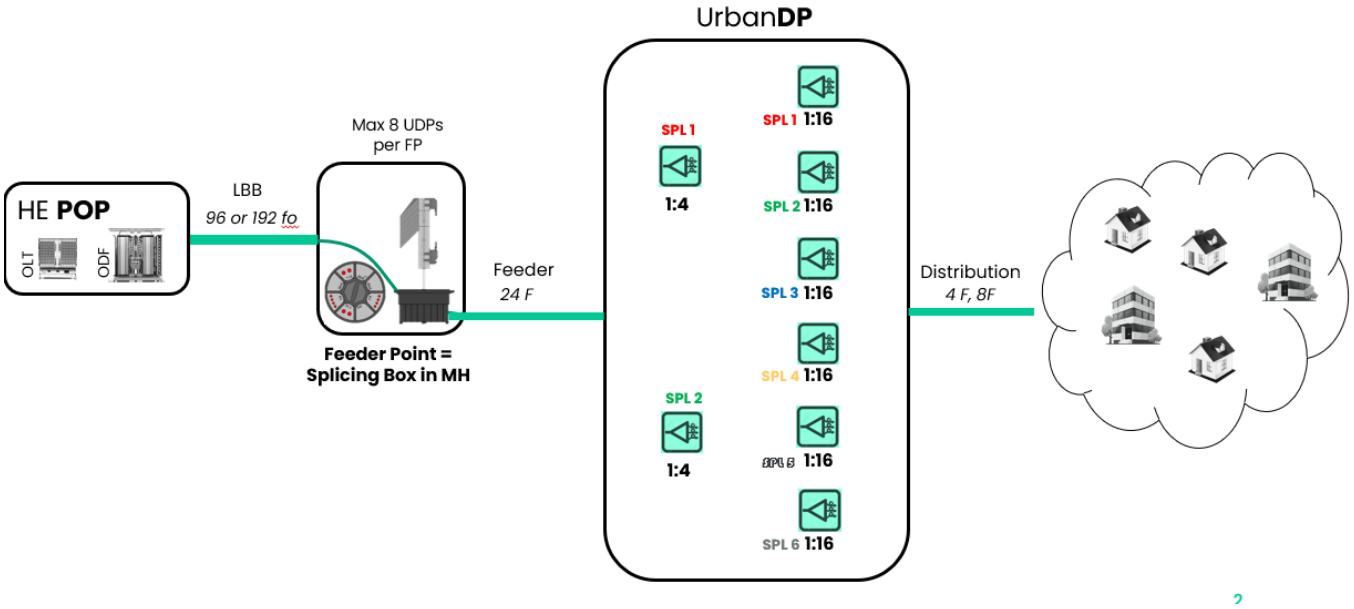


Figure 4.- Urban Distribution Point

2.1.1.4 DISTRIBUTION POINT (DP)

The Distribution Point is a medium-size passive street cabinet located on street-level pedestals. There are 2 types of outdoor DPs: DP serving 48 HPs (DP-48) or DP serving 96 HPs (DP-96).

DP-48 can be underground in a TC manhole (use allowed only when the Gemeinde does not allow to place a DP on the street). It is also possible to install 2 underground DP-48, with 2 independent 96fo cables, in the same TC manhole. However, DP-96 cannot be installed underground.

DPs can also be indoor closets installed inside medium or large size buildings (from 13HPs on).

Feeder fibers and drop connection cables are spliced one to one, using 2 positions of one DP tray by client.

DP-48 capacity is up to 96fo and 54 trays, and space enough to accommodate the termination of up to 48 micro-ducts and 48 drop cables towards the houses and buildings located nearby. Furthermore, DP-96 capactity is up to 192fo and 108 trays.

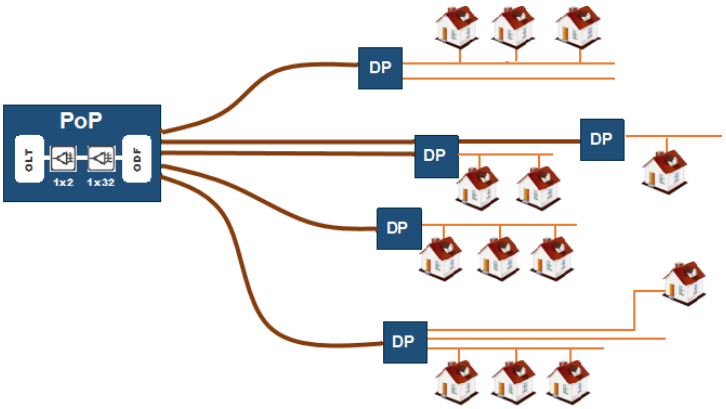


Figure 5.- Distribution Point

2.1.2 NETWORK SECTIONS

2.1.2.1 BACKHAUL (BH)

The Backhaul (BUL, BHR, BH) uplinks the Active POP network to the BNG (Broadband Network Gateway) Aggregation Node as part of the Backbone, through the SWD (Point of Interconnection from Telefonica Germany). The backhaul topology is based on the aggregation of several Active POPs' backhaul uplinks into L2 aggregation equipment deployed at Aggregation POPs. This topology provides some efficiency by sharing between a bunch of POPs the third party leased fiber for connecting with the Backbone. Cables and fibers used for BackHaul can be of own construction or use dark fiber sections (defined by Planning Team).

2.1.2.2 LOCAL BACKBONE (LB)

In the CS Arch., the Local Backbone is the part of the network between the Active POP (or Aggregator POPs) and other Passive POP(s) in the same area.

It is a point to multipoint (PtMP) network for GPON-based residential services and point to point (PtP) for B2B services.

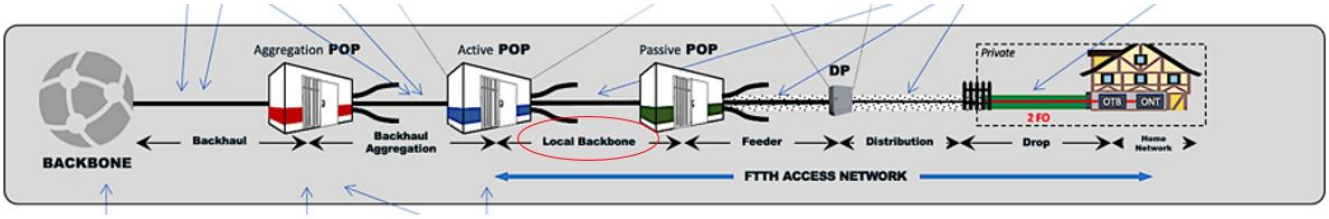


Figure 6.- Local Backbone in CS Arch..

In the DS Arch., the Local Backbone networks connects each Headend POP with the Feeder points in the area.

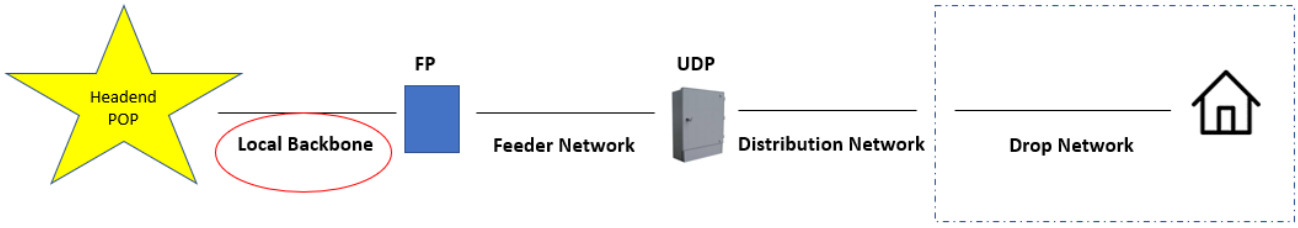


Figure 7.- Local Backbone in Distributed Splitting Architecture

2.1.2.3 FEEDER NETWORK (FN)

The Feeder Network covers the network sections connecting each POP (Active or Passive) and the Distribution Points in the area, in case of being in the CS Arch.

For the DS Arch., the Feeder Network is the one that connects the FP with the different UDPs connected to it.

It is a point to point (PtP) network.

2.1.2.4 DISTRIBUTION NETWORK (DN)

The Distribution Network connects each Distribution Point or Urban Distribution with the demarcation points defined near the customer premises.

It is a point to point (PtP) network. As for this document, distribution network can be considered as embracing also the drop section for network design purposes.

2.1.2.5 DROP NETWORK (DROP)

The Drop network covers at least one of these elements for each particular subscriber: infrastructure going across the private property, the Optical Termination Box (OTB) and the in-building cabling (or vertical infrastructure when required).

Optical Termination Boxes (OTBs) are located inside small capacity buildings, sized from 2 to 12 homes, for the CS Arch. The internal equipment in the building for the DS Arch. is explained in detail in 3.5.

The Optical Termination Outlet (OTO) is the last point in the FTTH optical network, installed inside the customers' premises. The OTO includes 2 LC/APC connectors.

2.1.2.6 IN-BUILDING VERTICAL NETWORK

The in-building vertical network comprises wiring and infrastructure deployed by UGG or by the property under certain conditions to reach the individual apartments inside residential or commercial buildings sized higher than 12 homes (in the CS Arch.).

The in-building network for the DS Arch. is detailed in 3.5. For more information, consult [5] MDU Design Technical Ammendment.

2.2 UGG NETWORK DEPLOYMENT PROCESS

The complete outside plant deployment process workflow is described in the document [1] Network deployment process and tools – Technical Schedule. The diagram in Figure 8 shows a generic workflow for outside plant works, from the initial negotiations with the local Authorities till the point in time when the service is ready to be activated.

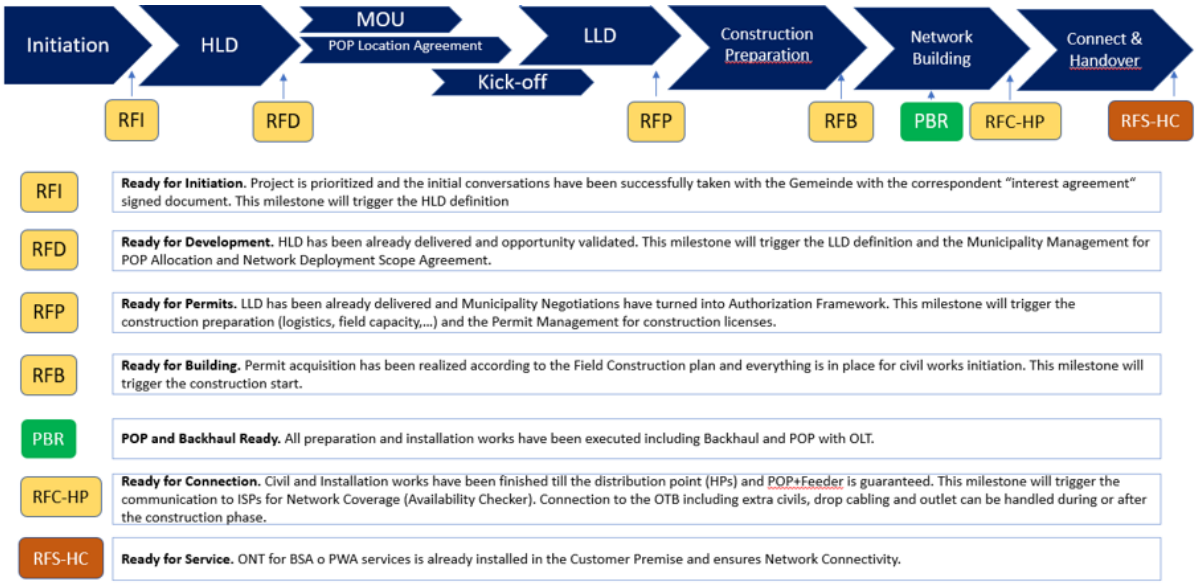


Figure 8. – UGG network deployment process

This document provides the design guidelines to be observed both in the "HL Design" phase (High Level Design, HLD) and "LL Design" phase (Low Level Design, LLD).

High Level Designs (HLD) provide principally a first view about the target area (map in PDF), a list of those addresses covered by the deployment (excel file) and a GIS project.

Low Level Designs (LLD) provide higher level of detail in the network design, additional documentation (civil works drawings, splicing cards, permit plans, etc.) and considers all the inputs provided by surveyors, local authorities and real estate agents.

In the LLD phase, every Gemeinde will have 2 projects associated within the process: Access Project and BH/LB Project. These projects could be carried out by different companies.

1) The **Access Project** comprises the access network design, as well as the BH/LB/Spare networks inside the access. The needed partials LLD will be created according to the rules explained 3.7.1. In this project, 2 BoQs will be delivered: Access BoQ and BH/LB-Access BoQ (this last BoQ includes the materials used in BH/LB/Spare inside the access network). See 6.3 for an exhaustive explanation.

2) The **BH/LB project** comprises the needed interurban network to connect the POPs/FPs of a Gemeinde to the ones of the higher hierarchy. It could comprise feeder network sections shared with BH/LB in case they were built by interurban specialist companies (this case is an exception and would be notified by UGG to the LLD provider). It always has a unique partial LLD and 1 BoQ (or 2 in case interurban feeder sections are included in this project. In this case, an Access BoQ and a BH/LB BoQ should be delivered).

2.3 UGG NETWORK DEPLOYMENT SYSTEMS

The key IT applications supporting the network design process are:

- **Keycom,** the browser-based GIS platform used for network design and network inventory.
- **Setics,** provides semi-automatic network design that can be used as a baseline for the LLD or for the first deliverables to municipalities.
- **LoMa,** for location management (addresses and homes).
- **DoMa,** the document repository.
- **NCM,** the workflow and process management application.
- **NRI,** UGG Network Resource Inventory (in a future it will develop to CTC).
- **Power BI,** dashboards tool to consult all information from NRI/CTC.
- **Mobile apps,** which main objective is to make the field work efficient.

For detailed information about these applications refer to the product descriptions and user manuals.

3. NETWORK DESIGN CRITERIA

3.1 ADRESSES AND HOMES

3.1.1 DEFINITION OF TERMS

- **Single Dwelling Unit** (SDU): A building used for residential purposes, containing solely one dwelling or home, which is typically occupied by one family.
- **Multi-Dwelling Unit** (MDU): A residential building comprising two or more homes, housing facilities or apartments.
- **Single Business Unit** (SBU): A building used for commercial or business purposes, containing a single and isolated unit.
- **Multiple Business Unit** (MBU): A non-residential building comprising two or more business or commercial units.
- **Premises:** A home or a place of business. For example, in a multi-dwelling unit each apartment is counted as one premise. In specific contexts a premise can also be designated as a Household (HH) or also a Home.
- **Homes Passed (HP)**: The potential number of premises which UGG has capability to connect to the FTTH network in a service area without further extending the distribution plant. Service activation of a Home Passed will just require the installation or connection of a drop cable from the homes passed point to the premise, and the installation of the required subscriber equipment.
- **Homes Connected (HC)**: The number of premises which are connected to the UGG network and are already subscribers of at least one network service under a commercial contract.
- **Street Address**: The address of a building, typically comprising a street name, house number, city, postcode and country.

3.1.2 TARGET ADDRESSES

UGG's original target was the residential market in rural settings. An architecture with Centralized Splitting has been used, but the evolution towards the urban objective, together with the advantages that we can find in Architecture with Distributed Splitting, the entire design will evolve until the latter.The network design will focus on providing service coverage to all the residential premises in the designated areas, adding also coverage to other types of premises following pre-defined design rules.

Target addresses are consequently classified in two main groups (Residential and Non-Residential), and then in different sub-groups depending on the specific characteristics of the location.

The different target address subgroups and the rules to calculate the number of homes passed to assign to each specific location is detailed in the tables below.

3.1.2.1 RESIDENTIAL ADDRESS

One building is considered residential in case that there is at least one residential premise (or home) inside.

Address Subgroup	Residential HP	Business HP	Notes
SDU	1(3)	0	A single-family home
MDU	1 x Home (1)(3)	1 x Business location	Building classified as residential, but a mix of residential + business premises is allowed
Empty Lots	0 x Lot (2)(3)	0	Only for urban vacant lots within or adjacent to the planned network routes

(1) Other specific demand points inside the building like elevators, surveillance systems, security booths or clubhouse facilities are considered additional units in the residential HP count.

(2) Plots under construction are considered as regular addresses / homes, so they have HP counts assigned.

New construction and development areas for which the local authorities request UGG to provide network coverage are included in the design using the data and dimensioning (number of homes and building locations) provided by the authority. The execution of this part of the network will probably be postponed, but the allocation of resources (POP and UDP/DP capacity, feeder and distribution infrastructure) must be guaranteed. Although they are taken into account for network dimensioning and included in urban planning, these areas will not be considered in the total HP re-counting of the Gemeinde and they must not be included in LOMA.

Empty lots located inside urban areas are considered in the design inside UDP/DPs and bundles capacity, but no specific ports are assigned for them in the UDP/DP, neither in the POP. These HPs are not included in the Gemeinde HP counts so, in LOMA they are only included with the address_id if the street and number are known (if the number is not known it must be obtained from the Gemeinde, so o.N. will not be accepted in LOMA if they are not clearly justified with documents, Gemeinde explanations, photos…). Before including the address in LOMA, the surveyor/designer will verify that the lot is classified as building plot by checking cadastral data or parcel classification maps, as well as the future real demand point asking to the Gemeinde.
Empty lots participating in the dimensioning of network elements (Feeder, UDP/DP and Distribution) but not in the total HP counts will be clearly identified in the LLD design.

(3) If an address (building) is named with two different numbers at the same time (i.e Haupstraße 7-11) we will keep always in LOMA the lowest number associated to this address (i.e Haupstraße 7) with the corresponding HPs amount and the rest of the numbers as vacant/empty lot with 0 HPs (i.e Haupstraße 8, Haupstraße 9, Haupstraße 10 and Haupstraße 11).

3.1.2.2 NON-RESIDENTIAL ADDRESS

Buildings or special locations that are not including residential premises inside. It is very important to identify the real demand points.

Address Subgroup	Residential HP	Business HP	Notes
SBU	0	1	Isolated shops, restaurants, gas stations, banks, churches, etc.
MBU	0	1 x Business location (1)	Office buildings, malls, …
Educational	0	1 x Building (2)	Schools, universities, training centres, libraries, etc.
Administrative buildings	0	3 (3)	City councils, fire stations, police stations, public service offices, etc.
Small/Medium businesses or industrial	0	2 (4)	Individual businesses from 400 m² up to 1600 m² (as reference).
Big businesses, factories or industrial	0	3 (3)	Individual business from 1600 m² on (as reference).
Special buildings	0	1 x Building (2)	Theaters, cinemas, sport centers, etc.
Empty Lots	0	0 x Lot (5)	For vacant commercial lots within or adjacent to the planned network routes if there is not construction evidence.

(1) When the number of locations cannot be determined, one unit is calculated for each 100 m2. Check always the estimations with UGG representatives.

(2) 1 HP per building or 1 HP per demand point (if there is more than one access to the building) is considered for these locations. The capacity of the drop cable will be the one required according to the total number of HP in the building.

(3) 3 HPs for the first building. If there are more buildings associated to the same address, 1 HP is considered for each 2nd,3rd… building. (i.e., 1st building=3HPs + 2nd building=1HP-> Total=4 HPs).

(4) 2 HPs for the first building. If there are more buildings associated to the same address, 1 HP is considered for each 2nd,3rd… building. (i.e., 1st building=2HPs + 2nd building=1HP-> Total=3 HPs).

(5) The general calculation rule for MBUs can be applied in case that enough information about the size of the planned business location is available.

3.1.3 ADDRESS ATTRIBUTES

Any street address characterizing a potential network demand point must include at least the attributes listed in LOMA Address List Template v2.6 (it can be downloaded directly from LOMA):

Formato_Address_List_Template_legend_O

Address attributes are standardized by the specialized UGG application, LoMa (based on Infas360), before being loaded into the management systems. Consult the Application Manual for details [7].

As a general rule, German location names shall be used instead of the equivalent English names, even if the applications supporting address management are written in English.

3.1.4 HOME UNITS (PREMISES)

Apartments inside a building are not physically identified with a number or a letter in most of the German Cities and Towns.

The usual way to identify apartments is by means of a label with the surname on the mailbox and on the apartment's door. The surname refers to the apartment's resident(s) rather than to the apartment owner(s).

Consequently, during the network design phase home units are identified with the attributes listed in ANNEX 3 – SURVEY GUIDELINES.

At subscriber provisioning time (out of the scope of this document) the Home Unit will be identified with additional attributes, like the customer's name, contact phone, email address, number and type of lines subscribed, etc. These attributes are subject to the Federal Data Protection Act (BDSG) management constraints.

For other considerations for the address survey see Annex 3.

3.2 POINTS OF PRESENCE (POP)

3.2.1 DESCRIPTION

The Point of Presence (POP) is a container-size cabinet that may include inside:

- **Active equipment**: The Optical Line Termination (OLT), transmission equipment, L2 switches, monitoring systems, etc.
- **Passive optical equipment**: Optical Distribution Frame (ODF), with splitters and patch-panels, splice and connector modules, etc.
- **Auxiliary elements**: AC and DC power equipment, cooling systems, ceiling light fixtures, security systems (fire protection, electronic access door), raised flooring and suspended structures for cabling systems.

For the OLTs the technology used is **GPON**, offering 2.5 Gbps in downstream and 1.25 Gbps in upstream per OLT port, but with the potential upgrade to **XGSPON** (multi-technology chassis). Both Point to Point (PtP) and Point to Multipoint (PtMP) services are supported on the OLT.

The standard split ratio is 1:64. In the CS Arch., this division is implemented in practice with a cascade of 1:2 + 1:32 splitters in the ODF (IPV) of the POP. However, in DS Arch. the division levels are moved to intermediate equipments, using 1:4 and 1:16 levels in cascade (in this order or in reverse). Depending on the type of buildings to be serviced, both levels are located in the Urban DP or one within it and the second within the building itself.

In the CS Arch., the outside plant fibers coming from the feeder network are terminated and spliced at the corresponding ODF frame. Outside plant fibers are connected to the output of a splitter (or a PtP port from the OLT) at subscriber provisioning time, by means of a patch cord.

In the DS Arch., the Local Backbone fibers coming from the FP are fully spliced in the ODF. However, only the 50% (as minimum) of the fibers belonging to each splitter type located at the UDP as 1st level is illuminated in the IPV (see 3.5.4.2).

There are Active POPs (with active equipment, passive optical equipment and auxiliary elements) and Passive POPs (without active equipment).

The area of an Active POP is defined by the addition of its UDPs/DPs´ service areas and UDPs/DPs´ service areas of those Passive POPs connected to it. This area is limited by the Optical Budget.

3.2.2 LOCATION OF THE POP

A Gemeinde (Municipality) can be made up of one or more population centres.

Planning Team will propose POPs distribution and their types in the different villages of a Gemeinde (or groups of Gemeinden) through the Cluster Structure document. This proposal has to be confirmed after the survey, depending on the number of HPs detected, soil conditions and Gemeinde authorization. From each POP, the Feeder Network is deployed until DPs, just as their links (BackHaul and BackBone), according to the cluster structure.

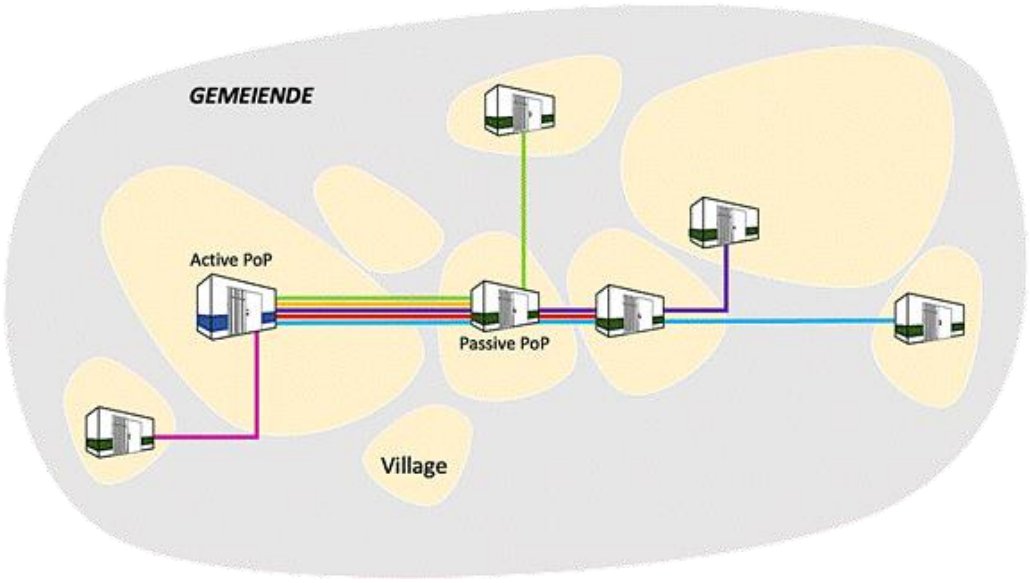


Figure 9.- Example of a Gemeinde with several population centres

The aggregation of Gemeinden (considering the limitations of the available optical power budget) is allowed, so that it is possible to concentrate several Gemeinden into a single Active POP. By doing so a cluster or group of Gemeinden will be made up.

The ideal location of a POP is always near the centroid (or 'centre of gravity') of the population centre, so that the network elements serving the area are equally distributed around the POP and the cable routes are optimized.

Candidate POP locations (empty plots or rented spaces on wider areas, preferably located on public land owned by the Gemeinde) near the ideal location are identified by the surveyors at the initial project phases.

The guidelines for selecting a POP location and the selection of the final position need to be coordinated case by case with the real estate agents and the Municipality, trying to satisfy our deployment rules (to make conduits capacities efficient, Feeder Network length, …).

As a reference for designers and surveyors, the minimum dimensions of the plot selected to place the POP are (see definition of POP Types in next sub-chapter):

	Front or Back entrance POP			Side entrance POP		
	Length[m]	**Width[m]**	**Area[m2]**	**Length[m]**	**Width[m]**	**Area[m2]**
Type 1	11.4	4.8	54.72	11.4	6.3	71.82
Type 2	11.9	4.8	57.12	11.9	6.3	74.97
Type 3	8.9	4.8	42.72	8.9	6.3	56.07
Type 4	11.4	4.8	54.72	11.4	6.3	71.82
Type 5	8.9	4.8	42.72	8.9	6.3	56.07

Based on the POP dimensions, the location selected must also allow for transport, unload and installation of the POP container.

Regarding to the POP´s sidewalk perimeter, these are the measurements depending on the POP type (POP Type 6 does not have sidewalk):

	Longer Length (m)	**Shorter Length (m)**	**Wall width (m)**	**Perimeter (m)**
Type 1	6	2,4	0,4	22,4 *
Type 2	6,5	2,4	0,4	23,4 *
Type 3	3,5	2,4	0,4	17,4 *
Type 4	6	2,4	0,4	22,4 *
Type 5	3,5	2,4	0,4	17,4 *

*4 sidewalk corners have been considered for calculations.

3.2.3 POP SELECTION CRITERIA

The available **POP types** and maximum capacities per model are:

Type	Class	Capacity	Nr. of ODF	Max. Fiber	Max. HP
1	ACTIVE	1 x SC	2 ODF	5.376 FO	2.352 HP
2	ACTIVE	2 x SC	4 ODF	10.752 FO	4.704 HP
3	PASSIVE	1 x SC	2 ODF	5.376 FO	2.352 HP
4	PASSIVE	2 x SC	4 ODF	10.752 FO	4.704 HP
5	ACTIVE	½ X SC	1 ODF	2.688 FO	1.176 HP
6	PASSIVE	½ x SC	1 ODF	1.152 FO	576 HP

Planning team will propose Architecture and POP types through the cluster structure document. The basic rules for **POP selection criteria** are:

For the DS Arch.:

- If the main population centre **has between 8.000 HP and 12.000 HP**, the Aggregation Headend POP is proposed as Active POP type 1 and as Active POP type 5 when the total number of HPs is **less than 8.000 HPs**. This POP is always involved in the DS Arch.
- The Active Headend POP (Active POP type 5) is connected to the Aggregation Headend POP to avoid the 15km optical budget. It can serve a maximum of **4000 HPs**.

For the CS Arch.:

- If the main population centre **exceeds 4.000 HP**, the POP will be split into a type 2 Active POP (large) plus a Passive POP type 4 (large) or 3 (standard), dividing the total number of HP into two balanced areas of influence, with the POP in centre of gravity of each one of them.
- If the main population centre has **from 2.000 up to 4.000 HP**, a single type 2 (large) Active POP will be installed.
- If the population centre has **from 1.000 HP up to 2.000 HP**, a single type 1 (standard) Active POP will be installed.
- If the population centre has **fewer than 1.000 HP**, a single type 5 (small) Active POP will be installed.
- If the population centre has **between 200-400 HP**, a single type 6 Passive POP (CDP-512, new name for the mini-POP) will be installed.
- If the **secondary population centres have fewer than 200 HP**, no POP will be installed in the centre, and the fibers from the DPs will be retracted to the nearest Passive or Active POP. In exceptional cases (<2%) in which the distance exceeds 15 Km, although the centre has fewer than 200 HP, the installation of a type 5 (small) Active POP will be analysed, after high-cost validation, in that centre in question or in another neighbourhood with Passive POP installed.
- If the **secondary population centres have more than 200 HP**, a Passive POP will be installed in the centre, from which the 96-fiber cables will be laid to the centre's DPs (and other DPs from centres with fewer than 200 retracted HHPP), and the link cables to the main POP.

- If two or more **population centres or Gemeinden are very close to each other**, at a maximum distance of 3 Km between the farthest points in the worst case, it is possible to reduce the number of needed POPs according to the general criteria and thus sharing one POP between two or more Gemeinden / Population centres.
- It is important to consider that, in Active POPs, ODFs capacities are reduced due to LB cables terminations, and they can compromise future expansions. A 10% of vacancy rate of trays is foreseen for those trays used over Feeder.
- If, after the survey, data clearly differ from those planned in the structure, UGG should be informed for review.

3.2.4 POP DESIGN

The **typical size and internal location of equipment** inside a POP is shown in the picture below.

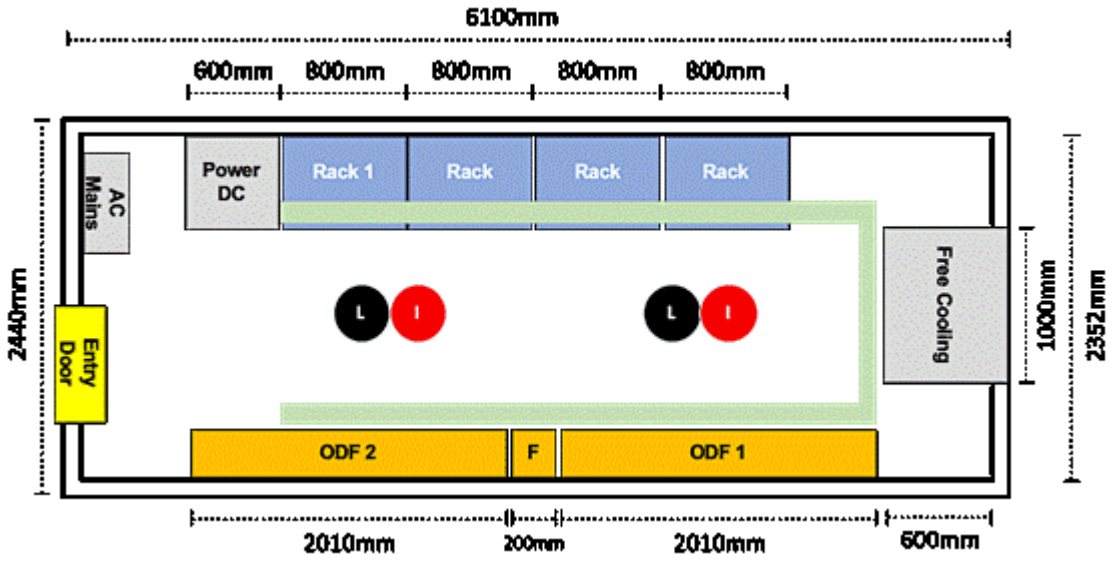


Figure 10.- Typical size and internal location of equipment inside a POP (Type 1)

The dimensions of the POP type 6 are the following:

- **Overground part:** 1600 x 2000 x 500 (Height x Width x Depth, mm).
- **Underground part:** 750 x 2000 x 500 (Height x Width x Depth, mm).

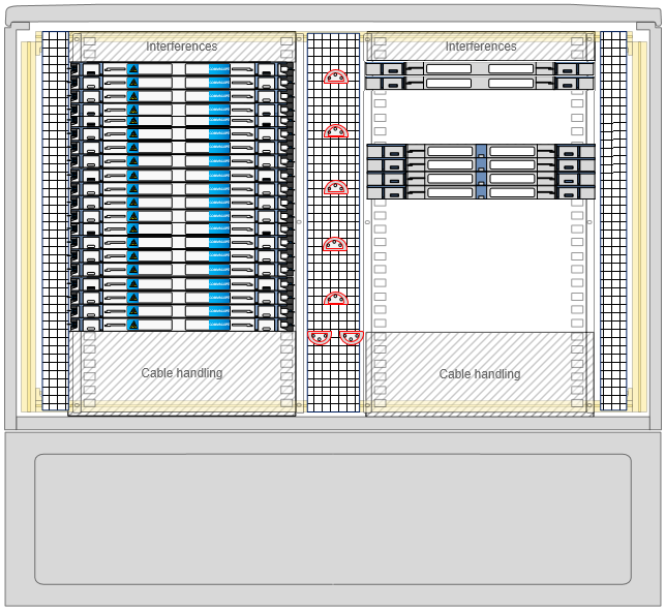


Figure 11.- Typical size and internal location of equipment inside a POP type 6 (CDP-512)

The **definition of the layout and internal design** of the POP is not part of the outside plant design projects. As a reference for the OSP designers, the main POP components and design rules are briefly described in the next subchapters, and a reference to the applicable documentation is provided.

3.2.4.1 OPTICAL DISTRIBUTION FRAME (ODF)

The **Optical Distribution Frame (ODF)** is the point where the fibers of the FTTH outside plant cables are terminated inside the POP.

The ODF is also the point in which the optical splitters needed for point-to-multipoint networks are installed and connected to the OLT ports.

The basic ODF frame is composed of two rack-mounted verticals, one used to terminate the optical fiber cables of the outside plant (the access network), and the other vertical to install different components, like optical splitters, Backbone and Backhaul end ports, etc. ODFs are fully modular and could be stacked and equipped with different modules according to the necessities of each installation. See Annex 1 for further module details and size of the ODF modules.

The ability to cross-connect any outside plant fiber with any splitter output or point-to-point connection port is the key functionality of the ODF. The interconnection is resolved by means of patch-cords connecting ports on each vertical, installed at subscriber connection time.

For the CS Arch., a correlative order will be followed in the installation of the cables of each DP, by Gemeinde, considering the "Load Distribution" by ODF (equitable distribution between ODFs) and the number of occupied trays by the Feeder network (every ODF must have the same number of trays occupied, whenever possible). All DPs of the same Gemeinde will be ordered in a correlative way at POPs´ODFs (according to DP number). Once the DPs of one Gemeinde are finished, those of the next one will be ordered, and so on, considering the Load Distribution between ODFs. In the event that, after installing the cables in

the ODF, a new cable has to be connected, it will be placed in the next free tray after the last cable installed, keeping the "Load Distribution".

The same criteria must be applied in the new DS Arch. where the Feeder Points must be balanced in the existing ODFs inside the Headend POP. All FPs of the same Gemeinde will be ordered in a correlative way at POPs´ODFs (according to FP number). Once the FPs of one Gemeinde are finished, those of the next one will be ordered, and so on, considering the Load Distribution between ODFs. In the event that, after installing the cables in the ODF, a new cable has to be connected, it will be placed in the next free tray after the last cable installed, keeping the "Load Distribution".

The responsibility of defining the **Optical Distribution Frame (ODF) positions, splices and numbering** in the CS Arch. is as follows:

- ODF positions and numbering for connecting **feeder cables** to the OPV ODF vertical are defined in the scope of the LLD Access project (see section 6 for samples and templates). When the POP has several ODF modules dedicated to this purpose, feeder cables are evenly distributed among them in a balanced way.
- Access project shall define the ODF positions and numbers of trays required for connection of the **Local Backbone cables** in the source and destination POPs as well as the ODF positions reserved for interconnection of **transmission cables.**

Regarding the new DS Arch., the responsibility of defining the **Optical Distribution Frame (ODF) positions, splices and numbering** will be the same:

- ODF positions and numbering for connecting **Local Backbone cables** (coming from the Feeder Point) to the OPV ODF vertical are defined in the scope of the LLD Access project (see section 6 for samples and templates). When the POP has several ODF modules dedicated to this purpose, Local Backbone cables are evenly distributed among them in a balanced way.
- Access project shall define the ODF positions and numbers of trays required for connection of the Local Backbone cables in the source and destination POPs as well as the ODF positions reserved for interconnection of transmission cables.

Check the document reference [2] for more details about the configuration of the ODF.

3.2.4.2 OPTICAL LINE TERMINATION (OLT)

The **Optical Line Termination (OLT)** is a central office equipment whose primary function is to manage and control data flows between the customers and the network across the optical access network. The OLT establish secured data links with the Optical Network Termination (ONT) located at customer premises.

The Optical Line Termination is only installed in **Aggregation and Active POPs**.

The Outside Plant shall be designed to support at least **15 Km loop lengths** (from OLT to ONT) in the worst signal attenuation conditions.

The most restrictive case, including an active POP + passive POP + MDU distribution, will result in a total attenuation of around 30 dB (see figure below). For this reason, **Class C+ optics** will be required for all GPON ports of the OLT.

In case of **retailer operators using B+** technology in co-located OLTs, and in order to achieve the 15 km 'worst case' reach, splitters 1:32 will be recommended in the design instead of the usual 1:64 splitters. The responsibility for ensuring correct optical power level for all the subscribers relies on the retailer.

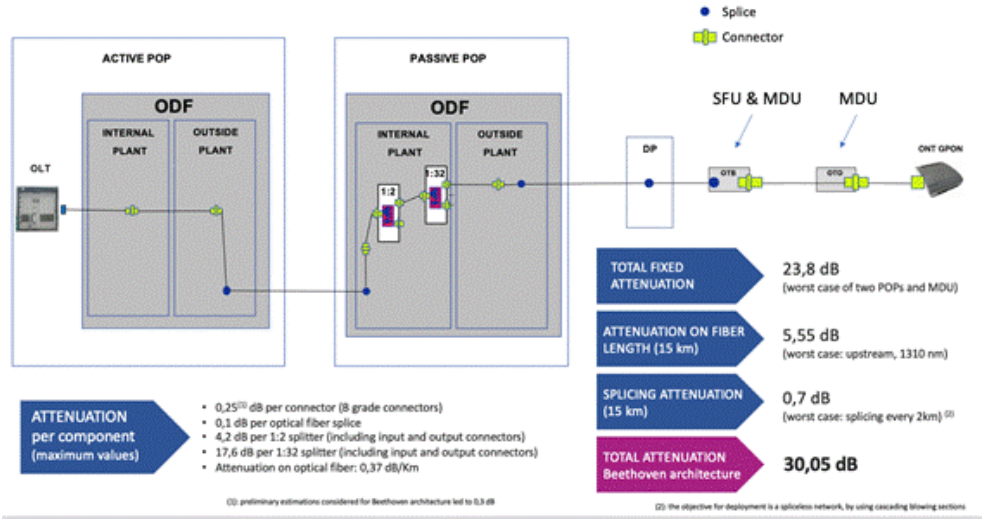


Figure 12.- Attenuation from OLT to ONT

The number of GPON ports required in the OLT depends on the expected homes connected. The number of expected homes connected is the number of homes passed multiply by an initial take (40%).

Considering the homes passed (HP), the initial take (40%) and the splitting level (1:64), the number of **GPON ports required in the OLT** is:

GPON Ports = (HP * 40%)/64

The class optics (C+/C++) will depend on the distance between the OLT and the most distant home.

The Small Form-factor Pluggable (SFP) transceiver used to connect the OLT with the L2 aggregation equipment (uplink) could be 10 Gbps 1-fiber or 10 Gbps 2-fiber. It depends on the distance between the OLT and the L2 aggregation switch.

The range of these SFPs could be 10 km, 20 km, 40 km or 80km. For 10 km, 20 km and 40 km the SFP will be always 10 Gbps 1-fiber. For 80 km the SFP will be always 10 Gbps 2-fiber.

Range	Type
10 km	10 Gbps 1-fiber
20 km	10 Gbps 1-fiber
40 km	10 Gbps 1-fiber
80 km	10 Gbps 2-fiber

Check document [3] Installation criteria on Active POP – Technical Normative for more details about the configuration of the OLT.

3.2.4.3 CONSOLE ROUTER

The console router is only installed on Active POP locations. The purpose of this router is to provide out-of-band access and management to the OLTs and L2AGG switch located on the Active POP.

Check document [3] Installation criteria on Active POP – Technical Normative for more details about the configuration of the Console Router.

3.2.4.4 L2 AGGREGATION SWITCH (L2AGG)

The L2AGG switch will be installed only in the POPs defined as Aggregation POP. The purpose of this switch is to aggregate the traffic of all the OLTs located on the Aggregation POP and on all the Active POPs connected to the Aggregation POP.

There are two L2AGG switch initial configurations available:

- **Type A**: 16 x 10 GbE ports + 1 x 100 GbE port, 290 Gbps internal switching capacity
- **Type B**: 6 x 10 GbE ports + 1 x 100 GbE port, 190 Gbps internal switching capacity

The selection of the configuration to install depends on the number of POPs aggregated and the traffic profile defined for each one:

Type	Available Ports	OLTs identified in the short and medium term
Type A	16 x 10 GbE + 1 x100 GbE	PoPs with 4 or more OLTs (local and remote), counting all the OLTs identified in the structure
Type B	6 x 10 GbE + 1 x100 GbE	PoPs with 1, 2 or 3 OLTs (local and remote), counting all the OLTs identified in the structure

The infrastructures available in all sites with OLT should allow, at least, the installation of two L2AGG switches. There are cases with 2 Aggregator POPs in the same cluster. Besides the route to the SWD, both POPs have a Backup route between them.

The typical L2AGG connectivity will be as follows:

- OLTs in the cluster area: N x 10 GbE ports, depending on the traffic profile
- Console router: For the out-of-band access and management the two L2AGG remote console ports are connected to the console router.
- The connection L2AGG – SWD (Point of Interconnection from Telefonica Germany) will be composed of 100 GbE links, or N x 10 GbE if not available.

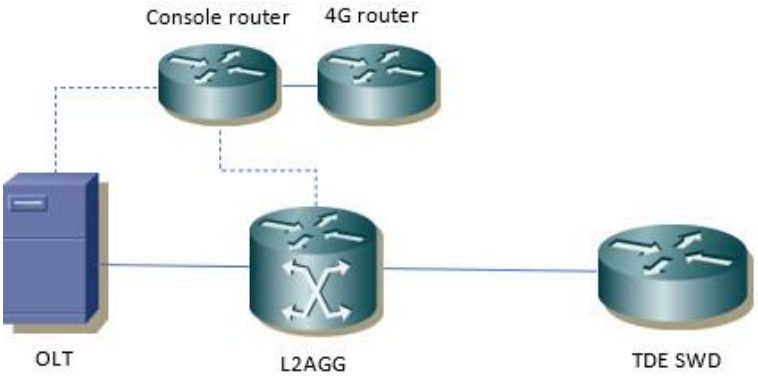


Figure 13.- L2AGG connectivity diagram

The connection L2AGG – OLT will be increased when the traffic reaches the 80% of the connection's current capacity.

The connection L2AGG – SWD will be increased when the traffic reaches the 70% of the connection's current capacity.

Document [3] Installation criteria on Active POP – Technical Normative contains more details about the configuration and characteristics of the L2AGG switches.

3.2.5 DELIVERABLES

The Network Planning phase encompasses the definition of the target areas (Municipalities and population centers), location and basic dimensioning of POPs, identification of the Point of Interconnection, internal design of the POP, etc.

All the deliverables from the planning phase are included in one document named as "Land+Landkreis+Nºcluster", followed by the Gemeinde's name. The document shows:

- Administrative units.
- Gemeinde characterization and clustering.
- Structure (high level network diagrams).
- POI and Backhaul routes.
- Cluster and backhaul initial phase and evolution.

3.3 BACKHAUL NETWORK (BH), BACKUP LINE (BUL) AND REDUNDANCY BACKHAUL (BHR)

3.3.1 DESCRIPTION

The backhaul is the part of the network that aggregates all the traffic from the BNG (Broadband Network Gateway) until a Point of Interconnection (POI) or SWD (Point of Interconnection from Telefonica Germany) and then to the active POPs.

The Point of Interconnection (POI or SWD) is the end-point of the Backhaul network. The location of this point is provided as part of the Network Planning documentation and cannot be changed without UGG written consent.

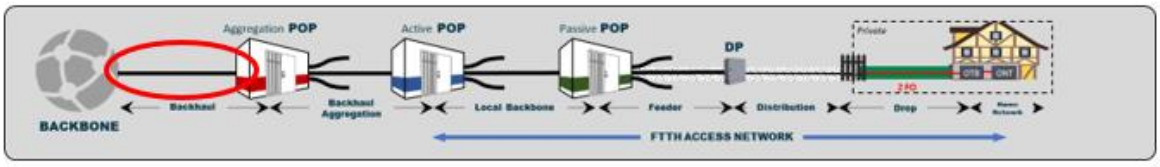


Figure 14.- Backhaul Network

The backhaul topology is based on the aggregation of several active POP uplinks into a L2 aggregation equipment deployed at some specific active POPs, thus called Aggregation POPs.

This topology provides some efficiency by sharing among a group of POPs the third party leased fiber (entirely or with a mix of renting and own construction) for connecting with the Backbone.

Regarding to **Backup Line (BUL)**, we define it as an alternative route to Backhaul, towards BNG, through another Aggregator POP inside the same cluster**.** The following image shows an example:

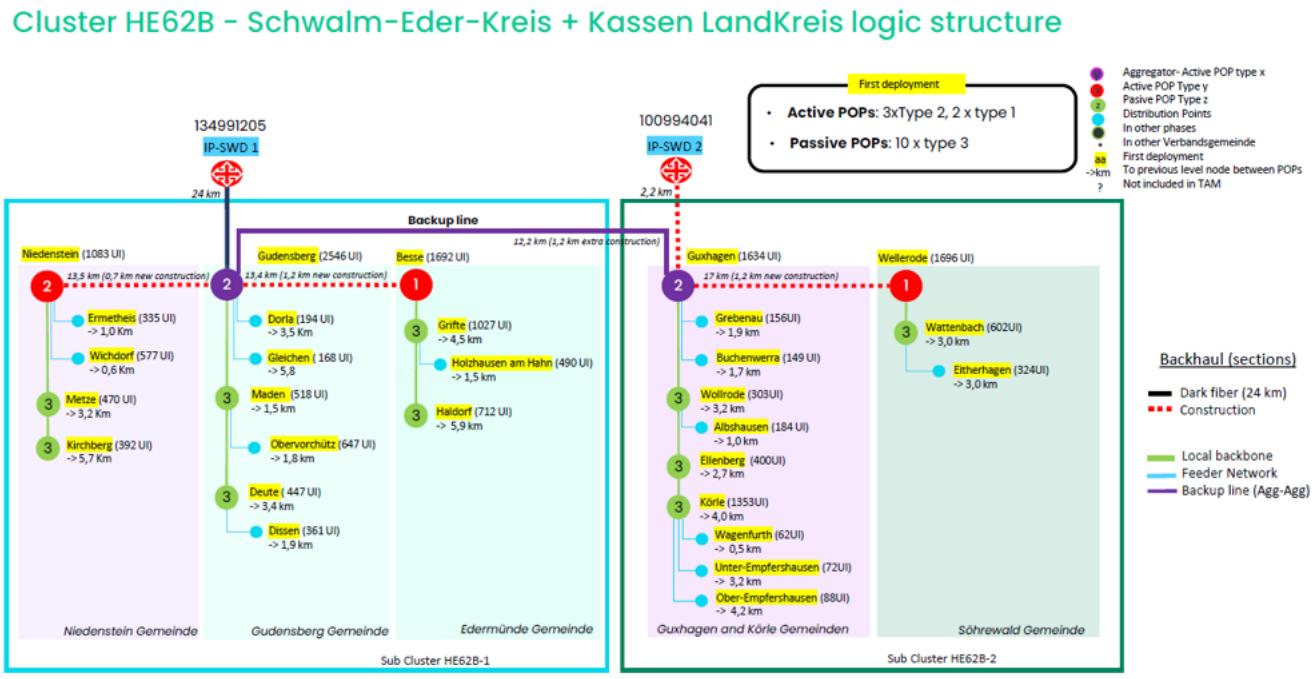


Figure 15.- Cluster Scheme: Backup Line

Unless specifically stated otherwise, in a Backup Line route, the first Access Project (corresponding to the first Aggregator POP) to be designed arrives with infrastructure until the limit of its deployment while the second project (corresponding to the second Aggregator POP) includes the needed bundles inside its deployment and the end-to-end cable in the Access Project, and pending interurban routes (those not carried out by other Gemeinden) in the BH/LB Project (civil works, bundles, manholes,…).

The **Redundancy BackHaul (BHR)** is a link between Aggregators POPs of different clusters which main objective is to have another alternative route against network downs. An element will be marked in the cluster structures with a red star: Virtual Handhole of Redundancy (VHR). It always marks the access limit of a border Gemeinden, independently of the coordinates showed in the cluster document as they are approximate.

Unless specifically stated otherwise, the bordering Gemeinden between clusters will design until their deployment limit (Red Star). The first Access Project to be designed (corresponding to the first Aggregator POP) arrives with infrastructure until the limit of its deployment while the second project (corresponding to the second Aggregator POP) includes the needed bundles inside its deployment and the end-to-end cable in the Access Project. This second Aggregator POP takes care also about the pending interurban routes (those not carried out by other LLDs) in the BH/LB Project (civil works, bundles, manholes, …).

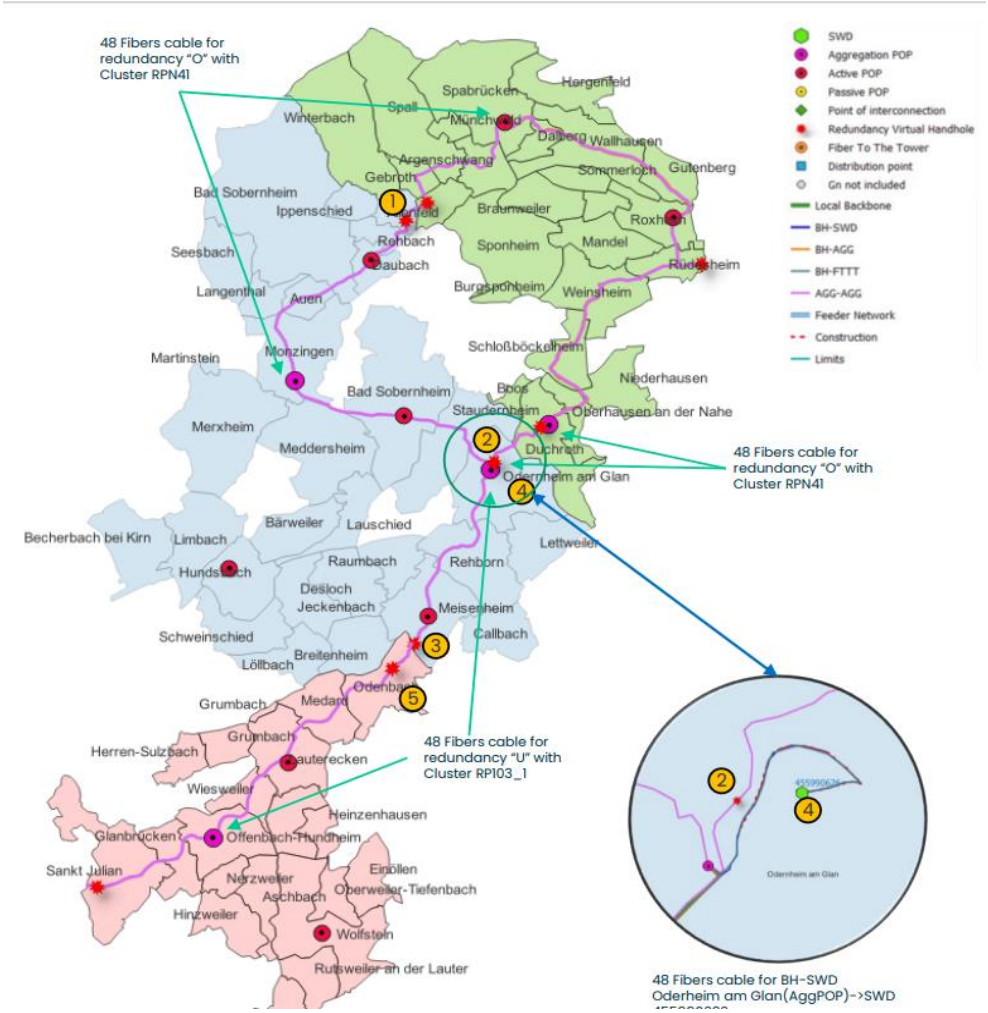


Figure 16.- Redundancy BackHaul

It is important to note that BH, BUL and BHR of the same POP Aggregator should follow different CW routes throughout the entire route, if possible.

3.3.2 NETWORK DIMENSIONING

A **48 or 96-fiber cable** will be deployed for all the routes of new construction. The initial cable capacity is defined in the Network Planning documentation.

In the event of not constructing this subsection but leasing totally or partially the fibers or the duct instead, the cable capacity or the number of used fibers will depend on the commercial terms or IRUs finally negotiated with the dark fiber provider. In any case, Outside Plant designs shall be designed, by default, with the possibility of 2 active fibers per link.

In case of new construction, a set of one (only one) **50/40 mm duct** and a **bundle of 4x14/10 mm micro-ducts** will be laid, one containing the 48 or 96-fiber cable and the others for future uses and spare capacity. A **7x14/10 bundle** can be deployed instead of **4x14/10 mm** in case that more backhaul or local backbone cables are running in parallel.

In all BackHaul routes only one 50/40mm bundle will be laid independently of the number of links.

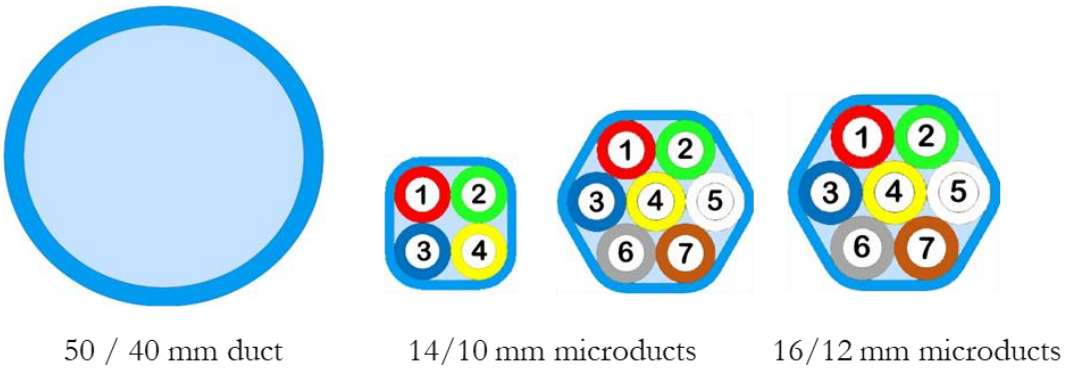


Figure 17.- Duct and micro-ducts in the Backhaul network

3.3.3 NETWORK ROUTES

The Backhaul network routes are usually simple **point-to-point lines** deployed close to existing roads that connect an Active POP with another Active POP (with aggregator function) or this last one with the SWD (point of interconnection with Telefonica Germany). The preferred construction method is Minitrenching Grass or Ploughing, if possible. BackHaul routes shall be calculated after completion of the Feeder and Distribution network design.

Splice boxes are added on every transition point between a new construction section and a third-party rented cable. These splice boxes will be installed in TC Handhole, next to the Interconnection Point.

The required **bundle lengths** must be oversized by adding 2% to the calculated distances, to consider the normal bundle waste at construction time. The Backhaul **cable lengths** are also oversized by the 2% of the total calculated length, plus **40 meters** (20 + 20) per cable in POP-POP/POP-SWD connections or **30 meters** (20 + 10) per cable in POP-POI/POI-SWD connections (only considered in BoQ). In addition, in all cases, 6m of cable will be added for each intermediate manhole, without splice but with loop element (storage).

In general, civil works in which different links (BH/LB) run will be considered in the lower-ranking project.

The Backhaul network micro-ducts bundles are always independent of the Access (Feeder and Distribution) network bundles, even in the case that the Backhaul and Access routes are coincident.

Backhaul and Local Backbone networks can share bundle in all the routes where the two networks are running in parallel, in CS Arch. 14/10 ducts will always be used, unless it must be shared with 288 fo LBB cable, in which case 16/12 ducts must be used. See the table below to calculate the merged bundle size and bundle occupancy.

(updated table)

Cables	Bundle	Occupancy
1 x (48 / 96 / 192 fo) **link routes and other services**	4x14/10	1
1 x 288 fo	7x**16/12**	1
1 x 288 fo + (1-2) any	7x**16/12**	2-3
(2-3) x (48 / 96 / 192 fo)	7x14/10	2-3
4 x (48 / 96 / 192 fo) *	7x14/12	4

**For BackBone and BackHaul sections where exist 4 cables of 3 different links (3 different POPs). A maximum of 4 microducts are occupied remaining 3 microducts in vacancy, one for each link (POP). If exist 5 or more cables in the same section it is necessary to combine different types of bundles according to the above table.*

Note: a link is a connection between SWD-POP or POP-POP. Every cable which shares route with the same origin-destination and function belongs to the same link.

For DS Arch., the BH routes will occupy the microducts equivalent to an FP LBB, therefore, and as explained in section 3.5.1., you can only share a Bundle with the LBB of 1 FP or with another BH.

3.3.4 INTERCONECTION WITH OTHER OPERATORS

It might be required (to be checked case by case) the installation of a dedicated handhole and splicing closure in the points of the network where it is expected to have a connection with other operators, either in the case that UGG uses resources from the other operator (e.g. dark fiber) or the other operator uses UGG resources (the Access network).

The handhole of UGG, when required, will be installed at 1-2 meters distance from the handhole of the other operator. For the connection between the different handholes, tubes of 50/40 mm will be used. A minimum of 2 tubes of 50/40 mm must be installed between handholes.

One handhole has to be foreseen/prepared next to each POI, with a Boxed Splice and 2 splices for every circuit. The handhole that must be installed is the TC model, see Annex 2 for dimensioning and other component details. If the handhole has to be foreseen/prepared next to a SWD which belongs to O2, the handhole must be OC model. Moreover, a loop of 6m cable must be considered, without splice.

If the SWD is located in a building that requires transition to fire-resistant cable, the transition between the BH cable and the riser shall be made with an indoor Splice closure (SC).

The cable used for the connection between handholes will be a 48 fo cable, unless stated otherwise. The fiber spliced will be only the fibers required for the transmission service, e.g. 2 or 4 fibers. For each cable

reaching the splicing closure **10 m**. extra per cable will be considered (for this splice execution) and added to the total cable lengths.

In case of direct connection with the SWD, the first patch panel (PP, see figure below) and other elements like patchcords are provided by the transmission operator that rented the service. Only in case of fiber 100% owned and constructed by UGG the patch panel must be included as part of the design. A patch panel with 48 connectors type E2000 will be considered.

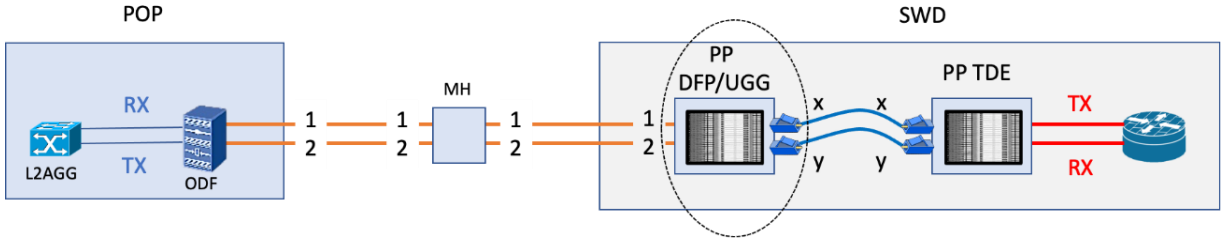


Figure 18.- Connection between POP and SWD

3.3.5 DELIVERABLES

The deliverables of the Backhaul project are specified and discussed in chapter 6.

3.4 CENTRALIZED SPLITTING ARCHITECTURE (CS ARCH.)

Until now, UGG has used the CS Arch. for low-density areas. The type of architecture to use will be defined in the cluster structure document. The mix of both architectures will be avoided in the same Gemeinden, but maybe not in the same cluster (depend on the necessities).

In the following sections each part of network is explained, focused on this type of architecture.

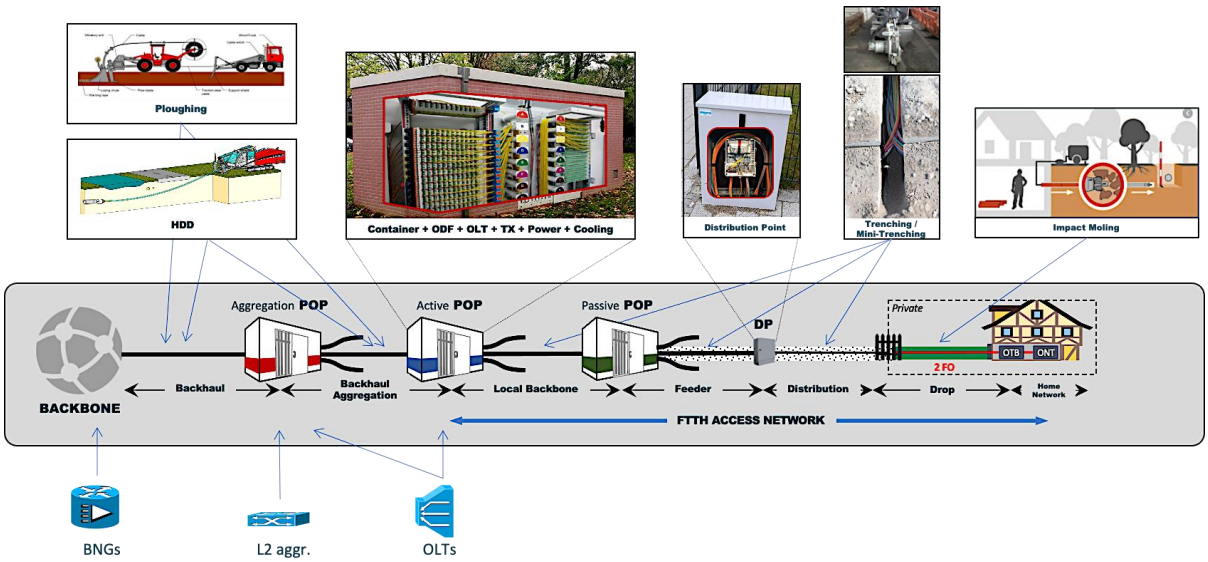


Figure 19.- UGG Centralized Splitting Architecture.

3.4.1 LOCAL BACKBONE NETWORK (LB)

3.4.1.1 DESCRIPTION

The connection of Passive Points of Presence (POPs) with the active POP makes up the so-called Local Backbone Network.

This section includes the uplink fibers multiplexing homes passed on passive POP (with 1:2 + 1:32 splitters), from their own serving area, as shown in the following figure.

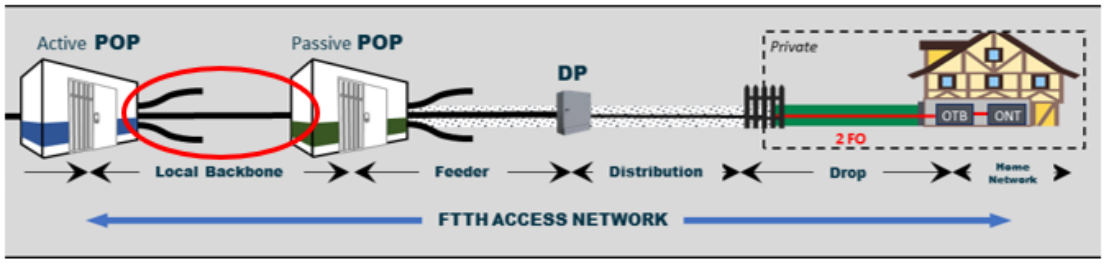


Figure 20.- Local Backbone Network in the CS Arch.

3.4.1.2 NETWORK DIMENSIONING

The number of fibers deployed in the cable section from one passive POP to the active POP is **1 fiber for every 4 equivalent Homes Passed** in the passive POP. This number has been chosen considering that civil works is the most expensive section of the deployment, so it must be fibers enough in order to guarantee future uses or breakdowns.

Once the survey is finished, if data are different compared to those planned in the structure they should be reported to UGG for review.

The minimum number of fibers in the Local Backbone is 96 fibers and it will be adjusted to the immediately higher cable capacity. Approved cable capacities for the Local Backbone are **96, 192 and 288 fibers**. If more than 288 fibers are required, several cables running in parallel are used.

This measurement criteria is **independent of the number of Passive POPs** being aggregated by the Active POP, that is, independent of the number of population centres in the Gemeinde.

When the Local Backbone ends in POP type 6, the first fibers of the Local Backbone must be continued into the Active Pop. These connections must be valued and executed in the deployment with the instructions of Internal Plant Engineering.

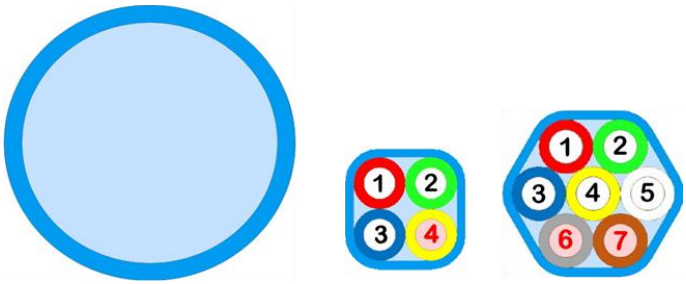
In case of new construction, a set of one (only one) **50/40 mm duct** (which maximum capacity is up to 3 subducts 12/10mm) and a minimum of one **bundle of 4x14/10 mm micro-ducts** will be laid along the local backbone route. 7x14/10 or **7x16/12 mm bundles** can be deployed instead of the 4x16/12 mm when several local backbone cables are running in parallel. (see table in: 3.4.1.3)

This means that, in all Local Backbone routes only one 50/40mm bundle will be laid independently of the number of links. For exceptional proposals, consult the UGG design team.

In POP type 6 exclusive routes (routes where there are only bundles occupied by cables which destination is this type of POP), the bundle 50/40mm must not be installed. In case that spare routes to other Gemeinden inside a radius of 6km are foreseen through the same route, the bundle 4x14/10mm must be changed by a 7x14/10mm bundle.

For example, as there is a spare route foreseen from Obertiefenbach to feed Schwerte the duct 7x14/10mm must be laid between both POPs (green section).

However, in this example, as there is not a spare route foreseen from Obertiefenbach to feed Schwerte (because it is more than 6km far from the Gemeinde with POP type 6) the unique bundle laid between both POPs must be the 4x14/10mm.



50 / 40 mm duct 16/12 mm microducts

Figure 21.- Duct and micro-ducts used in the Local Backbone network for CS Arch.

3.4.1.3 NETWORK ROUTES

The Local Backbone network routes are usually point-to-point lines deployed mostly along existing roads.

The Local Backbone network micro-duct bundles are always independent of the Access (Feeder and Distribution) network bundles, even in the case that the Local Backbone and Access routes are coincident.

The required **bundle lengths** must be oversized by adding **2%** to the calculated distances, to consider the normal bundle waste at construction time. The Local Backbone **cable lengths** are also oversized by the **2%** of the total calculated length, plus **40 meters (20 per cable end)**, considered in BoQ (not necessary to reflect in Keycom). In addition, in all cases, 6m of cable will be added for each intermediate manhole, without splice but with loop element (storage).

As mentioned in section 3.3.3, Backhaul and Local Backbone networks can share micro-duct bundles in all the routes where the two networks are running in parallel. The following table helps to calculate the merged bundle size and bundle occupancy.

In all the cases that the civil works required to place the pipes underground are shared with feeder and distribution must be accounted only once in the Access project.

(updated table)

Cables	Bundle	Occupancy
1 x (48 / 96 / 192 fo) **link routes and other services** (*)	4x14/10	1
1 x 288 fo	7x**16/12**	1
1 x 288 fo + (1-2) any	7x**16/12**	2-3
(2-3) x (48 / 96 / 192 fo)	7x14/10	2-3
4 x (48 / 96 / 192 fo) **	7x14/12	4

**For bundles 4x14/10mm used exclusively by cables with destination POP type 6, 2 microducts must be occupied (instead of 1).*

***For BackBone and BackHaul sections where exists 4 cables of 3 different links (3 different POPs). A maximum of 4 microducts are occupied remaining 3 microducts in vacancy, one for each link (POP). If exist 5 or more cables in the same section it is necessary to combine different types of bundles according to the above table.*

Note: a link is a connection between SWD-POP or POP-POP. Every cable which shares route with the same origin-destination and function belongs to the same link.

3.4.1.4 DELIVERABLES

The deliverables of the Local Backbone project are specified and discussed in chapter 6.

3.4.2 SPARE INFRASTRUCTURE FOR FUTURE USE

The objective of spare infrastructures is to be able to provide services in the future or to have the infrastructure prepared for futural structural changes.

Always, in every Gemeinde, an alternative route must exist to all Gemeinden not included in the cluster structure document and located within a radius of 6km (coil length), By default, the capacity of these infrastructures is the following: only 1 Bundle 4x14/10mm. In those sections where the planned spare route coincides with other BH, BUL, BHR or LB bundles, no exclusive spare bundle is required. although it will be ensured that the Bundle of the shared section up to the POP will be 7x. This spare infrastructure will be installed until the deployment access limit of the Gemeinde.

3.4.3 FEEDER NETWORK (FN)

3.4.3.1 DESCRIPTION

The Feeder Network covers the network sections connecting each Active or Passive POP to the Distribution Points (DPs) in the area.

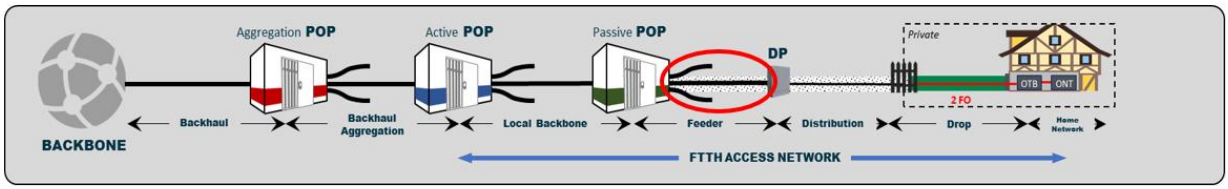


Figure 22.- Feeder Network in CS Arch.

3.4.3.2 NETWORK DIMENSIONING

In general, the Feeder network is composed of point-to-point cables connecting each DP with the POP. **The capacity of the cable feeding the DP is 96 fibers (DP-48) or 192 fibers (DP-96)**. As an exception, for indoor DPs [pending its inclusion in BoQ] serving 24 or less HPs, the feeder cable capacity must be reduced to 48 fibers.

It is accepted to feed two indoor DPs with the same 96-fiber cable if building infrastructure allows it. Also, a 192fo cable can be used to feed 3-4 indoor DPs, as long as the existing infrastructure ensures uninterrupted cable continuity between the Indoor DPs. Whenever a cable is shared, the tube termination in every equipment must be complete.

Moreover, regarding to outdoor DPs, only those that serve 20 or less HPs can be fed with a 48 fibers cable. It is important to consider future HPs before feeding an outdoor DP with a 48 fibers cable (keep in mind future HPs expansions). However, this type of DP cannot share the same feeder cable with another DP.

When calculating the required feeder cable length, network designers must consider on top of the measured lengths:

- + 2% of the total measured length, for cable waste
- + 20-meter slack loops per feeder cable (most of it looped inside the POP, a smaller part inside the DP cabinet)
- In all cases, 6m of cable will be added for each intermediate manhole, without splice but with loop element in Keycom.

Each feeder network cable (48fo, 96fo and 192 fo) is blown into a **14/10 mm micro-duct**. The micro-duct is terminated on both ends (POP and DP) and has non-interrupted continuity all along the route. Feeder network micro-ducts are **bundled in groups of 2, 4 or 7**.

Micro-ducts are grouped within a common micro-duct bundle. In the initial network design, a **minimum of 25% of the bundle capacity is reserved** for future uses and/or breakdowns.

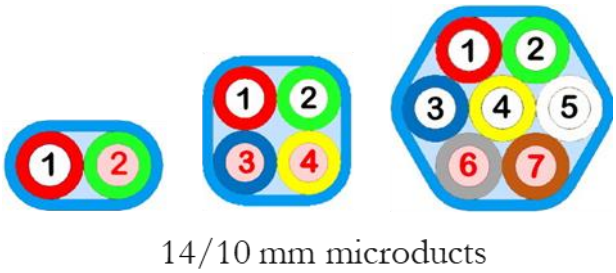


Figure 23.- Micro-duct bundles in the Feeder Network

The accepted **bundle capacity** and the number of useable/spare micro-ducts is summarized in the following table:

Bundle Capacity	Used Max.	Vacant Min.
7x14/10 mm	5	2
4x14/10 mm	2	2
2x14/10 mm	1	1

A 2 x 14/10 mm bundle will always arrive to each DP in the network. This bundle might be segregated from the main feeder bundle, having the first micro-duct connected to one duct of the main pipeline (thus having full continuity from the DP till the POP), and the second will remain as a spare duct, terminated close to the main pipeline section with the appropriate end-caps.

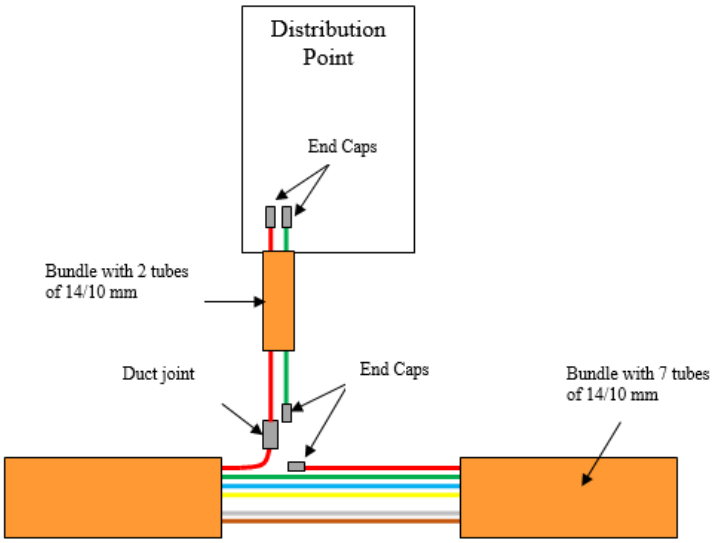


Figure 24.- Connection of a DP to the Feeder Network

Bundle branches segregated from the main bundle are allowed. The minimum branch size will be a 2 x 14/10 bundle. Ducts from the main and secondary bundle(s) will be connected by approved ducts joint.

When a bundle is derived into two branches, the capacity of the branch bundles will be the minimum required. Exceptions to this rule are these 2 cases:

- 7x14 bundle derives into (2) 4x14 bundles. If one of the branches is shorter than 100 m. then the 7x14 bundle continues through this branch, and only one 4x14 bundle (the longest) is segregated from it.

- 7x14 bundle derives into (1) 4x14 and (1) 2x14. If the 4x14 branch is shorter than 100 m. then the 7x14 bundle is extended through this branch, and only the 2x14 bundle is segregated.

In Feeder network, in the main bundles (those connected directly to the POP), segregation will start always with the first microducts (red, green, …). Also, in the secondary bundles, segregation will start with the first microducts (red, green, …). Regarding to spare microducts, they will be located at the end of the bundle.

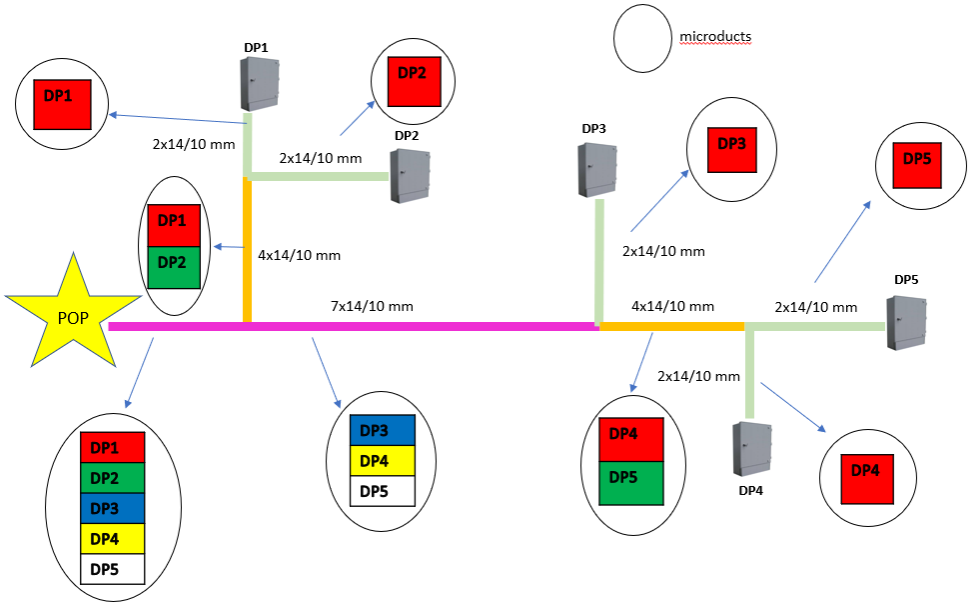


Figure 25.- Segregation in Feeder Network

In the future, when needed, the spare microducts of the different bundle branches must be connected to each other, in consecutive order, until the new DP to feed.

The required **bundle lengths** must be oversized by +2% of the calculated distances, to consider the normal bundle waste at construction time.

3.4.3.3 NETWORK ROUTES

Feeder network routes connecting each DP with the POP should share civil work with Distribution network, avoiding parallelism of civil work.

In order to minimize the number of bundles in the feeder network, the **POP to DP routes** must be ideally designed in tree topology. DP_IDs will be assigned consecutively following the feeder infrastructure, thus being DP001 the nearest DP to the POP which is connected to Feeder Bundle 001.

Dimensioning rules and constraints in place for **civil works** (as per Annex 2 to this document) must be considered to calculate always the lowest cost routes.

3.4.3.4 DELIVERABLES

The Feeder Network design is packed with the Distribution Network design to create a single Access Network delivery project.

Network design deliverables of the Access project are specified and discussed in chapter 6.

3.4.4 DISTRIBUTION NETWORK (DN)

3.4.4.1 DESCRIPTION

The Distribution Network connects each Distribution Point with the customer premises in the area.

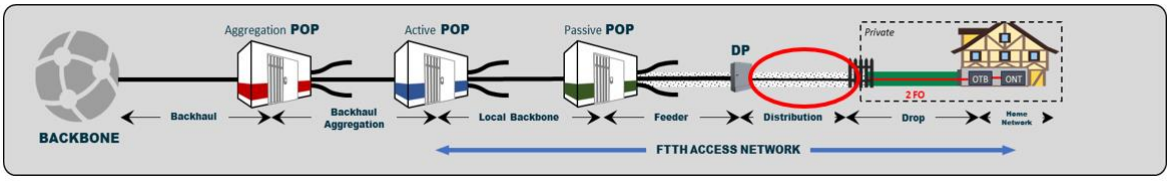


Figure 26.- Distribution Network in CS Arch.

3.4.4.2 DISTRIBUTION POINT (DP)

The Distribution Point is a medium-size passive street cabinet located on street-level pedestals. There are 2 types of outdoor DPs: DP serving 48 HPs (DP-48) or DP serving 96 HPs (DP-96).

DP-48 can be underground indeed an OC manhole (only allowed when the Gemeinde does not allow to place a DP on the street). It is also possible to install 2 underground DP-48 with a 192fo cable in the same TC manhole or different manholes (type OC). However, DP-96 cannot be installed underground.

DPs can also be indoor closets installed inside medium or large size buildings (from 13HPs on).

Feeder fibers and drop connection cables are spliced one to one, using 2 positions of one DP tray by client.

DP-48 capacity is up to 96fo and 54 trays, and space enough to accommodate the termination of up to 48 micro-ducts and 48 drop cables towards the houses and buildings located nearby. Furthermore, DP-96 capactity is up to 192fo and 108 trays.

In design, the **DP-48 serves a maximum of 42 homes.** Empty lots must be considered inside these 42, as if they had 1 HP (in LOMA they remain with 0 homes).

The **spare capacity** reserved on each DP-48 for future use is at least equivalent to **6 HP** (from 43 to 48), or even higher if the initial capacity of the DP is lower than 42.

In design the DP serving 96 HPs (DP-96) can be used under these requirements:

- Service Area with a homes/buildings ratio higher than '3' for buildings covered by the DP. MDUs > 12 HP would not be included in any of these counts as they would likely go with Indoor DP. Neither the Vacant Lots.

- A minimum of 43 HPs and a maximum of 84 HPs served by a DP-96.

- A distribution distance less than 500 meters.

- If the Gemeinde forces to install 2 x DP-48 together a DP-96 must be installed, although the previous requirements are not fulfilled.

As an **exception to the default dimensioning** and spare capacity rules, in case that there are empty lots not under construction in the DP area, resources are allocated for these lots in this way:

- DP ports are taken from the spare capacity. This means that, worst case, a DP-48 can initially provide service to 42 HP (sum of real homes, minimum 10 HPs, and units of urban vacant lots).
- There must be distribution microducts assigned for urban empty lots or plots, which must not be included as bundle spare. This microduct can be assigned location order, or at the end of the usable capacity of the bundle, as they were regular addresses and with continuity along the distribution network. For example, if there is a section with 5 real addresses (with homes) and 2 empty lots, a bundle of 12x7/4mm must be used.
- Regarding to intermixed addresses or areas served by other operators which do not deploy optic fiber, their HPs must be considered in the distribution bundles, DP (but always with a minimum of 10 HPs served by UGG) and POP capacity. However, **those addresses served by other operators with optic fiber will be discarded directly from the design** and will not be considered in the spare capacity.

The expected average efficiency must not be lower than 36 HP, following this rule:

$$\frac{\text{Total amount of HPs}}{(2 * \text{Total amount of DP96} + 1 * \text{Total amount of DP48} + 0{,}5 * \text{Total amount of indoor DP})}$$

The load should be balanced among all the DPs whenever possible, always considering an equitable trays occupation distribution between ODFs.

DP preferred locations will be centred to the service area, near to street crossings. The visual impact and occupancy of public space must be minimized.

3.4.4.3 NETWORK DIMENSIONING

Drop connections are:

- **For Single Dwelling Units (SDU) 2-fiber cables**. One cable is installed per home.
- **For Multi-Dwelling Units (MDU) 8-fiber or 12-fiber cables**. One cable is installed for each group of 4 or 6 homes located inside the building., according to the table included in 3.4.5.

The drop cable distance from the DP to the premise is around **500 m.** Please notice that this limit is not a radius around the DP, it is the actual cable length installed over the planned infrastructure routes. As an exception, drop cable lengths up to **800 m.** can be designed for isolated houses included in the HLD.

For distances greater than 800m between DPs and addresses inside the HLD the following criteria must be followed:

- Try to reduce the distance by moving the DP to a position closer to the premise.
- Create a new DP if the number of distant HPs is equal to or higher than 10.
- If the previous rules cannot be applied, the addresses are directly discarded in the LLD (leaving capacity for them in the nearest DP).

Each distribution network cable is blown into a **7/4 mm micro-duct**. The micro-ducts are **bundled in groups of 12 or 24**.

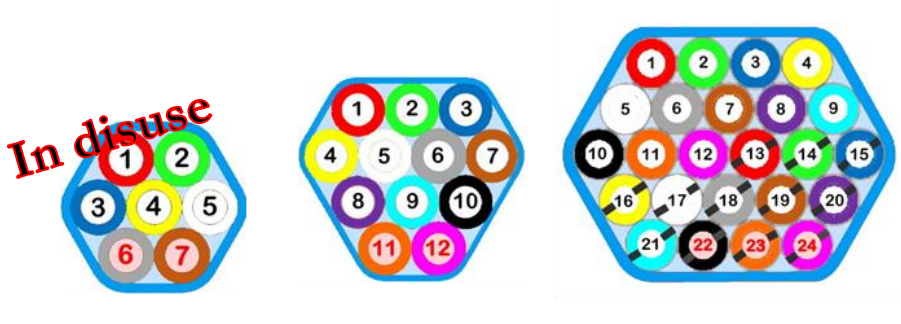
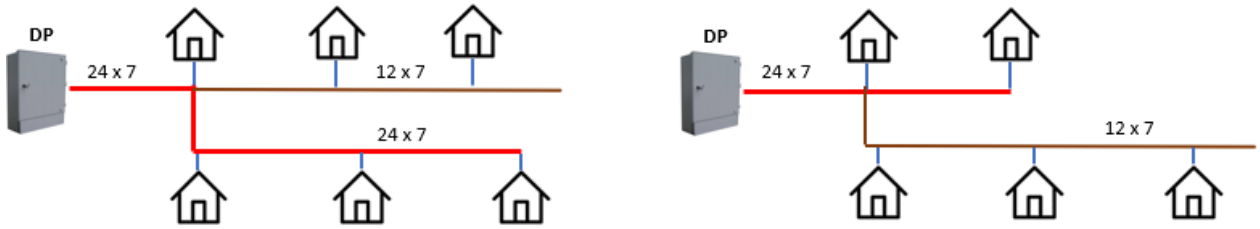


Figure 27.- Micro-duct bundles in the distribution network

At least **10% of the micro-ducts on each bundle are reserved** for future uses.

The accepted bundle modularities and the number of usable/spare micro-ducts is summarized in the following table:

Bundle Capacity	Used Max.	Vacant Min.
24x7/4 mm	21	3
12x7/4 mm	10	2



When a bundle is divided into 2 branches, the general rule is to continue with the incoming bundle along the shortest outgoing branch, in case that the longest branch can be attended with a lower capacity bundle. If the two branches have similar length, then the incoming bundle should be continued along the branch with more twists (to ease the fiber blowing at fiber installation time), as shown in this example:

The segregation of a micro-duct from a bundle towards the customer premises is not considered a bundle branch, but just the drop connection.

In the future, whenever necessary, **spare micro-ducts** can be given end-to-end continuity towards the different branches of the bundle by manipulating the micro-duct connections at the branch jointing points. By doing so, the vacant duct is available for use in any part of the main bundle or branches. In general, the connection of vacant ducts between the main bundle and the branch one is not defined in the network design phase. When needed, the spare microducts of the different bundle branches must be connected to each other, in consecutive order.

It is allowed the **mid-span reduction of bundle size** when the associated cost savings are significant. For example, in the case a 24x7/4 mm bundle connecting the DP with 20 houses, the 24x7/4 mm bundle can be continued with a 12x7/4 mm bundle after serving the 10 houses closer to the DP, using the appropriate duct couplers. This rule is only applied for large spans (above 200 m.) that are subject of reduction.

All the distribution bundles must be terminated in a position near the mid-point of the front side of the last home. All the bundle micro-ducts will be sealed at this point with the appropriate end caps.

The required **bundle lengths** must be oversized by **adding 2%** to the calculated distances, to consider the normal bundle waste at construction time. The distribution cable lengths are also oversized by the **2% of the calculated length, plus 5 meters** per cable (considered in BoQ and not necessary to be reflected in Keycom.

Bundle branches segregated from the main bundle are allowed. The minimum branch size will be a 12x7/4 mm bundle. Ducts from the main and secondary bundle(s) will be connected by approved ducts joint.

When a bundle is branched, the branch will reduce its capacity, connecting the microducts necessary for the service of its branch to the main distribution bundle. The color correspondence of the microducts of the main bundle on the branch must be maintained, without taking into account the striping, of the microducts greater than 12.

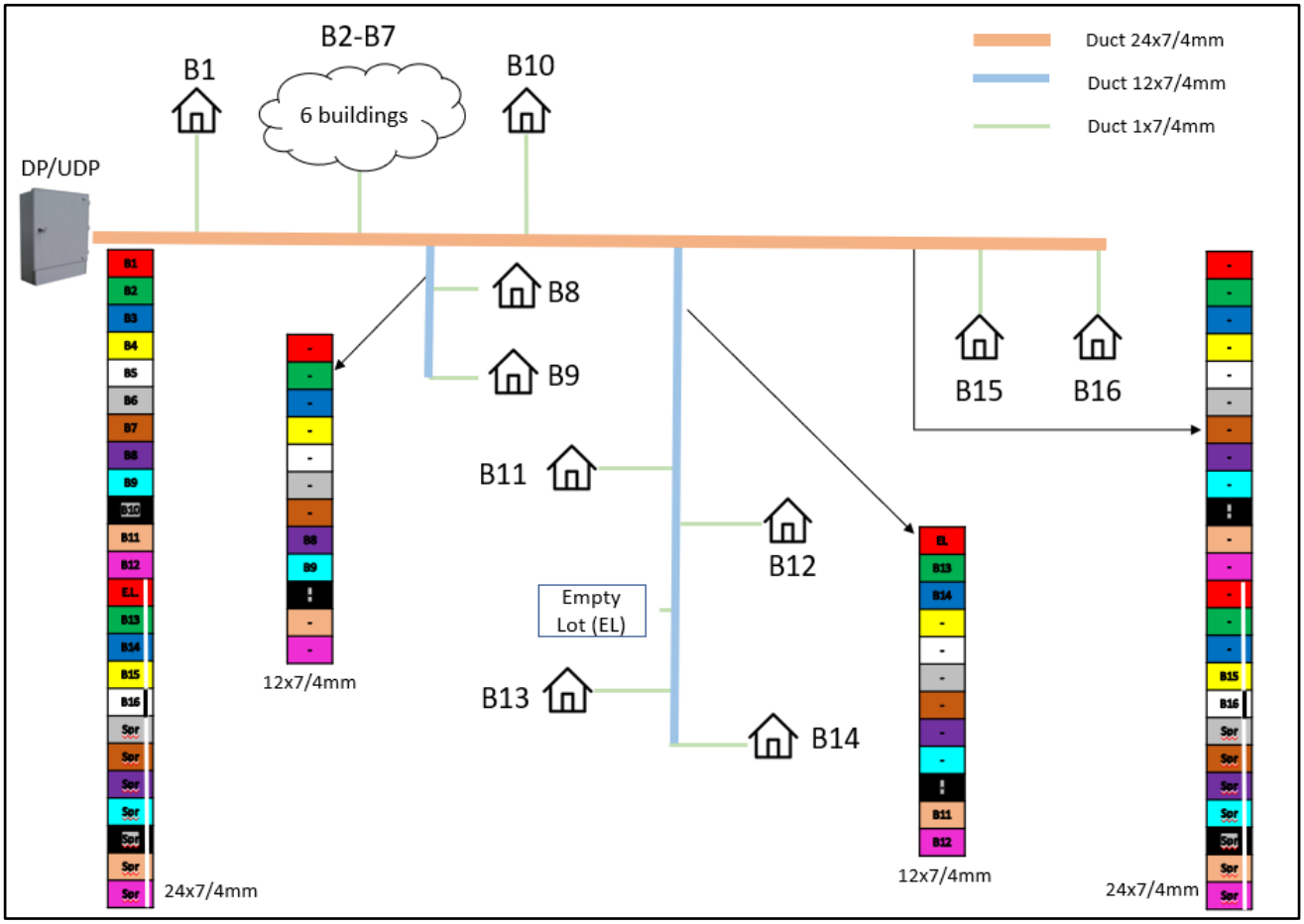


Figure 28.- Segregation in Distribution Network

3.4.4.4 NETWORK ROUTES

As a general rule, the total **number of distribution bundles** connected to the DP should **not be higher than 4 for DP-48 and 8 for DP-96**. Exceptions are only accepted in DPs covering areas with very complex distribution of homes.

The maximum number of micro-ducts terminated inside the DP-48 is 48 and 96 for DP-96.

One of the sides of the street will be categorized as primary deployment side (the one with the higher number of addresses) and the other one as secondary side (the opposite side to the primary). The primary/secondary side can alternate each other depending on the addresses density in each side.

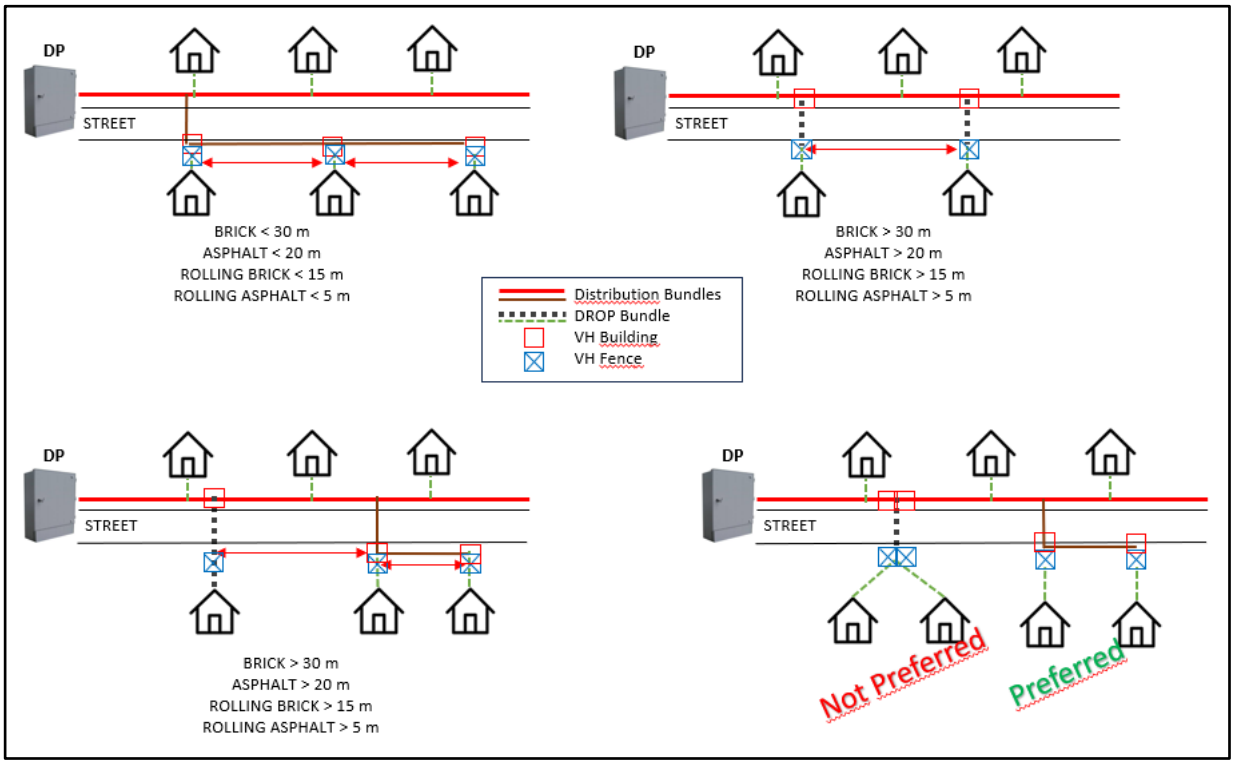
Distribution network routes will always run along the primary side of the street. In some cases, depending on the density of homes per side, the route goes also along the secondary side.

The following **trenching priorities based on the soil surface** will be considered when planning new infrastructure routes in residential areas: (1) Unpaved surfaces, (2) Brick, (3) Asphalt.

Trenching on both sides of the street will be avoided whenever possible. In particular, the use of trenchless road crossing (drilling) instead of double trenching will be mandatory when:

- Brick surfaces: If the distance between fence virtual handholes (VHF) is higher than 30 m.
- Asphalt surfaces: If the distance between fence virtual handholes (VHF) is higher than 20 m.
- Rolling brick: If the distance between fence virtual handholes (VHF) is higher than 15 m.
- Rolling asphalt: If the distance between fence virtual handholes (VHF) is higher than 5 m.

(new recommendation)



Crossing State (Land) or District (Kreis) roads in the Distribution network will be avoided. The number of these road crossings will be reduced to the minimum. Depending on the number of crossings, parallelisms of 100 meters, 200 meters and, exceptionally, higher will be accepted.

Dimensioning rules and constraints in place for civil works (as per Annex 2 to this document) must also be considered to calculate the lowest cost routes.

3.4.4.5 DELIVERABLES

The Distribution and Feeder Network design is delivered in a single Access Network delivery. Network design deliverables of the Access project are specified and discussed in chapter 6.

3.4.5 DROP NETWORK

The Drop network covers the infrastructure going across the private property, the Optical Termination Box (OTB) and/or Outlet (OTO) and the in-building cabling (or vertical infrastructure when required).

The drop network is **deployed at subscriber connection time**, which can be either at the same time that the distribution network is deployed (when the service contract is signed by the subscriber before building the network), or at a later time.

The **drop connection infrastructure** consists of a 7/4 microduct per cable connected to the distribution bundle in the building virtual handhole, as shown in the figure. The micro-duct runs along the private property and ends (at the effect of network design and estimation of materials and labour) at the façade of the house or building.

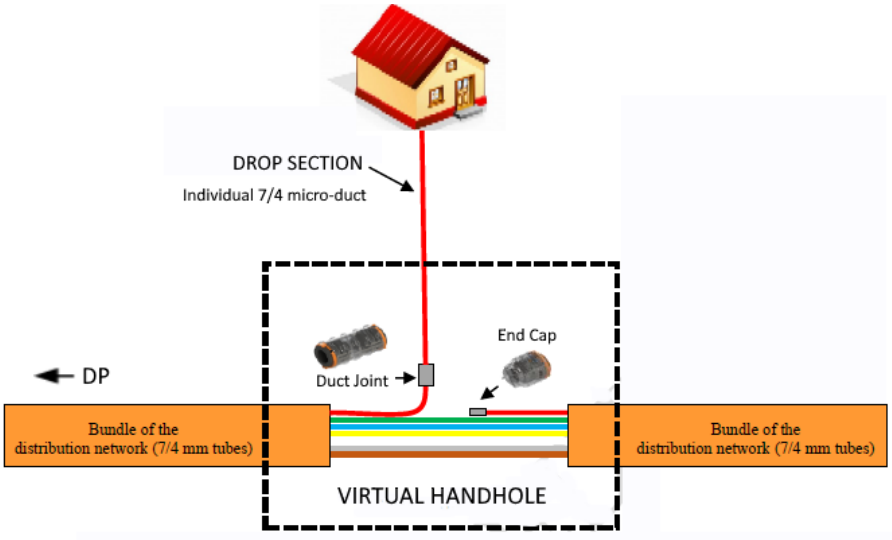


Figure 29.- Drop connection

In **Single Dwelling** or Single Business Units (SDU/SBU), the 2-fiber drop cable coming from the nearest Distribution Point is terminated directly in the subscriber's Optical Termination Outlet (OTO).

In **Multi Dwelling** or Multi Business Units (MDU/MBU) from 2 to 12 HP, one or two 8-fiber or 12-fiber drop cables from the DP are terminated in dedicated Optical Termination Boxes (OTB) located in the building basement.

The **number and capacity of the drop cables**, and the terminal equipment(s) to install in the building are summarized in the table below. In all the cases, connection from the OTB to each OTO is made via duplex connectorized optical fiber patchcords.

To count homes in MDUs it is important to take into account possible common utility services such as elevators, surveillance systems, security booths or clubhouse, …

Number of HP	Input micro-ducts	Drop Cable	Terminal Equipment	Architecture
1	1 x 7/4 mm	2 fo	OTO	PtP (No MDU)
2 - 4	1 x 7/4 mm	8 fo	OTB (4)	On-demand
5 - 6	1 x 7/4 mm	12 fo	OTB (4+2)	On-demand
7 - 8	2 x 7/4 mm	2 x 8 fo	2 x OTB (4)	On-demand
9 - 10	2 x 7/4 mm	12 fo+ 8 fo	OTB (4+2) + OTB (4)	On-demand
11 - 12	2 x 7/4 mm	2 x 12 fo	2 x OTB (4+2)	On-demand
> 12	N x 14/10mm	In-Building	Indoor DP	On-demand, with riser or with star topology

In Multi Dwelling or Multi Business Units (MDU/MBU) with 13 HP or more, a Distribution Point (DP) is installed inside the building. A 96-fiber feeder cable or a 48-fiber cable connects point-to-point the building with the POP.

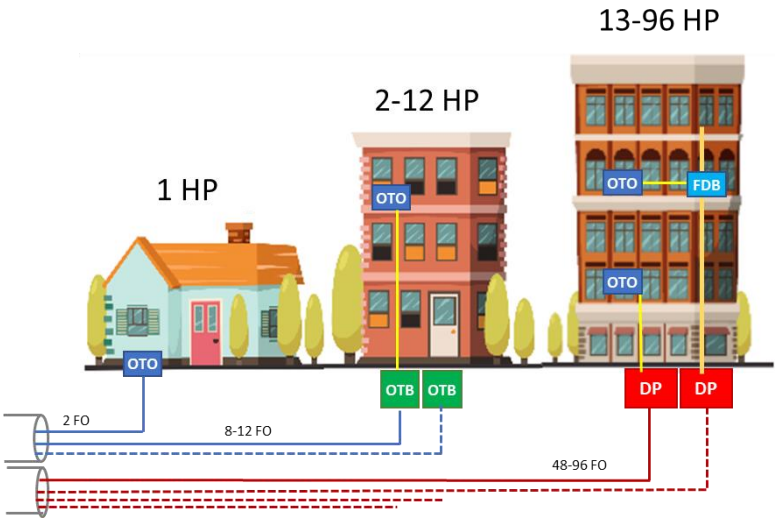


Figure 30.- Drop Network in CS Arch.

The **Optical Termination Outlet (OTO)** is the last point in the FTTH optical network, installed inside the customers' premises. The OTO includes 2 LC/APC connectors.

3.4.6 IN-BUILDING NETWORK

NOTE: *At the date of publication of this document, the in-building network is being introduced in the List of Materials / Services (BOQ) and construction companies' contracts. Until these subjects are finalized, the outside plant design (the feeder network branch from the POP to the MDU) will be included in the network design, but the in-building design will be postponed.*

All in-building installations will require a specific design and they will follow the rules indicated in the document [5] In-Building Network Design.

In the LLD a BOQ estimation will be made, based on:

- **2 to 12 HP (OTB):** Building input infrastructure and civil works, microduct and distribution cable. OTB, OTO and drop cables not included in the estimation.
- **From 13 HP on:** Building input infrastructure and civil works, microducts and feeder cable. The Indoor DP type, amount and installation will be the expected ones.

All Multi-Dwelling or Multi-Business Unit buildings having **more than 12 HP** will have a dedicated indoor Distribution Point (DP) installed inside the building.

It is a mandatory pre-requisite for the in-building network design to conduct an **in-building site survey**, checking the availability and vacant space on the common infrastructure, preferred location of equipment and cable routes.

Expected solutions for buildings from 13 to 96 HP

Number of HP	Input micro-ducts	Input Cables	Gf-AP Equipment	Architecture
13 – 24	2x14/10mm	1 x 48 FO (Feeder)	**1 x DP connectorized**	On-demand
25 – 48	2x14/10mm (1)	1 x 96 FO (Feeder) (1)	**2 x DP**	Riser or star topology
49 – 72	4x14/10mm (1)	1 x 96 FO + 1 x 48 FO (Feeder) (1)	**3 x DP**	Riser or star topology
73 – 96	4x14/10mm (1)	2 x 96 FO (Feeder) (1)	**4 x DP**	Riser or star topology
Above 96	Solution to be checked with UGG			

Notes:

1) For co-located DPs (installed in the same room inside the building). A 96fo cable can be used to feed 2 indoor DPs or a 192fo cable to feed 3-4 indoor DPs, as long as the existing infrastructure ensures uninterrupted cable continuity between Indoor DPs.

The following figure represents a design plan of the interior network of a building with 47 Homes distributed along 3 verticals and 4 riser cables.

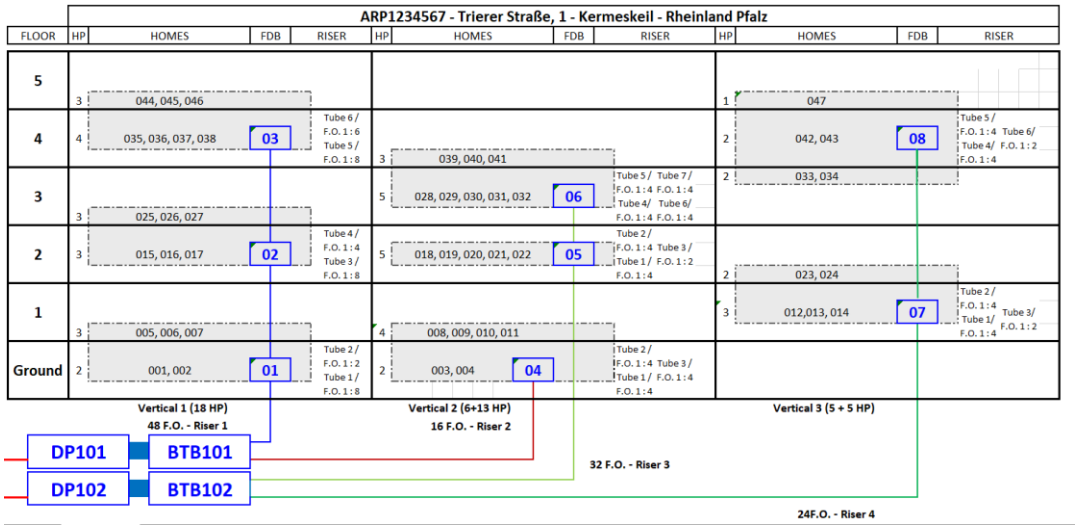


Figure 31.- Example of an in-building network design with riser architecture

3.5 DISTRIBUTED SPLITTING ARCHITECTURE (DS ARCH.)

As commented in previous sections, UGG has started to deploy in a variety of urban areas, and to carry it out a new architecture has been introduced, based on two splitting levels out of the POP and equivalent to 1:64. In the next points every section of the network is explained together with the new elements and materials involved.

Only the areas whose POP is indicated as Headend POP in the Cluster Structure Document will be designed with this architecture.

3.5.1 LOCAL BACKBONE NETWORK (LB)

3.5.1.1 DESCRIPTION

In areas with DS Arch., the connection between the Headend POP and every Feeder Point (FP) connected to it is also called Local Backbone network.

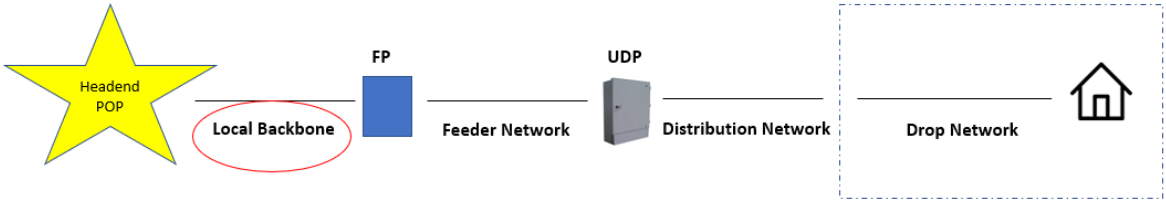


Figure 32.- Local Backbone Network in DS Arch.

3.5.1.2 NETWORK DIMENSIONING

The minimum number of fibers in the Local Backbone is 96 fibers and it will be adjusted to the immediately higher cable capacity. Approved cable capacities for the Local Backbone are **96 and 192 fibers**. The cable to use will depend on the total number of dragged fibers by every Urban DP (UDP) to the ODF (see 3.5.4.2 for details). The Local Backbone cables are fully connected to the ODF.

Cable	Maximum number of usable fibers in the Feeder Point (in design)
96 fo	72 fibers (*)
192 fo	144 fibers

(*) In any case, but especially in low-density areas, we must cluster to prioritize the use of efficient 96 fo cables, rather than underused 192 fo cables.

In the Local Backbone network, between Headend POP and Feeder Points, the 50/40mm bundle must not be used. The bundle used for these cables will be always the 7x14/10mm, maintaining the number and color of the microduct in the branches.

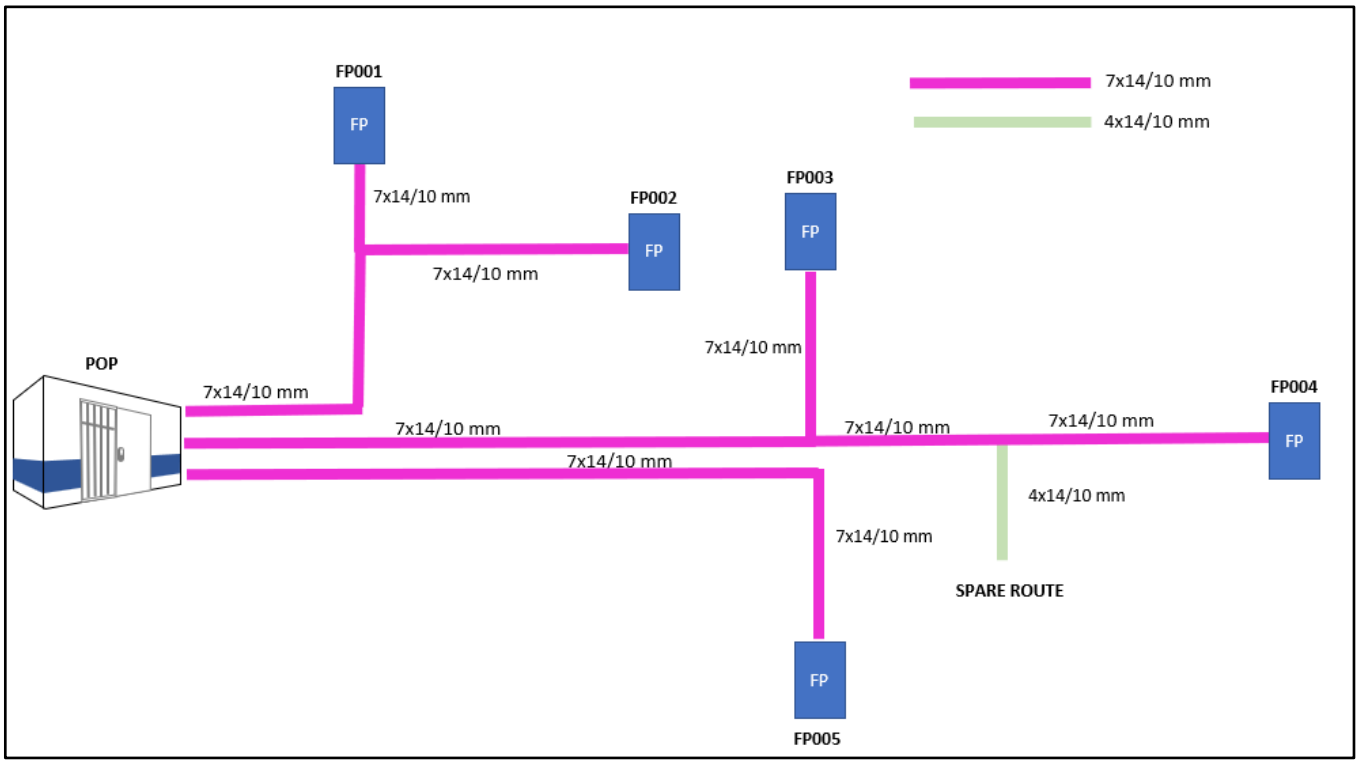


Figure 33.- Bundle Capacity in Local Backbone Network for DS Arch.

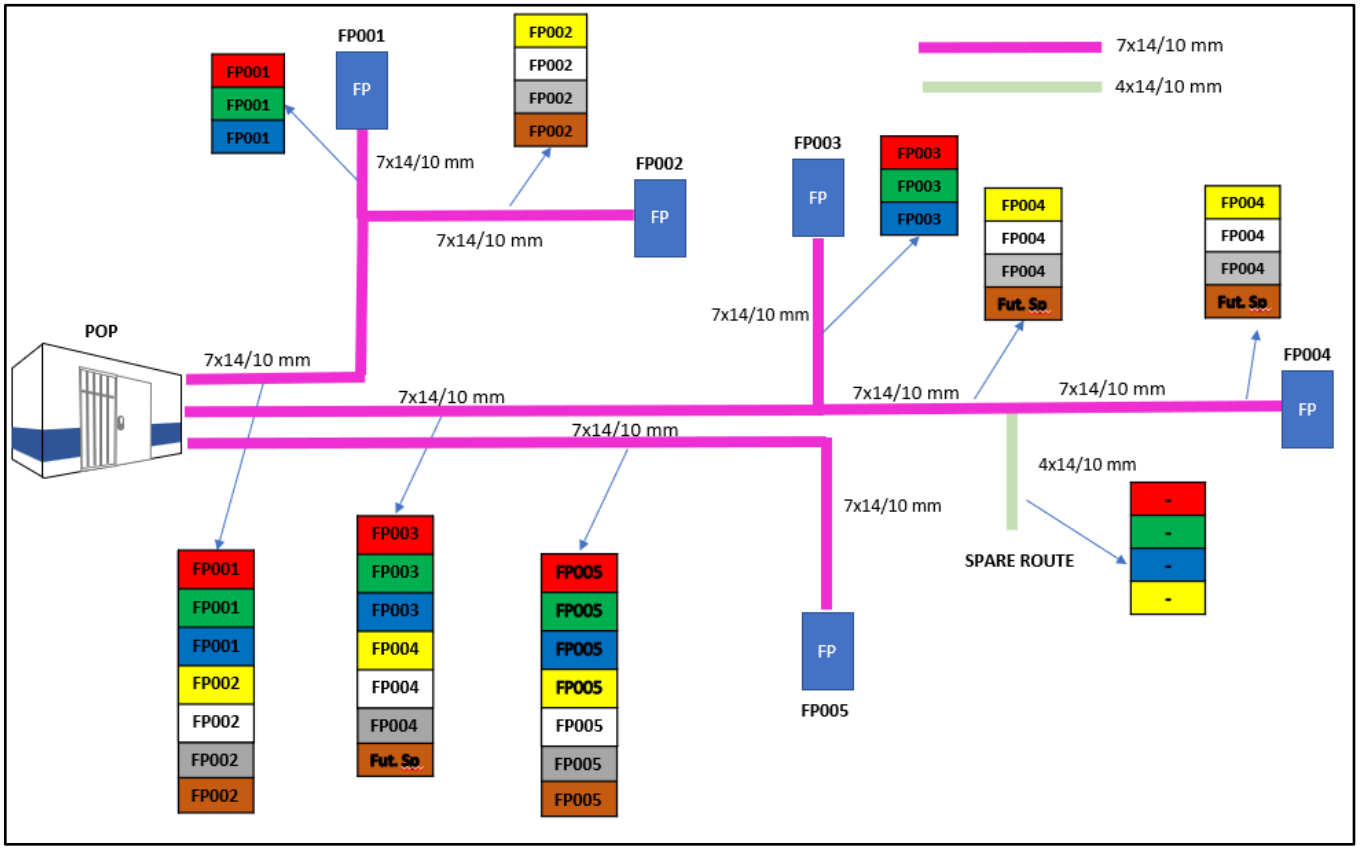


Figure 34.- Segregation in Local Backbone Network for DS Arch.

3.5.1.3 NETWORK ROUTES

In DS Arch., the Local Backbone network routes are point-to-point lines deployed mostly along existing streets inside the access network.

The Local Backbone network micro-duct bundles are always independent of the Feeder and Distribution network bundles, even in the case that the Local Backbone and Access routes are coincident. This means that Local Backbone cables cannot share bundle with Feeder and Distribution networks.

The required **bundle lengths** must be oversized by adding **2%** to the calculated distances, to consider the normal bundle waste at construction time. The Local Backbone **cable lengths** are also oversized by the **2%** of the total calculated length, plus **30 meters (20 per cable end in the POP and 10m in the Feeder Point**), considered in BoQ (not to reflect it in Keycom). In addition, in all cases, 6m of cable will be added for each intermediate manhole, without splice but with loop element (storage).

In DS Arch., Backhaul and Local Backbone networks can share micro-duct bundles in all the routes where the two networks are running in parallel. The following table helps to calculate the merged bundle size and bundle occupancy.

Cables	LBB Bundle	Occupancy
1-2 x cables (48, 96 and 192 fo)	7x14/10	2*

**If in the future at least one replacement route is planned for Gemeinden within a radius of 6 km, microduct number 7 in each Bundle will be used for this continuity, if necessary.*

In all the cases that the civil works required to place the pipes underground are shared with feeder and distribution must be accounted only once in the Access project.

3.5.1.4 DELIVERABLES

The deliverables of the Local Backbone in DS Arch. are specified and discussed in chapter 6.

3.5.2 SPARE INFRASTRUCTURE FOR FUTURE USE

The objective of spare infrastructures is to be able to provide services in the future or to have the infrastructure prepared for futural structural changes.

Always, in every Gemeinde, an alternative route must exist to all Gemeinden not included in the cluster structure document and located within a radius of 6km (coil length). By default, the capacity of these infrastructures is the following: only 1 Bundle 4x14/10mm. In those sections where the planned spare route coincides with other BH, BUL, BHR or LB bundles, no exclusive spare bundle is required. although it will be ensured that the Bundle of the shared section up to the POP will be 7x.. This spare infrastructure will be installed until the deployment access limit of the Gemeinde.

3.5.3 FEEDER NETWORK (FN)

3.5.3.1 DESCRIPTION

In DS Arch., the Feeder Network covers the network sections connecting each Feeder Point (FP) with the different Urban Distribution Points (UDPs) connected to it.

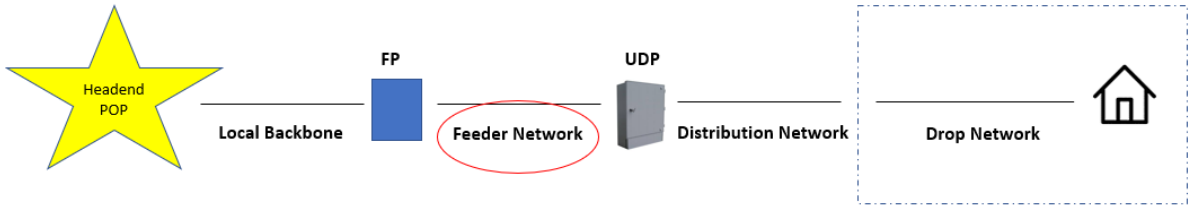


Figure 35.- Feeder Network in DS Arch.

3.5.3.2 NETWORK DIMENSIONING

For DS Arch., the Feeder network is composed of point-to-point cables connecting each FP with the different Urban DPs in the area. **The capacity of the cable feeding every Urban DP is 24 fibers** and it is not allowed to share a feeder cable between 2 or more UDPs. The maximum number of UDPs per FP will depend on the configuration of the different UDPs of the area, any combination of UDPs is allowed inside the service area of the Feeder Point. In case, and only in this case, of all DPs connected to a FP have the same number of dragged fibers this will be the maximum number of UDPs per FP:

-For 12 dragged fibers per UDP: maximum 12 UDPs per FP.

-For 24 dragged fibers per UDP: maximum 8 UDPs per FP.

In design, the maximum number of UDPs per FP shall be the one that does not exceed 75% of the fibers dragged in the Local Backbone, taking into account the fibers dragged per UDP connected to the FP.

For isolated areas, a UDP will be installed if the total number of HP is >=10. The necessary Configuration will be used, usually Conf. 2, keeping the feeder cable at 24 fo and the drag of 12 fibers. (see 3.5.4.2)

When calculating the required feeder cable length, network designers must consider on top of the measured lengths:

- **+ 2%** of the total measured length, for cable waste
- **+ 20-meter** slack loops per feeder cable (10 per each cable end)
- In all cases, 6m of cable will be added for each intermediate manhole, without splice.

Feeder cables of 24fo must be blown always in a 7x14/10mm bundle and the micro-ductS is terminated on both ends (FP and UDP). It must have non-interrupted continuity all along the route. Each UDP will have 2 microducts assigned, which will maintain the colors from the 7x14/10mm bundle connected to FP, or any branch thereof, to the UDP.

The accepted **bundle capacity** and the number of useable/spare micro-ducts is summarized in the following table:

Bundle Capacity	Used Max.	Vacant Max.
7x14/10 mm	1-3 x cables (24fo)	3-4*

**In this case, 2 microducts with full continuity are assigned per UDP. Every 7x14/10mm bundle is allocated for a maximum of 3 UDPs, leaving the 7th microduct for future use.*

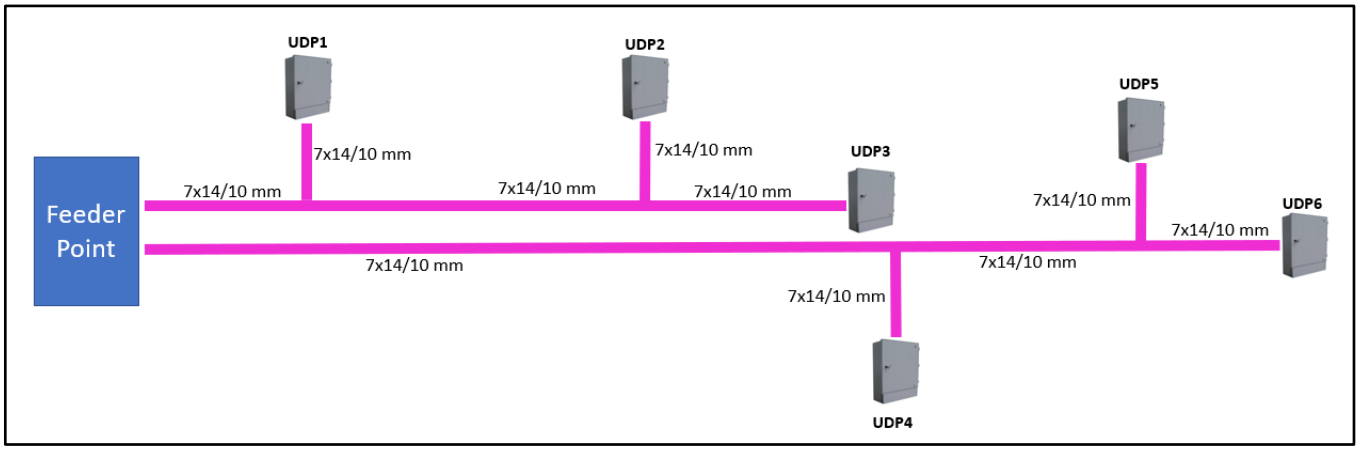


Figure 36.- Bundle Capacity in Feeder Network for DS Arch.

The microduct assignation per DP is by pair of microducts and in a consecutive way (the first UDP will have the microducts 1 and 2 assigned, the second one the microducts 3-4 and the third UDP the microducts 5-6 in the main feeder bundle).

Bundle branches segregated from the main bundle are allowed, always keeping the bundle size of 7, , maintaining the number and color of the microduct in the branches. The microducts will be segregated to the Urban DPs by location order of the own UDP. Regarding to Free microducts, they will be located at the end of the bundle. Ducts from the main and secondary bundle(s) will be connected by approved ducts joint.

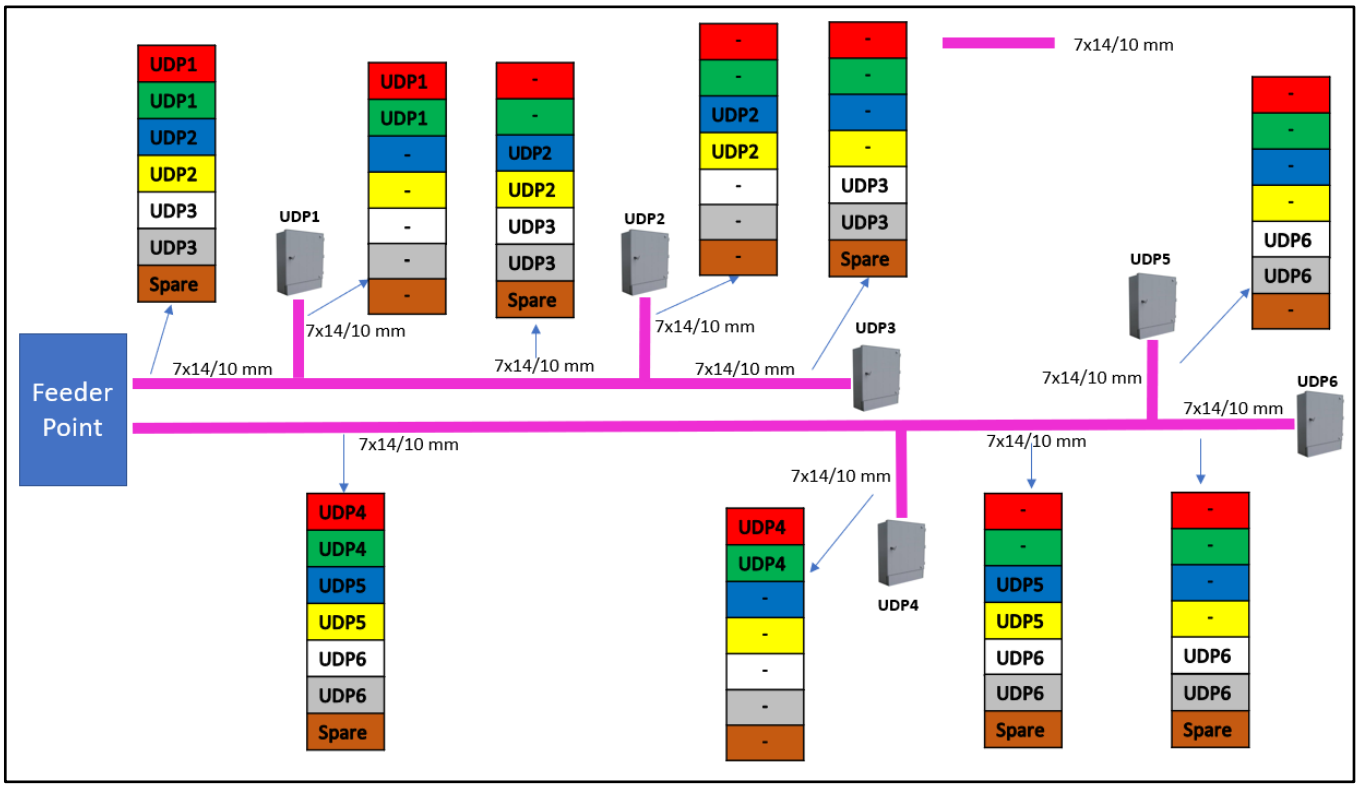


Figure 37.- Segregation in Feeder Network for DS Arch.

3.5.3.3 NETWORK ROUTES

Feeder network routes connecting each FP with the UDPs should share civil work with Distribution network, but not bundles, avoiding as much as possible the parallelism of civil work..

In order to minimize the number of bundles in the feeder network, the **FP to UDP routes** must be ideally designed in tree topology. Urban DP IDs will be assigned consecutively following the feeder infrastructure, thus being UDP001 the nearest Urban DP to the FP which is connected to Feeder Bundle 001.

Dimensioning rules and constraints in place for **civil works** (as per Annex 2 to this document) must be considered to calculate always the lowest cost routes.

3.5.3.4 DELIVERABLES

In DS Arch. the Feeder Network design is packed with the Local Backbone and Distribution Network design to create a single Access Network delivery project.

Network design deliverables of the Access project are specified and discussed in chapter 6.

3.5.4 DISTRIBUTION NETWORK (DN)

3.5.4.1 DESCRIPTION

The Distribution Network connects each Urban Distribution Point with the customer premises in the area.

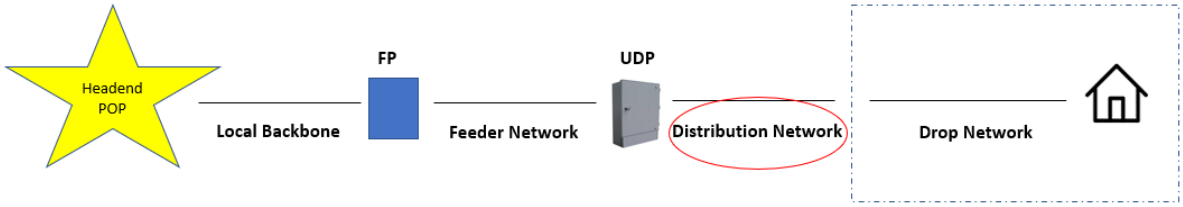


Figure 38.- Distribution Network in DS Arch.

3.5.4.2 URBAN DISTRIBUTION POINT (UDP)

The Urban Distribution Point is a medium-size passive street cabinet located on street-level pedestals (it is similar to the DP-96). Currently, there is only one type defined: Type A, equipped with 2 splitters 1x4 and 6 splitters 1x16 preinstalled from factory. This Urban DP has 7 different configurations depending on the number and type of addresses/homes to serve, however the 6th configuration is not allowed by technical reasons (it will not appear in this document) and it will be covered by the 7th configuration, solving the SDUs cases by installing OTB-4 with splitters as Network termination equipment at the client. This 7th configuration must be used when the amount of SDUs is between 1-14 HPs, while the 5th configuration is used from 15HPs on (always considering the allowed amount of MDU buildings in design).

The configuration of every UDP will be decided by the designer after the definition of the Service Area. For the UDP configuration decision only those homes not served by indoor DP inside the Service Area must be considered inside the maximum design capacity. Empty lots are considered between the maximum number of SDUs designed and the maximum capacity of SDUs of the UDP. The objective must be to make the network efficient, reducing the number of elements (FPs, UDPs, cables, bundles size, etc).

In case that **after defining the UDP configuration an address changes from 1HP to 2HPs** (one more HP) this new MDU will be served with an OTB-2 without splitters, as both splitting levels are located inside the UDP (1:4 as first level and 1:16 as second level) because the address was as an SDU previously. This 2HPs occupy 2 consecutive trays destinated to SDUs in the UDP.

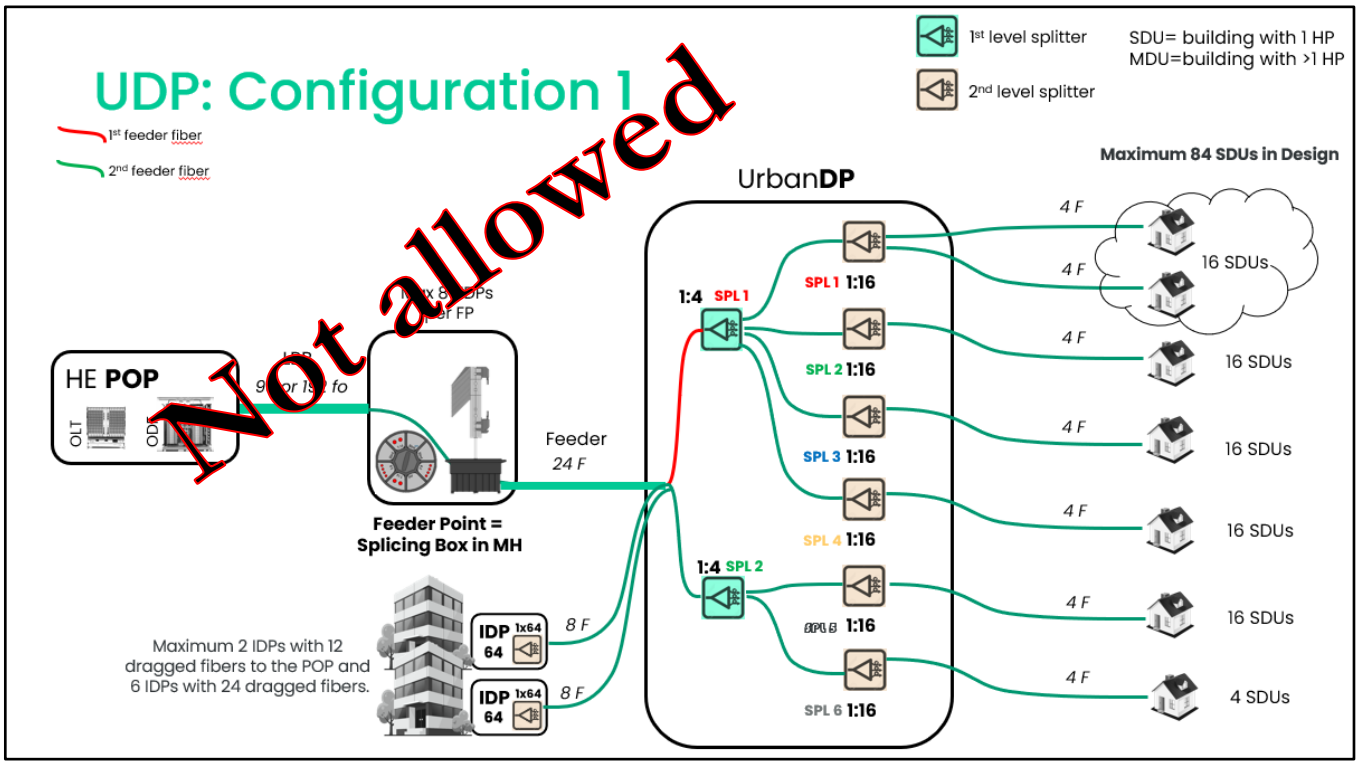
The following table summarizes the number and type of splitters used in every level for each UDP configuration.

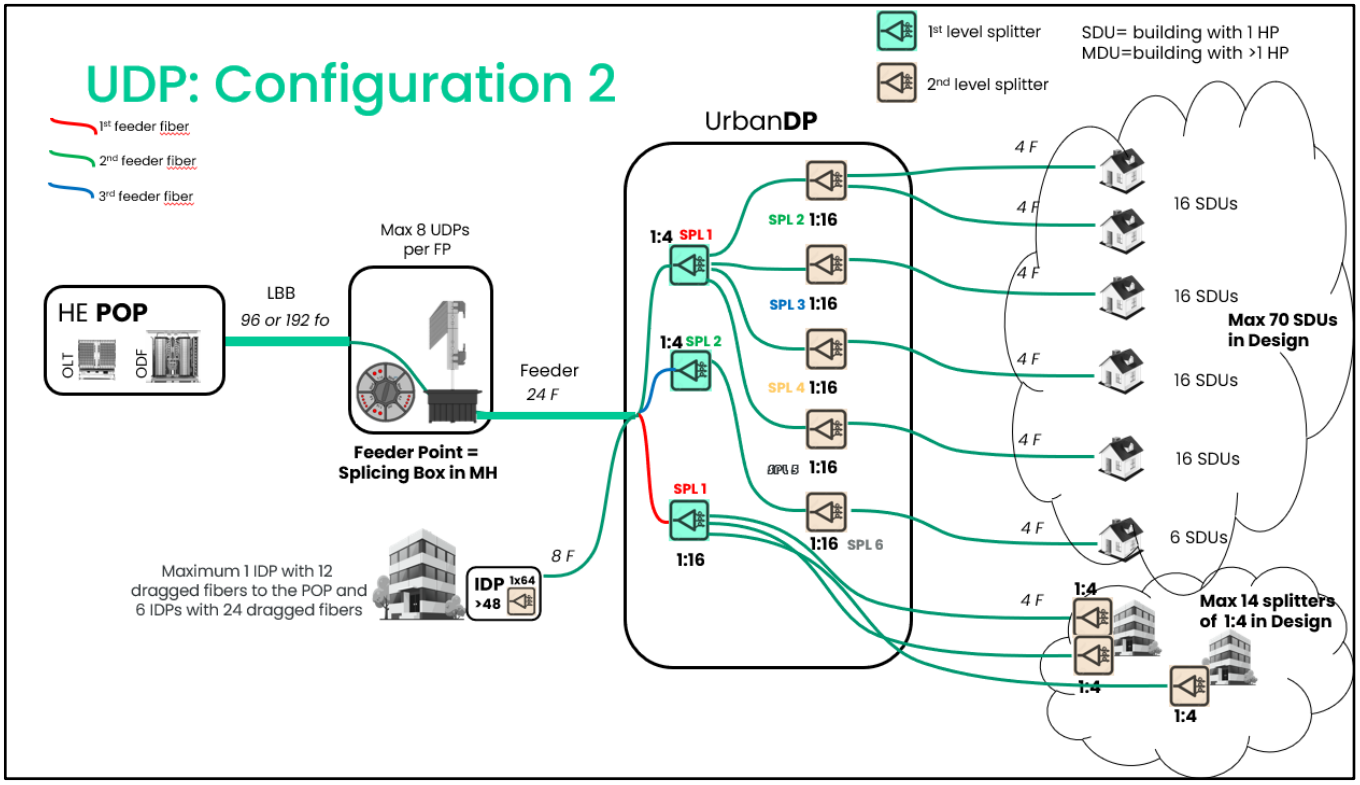
UDP Configuration	Number of 1:4 as first splitting level	Number of 1:16 as second splitting level	Number of 1:16 as first splitting level	Maximum number of SDUs in Design	Maximum number of 1:4 as second splitting level in Design
Configuration 1 Not allowed	2	6	0	84	0
Configuration 2	2	5	1	70	14
Configuration 3	1	4	2	56	28
Configuration 4	1	3	3	42	42
Configuration 5	1	2	4	28	56
Configuration 7	0	0	6	14	84 (*)

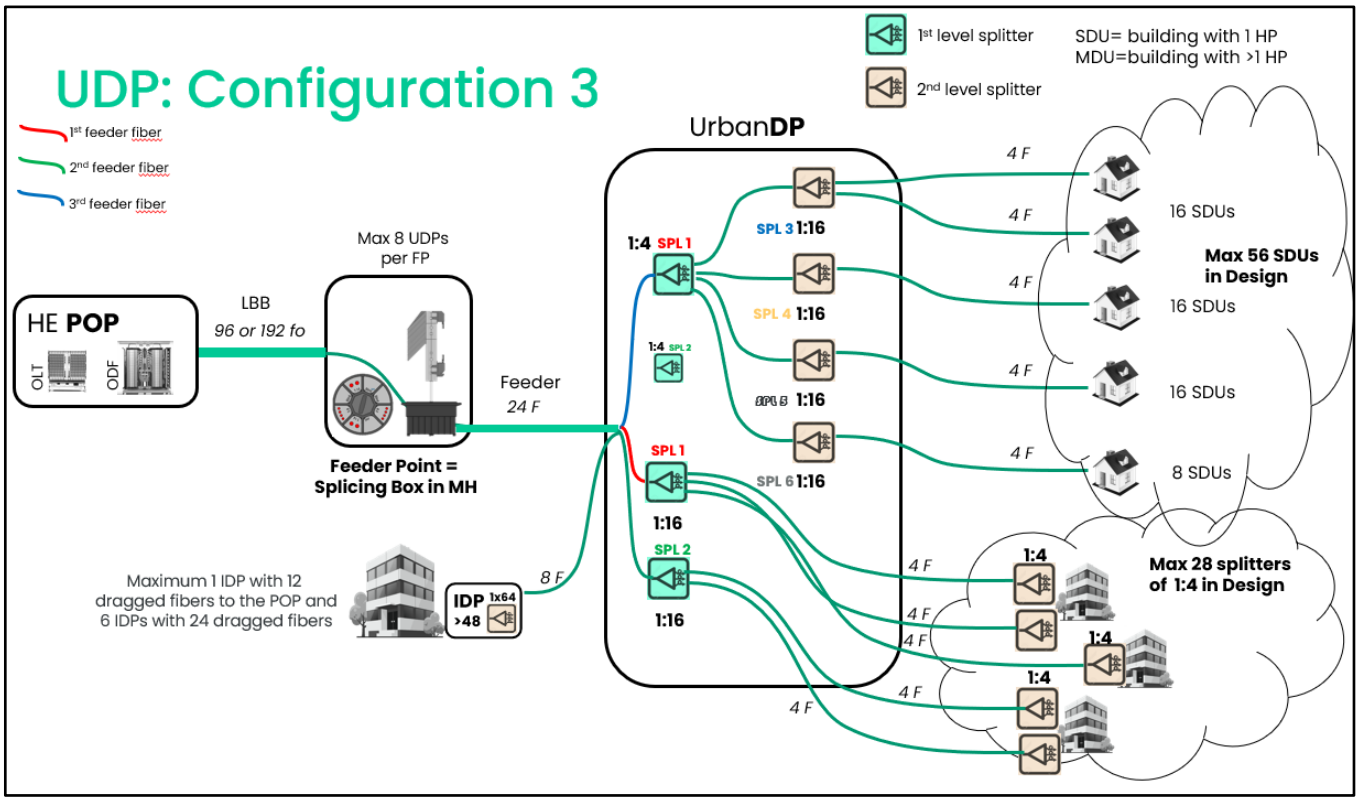
(*) This capacity will be reduced for each SDU assigned.

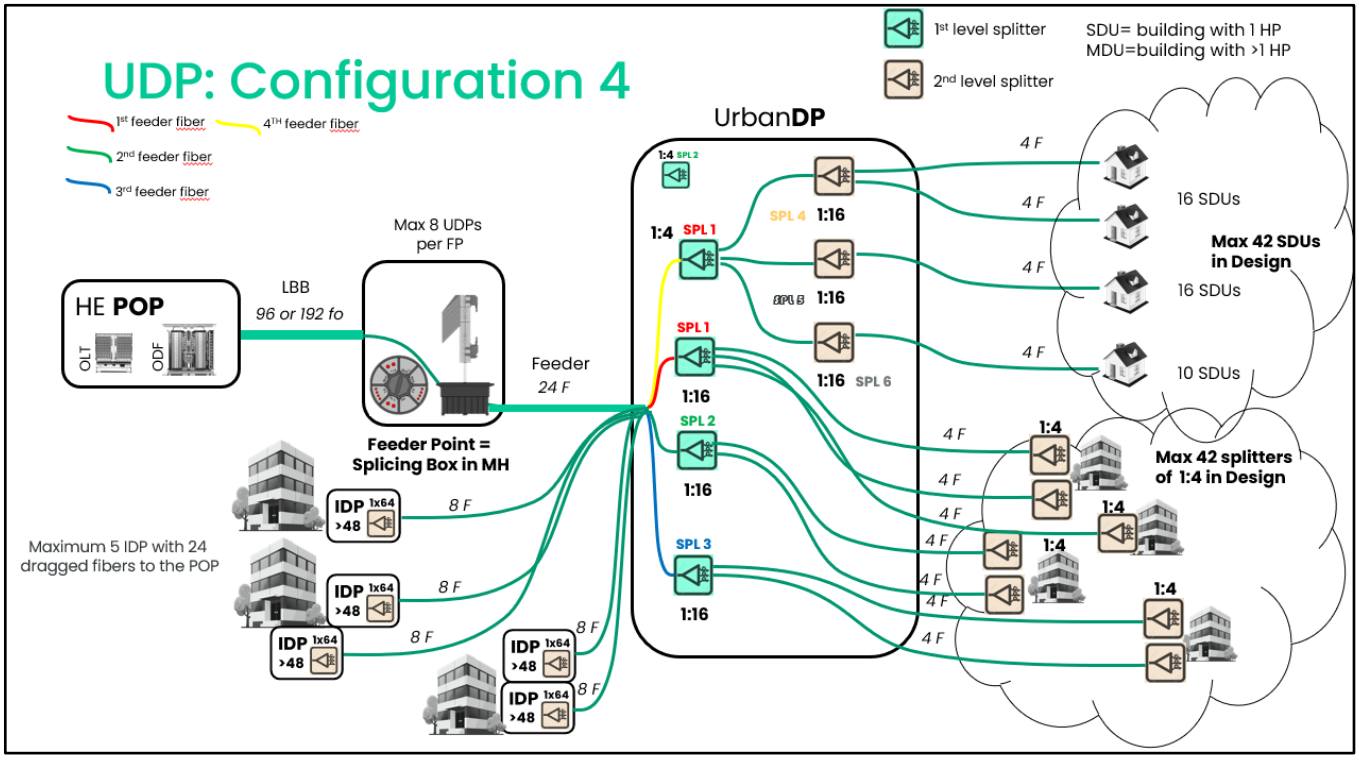
Configurations 2 and 3 will be appropriate for areas with low housing density and configurations 4, 5 and 7 for more dense areas. If we have an alternative configuration choice, we must choose the largest one (more MDUs), but with this consideration: if we are in an obviously rural area, and especially if the change affects the Feeder drag (Config. 3 to Config 4), we can justify keeping the minor, to also avoid unnecessary growth of the Feeder drag.

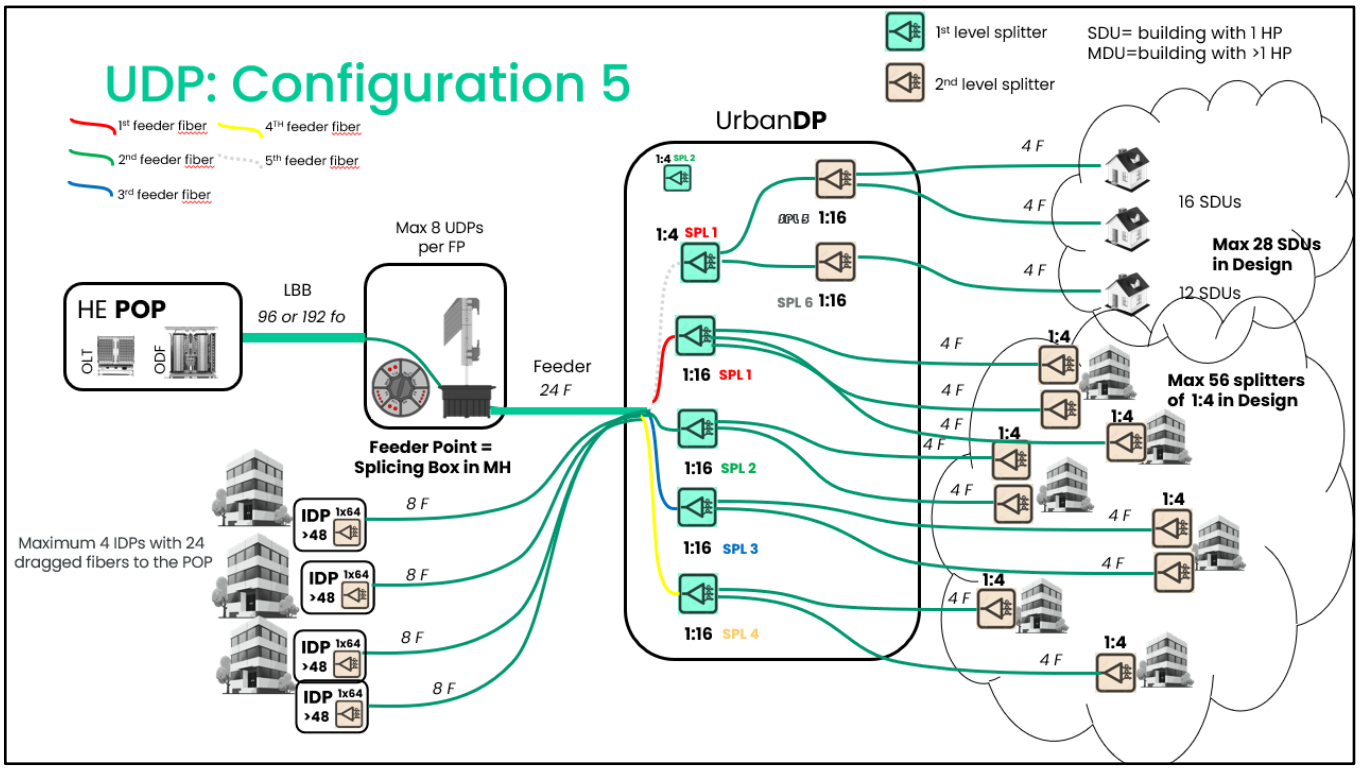
Every configuration is shown graphically in the following pictures. Please, note that these examples are theorical and represent the maximum capacities that can be applied in design. For the maximum amount of SDUs in design the empty lots must not be considered, they are included in the remaining capacity of SDUs inside the UDP. If there is reliable information about an upcoming MDU construction in an empty lot, the possible trays necessary for its connection can be counted among the maximum to be designed.

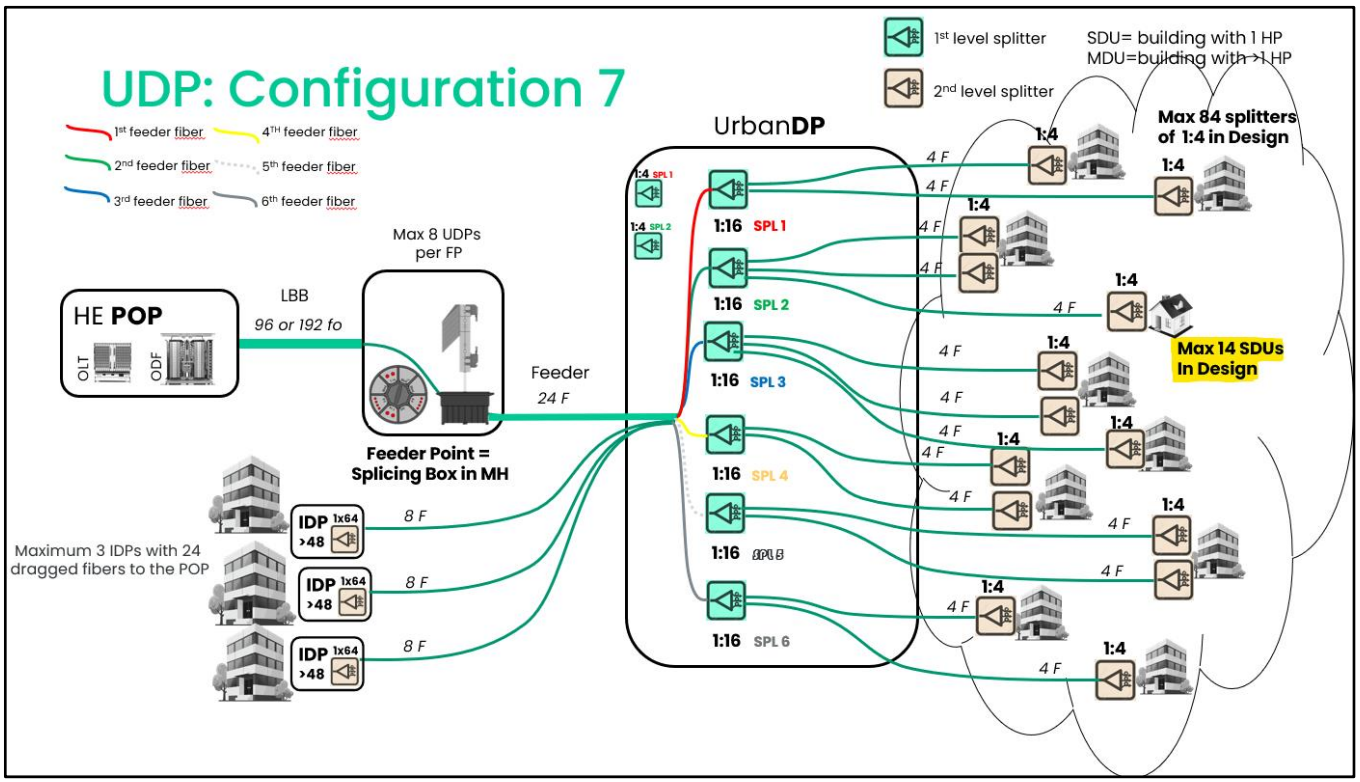

UDP: Configuration 1
1st feeder fiber
2nd feeder fiber
1st level splitter
2nd level splitter
SDU= building with 1 HP
MDU=building with >1 HP
Maximum 84 SDUs in Design
Not allowed
UrbanDP
HE POP
OLT
ODF
LBB
96 or 192 fo
Feeder
24 F
Feeder Point =
Splicing Box in MH
1:4 SPL 1
1:4 SPL 2
SPL 1 1:16
SPL 2 1:16
SPL 3 1:16
SPL 4 1:16
SPL 5 1:16
SPL 6 1:16
4 F
16 SDUs
4 SDUs
Maximum 2 IDPs with 12
dragged fibers to the POP and
6 IDPs with 24 dragged fibers.
IDP 1x64
64
8 F

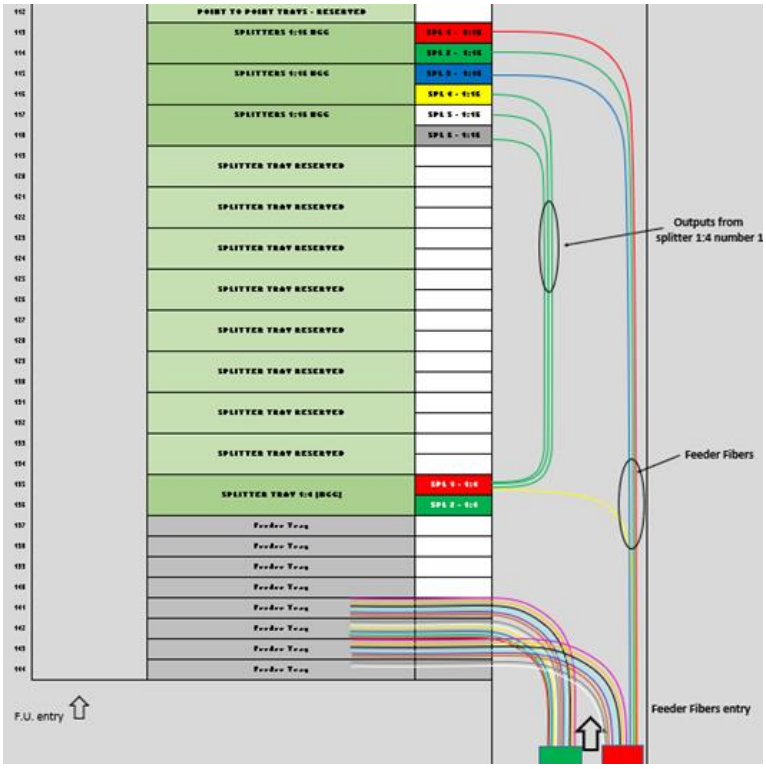

UDP: Configuration 2
1st feeder fiber
2nd feeder fiber
3rd feeder fiber
1st level splitter
2nd level splitter
SDU= building with 1 HP
MDU=building with >1 HP
UrbanDP
Max 8 UDPs
per FP
HE POP
OLT
ODF
LBB
96 or 192 fo
Feeder
24 F
Feeder Point =
Splicing Box in MH
1:4 SPL 1
1:4 SPL 2
SPL 1
1:16
SPL 2 1:16
SPL 3 1:16
SPL 4 1:16
SPL 5 1:16
SPL 6
4 F
16 SDUs
6 SDUs
Max 70 SDUs
in Design
Max 14 splitters
of 1:4 in Design
Maximum 1 IDP with 12
dragged fibers to the POP and
6 IDPs with 24 dragged fibers
IDP 1x64
>48
8 F


UDP: Configuration 3
1st feeder fiber
2nd feeder fiber
3rd feeder fiber
1st level splitter
2nd level splitter
SDU= building with 1 HP
MDU=building with >1 HP
UrbanDP
HE POP
OLT
ODF
LBB
96 or 192 fo
Max 8 UDPs per FP
Feeder
24 F
Feeder Point = Splicing Box in MH
1:4 SPL 1
SPL 3 1:16
SPL 4 1:16
SPL 5 1:16
SPL 6 1:16
SPL 1
1:16
SPL 2
1:16
4 F
16 SDUs
Max 56 SDUs in Design
16 SDUs
16 SDUs
8 SDUs
Maximum 1 IDP with 12 dragged fibers to the POP and 6 IDPs with 24 dragged fibers
IDP 1x64 >48
8 F
Max 28 splitters of 1:4 in Design
1:4


UDP: Configuration 4
1st feeder fiber
2nd feeder fiber
3rd feeder fiber
4TH feeder fiber
1st level splitter
2nd level splitter
SDU= building with 1 HP
MDU=building with >1 HP
UrbanDP
HE POP
OLT
ODF
LBB
96 or 192 fo
Max 8 UDPs per FP
Feeder
24 F
Feeder Point = Splicing Box in MH
1:4 SPL 1
SPL 4 1:16
SPL 5 1:16
1:16 SPL 6
SPL 1
1:16
SPL 2
1:16
SPL 3
1:16
4 F
16 SDUs
Max 42 SDUs in Design
16 SDUs
10 SDUs
Maximum 5 IDP with 24 dragged fibers to the POP
IDP 1x64 >48
8 F
Max 42 splitters of 1:4 in Design
1:4


UDP: Configuration 5
1st feeder fiber
2nd feeder fiber
3rd feeder fiber
4TH feeder fiber
5th feeder fiber
HE POP
OLT
ODF
LBB
96 or 192 fo
Max 8 UDPs per FP
Feeder
24 F
Feeder Point = Splicing Box in MH
Maximum 4 IDPs with 24 dragged fibers to the POP
IDP 1x64 >48
8 F
UrbanDP
1:4 SPL 1
1:4 SPL 2
1:16 SPL 1
1:16 SPL 2
1:16 SPL 3
1:16 SPL 4
1:16 SPL 5
1:16 SPL 6
1st level splitter
2nd level splitter
SDU= building with 1 HP
MDU=building with >1 HP
4 F
16 SDUs
12 SDUs
Max 28 SDUs in Design
Max 56 splitters of 1:4 in Design
1:4


UDP: Configuration 7
1st feeder fiber
2nd feeder fiber
3rd feeder fiber
4TH feeder fiber
5th feeder fiber
6th feeder fiber
HE POP
OLT
ODF
LBB
96 or 192 fo
Max 8 UDPs per FP
Feeder
24 F
Feeder Point = Splicing Box in MH
Maximum 3 IDPs with 24 dragged fibers to the POP
IDP 1x64 >48
8 F
UrbanDP
1:4 SPL 1
1:4 SPL 2
1:16 SPL 1
1:16 SPL 2
1:16 SPL 3
1:16 SPL 4
1:16 SPL 5
1:16 SPL 6
1st level splitter
2nd level splitter
SDU= building with 1 HP
MDU=building with >1 HP
4 F
Max 84 splitters of 1:4 in Design
Max 14 SDUs In Design
1:4



UDP: Example of connecting Feeder and Splitters in Configuration 4

The 24 fibers of feeder network, coming from the FP, enter in the UDP through 4 trays reserved for this purpose (in this order: 144-141), **except for those feeder fibers connected to the first splitter level which do not pass through these 4 trays.** The first fibers connected to the 1st stage Splitter, in UDP, will be those indicated in each Configuration diagram. In case of serving and IDP the first splitter level is located inside the building, being the fibers splices in the UDP in the trays 97-112 (as shown in the following images). In the UDP, FTOS and Point to Point services will be treated as the IDP, in the trays reserved for this purpose. The feeder fiber for these services will be defined and connected when the service is processed.

Whatever the manufacturer, the equipment and trays of the UDP will be always the same, as shown in the following image:

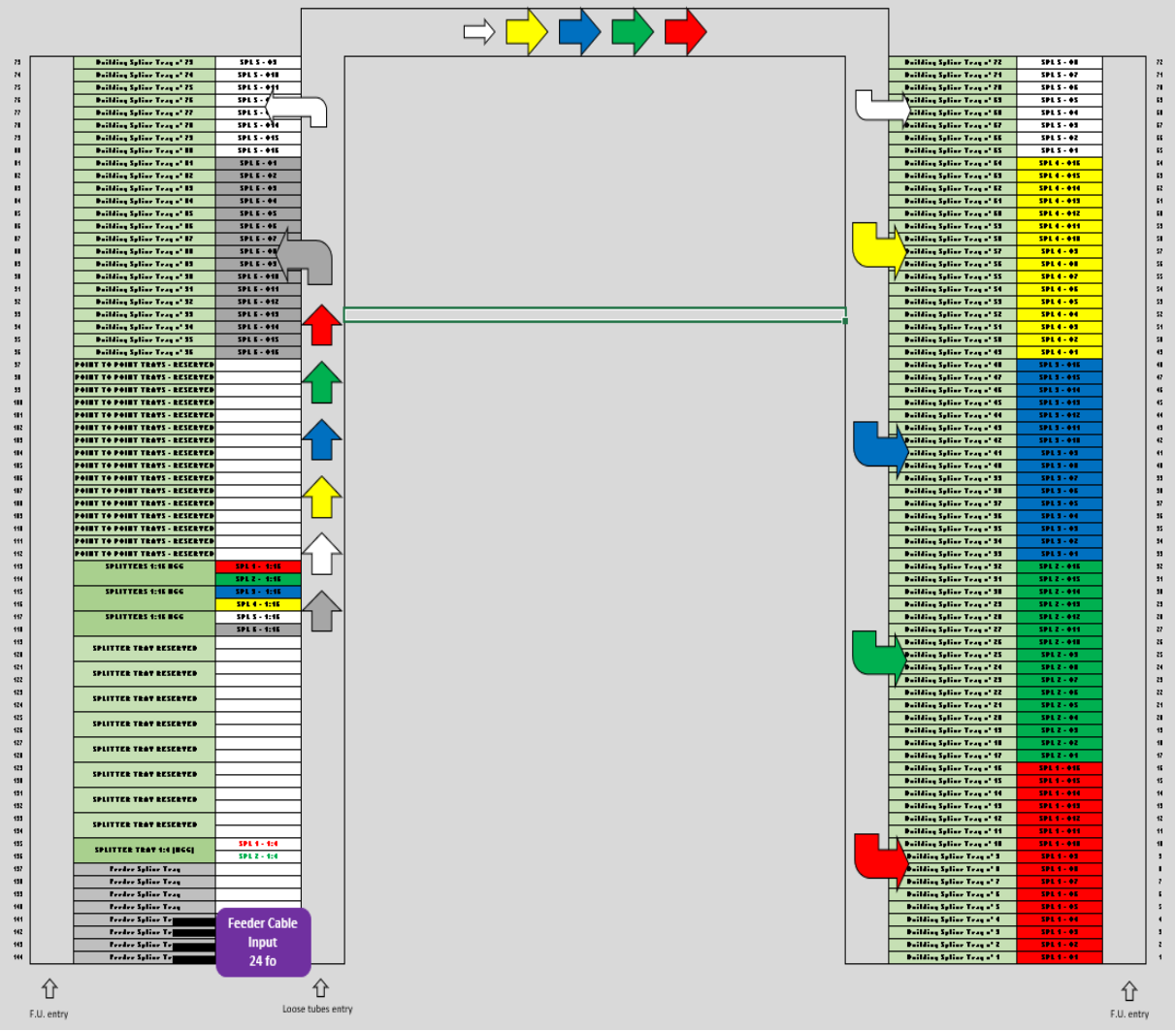


Figure 39.- UDP internal configuration (1)

In case that the feeder cable enters from the top the internal configuration is the following:

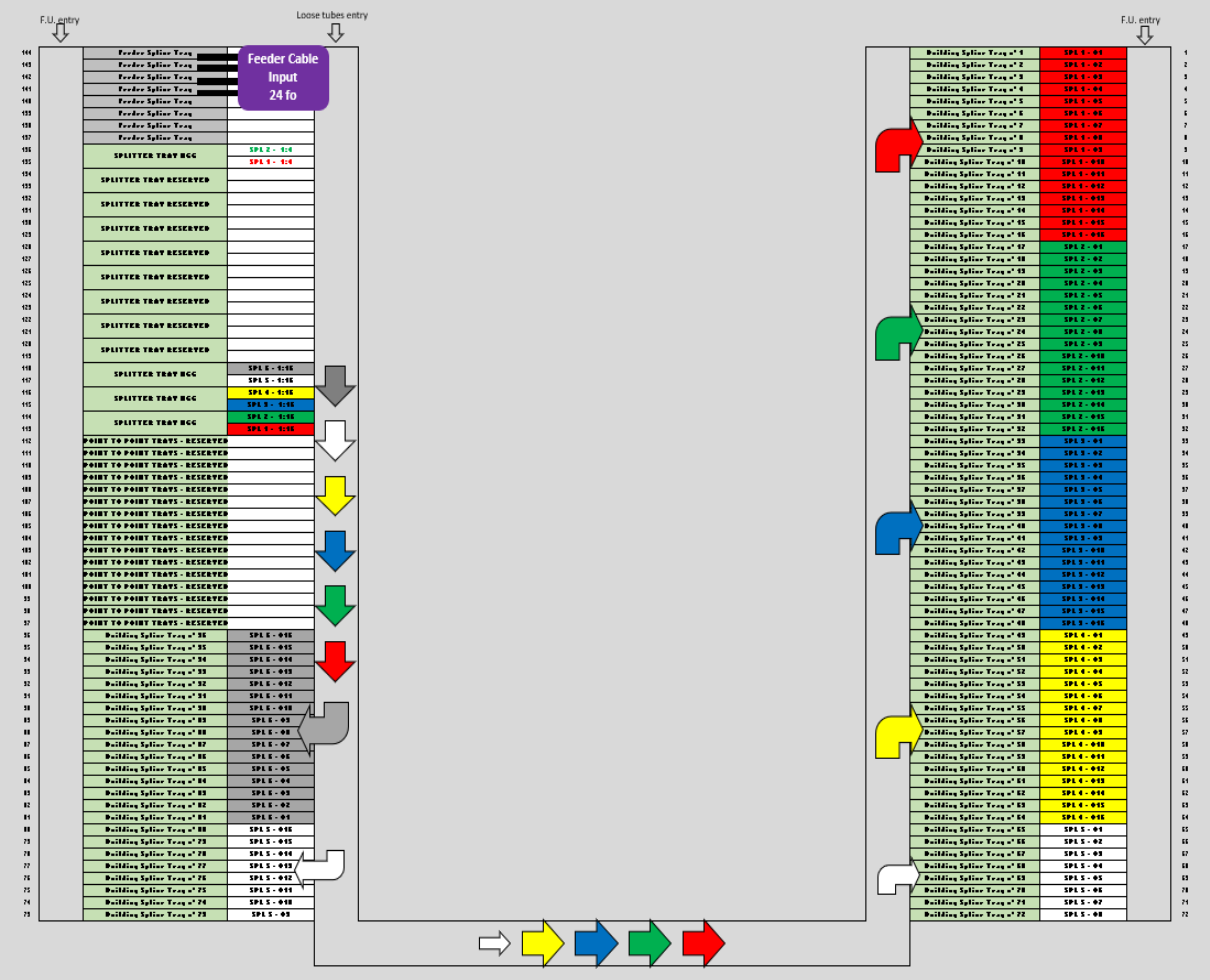


Figure 40.- UDP internal configuration (2)

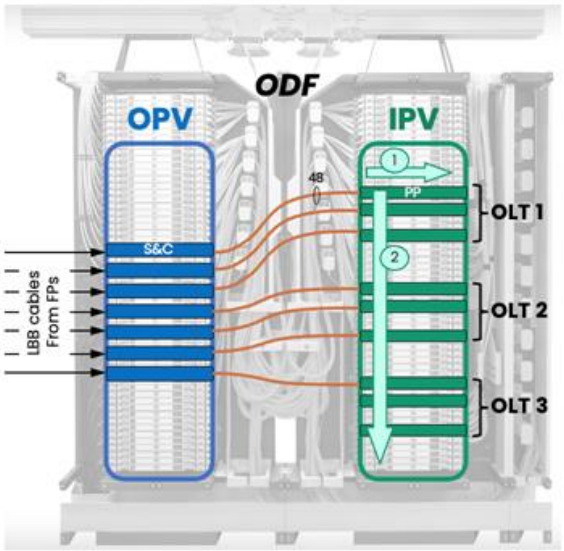
For more information, consult [8] Annex for Urban DP-96 (with splitters).

The Feeder cable fibers dragged from the UDP to the ODF will be the following, depending on the UDP configuration:

UDP configuration	Needed fibers (includes spare for 2nd Operator)	Fibers dragged to ODF	Feeder Cable
CONF.1: 6 splitters 1:16 as second level Not allowed	4	12	24 F
CONF.2: 5 splitters 1:16 as second level- 1 splitter 1:16 as first level	6	12	
CONF.3: 4 splitters 1:16 as second level - 2 splitters 1:16 as first level	6	12	
CONF.4: 3 splitters 1:16 as second level - 3 splitters 1:16 as first level	8	24	
CONF.5: 2 splitters 1:16 as second level - 4 splitters 1:16 as first level	10	24	
CONF.7: 6 splitters 1:16 as second level	12	24	

To ensure efficient occupancy of LBB and ODF, we must properly combine UDP drags in FP, to approach 75% occupancy of the LBB cable. Taking each FP into design between 4 and 6 UDP, as appropriate.

Regarding the connection from the ODF to the IPV, which consists in connecting the fibers coming from the 1st splitting level in the UDP to the first position free in the patch panel module of the IPV must be done in the following way: the fibers illuminated will be the ones corresponding to the 50% (as minimum) of 1st level splitters for each type (1:4 and 1:16) in the UDP. In construction phase, this must be done by the Access Construction Company. The fibers not illuminated end in the OPV.



Moreover, alarms are used in case that new fibers must be enlightened. This extension should be done by CC-Home Connection.

UDP configuration	Patchcord to IPV	Splitter illuminated in UDP
CONF.1: 6 splitters 1:16 as second level Not allowed	1 fiber	SPL1 1:4
CONF.2: 5 splitters 1:16 as second level- 1 splitter 1:16 as first level	2 fibers	SPL1 1:4 + SPL1 1:16
CONF.3: 4 splitters 1:16 as second level - 2 splitters 1:16 as first level	2 fibers	SPL1 1:4 + SPL1 1:16
CONF.4: 3 splitters 1:16 as second level - 3 splitters 1:16 as first level	3 fibers	SPL1 1:4 + SPL1 1:16 + SPL2 1:16
CONF.5: 2 splitters 1:16 as second level - 4 splitters 1:16 as first level	3 fibers	SPL1 1:4 + SPL1 1:16 + SPL2 1:16
CONF.7: 6 splitters 1:16 as second level	3 fibers	SPL1 1:16 + SPL2 1:16 + SPL3 1:16

As an **exception to the default dimensioning** and spare capacity rules, in case that there are empty lots not under construction in the DP area, resources are allocated for these lots in this way:

- There must be distribution microducts assigned for urban empty lots or plots, which must not be included as bundle spare. This microduct can be assigned by location order, or at the end of the usable capacity of the bundle, as they were regular addresses and with continuity along the distribution network. For example, if there is a section with 5 real addresses and 2 empty lots, a bundle of 12x7/4mm must be used.
- Regarding to intermixed addresses or areas served by other operators which do not deploy optic fiber, their HPs must be considered in the distribution bundles, DP (but always with a minimum of 10 HPs served by UGG) and POP capacity. However, **those addresses served by other operators with optic fiber will be discarded directly from the design** and will not be considered in the spare capacity.

UDP preferred locations will be centred to the service area, near to street crossings. The visual impact and occupancy of public space must be minimized.

3.5.4.3 INDOOR DP-64 (IDP-64)

Large MDU buildings (from 45HPs on) will use Indoor Distribution Points (IDPs). The IDP includes the 1st and 2nd level splitters or a unique splitting level, in both cases the equivalent level is 1:64. IDPs can coexist with OTBs inside the same building.

All UDPs configurations allow the use of IDPs, limited by the total dragged fibers by the UDP (considering a minimum of 25% vacancy in the dragged fibers).

# IDP_{64} in MDU buildings	Additional needed fibers	Fibers to be dragged to ODF	Splicing trays conssumption	Max. capacity criterion
1-6	2 per IDP	2 per IDP	1 per IDP	Total HPs (*) per UDP < 384
>6 not allowed	-			

(*)only for large MDUs buildings

As commented previously, there must be a minimum of 25% of vacant fibers in the dragged ones. For this reason, the number of IDPs accepted in each configuration will depend on the dragged fibers (12fo or 24fo). For example, for the 1st configuration the 25% of vacancy of the 12 dragged fibers are 8 fibers (these fibers must be even). As 4 are needed for the entrance of the first splitting level the 4 remaining can be used for IDPs. As stated in the previous table each IDP needs 2 fibers, so a maximum of 2 IDPs can be used in the configuration 1.

Configuration type in UDP	Needed fibers (includes spare for 2nd Operator)	Fibers to be dragged to ODF	Feeder cable	Maximum number of IDPs allowed
CONF.1: 6 splitters 1:16 as second level Not allowed	4	12*	24	2/6(**)
CONF.2: 5 splitters 1:16 as second level- 1 splitter 1:16 as first level	6	12*		1/6(**)
CONF.3: 4 splitters 1:16 as second level - 2 splitters 1:16 as first level	6	12*		1/6(**)
CONF.4: 3 splitters 1:16 as second level - 3 splitters 1:16 as first level	8	24		5
CONF.5: 2 splitters 1:16 as second level - 4 splitters 1:16 as first level	10	24		4
CONF.7: 6 splitters 1:16 as second level	12	24		3

(*):

Configurations 1,2 and 3 can drag 24 fibers to the POP depending on the IDP, P2P or FTOS necessities.

(**):

First value valid for 12 dragged fibers to POP

Second value implies 24 dragged fibers to POP

The HPs served by IDP must not be considered int the total recount of the service area at the time of choosing the UDP configuration as the splitting levels are not located in the UDP.

The IDP has trays for installing splitters, for splicing the fibers to connect to the UDP, and for future equipment that could be necessary to install inside the IDP. It is designed for serving 64 end users.

The IDP is fed by an 8fo distribution cable and has an exclusive microduct assigned inside the distribution bundle.

3.5.4.4 NETWORK DIMENSIONING

The following table shows the number/type of splitters in the UDP and building, types of OTBs, the distribution cable and the number of drop bundles depending on the number of homes inside every building. An excess for possible building services is accounted for the capacity of the equipment in the building.

Homes/ Building	Fibers deployed (*)	Splitter in UDP	Splitters in building (*)	OTBs type And Q	Duct 7/4 to Building
1	4 fo	1:4 + 1:16	-	1 x OTO	1
2-3		1:16	1:4 (x1)	1 x OTB 4_S	1
4-7		1:16	1:4 (x2)	1 x OTB 8_S	1
8-15	8 fo	1:16	1:4 (x4)	2 x OTB 8_S	1
16 - 22	12 fo	1:16	1:4 (x6)	1 x OTB 24_S	1
23 - 30	12 fo + 4 fo	1:16	1:4 (6 + 2)	OTB 24_S + OTB 8_S	2
31 - 37	12 fo + 8 fo	1:16	1:4 (6 + 4)	OTB 24_S + 2 x OTB 8_S	2
38 - 44	12 fo + 12 fo	1:16	1:4 (6 + 6)	2 x OTB 24_S	2
45 - 60	8 fo (x1)	-	"1:64"	1 x "IndoorDP-64"	2
61 - 67	8 fo + 4 fo	1:16	"1:64" + 1:4 (x2)	IDP-64 + OTB 8_S	2
68 - 75	8 fo + 8 fo	1:16	"1:64" + 1:4 (x4)	IDP-64 + 2 x OTB 8_S	2
76 - 82	8 fo + 12 fo	1:16	"1:64" + 1:4 (x6)	IDP-64 + OTB 24_S	2
83 - 105	8 fo + (12 fo + 12 fo)	1:16	"1:64" + 1:4 (6 + 6)	IDP-64 + (2 x OTB 24_S)	3
106 - 120	8 fo (x2)	-	"1:64" (x2)	2 x "IndoorDP-64"	3

(*) Only the necessary Trays to serve the 1:4 Splitters with Homes will be used. Example: 18 HP - 5 MDU Trays

The distribution cables allowed for DS Arch. are the 4fo, 8fo and 12fo. Their use will depend in the number of HPs of the building, as shown in the following table (see 2nd column).

An important difference with respect to the CS Arch.is that in DS Arch. the allocation of UDP Tray for Distribution Cable termination will be carried out dynamically, through the Provisioning Application (CTC). This implies that, in the LLD design, the physical connection of the distribution cable fibers to the UDP output trays must not be done.

The distribution cable distance from the UDP to the premise is around **500 m.** Please notice that this limit is not a radius around the UDP, it is the actual cable length installed over the planned infrastructure

routes. As an exception, distribution cable lengths up to **800 m.** can be designed for isolated houses included in the HLD.

For distances **greater than 800m** between UDPs and addresses inside the HLD the following criteria must be followed:

- Try to reduce the distance by moving the UDP to a position closer to the premise.
- Create a new UDP if the number of distant HPs is equal to or higher than 10.
- If the previous rules cannot be applied, the addresses are discarded in the LLD (leaving capacity for them in the nearest UDP and inside the distribution bundle).

Each distribution network cable is blown into a **7/4 mm micro-duct**. The micro-ducts are **bundled in groups of 7, 12 or 24**.

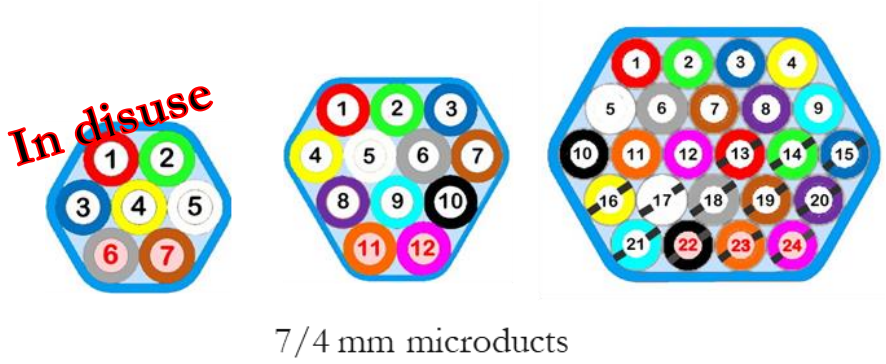
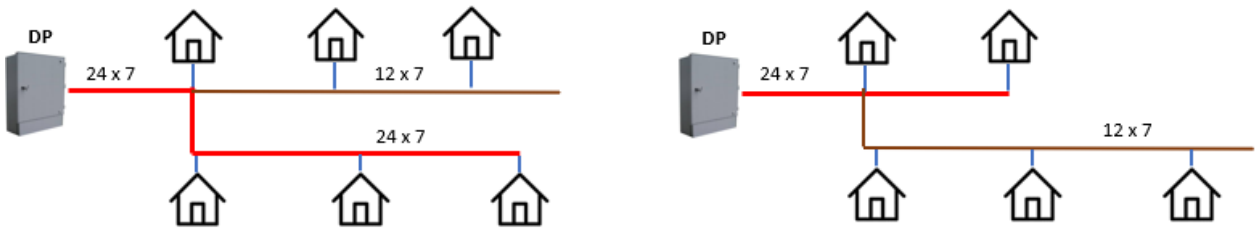


Figure 41.- Micro-duct bundles in the distribution network

At least **10% of the micro-ducts on each bundle are reserved** for future uses.

The accepted bundle modularities and the number of usable/spare micro-ducts is summarized in the following table:

Bundle Capacity	Used Max.	Vacant Min.
24x7/4 mm	21	3
12x7/4 mm	10	2



When a bundle is divided into 2 branches, the general rule is to continue with the incoming bundle along the shortest outgoing branch, in case that the longest branch can be attended with a lower capacity bundle. If the

two branches have similar length, then the incoming bundle should be continued along the branch with more twists (to ease the fiber blowing at fiber installation time), as shown in this example:

The segregation of a micro-duct from a bundle towards the customer premises is not considered a bundle branch, but just the drop connection.

In the future, whenever necessary, **spare micro-ducts** can be given end-to-end continuity towards the different branches of the bundle by manipulating the micro-duct connections at the branch jointing points. By doing so, the vacant duct is available for use in any part of the main bundle or branches. In general, the connection of vacant ducts between the main bundle and the branch one is not defined in the network design phase. When needed, the spare microducts of the different bundle branches must be connected to each other, in consecutive order.

It is allowed the **mid-span reduction of bundle size** when the associated cost savings are significant. For example, in the case a 24x7/4 mm bundle connecting the UDP with 20 houses, the 24x7/4 mm bundle can be continued with a 12x7/4 mm bundle after serving the 10 houses closer to the UDP, using the appropriate duct couplers. This rule is only applied for large spans (above 200 m.) that are subject of reduction.

All the distribution bundles must be terminated in a position near the mid-point of the front side of the last home. All the bundle micro-ducts will be sealed at this point with the appropriate end caps.

The required **bundle lengths** must be oversized by **adding 2%** to the calculated distances, to consider the normal bundle waste at construction time. The distribution cable lengths are also oversized by the **2% of the calculated length, plus 5 meters** (considered in BoQ, loop element must not be designed in Keycom).

Bundle branches segregated from the main bundle are allowed. The minimum branch size will be a 12x7/4 mm bundle. Ducts from the main and secondary bundle(s) will be connected by approved ducts joint.

When a bundle is branched, the branch will reduce its capacity, connecting the microducts necessary for the service of its branch to the main distribution bundle. The color correspondence of the microducts of the main bundle on the branch must be maintained, without taking into account the striping, of the microducts greater than 12.

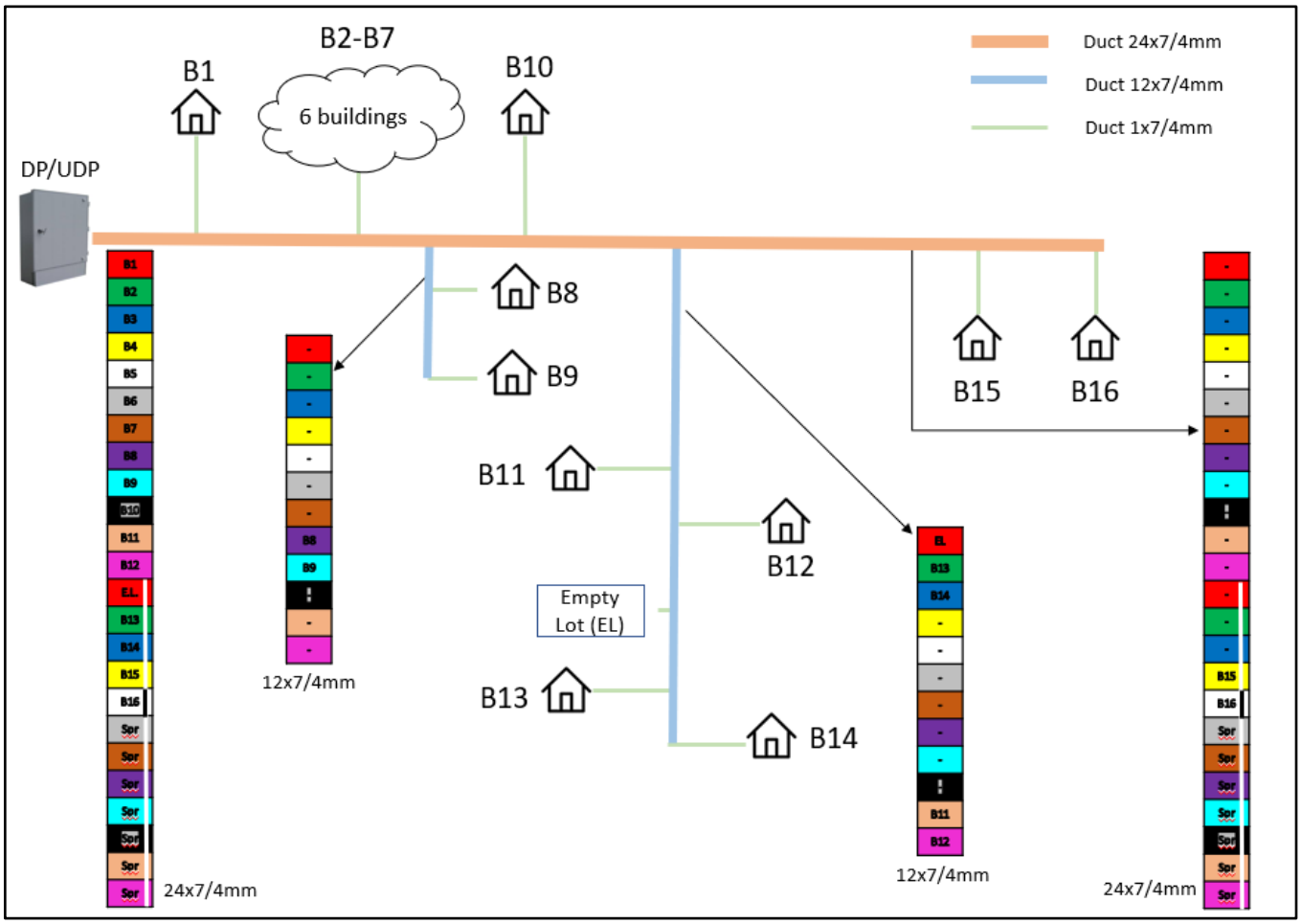


Figure 42.- Segregation in Distribution Network

3.5.4.5 NETWORK ROUTES

As a general rule, the total **number of distribution bundles** connected to the UDP should **not be higher than 8**. Exceptions are only accepted in UDPs covering areas with very complex distribution of homes.

The maximum number of micro-ducts terminated inside the UDP is 96.

One of the sides of the street will be categorized as primary deployment side (the one with the higher number of addresses) and the other one as secondary side (the opposite side to the primary). The primary/secondary side can alternate each other depending on the addresses density in each side.

Distribution network routes will always run along the primary side of the street. In some cases, depending on the density of addresses per side, the route goes also along the secondary side.

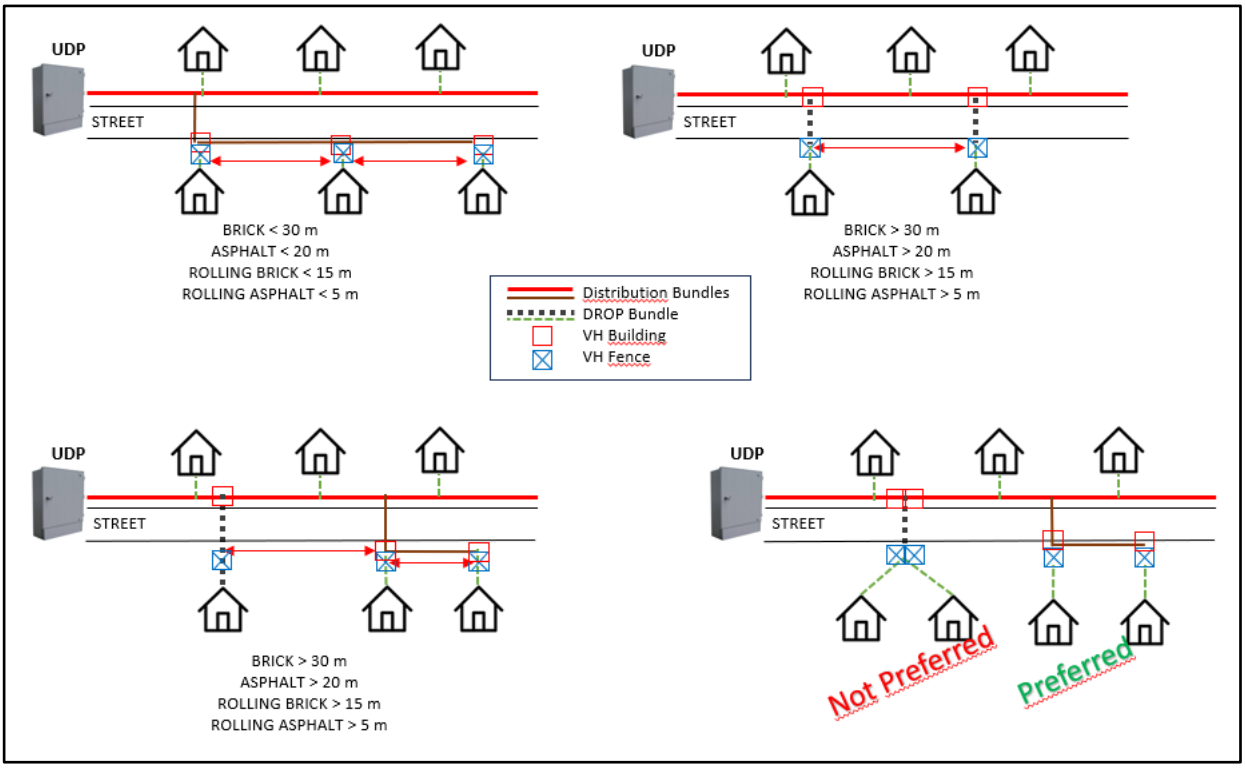
The following **trenching priorities based on the soil surface** will be considered when planning new infrastructure routes in residential areas: (1) Unpaved surfaces, (2) Brick, (3) Asphalt.

Trenching on both sides of the street will be avoided whenever possible. In particular, the use of trenchless road crossing (drilling) instead of double trenching will be mandatory when:

- Brick surfaces: If the distance between fence virtual handholes (VHF) is higher than 30 m.
- Asphalt surfaces: If the distance between fence virtual handholes (VHF) is higher than 20 m.

- Rolling brick: If the distance between fence virtual handholes (VHF) is higher than 15 m.
- Rolling asphalt: If the distance between fence virtual handholes (VHF) is higher than 5 m.

(new recommendation)



Crossing State (Land) or District (Kreis) roads in the Distribution network will be avoided. The number of these road crossings will be reduced to the minimum. Depending on the number of crossings, parallelisms of 100 meters, 200 meters and, exceptionally, higher will be accepted.

Dimensioning rules and constraints in place for civil works (as per Annex 2 to this document) must also be considered to calculate the lowest cost routes.

3.5.4.6 DELIVERABLES

The Distribution and Feeder Network design is delivered in a single Access Network delivery. Network design deliverables of the Access project are specified and discussed in chapter 6.

3.5.5 DROP NETWORK

The Drop network covers the infrastructure going across the private property, the Optical Termination Box (OTB) and/or Outlet (OTO) and the in-building cabling (or vertical infrastructure when required).

The drop network is **deployed at subscriber connection time**, which can be either at the same time that the distribution network is deployed (when the service contract is signed by the subscriber before building the network), or at a later time.

The **drop connection infrastructure** consists of a 7/4 microduct per cable connected to the distribution bundle in the building virtual handhole, as shown in the figure. The micro-duct runs along the private property and ends (at the effect of network design and estimation of materials and labour) at the façade of the house or building.

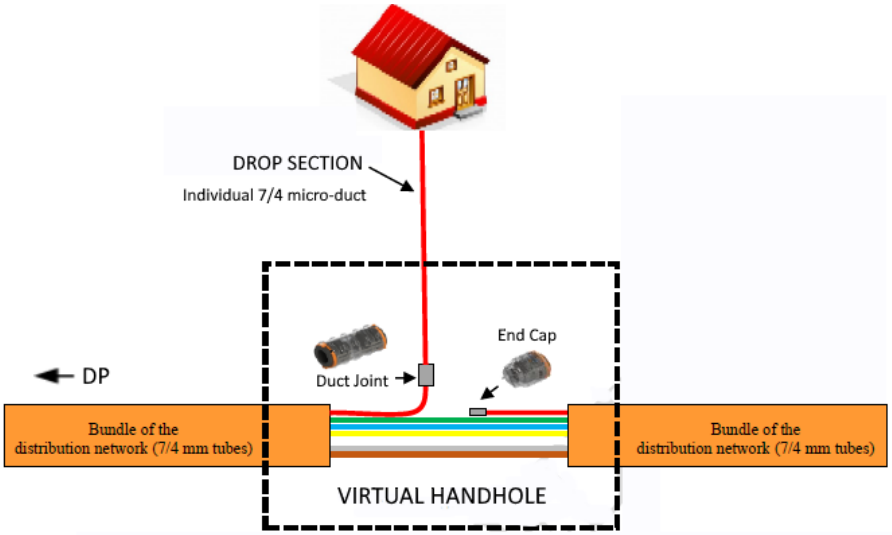


Figure 43.- Drop connection

In **Single Dwelling** or Single Business Units (SDU/SBU), the 4-fiber drop cable coming from the nearest Urban Distribution Point is terminated directly in the subscriber's Optical Termination Outlet (OTO).

In **Multi Dwelling** or Multi Business Units (MDU/MBU), from 2 HPs on, one or more 4-fiber cables end at the entrance of the second level splitter of 1:4 (connected later to the OTB_S) located inside the building.

The **number and capacity of the drop cables**, and the terminal equipment(s) to install in the building are summarized in the table below. In all the cases, connection from the OTB_S to each OTO is made via duplex connectorized optical fiber patchcords.

Homes/ Building	Duct 1x7/4 to Building	Drop Cable	Splitters in building	OTBs type
1	1	4 fo	-	1 x OTO
2-3	1	4 fo	1:4 (x1)	1 x OTB 4_S
4-7	1	4 fo	1:4 (x2)	1 x OTB 8_S
8-15	1	8 fo	1:4 (x4)	2 x OTB 8_S
16 - 22	1	12 fo	1:4 (x6)	1 x OTB 24_S
23 – 30	2	12 fo + 4 fo	1:4 (6 + 2)	OTB 24_S + OTB 8_S
31 – 37	2	12 fo + 8 fo	1:4 (6 + 4)	OTB 24_S + 2 x OTB 8_S
38 – 44	2	12 fo + 12 fo	1:4 (6 + 6)	2 x OTB 24_S
45 – 60	2	8 fo (x1)	"1:64"	1 x "IndoorDP-64"
61 - 67	2	8 fo + 4 fo	"1:64" + 1:4 (x2)	IDP-64 + OTB 8_S
68 – 75	2	8 fo + 8 fo	"1:64" + 1:4 (x4)	IDP-64 + 2 x OTB 8_S
76 – 82	2	8 fo + 12 fo	"1:64" + 1:4 (x6)	IDP-64 + OTB 24_S
83 - 105	3	8 fo + (12 fo + 12 fo)	"1:64" + 1:4 (6 + 6)	IDP-64 +(2 x OTB 24_S)
106 - 120	3	8 fo (x2)	"1:64" (x2)	2 x "IndoorDP-64"

The occupation of trays in the UDP by distribution cables shall be 2 fibers/tray, and of these, it shall be the odd one that activates the splitter 1:4 in MDU.

In Multi Dwelling or Multi Business Units (MDU/MBU), from 45 HPs on, an Indoor Distribution Point (IDP-64) is installed inside the building connected with an 8-fiber cable. It can be complemented with OTBs as detailed in the previous table.

The **Optical Termination Outlet (OTO)** is the last point in the FTTH optical network, installed inside the customers' premises. The OTO includes 2 LC/APC connectors

3.5.6 IN-BUILDING NETWORK

NOTE: *At the date of publication of this document, the in-building network is being introduced in the List of Materials / Services (BOQ) and construction companies' contracts. Until these subjects are finalized, the outside plant design (the feeder network branch from the POP to the MDU) will be included in the network design, but the in-building design will be postponed.*

All in-building installations will require a specific design and they will follow the rules indicated in the document [5] In-Building Network Design.

In the LLD a BOQ estimation will be made, based on:

- **From 2 to 44 HP (OTB):** The materials to account will be the ones present in the BoQ.
- **From 45 HPs on, and indoor DP is installed with an equivalent splitting level of 1:64, complemented in some cases with OTBs**. The Indoor DP type, amount and installation will be the expected ones.

It is a mandatory pre-requisite for the in-building network design to conduct an **in-building site survey**, checking the availability and vacant space on the common infrastructure, preferred location of equipment and cable routes.

3.6 VIRTUAL HANDHOLES (VH)

Virtual handholes are defined as:

- The point where a micro-duct is segregated from the main feeder/distribution bundle to another/s (**VH Branching**).
- The point where a micro-duct is segregated from the bundle to create a new route towards a building (**VH Building**). This virtual handhole must be located at the closest point that makes feasible the access to the building independently if the nearest point is public or a private common area (this must be determined in survey). It marks the separation between the access and drop networks and where the distribution bundle is segregated to duct 1x7/4mm.

  In case that the building is fed by an indoor-DP the VH Building must be located at the point when the main feeder bundle is segregated to the 2x14/10mm (in public soil).
- The point which marks the private property limit is the **VH Fence** and must be located always after the VH Building.

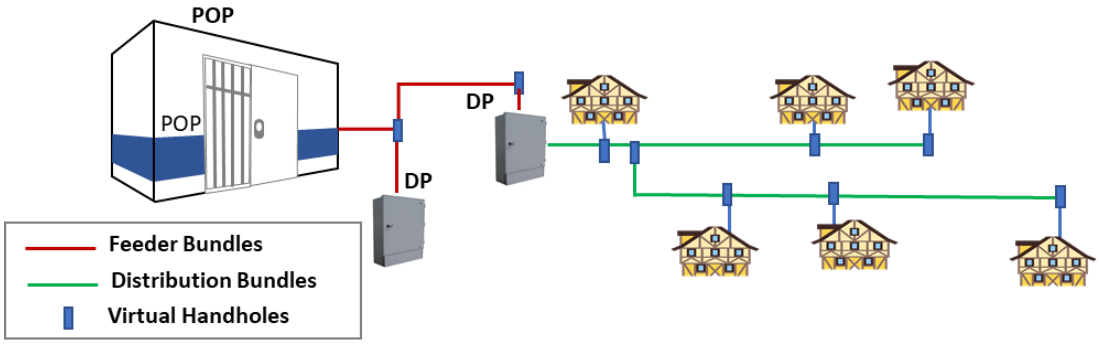


Figure 44.- Virtual Handholes

Regarding to the access through private streets/areas, a VH Fence must be placed in the limit between the public and private soil. Some examples are shown (not all) in the following images depending on the number of addresses to serve inside the private area:

For serving only one address, the VH Building will be located in public soil and the VH Fence at the property limit:

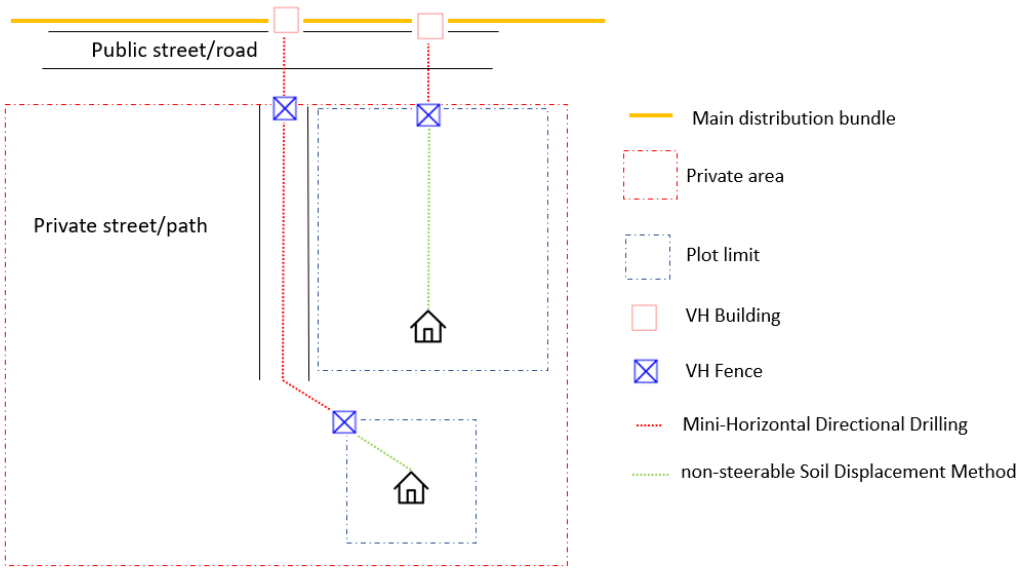


Figure 45.- Virtual Handholes for accessing to one address in private area

For serving more than one address, the distribution network runs along the private street, branching towards the drop network in every VH Building (one per addresses). Every address has a VH Fence located at the property limit:

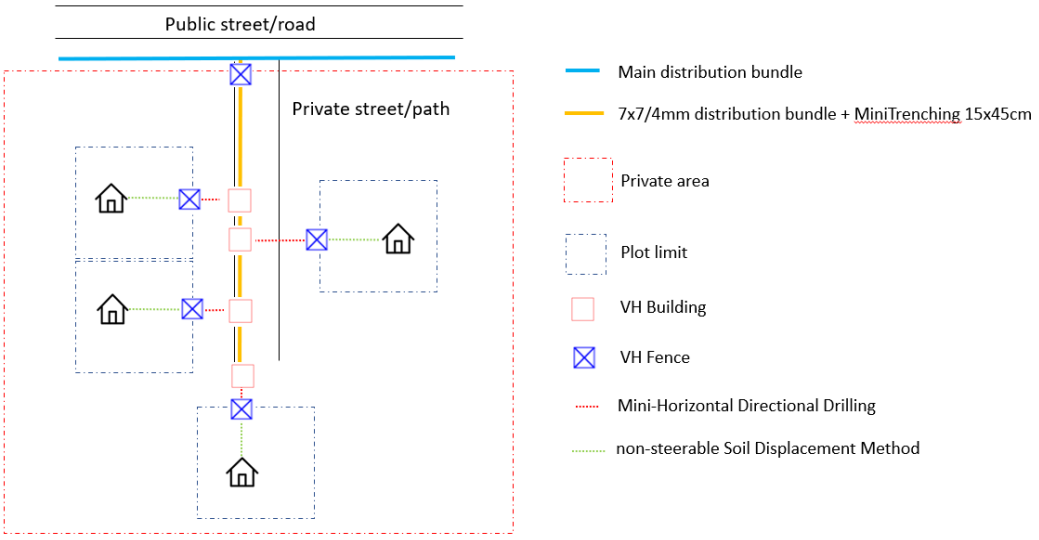


Figure 46.- Virtual Handholes for accessing to more than one address in private area

3.7 REQUIREMENTS FOR THE NETWORK DESIGN

This point summarizes all the requirements that must be considered before and during the LLD design.

3.7.1 GENERAL CONSIDERATIONS

The LLD Process starts once the Gemeinde is out of ON-HOLD in Service Now so, no documents (HLD, cluster structure) must be considered while the Gemeinde is ON-HOLD as they can change during this period. Before starting the LLD design, the following documents must be provided by UGG to the Technical Office and LLD design company:

- HLD Express approved by the MOU and presented to the Gemeinde. Also, it is the one approved by the Investment Committee. It will be uploaded to the Gemeinde´s folder in DOMA (.zip format).
- Last version of the cluster structure. This document will be accessible through Service Now once the Gemeinde is out of ON-HOLD.

Once the LLD design company has all the required documentation, the following premises must be considered before starting the LLD design:

- Use as reference the HLD version approved by the MOU and presented to the Gemeinde.
- Use and consider the last version of the cluster structure uploaded to systems.

- Have the POP, FPs/UDPs/DPs and POI location confirmation according to cluster coordinates and Gemeinde´s approval.
- Confirm POPs´ coding according to Service Now.
- If it is necessary, a document/email with all the exceptional instructions requested by the Gemeinde/administrations that are out of the design criteria must be prepared.
- ALKIS Data is recommended for the design and UGG will provide it to the Design Company through DOMA once it is available.
- Confirm with the Gemeinde those areas deployed by other Operators and the type of technology deployed (fiber, copper, …) as well as future growing areas.

On the one hand, regarding to big Gemeinden (from 3000 HPs and with more than 1 POP) and deployed with the CS Arch., in order to speed up the design, construction and to provide service as soon as possible, it will be necessary to split those Gemeinden by POP or groups of POPs (trying to keep a minimum of 1000 HPs) depending on design features and logical structure (according to the cluster document). The steps to follow are the following:

- The first POP to design will be the most hierarchical one (normally Aggregator or Active POP), including its link (BackHaul).
- During its design (Aggregator/Active POP design), every link to the rest of POPs (Passive POPs) which it is connected must be considered and designed inside the access network.
- When the most hierarchical POP is designed the rest of the POPs connected to it will be designed, following with POPs which share BackHaul routes with it. After that, other criteria can be applied, for example, location, proximity order or number of HPs serviced. Further proposals outside this document are welcome, with prior authorisation from UGG.

On the other hand, regarding to Gemeinden deployed with the DS Arch., the split of the design will be by Feeder Points. Each partial LLD will have a minimum of 2 and a maximum of 5 FPs (this maximum is recommended). The first partial LLD to be designed should be the one that contains the POP. It is important to have the complete Local Backbone network "clear" (between Headend POP and FP) in case that the dimensioning of the bundles to other FPs of other partials has to be considered. The Local Backbone cable arriving to each FP is designed and accounted in each partial LLD where this FP is present.

At the time of creating the partial LLD in Service Now a description is needed (field ´Part Description´ in Service Now). It must be filled in with the following criteria:

1) Partial LLDs designed with the CS Arch.:

   1.1) Access partial LLDs-> "**POP_IDs-Access**", for example NOCHR01_Access or NOCHR02- NOCHR03_Access.

   1.2) BH/LB partial LLD (unique by Gemeinde)-> "**Gemeinde_ID_BH/LB**", for example NOCHR_BH/LB.

2) Partial LLDs designed with the new DS Arch.:

   2.1) Access partial LLDs-> "**FP_IDs-Access**", for example NOCHR01/FP01-FP02_Access or NOCHR01/FP01-FP04_Access (it would include from FP01 to FP04).

2.2) BH/LB partial LLD (unique by Gemeinde)-> "**Gemeinde_ID_BH/LB**", for example NOCHR_BH/LB

Each partial LLD will have a separate progress within the process. All documentation must be delivered through DOMA instead of Microsoft Teams following the folder structure and encoding rules defined in 6.1 and 6.2.

The following **network design considerations** must be considered in the design process:

- Lowest cost solutions, minimizing the initial Capex.
- Fast deployment, avoiding routes or places requiring longer approval processes.
- Low maintenance, initial designs and sparing rules must provide for natural growth and typical expansions of the network over a long period without significant rework of the network design.
- Resistant network design, especially in the critical segments that could affect large number of subscribers.

All addresses included/served in the HLD must be included in the LLD too. For those addresses that are inside the HLD but do not fulfill the design criteria in the LLD are discarded at the beginning (leaving capacity for them in the nearest UDP/DP). The excluded addresses in the HLD must be discarded in the LLD too.

In design, the treatment of the different types of addresses will be as follows:

- Future development areas out of the HLD for which the local authorities request UGG to provide network coverage will not be included in the LLD design. The execution of this part of the network will probably be postponed, but the allocation of resources (POP and DP capacity, feeder and distribution infrastructure) must be guaranteed using the data (number of homes and building locations) provided by the authority.
- Plots in building construction process are considered as regular addresses/homes and construction evidence must be sent to LOMA´s team before creating the homes in LOMA.
- Before including the address in the network design, the designer will verify that the lot is classified as building plot by checking cadastral data or parcel classification maps. Empty lots participating in the dimensioning of network elements (Feeder, UDP/DP and Distribution) but not in the total HP counts will be clearly identified in LLD designs.

3.7.2 FTTF

The LLD design has to follow the FTTF model (Fiber to The Fence). All addresses (excluding all empty lots) must be designed as FTTF. As stated in 3.4.4.2 and 3.5.4.2 urban empty lots must have a microduct assigned in distribution bundles.

In design, all addresses must have a VH Building and a VH Fence designed (VHF is at the property boundary being an approximate proposal to be adjusted on construction). Urban empty lots must have a VH Building designed (but not VH fence), and they do not generate any exclusive civil work.

3.7.3 DEPLOYMENT LIMTATIONS

The distance to cover in the Backhaul, Backup Line, Redundancy BackHaul, Local Backbone and Feeder networks will sometimes exceed the maximum length of a cable drum. Therefore, at least on every section of **6 km** a **splicing closure with a manhole** will be added to the design, including also fusion splices for all the fibers in the cable. The splicing point will be planned at the midpoint of the section, or at an existing branching point when available. For each cable reaching these mid-span splicing closures **10 m**. extra per cable will be considered (for this splice execution) and added to the total cable lengths.

Depending on the number and cables capacity these are the amount and type of splices to use:

SC Type	Cables	Cable capacity
1x96	1-4	24 fo
1x96	1-2	48 fo
1x96	1	96 fo
1x288	1	192 fo / 288 fo
1x288	2-3	96 fo
2x288	4-6	96 fo
nx288	n	192 fo / 288 fo

In general, all cable installations longer than 1500 m will need manholes, as a storage point (loop) and register to facilitate the installation and maintenance. The minimum number of manholes necessary will be installed so that no section between them exceeds 1500 metres. In design, a proposal will be made for their location, which will be corrected, if necessary, in construction to their suitable location for use. In these manholes a storage (loop) of 6 meters will be considered. The type of manhole should be OC (maximum 16 loops). In case that more than 16 loops are stored the manhole type must be TC (different capacities are explained in 5.2.4).

The following image shows an example of the use of manholes, loops and splices in a BackHaul link between POP and SWD:

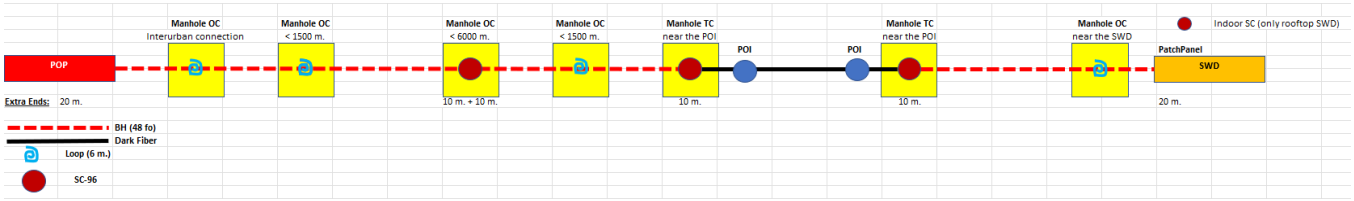


Figure 47.- Manholes scheme

In general, for links sections (BackHaul, Local Backbone, other services), in every Gemeinde the necessary interurban civil work and infrastructure to assure the connection to the higher hierarchy in addition to the end-to-end cable must be considered. In case of doubt, UGG together with the Technical Office and the Design Company will agree the sections designed and accounted per Gemeinde.

3.7.4 FIBER TO OTHER SERVICES

UGG provides other services, for example connecting different antennas of other providers, taking advantage of the fiber optic network (Fiber to the Site, …). In some cluster structures some schemes can appear. A new element is introduced in these schemes: Fiber to the Site. In every Gemeinde design, the infrastructure section (bundles) and cable between Active POPs (defined in the cluster document) will be considered. It will be taken into account as another link and will share bundles with the rest of the links on its route (Redundancy BackHaul, Backup Line, BackHaul and Local Backbone).

Regarding the CS Arch., for every Gemeinde, feeder and distribution networks will foresee until the deployment limit. Antennas will be considered equivalent to 2HPs with a maximum of 4fo in feeder network capacity and an exclusive 12fo cable in distribution network connected to an OTB-6 (while antennas´ location are confirmed in the cluster structure). If the antenna is in the mid-route interurban a manhole will be installed (normally OC), leaving a tube from the FTOS cable (the cable between Active POPs) and feeding the antenna with a 12fo cable.

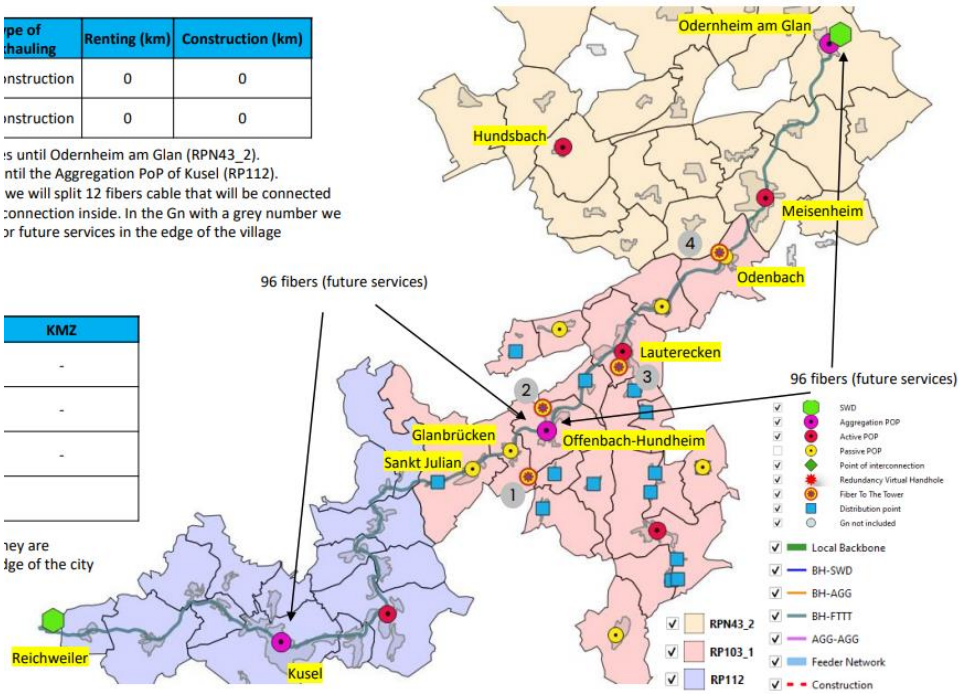


Figure 48.- Fiber to Other Services in CS Arch.

Regarding the new DS Arch. for every Gemeinde, local backbone, feeder and distribution networks will foresee until the deployment limit. The antennas will be considered as 1 Point to Point client, and will be served depending on their location. If the antenna is located inside the access network, it will be served directly from the nearest Urban DP. In this case the antenna will be treated as an IDP in each UDP configuration with an exclusive distribution cable of 12 fibers conectado a an OTB-6 without splitters. And 2 feeder fibers fragged to the ODF, always observing in design the minimum of 25% vacancy of the dragged fibers. However, if the antenna is in the mid-route interurban a manhole will be installed (normally OC),

leaving a tube from the FTOS cable (the cable between Active POPs) and feeding the antenna with a 12fo cable.

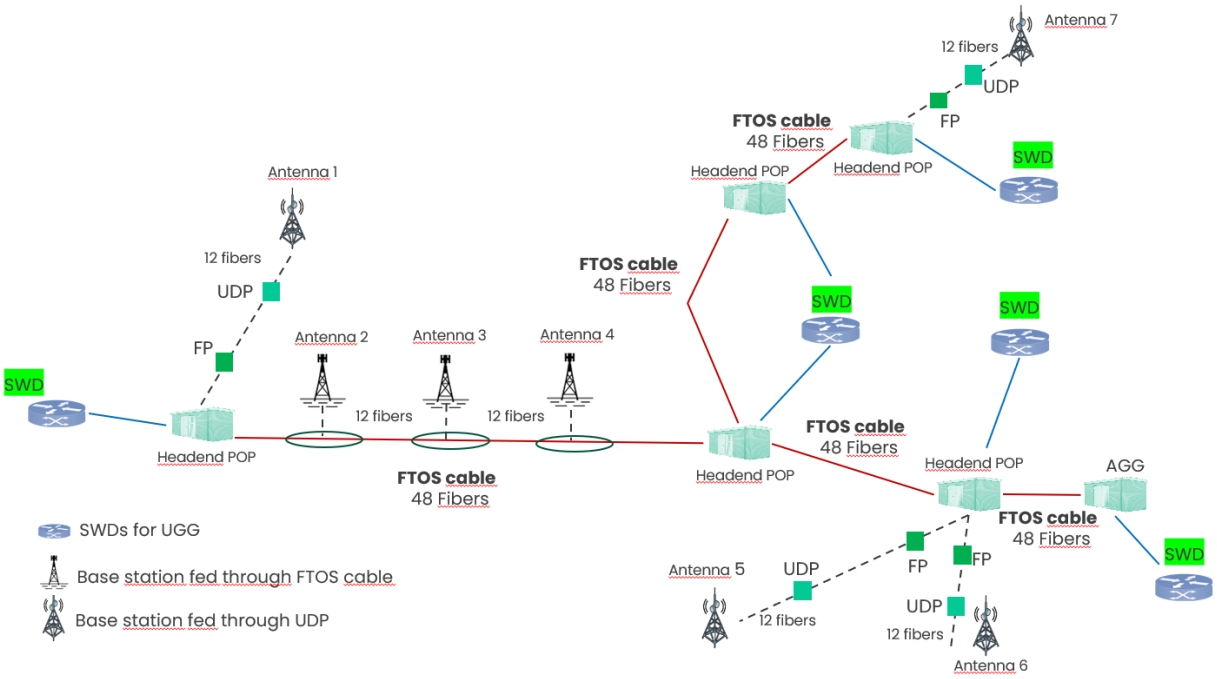


Figure 49.- Fiber to Other Services in DS Arch.

4. NAMING CONVENTION AND LABELING

Labels with "-" must keep an space at both sides of the "-".

4.1 COMMON LABELLING FOR CENTRALIZED AND DISTRIBUTED SPLITTING ARCHITECTURE

In this point the labelling for the elements involved in the design of both Architectures is explained:

4.1.1 POINT OF PRESENCE

The relationship Gemeinde – POP is not univocal. There are Gemeinden served by a POP located in another Gemeinde, and there are also Gemeinden with more than one POP.

POP code is created automatically by NCM. They are identified by the Gemeinde's acronym followed by one or more digits.

4.1.2 ADDRESSES AND HOMES

Address Identifiers (ADDRESS_ID) are proprietary 10-character unique names, assigned by UGG to each address in the Country.

Address Identifiers are composed by the capital letter 'A' followed by two capital letters representing the State, and then 7 digits from 0 to 9.999.999.

The two initial letters are assigned according to the values in the table below:

Bundesland	Code	State
1	SH	Schleswig-Holstein
2	HH	Hamburg
3	NI	Niedersachsen
4	HB	Bremen
5	NW	Nordrhein-Westfalen
6	HE	Hessen
7	RP	Rheinland-Pfalz
8	BW	Baden-Württemberg
9	BY	Bayern
10	SL	Saarland
11	BE	Berlin
12	BB	Brandenburg
13	MV	Mecklenburg-Vorpommern
14	SN	Sachsen
15	ST	Sachsen-Anhalt
16	TH	Thüringen

Home Identifiers (HOME_ID) are proprietary 13-character unique names, assigned by UGG.

Home Identifiers are composed by the ADDRESS_ID, followed by the 3-digit Unit Number field.

ADDRESS_ID / HOME_ID	Examples
ADDRESS_ID	ARP1234567 AST0011223 ASN9876543
HOME_ID	ARP1234567001 AST0011223007 ASN9876543002

4.1.3 VIRTUAL HANDHOLES

Virtual handhole names used for Branching are composed of the letters "VH_" followed by the POP_ID and a 'unique in the POP area' 3-digit number assigned to the virtual handhole, starting by 001 (Setics/KeyCom can use more digits. Regarding to Generic VH the identification must not be repeated). In case of exceeding the numbering 999 we would include a fourth digit (1000, 1001...)

IMPORTANT: The numbering must not overlap in any case with the Generic VHs, trying to use the lowest numbering range for the Branching VHs.

VIRTUAL_HANDHOLE_ID	Examples
VH_<POP_ID>_<Serial number>	VH_HERMS1_001 (POP HERMS1 – First virtual handhole) VH_MARNG1_007 (POP MARNG1 – Virtual handhole nr. 7)

Regarding to building virtual handhole, its labelling will depend on where it is connected.

-For a unique access, it will be labelled with the ADDRESS_ID, as follows: VH_<*ADDRESS_ID*>

BUILDING VIRTUAL_HANDHOLE_ID	Examples
VH_<ADDRESS_ID>	VH_ARP0123456 VH_AST0011223

-For more than one access, it will be labelled depending on where it is connected:

VH_<OTO_ID> or VH_<OTB_ID>

BUILDING VIRTUAL_HANDHOLE_ID	Examples
VH_<OTO_ID>	VH_ARP0123456001 VH_AST0011223002
VH_<OTB_ID>	VH_ARP0123456_A VH_AST0011223_B

Regarding to fence virtual handhole, its labelling will depend on where it is connected.

-For a unique access, it will be labelled with the ADDRESS_ID, as follows: VHF_<*ADDRESS_ID*>

FENCE VIRTUAL_HANDHOLE_ID	Examples
VHF_<ADDRESS_ID>	VHF_ARP0123456 VHF_AST0011223

-For more than one access, it will be labelled depending on where it is connected:

VHF_<OTO_ID> or VHF_<OTB_ID>

FENCE VIRTUAL_HANDHOLE_ID	Examples
VHF_<OTO_ID>	VHF_ARP0123456001 VHF_AST0011223002
VHF_<OTB_ID>	VHF_ARP0123456_A VHF_AST0011223_B

The VH Fence used when it is necessary to serve addresses through private zones (different from the address plot) is labelled with the DP_ID and 2-digit number assigned, starting by 01.

FENCE VIRTUAL_HANDHOLE_ID	Examples
VHF _<DP_ID>_XX	VHF _ GUXGH1/DP005_01 VHF _ GUXGH1/DP005_02 VHF _ GUXGH1/DP006_01

Virtual Handhole of Redundancy (VHR) which has to be designed as a generic virtual handhole in Keycom will be labelled as follows. The GEMEINDE_ID is the one where the VHR is located and X the sequence number (1,2,3,4…) corresponding to that Gemeinde:

REDUNDANCY VIRTUAL_HANDHOLE_ID	Examples
VHR _<GEMEINDE_ID>_X	VHR _ GUXGH_1 VHR _ GUXGH_2 VHR _ KORLL_1

This figure shows an example of virtual handholes names.

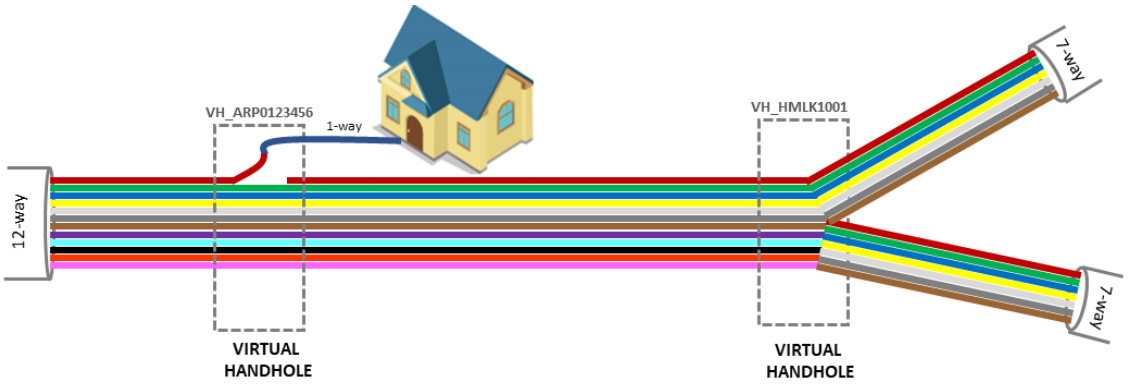


Figure 50.- Example of virtual handhole naming

4.1.4 HANDHOLES

Handholes used in the Backhaul and Local Backbone networks are named with the letters "HH_" followed by the **project's POP_ID** (POP code of the project where that civil work section is accounted) an underscore, and a 'unique in the POP area' 3-digit number assigned to the physical handhole.

HANDHOLE_ID	Examples
HH_<POP_ID>_<Serial number> Type	HH_HERMS1_100 TC B125 (iron cover) (POP HERMS1 – handhole 100)

4.1.5 SPLICING CLOSURES

Splicing closures used for long cable sections or for interconnection with other networks are named with the letters "SC_" followed by the **project's POP_ID** (POP code of the project where that civil work section is accounted), an underscore and a 'unique in the POP area' 3-digit number assigned to the closure.

SC_ID	Examples
SC_<POP_ID>_<Serial number> (Type)	SC_HERMS1_001 (96 FO) (POP HERMS1 – First splicing closure)

Loop labelling will be as follows where X is the sequence number (1,2,3,4…) corresponding to the cable:

LOOP_ID	Examples
LOOP_<CABLE_ID>_X	LOOP_HERMS1-MARNG1_1 LOOP_GUXGH1-KORLL1_1_1 LOOP_GUXGH1-KORLL1_2_1 LOOP_GUXGH1-KORLL1_1_2 LOOP_GUXGH1-KORLL1_2_2

4.1.6 OPTICAL TERMINATION OUTLET (OTO)

OTOs are identified by the HOME_ID (unique code assigned to each unit inside a house or building).

OTO_ID	Simplified OTO_ID	Examples: OTO_ID (Simplified OTO_ID)
<POP_ID>/<HOME_ID>	<HOME_ID>	MARNG1/ARP0123456001 (ARP0123456001) MARNG1/ARP0123456002 (ARP0123456002)

.

4.1.7 BACKHAUL, BACKUP LINE AND REDUNDANCY BACKHAUL NETWORK INFRASTRUCTURE

Backhaul, Backup Line and Redundancy BackHaul network bundles are named with the letters 'BH/BUL/BHR' followed by a 2-digit number starting at 01, a slash '/' and a 2-digit number identifying the Section.

BH_BUNDLE_ID	Examples
<POP_ID>/BH<Bundle Code>/<Section>	HERMS1/BH01/01
<POP_ID>/BUL<Bundle Code>/<Section>	GUXHG1/BUL01/01
<POP_ID>/BHR<Bundle Code>/<Section>	LANGP1/BHR01/01

For shared section between different types of routes the following priority must be considered:

1°) Redundancy BackHaul (BHR)

2°) Backup Line (BUL)

3°) BackHaul between SWD/POI and AggregatorPOP

4°) BackHaul between AggregatorPOP and ActivePOP

5°) Local Backbone

The POP code used in the previous labels must be the code of the Gemeinde which designs that civil work section. It must be reflected in the Cluster Scheme for the coordination of the remain designs in the same cluster.

4.1.8 BACKHAUL, BACKUP LINE AND REDUNDANCY BACKHAUL NETWORK CABLES

Backhaul (BH), Backup Line (BUL) and Redundancy BackHaul (BHR) network cables are labelled considering the origin and destination of the link.

BH, BUL and BHR point-to-point cables are named with the ID of the source equipment, a "-" and the ID of the destination equipment. Source and Destination equipment can be as follows:

SOURCE EQUIPMENT	DESINATION EQUIPMENT
SWD	Aggregation POP
SWD	Point of Interconnection (POI)
Point of Interconnection (POI)	Aggregation POP
Aggregation POP	Aggregation POP (BUL or BHR) (*)
Aggregation POP	Aggregation POP (Subtended)
Aggregation POP	Point of Interconnection (POI)
Point of Interconnection (POI)	Active POP
Aggregation POP	Active POP

(*) Direct BUL and BHR cables, between POPs, will be labelled alphabetically according to POP ID.

POI is identified by id_route and a letter which identifies the POI inside the route. In other words, POI and SWD will be identified as follows:

SWD_ID: SWD_NNNNNNNNN (it is showed in the Service Now).

POI_ID: Route_ID-NNNNNNNNN_A (or B) (showed in the Service Now), ´A´ for the more hierarchic POI (closest to the SWD) and ´B´ (and so on) for the less hierarchic ones.

BH_CABLE_ID	Examples
<SWD_ID> - <AGG-POP_ID>	SWD_579990086 - RIGLM1
<POI _ID> - < AGG_POP _ID>	GL-28756_B - HERMS1
<AGG_POP_ID> - < AGG_POP_ID> *(BUL)*	GUDNS1 - GUXHG1
<AGG_POP_ID> - < AGG_POP_ID> *(Subtended)*	BRNBR1 - KROVV1
<AGG_POP_ID> - <POI_ID>	HERMS1 - GL-31839_A
<POI _ID> - < ACTIVE_POP _ID>	GL-31839_B - HERMS2
<AGG_POP _ID> - < ACTIVE_POP _ID>	HERMS1 - HERMS2

4.1.9 OTHER SERVICES NETWORK INFRASTRUCTURE

Exclusive Future Other Services (FTTS, …) bundles will be labelled with a 2-digit number starting at 01, a slash '/' and a 2-digit number identifying the Section, as follows:

FTOS_BUNDLE_ID	Examples
GEMEINDE_ID/FTOS/0X/0X (X=1,2,3…)	ODRNH/FTOS/01/01 ODRNH/FTOS/01/02 ODRNH/FTOS/01/03 ODRNH/FTOS/02/01

The Gemeinde_ID to use is the one where that civil work section is accounted.

4.1.10 OTHER SERVICES NETWORK CABLES

Future Services (FTTS, …) cables are named with the own origin and destination of the cable. Intermediate branching splices must be also considered for labelling (however, straight splices (all fibers with all fibers connected) must not be considered). Here some examples:

FTOS_CABLE_ID	Examples
FTOS: <SWD_ID> - <SPLICING CLOSURE>	FTOS: SWD_579990086 - SC_ODRNH1_01
FTOS: <SWD_ID> - <POP_ID>	FTOS: SWD_579990086 - ALTNG1
FTOS: <SPLICING CLOSURE> - <POP_ID>	FTOS: SC_ODRNH1_01 - ODRNH1
FTOS: <POP_ID> - <POP_ID>	FTOS: ODRNH1- OFFKM1

4.1.11 SPARE INFRASTRUCTURE

Bundles of 50/40 mm must be labelled based on the link they accompany. If they accompany to bundles of different networks (BH, BHR, BUL, LB) the hierarchy explained in point 4.1.7 must be considered.

SPARE_BUNDLE_ID	Examples
<POP_ID>/ LB<Bundle Code>_Duct50_<Bundle Code>/<Section>	VELDN1/LB01_Duct50
<POP_ID>/ BH<Bundle Code>_Duct50_<Bundle Code>/<Section>	HERMS1/BH01_Duct50
<POP_ID>/ BUL<Bundle Code>_Duct50_<Bundle Code>/<Section>	LANGP1/BUL01_Duct50
<POP_ID>/ BHR<Bundle Code>_Duct50_<Bundle Code>/<Section>	HERMS1/BHR01_Duct50

Regarding to Spare bundles labels (those bundles through Gemeinden located within a radius of 6km), they must be labelled as follows: <POP_ID (origin)> - <GEMEINDE_ID (destination)>/Spare

SPARE BUNDLE_ID	Examples
<POP_ID (origin)> - <GEMEINDE_ID (destination)>/Spare	URZIG1 - WENGR/Spare URZIG1 - KINDR/Spare URZIG1 - MARNG/Spare

For those spare bundles to different Gemeinden, they must be labelled as follows:

SPARE BUNDLE_ID	Examples
<POP_ID (origin)> - <GEMEINDE_ID _1(destination)> - <GEMEINDE_ID _2(destination)> - <GEMEINDE_ID _X(destination)>/Spare	LANGP1 - MOLSF - ZOLLN/Spare LANGP1 - MOLSF/Spare LANGP1 - ZOLLN/Spare LANGP1 – MARNG – HERMS – EITTN – FRNEG - THLHM/Spare

The *POP code* used in the previous labels must be the code of the Gemeinde which designs that civil work section. Gemeinden

4.1.12 CIVIL WORK

For the registration application only, Civil Work Coding:

- <POP_ ID>_Correlative alphanumeric
- <POP_ID>/<DC_ADDRESS_ID> (for Drop section)

4.1.13 SERVICE AREAS

For the registration application only, Service Area indicates the DP/UDP destination area.

- **Coding**: <POP_ID/DPXXX> or <POP_ID/IDPXXX> or <POP_ID/UD-PXXX> (In DSA, Service Area does not apply for IDPs)

4.1.14 PERMITS

Once the permits have been identified in field, they must be uploaded to Keycom or dumped directly through the mobile app with the following codification, being XX a serial number for this type of permit inside the Gemeinde (starting in 01 by Permit type):

PERMIT TYPE	PERMIT CODIFICATION	Examples
Autobahn Crossing	<GEMEINDE_ID>_Autobahn_XX	MARNG_Autobahn_01 BADRS _Autobahn_01 BADRS _Autobahn_02
Railway Crossing	<GEMEINDE_ID>_Railway_XX	ALTNG_Railway_01 ALTNG_Railway_10
Bridge- and River Crossing	<GEMEINDE_ID>_Bridge/River_XX	KORLL_Bridge/River_04
Heritage Protection Release	<GEMEINDE_ID>_Heritage_XX	MONZL_Heritage_11
Ordenance Release	<GEMEINDE_ID>_Ordenance_XX	LYKRS_Ordenance_08
Natural Protection Release	<GEMEINDE_ID>_Natural_XX	PLTTN_Natural_15
Private Contract	<GEMEINDE_ID>_Private_XX	BADRS_Private_02
Water Protection	<GEMEINDE_ID>_Water_XX	WISBC_Water_09
Underpasses	<GEMEINDE_ID>_Underpasses_XX	THLLL_Underpasses_07

4.2 LABELLING FOR CENTRALIZED SPLITTING ARCHITECTURE (CS ARCH.)

In this point the labelling for only the elements involved in the design of CS Arch. is explained:

4.2.1 DISTRIBUTION POINT

Distribution Points (DPs) are assigned with 3-digit numbers (starting at 001) per POP at the Network Design time, although they belong to different Gemeinden. Expansion phase DPs in a Gemeinde must keep the order in numbering followed by the existing ones.

The full DP_ID is composed of the POP_ID, followed by a slash ('/'), the letters "DP" and the 3-digit code assigned.

The simplified DP_ID (for limited use) is just composed by "DP" followed by the 3-digit code.

DP_ID	Simplified DP_ID	Examples: DP_ID (Simplified DP_ID)
<POP_ID>/DP<DP Code>	DP<DP Code>	MARNG1/DP123 (DP123) HERMS1/DP012 (DP012) HERMS2/DP024 (DP024)

4.2.2 INDOOR DISTRIBUTION POINT

Indoor Distribution Points (IDPs) are assigned with 3-digit numbers per POP at the Network Design time (following a correlative order with the existing DPs connected to the POP), although they belong to different Gemeinden. Expansion phase IDPs in a Gemeinde must keep the order in numbering followed by the existing ones.

The full IDP_ID is composed of the POP_ID, followed by a slash ('/'), the letters "IDP" with the 3-digit code assigned, a down dash ("_") and the ADDRESS_ID.

The simplified IDP_ID (for limited use) is just composed by "IDP" followed by the 3-digit code, the down dash ("_") and the ADRESS_ID.

IDP_ID	Simplified IDP_ID	Examples: IDP_ID (Simplified IDP_ID)
<POP_ID>/IDP<IDP Code>_ADDRESS_ID	IDP<IDP Code>_ADDRESS_ID	ALTNG1/IDP021_ARP0123456 (IDP021_ ARP0123456) ALTNG1/IDP022_ARP0123487 (IDP022_ARP0123487) ALTNG2/IDP021_ARP3456895 (IDP021_ARP3456895)

4.2.3 LOCAL BACKBONE NETWORK CABLES

Local Backbone (LB) network cables are connecting point-to-point the Active POP with each Passive POP in the area.

LB point-to-point cables are named with the ID of the **active** equipment, a dash ("-") and the ID of the **passive** equipment, plus an underscore and the number of cables of this local backbone section (if there is only one cable the cable number must be skipped).

LB_CABLE_ID	Examples
<ACTIVE POP_ID> - <PASSIVE POP_ID>_<Cable Nr>	HERMS1 - HERMS2_1 HERMS1 - HERMS2_2 HERMS1 - HERMS3_1 HERMS1 - HERMS3_2 HERMS1 - HERMS4

4.2.4 LOCAL BACKBONE NETWORK INFRASTRUCTURE

Local Backbone network bundles, connecting the active POP with the passive POPs, are named with the POP_ID of the Gemeinde that installs the bundle, letters 'LB' followed by a 2-digit number starting at 01, a slash '/' and a 2-digit number identifying the Section. Bundle size is shown at the end of the label adding just the bundle capacity in parenthesis. Bundle sections are numbered starting at 01.

In case of a shared Bundle with Backhaul or Backup Line, the most hierarchical link will be the one labelling the bundle. Hierarchy between the different networks are explained in point 4.1.7.

LB_BUNDLE_ID	Examples
<POP_ID>/LB<Bundle Code>/<Section>	VELDN1/LB01/01 (7)

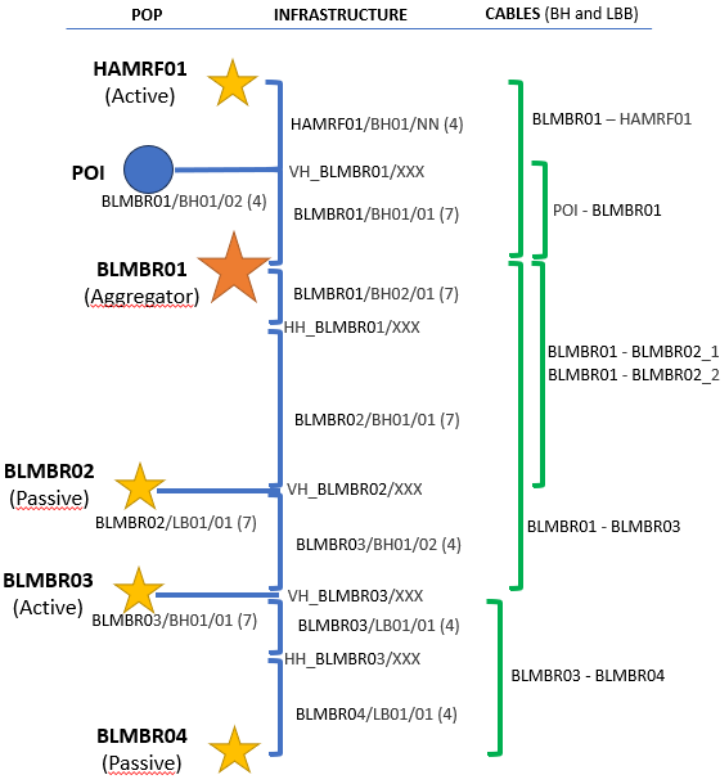


Figure 51.- Example of Local Backbone and BH labelling

4.2.5 FEEDER NETWORK INFRASTRUCTURE

Regardless the bundle size, Feeder network bundles leaving the POP are named with a letter 'F', a 3-digit number starting at 001, a slash '/' and a 2-digit number identifying the Section. Bundle size is shown at the end of the label adding just the bundle capacity in parenthesis.

Bundle sections are numbered starting at 01.

When a micro-duct is segregated from the bundle towards a DP, a new section number is assigned to this segregation.

When the main bundle is segregated into two or more branches having more than one micro-duct each, a new section number is assigned to each branch.

FEEDER_BUNDLE_ID	Simplified BUNDLE_ID	Examples
<POP_ID>/F<Bundle Code>/<Section> (<Size>) (in field)	F<Bundle Code>/<Section> (<Size>)	MARNG1/F001/01 (7) → Bundle 1, Section 1 MARNG1/F001/02 (1) → Bundle 1, 2nd section after the first DP MARNG1/F001/03 (4) → Bundle 1, 1st bundle branch

This figure shows an example of feeder network infrastructure naming.

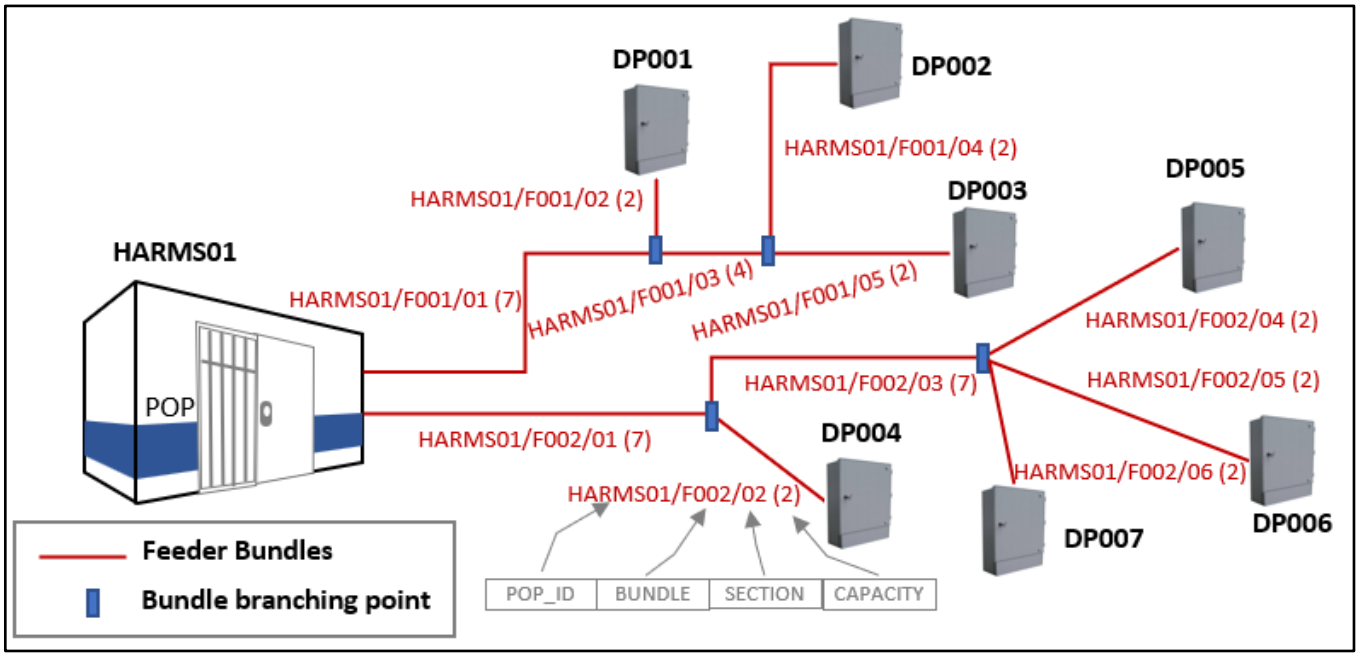


Figure 52.- Example of feeder network infrastructure naming

4.2.6 FEEDER NETWORK CABLES

Feeder network cables are connecting point-to-point the POP with each Distribution Point in the area.

Point-to-point cables are generally named with the ID of the source equipment, a dash and the ID of the destination equipment. If the feeder cable is connected to 2 or more IDPs, the simplified IDP code of the following ones will be used.

FEEDER_CABLE_ID	Simplified CABLE_ID	Examples
<POP_ID> - <DP_ID>	<POP_ID> - <Simplified DP_ID>	HERMS1 – HERMS1/DP001 (HERMS1 - DP001) MARNG1 – MARNG1/DP007 (MARNG1 - DP007)
<POP_ID> - <Simplified IDP_ID>	<POP_ID> - <Simplified IDP_ID>	HERMS1 - HERMS1/IDP011_ARP1234567 (HERMS1 - IDP001_ARP1234567)
<POP_ID> - <IDP_ID>(1) - <Simplified IDP_ID >(2)	<POP_ID> - <Simplified IDP_ID>(1) - <Simplified IDP_ID>(2)	MARNG1 - MARNG1/IDP007 - IDP008_ ARP1234588 (MARNG1 - IDP007 - IDP008_ ARP1234588)

This figure shows an example of feeder cable naming and labelling.

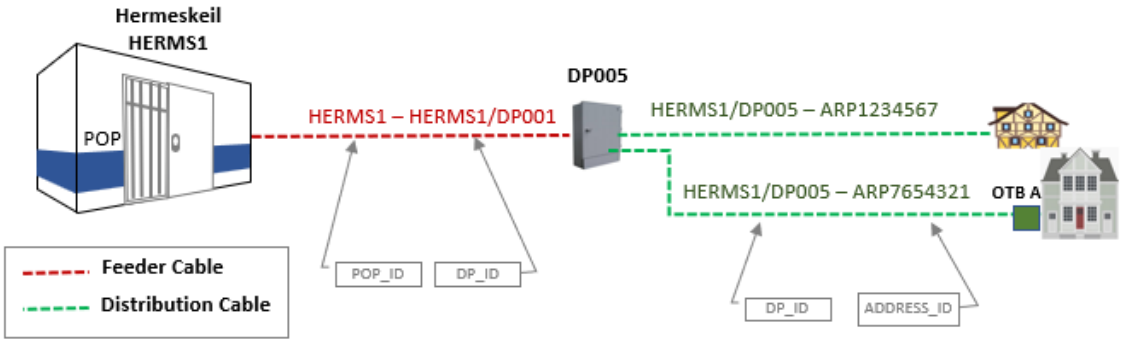


Figure 53.- Example of feeder cable naming and labelling

4.2.7 OPTICAL TERMINATION BOX (OTB)

OTBs are identified by the ADDRESS_ID (unique code assigned to each house or building) followed by an underscore and a capital letter, starting by the letter 'A'.

OTB_ID	Simplified OTB_ID	Examples: OTB_ID (Simplified OTB_ID)
<POP_ID>/<ADDRESS_ID>_ <OTB Code>	<ADDRESS_ID>_<OTB Code>	MARNG1/ARP0123456_A (ARP0123456_A) MARNG1/ARP0123456_B (ARP0123456_B)

For the registration application, Subscriber Coding:

- POP_ID/ADDRESS_ID
- POP_ID/OTB_ID if there is more than 1 subscriber

4.2.8 DISTRIBUTION NETWORK INFRASTRUCTURE

Distribution network bundles leaving the DP are named with a letter 'D', a 2-digit number starting at 01, a slash '/' and a 2-digit number identifying the Section. Bundle size is shown at the end of the label adding just the bundle capacity in parenthesis.

Bundle sections are numbered starting at 01 and incremented each time that a branch is segregated from the main bundle.

DISTRIBUTION_BUNDLE_ID	Simplified BUNDLE_ID	Examples
<POP_ID>/<DP_ID>D<Bundle Code>/<Section> (<Size>)	<DP_ID>D<Bundle Code>/<Section> (<Size>)	MARNG1/DP002/D01/01 (24) → DP 2, Bundle 1, Section 1, Size 12 MARNG1/DP002/D01/02 (12) → DP 2, Bundle 1, first branch segregated from the main bundle, Size 7

This figure shows an example of distribution network infrastructure naming.

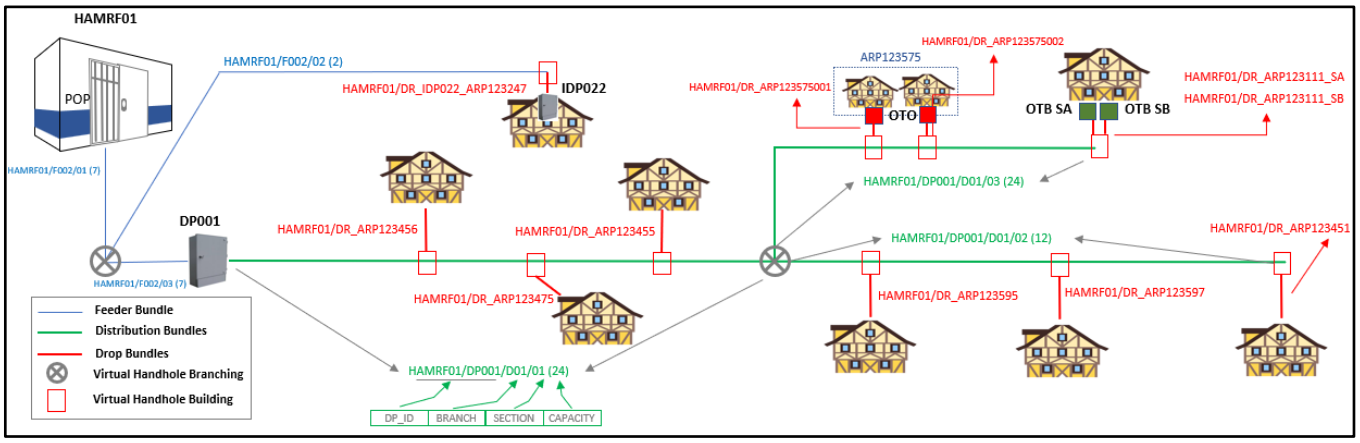


Figure 54.- Example of distribution network infrastructure naming

In Keycom, Drop infrastructure (1x7/4mm) will be identified as follows:

-For a unique access: <POP_ID>/DR_<*ADDRESS_ID*>

DROP_BUNDLE_ID	Examples
<POP_ID>/DR_<*ADDRESS_ID*>	HERMS1/DR_ARP0123456 HERMS2/DR_ARP1234567
<POP_ID>/DR_<Simplified IDP_*ID*>	HERMS2/DR_IDP022_ARP1234567

-For more than one access, it will be identified depending on where it is connected (n x 7/4 mm): <POP_ID>/DR_<OTO_*ID*>, <POP_ID>/DR_<OTB_*ID*> or <POP_ID>/DR_<Simplified IDP_*ID*>

DROP_BUNDLE_ID	Examples
<POP_ID>/DR_<OTO_*ID*> (An address connected from different VH Building)	HERMS2/DR_ARP1234567001 HERMS2/DR_ARP1234567002
<POP_ID>/DR_<OTB_*ID*>	HERMS2/DR_ARP1234567_A HERMS2/DR_ARP1234567_B
<POP_ID>/DR_<Simplified IDP_*ID*>	HERMS2/DR_IDP031_ARP1234568

4.2.9 DISTRIBUTION NETWORK CABLES

Distribution network cables are also point-to-point connections between the DP on the street and the inside of the customer home. Distribution network cables are labelled with the DP_ID and the ADDRESS_ID, as follows:

-For a unique access: <DP_ID> - <ADDRESS-ID>

DISTRIBUTION_CABLE_ID	Simplified CABLE_ID	Examples
<DP_ID> - <ADDRESS_ID>	<Simplified DP_ID> - <ADDRESS_ID>	HERMS1/DP001 - ARP0123456 (DP001 - ARP0123456)

-To distinguish several cables of the same address (2fo, 8fo or 12fo):

<DP_ID> - <OTO_*ID*> or <DP_ID> - <OTB_*ID*>

DISTRIBUTION_CABLE_ID	Simplified CABLE_ID	Examples
<DP_ID> - <OTO_*ID*>	<Simplified DP_ID> - <OTO_ID>	MARNG1/DP007 - ARP1234567001 (DP007 - ARP1234567001) MARNG1/DP007 - ARP1234567002 (DP007 - ARP1234567002)
<DP_ID> - <OTB_*ID*>	<Simplified DP_ID> - <OTB_ID>	MARNG1/DP007 - ARP1234567_A (DP007 - ARP1234567_A) MARNG1/DP007 - ARP1234567_B (DP007 - ARP1234567_B)

This figure shows an example of distribution cable naming and labelling.

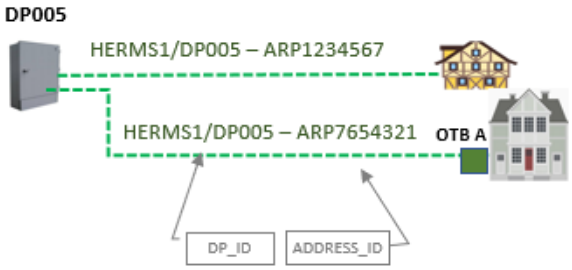


Figure 55.- Example of distribution cable naming and labelling with one access

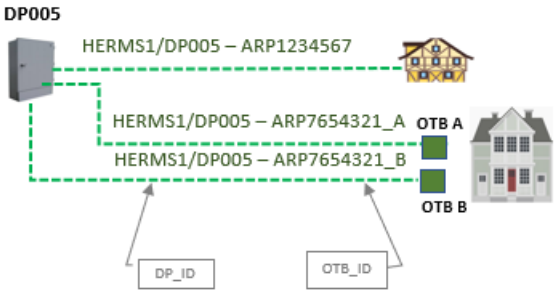


Figure 56.- Example of distribution cable naming and labelling with 2 OTBs

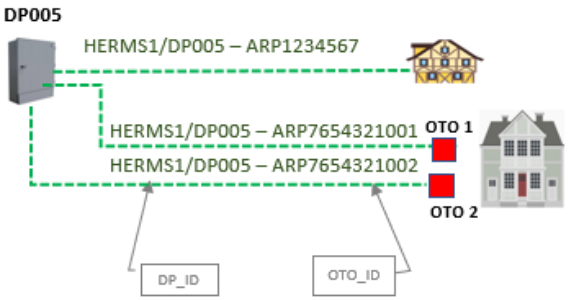


Figure 57.- Example of distribution cable naming and labelling with 2 OTOs

Regarding the in-building cables labelling, providing point-to-point connections between the OTB or DP located in the building basement, and the OTO located inside the customer premises, it will be as follows:

Nr. of HP	DROP_CABLE_ID	Simplified DROP_CABLE_ID	Examples: DROP_CABLE_ID (Simplified DROP_CABLE_ID)
1 HP	<DP_ID> - <ADDRESS_ID>	<Simplified DP_ID> - <ADDRESS_ID>	HERMS1/DP001 - ARP0123456 (DP001 - ARP0123456)

2-12 HP	<OTB_ID> - <OTO_ID>	<Simplified OTB_ID> - <OTO_ID>	MARNG1/ ARP1234567_A - ARP12345670001 (ARP1234567_A - ARP1234567001)
13-24 HP (On Demand)	<DP_ID> - <OTO_ID>	<Simplified DP_ID> - <OTO_ID>	HERMS1/DP058 - ARP0123450001 (DP058 - ARP0123450001)
13-48 HP (Riser)	<FDB_ID> - <OTO_ID>	<Simplified FDB_ID> - <OTO_ID>	HERMS1/IDP058/FDB02 - ARP0123450001 (FDB02 - ARP0123450001)

4.3 LABELLING FOR DITRIBUTED SPLITTING ARCHITECTURE (DS ARCH.)

In this point the labelling for only the elements involved in the design of DS Arch. is explained:

4.3.1 FEEDER POINT

Feeder Points (FPs) are assigned with 2-digit numbers (starting at 01) per POP at the Network Design time, although they belong to different Gemeinden. Expansion phase FPs in a Gemeinde must keep the order in numbering followed by the existing ones.

The full FP_ID is composed of the POP_ID, followed by a slash ('/'), the letters "FP" and the 2-digit code assigned.

The simplified FP_ID (for limited use) is just composed by "FP" followed by the 2-digit code.

FP_ID	Simplified FP_ID	Examples: FP_ID (Simplified FP_ID)
<POP_ID>/FP<FP Code>	FP<FP Code>	ALTNG1/FP01 (FP01) ALTNG1/FP02 (FP02) ALTNG2/FP01 (FP01)

4.3.2 URBAN DISTRIBUTION POINT

Urban Distribution Points (UDPs) are assigned with 3-digit numbers (starting at 001) per POP at the Network Design time, although they belong to different Gemeinden. Expansion phase Urban DPs in a Gemeinde must keep the order in numbering followed by the existing ones.

The full UDP_ID is composed of the POP_ID, followed by a slash ('/'), the letters "UDP" and the 3-digit code assigned.

The simplified UDP_ID (for limited use) is just composed by "UDP" followed by the 3-digit code.

UDP_ID	Simplified UDP_ID	Examples: UDP_ID (Simplified UDP_ID)
<POP_ID>/UDP<UDP Code>	UDP<UDP Code>	ALTNG1/UDP001 (UDP001) ALTNG1/UDP002 (UDP002) ALTNG2/UDP001 (UDP001)

4.3.3 INDOOR DISTRIBUTION POINT

Indoor Distribution Points (IDPs) are assigned with 3-digit numbers per POP at the Network Design time (following the correlative order with the existing UDPs connected to the POP), although they belong to different Gemeinden. Expansion phase Indoor DPs in a Gemeinde must keep the order in numbering followed by the existing UDPs and IDPs.

The full IDP_ID is composed of the POP_ID, followed by a slash ('/'), the letters "IDP" with the 3-digit code assigned, a down dash ("_") and the ADDRESS_ID.

The simplified IDP_ID (for limited use) is just composed by "IDP" followed by the 3-digit code, the down dash ("_") and the ADDRESS_ID.

IDP_ID	Simplified IDP_ID	Examples: IDP_ID (Simplified IDP_ID)
<POP_ID>/IDP<IDP Code>_ADDRESS_ID	IDP<IDP Code>_ADDRESS_ID	ALTNG1/IDP021_ARP0123456 (IDP021_ ARP0123456) ALTNG1/IDP022_ARP0123487 (IDP022_ARP0123487) ALTNG2/IDP021_ARP3456895 (IDP021_ARP3456895)

4.3.4 LOCAL BACKBONE NETWORK INFRASTRUCTURE

Local Backbone network bundles, connecting the Headend POP with the FPs, are named with the Headend POP_ID, letters 'LB' followed by a 2-digit number starting at 01, a slash '/' and a 2-digit number identifying the Section. Bundle size is shown at the end of the label adding just the bundle capacity in parenthesis. Bundle sections are numbered starting at 01.

In case of a shared Bundle with Backhaul or Backup Line, the most hierarchical link will be the one labelling the bundle. Hierarchy between the different networks are explained in point 4.1.7.

LB_BUNDLE_ID	Examples
<Headend POP_ID>/LB<Bundle Code>/<Section> (<Size>)	HERMS1/LB01/01 (7)

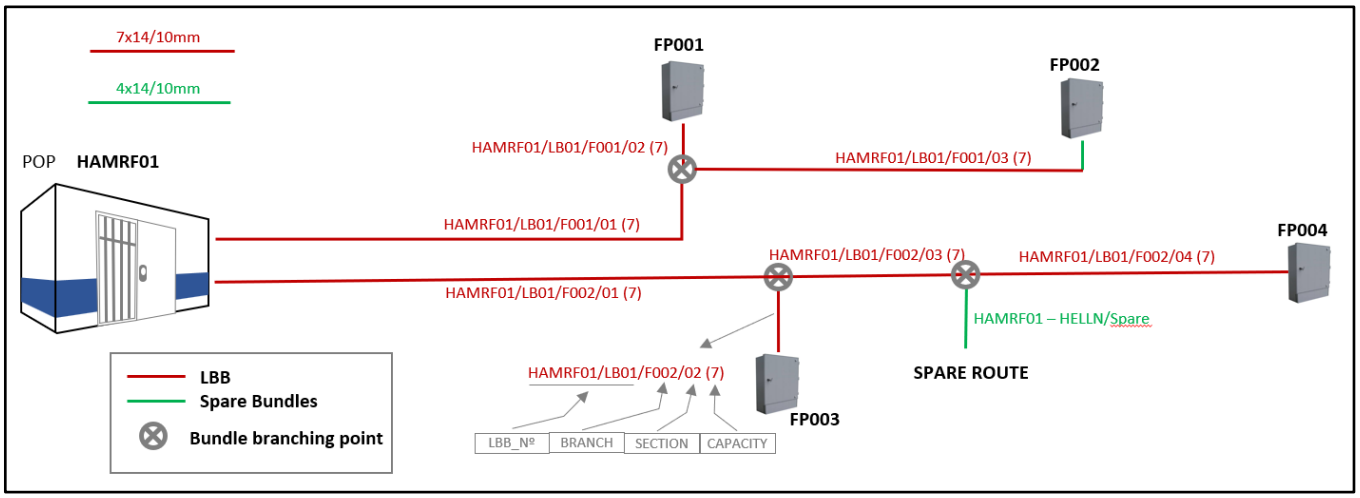


Figure 58.- Example of Local Backbone bundles labelling for DS Arch.

4.3.5 LOCAL BACKBONE NETWORK CABLES

Local Backbone (LB) network cables are connecting point-to-point the Headend POP with each Feeder Point in the area.

LB point-to-point cables are named with the ID of the **source** equipment, a dash ("-") and the ID of the **destination** equipment.

LB_CABLE_ID	SIMPLIFIED_ID	Examples
<HEADEND_POP_ID> - <FP_ID>	<HEADEND_POP_ID> – <Simplified FP_ID>	HERMS1 - HERMS1/FP01 (HERMS1 - FP01) HERMS1 - HERMS1/FP02 (HERMS1 - FP02) HERMS2 - HERMS2/FP01 (HERMS2 - FP01)

4.3.6 FEEDER NETWORK INFRASTRUCTURE

Regardless the bundle size, Feeder network bundles leaving the Feeder Point are named with a letter 'F', a 3-digit number starting at 001, a slash '/' and a 2-digit number identifying the Section. Bundle size is shown at the end of the label adding just the bundle capacity in parenthesis.

Bundle sections are numbered starting at 01.

When a micro-duct is segregated from the bundle towards a DP, a new section number is assigned to this segregation.

When the main bundle is segregated into two or more branches having more than one micro-duct each, a new section number is assigned to each branch.

FEEDER_BUNDLE_ID	Simplified BUNDLE_ID	Examples
<FP_ID>/F<Bundle Code>/<Section> (<Size>) (in field)	F<Bundle Code>/<Section> (<Size>)	MARNG1/FP01/F001/01 (7) → Bundle 1, Section 1 MARNG1/FP01/F001/02 (7) → Bundle 1, 2nd section after the first Urban DP MARNG1/FP01/F001/03 (7) → Bundle 1, 1st bundle branch

This figure shows an example of feeder network infrastructure naming.

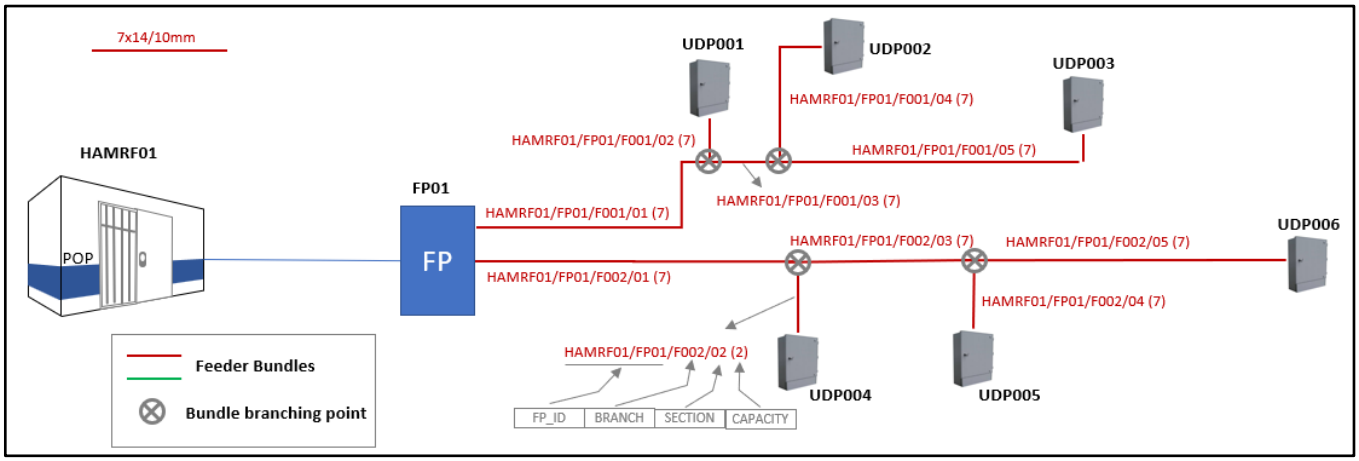


Figure 59.- Example of feeder network infrastructure naming for DS Arch.

4.3.7 FEEDER NETWORK CABLES

Feeder network cables are connecting point-to-point the Feeder Point with each Urban Distribution Point in the area.

Point-to-point cables are generally named with the ID of the source equipment, a dash ("-") and the ID of the destination equipment.

FEEDER_CABLE_ID	Examples
<FP_ID> - < Simplified UDP_ID>	HERMS1/FP01 - UDP001 HERMS1/FP01 - UDP002 HERMS1/FP02 - UDP010 HERMS2/FP01 - UDP001

This figure shows an example of feeder cable naming and labelling.

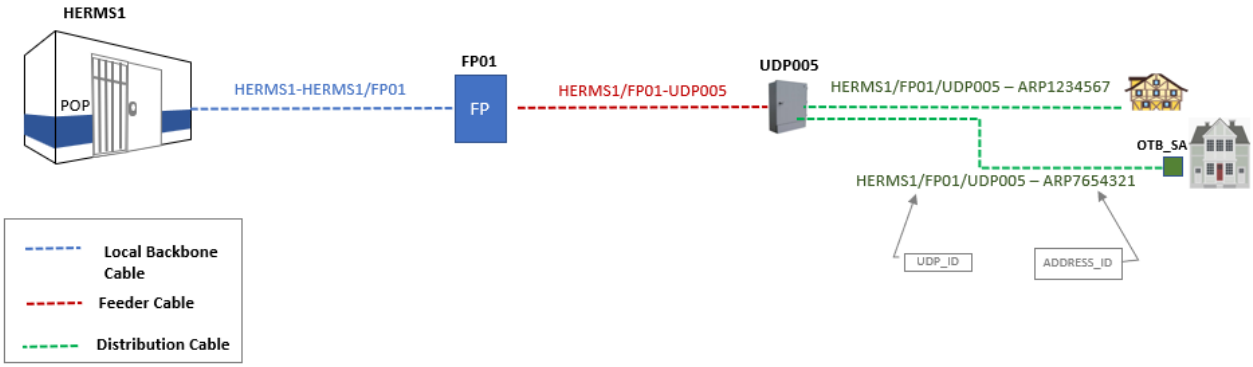


Figure 60.- Example of feeder cable naming and labelling for DS Arch.

4.3.8 DISTRIBUTION NETWORK INFRASTRUCTURE

Distribution network bundles leaving the Urban DP are named with a letter 'D', a 2-digit number starting at 01, a slash '/' and a 2-digit number identifying the Section. Bundle size is shown at the end of the label adding just the bundle capacity in parenthesis.

Bundle sections are numbered starting at 01 and incremented each time that a branch is segregated from the main bundle.

DISTRIBUTION_BUNDLE_ID	Examples
<UDP_ID>/D<Bundle Code>/<Section> (<Size>)	MARNG1/UDP002/D01/01 (12) → UDP 2, Bundle 1, Section 1, Size 12 MARNG1/UDP002/D01/02 (7) → UDP 2, Bundle 1, first branch segregated from the main bundle, Size 7

In Keycom, Drop infrastructure (1x7/4mm) will be identified as follows:

-For a unique access: <POP_ID>/DR_<*ADDRESS_ID*> or <POP_ID>/DR_<Simplified IDP_*ID*>

DROP_BUNDLE_ID	Examples
<POP_ID>/DR_<*ADDRESS_ID*>	HERMS1/DR_ARP0123456 HERMS2/DR_ARP1234567
<POP_ID>/DR_<Simplified IDP_*ID*>	HERMS2/DR_IDP011_ARP1234567

-For more than one access, it will be identified depending on where it is connected (n x 7/4 mm): <POP_ID>/DR_<Simplified OTO_*ID*>, <POP_ID>/DR_<Simplified OTB_*ID*> or <POP_ID>/DR_<Simplified IDP_*ID*>

To identify a reserve pipeline: <1st*Duct_ID*>/Spare.

DROP_BUNDLE_ID	Examples
<POP_ID>/DR_<Simplified OTO_*ID*> (An address connected from different VH Building)	HERMS2/DR_ARP1234567001 HERMS2/DR_ARP1234567002
<POP_ID>/DR_<Simplified OTB_*ID*>	HERMS2/DR_ARP1234567_SA HERMS2/DR_ARP1234567_SB
<POP_ID>/DR_<Simplified IDP_*ID*>	HERMS2/DR_IDP031_ARP1234569
<1st*Duct_ID*>/Spare	HERMS2/DR_IDP031_ARP1234569/Spare

This figure shows an example of distribution network infrastructure naming.

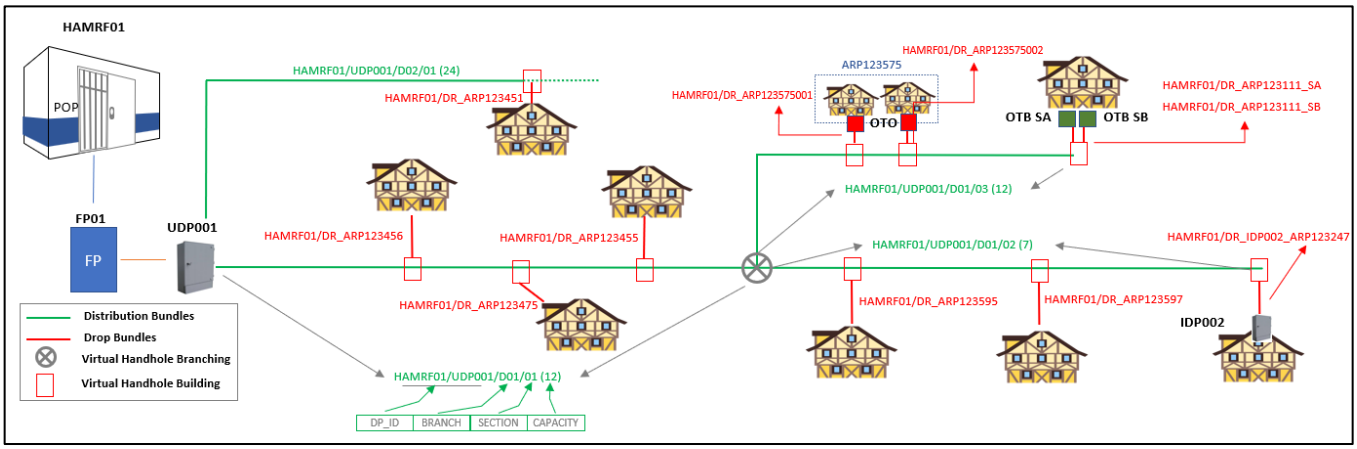


Figure 61.- Example of distribution network infrastructure naming for DS Arch.

4.3.9 DISTRIBUTION NETWORK CABLES

Distribution network cables are also point-to-point connections between the UDP on the street and the inside of the customer home. Distribution network cables are labelled with the UDP_ID and the destination of the cable, as follows:

-For a unique access: <UDP_ID> - <ADDRESS-ID> or <UDP_ID> - <IDP_ID>

DISTRIBUTION_CABLE_ID	Simplified CABLE_ID	Examples
<UDP_ID> - <ADDRESS_ID>	<Simplified UDP_ID> - <ADDRESS_ID>	HERMS1/UDP001 - ARP0123456 (UDP001 - ARP0123456)
<UDP_ID> - <IDP_ID>	<Simplified UDP_ID> - <Simplified IDP_ID>	HERMS1/UDP001 - IDP021_ ARP0123457 (UDP001 – IDP021_ ARP0123457)

-To distinguish several cables of the same address (4fo, 8fo or 12fo):

<UDP_ID> - <OTO_*ID*>, <UDP_ID> - <OTB_*ID*> or <UDP_ID> - <Simplified IDP_ID>

DISTRIBUTION_CABLE_ID	Simplified CABLE_ID	Examples
<UDP_ID> - <Simplified OTO_*ID*> (An address connected from different VH Building)	<Simplified UDP_ID> - <Simplified OTO_ID>	MARNG1/UDP007 - ARP1234567001 (UDP007 - ARP1234567001) MARNG1/UDP007 - ARP1234567002 (UDP007 - ARP1234567002)
<UDP_ID> - <Simplified OTB_*ID*>	<Simplified UDP_ID> - <Simplified OTB_ID>	MARNG1/UDP007 - ARP1234567_SA (UDP007 - ARP1234567_A) MARNG1/UDP007 - ARP1234567_SB (UDP007 - ARP1234567_B) MARNG1/UDP007 - ARP1234567_SA-B (UDP007 - ARP1234567_A-B)
<UDP_ID> - <Simplified IDP_ID>	<Simplified UDP_ID> - <Simplified IDP_ID>	HERMS1/UDP001 – IDP021_ARP0123456 (UDP001 – IDP021_ARP0123456)

This figure shows an example of distribution cable naming and labelling.

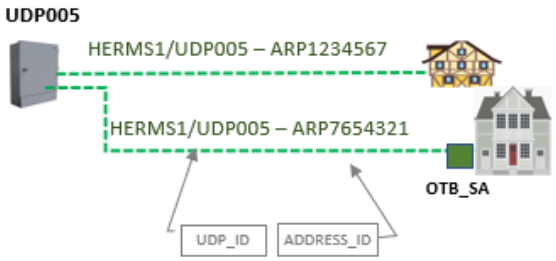


Figure 62.- Example of distribution cable naming and labelling with one access

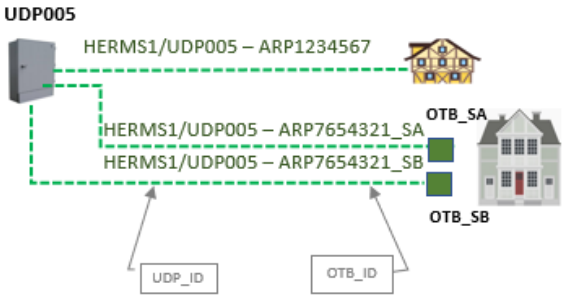


Figure 63.- Example of distribution cable naming and labelling with 2 OTBs

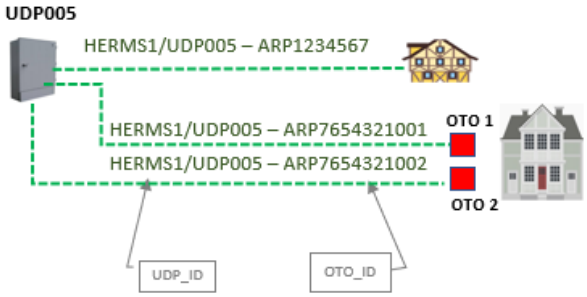


Figure 64.- Example of distribution cable naming and labelling with 2 OTOs

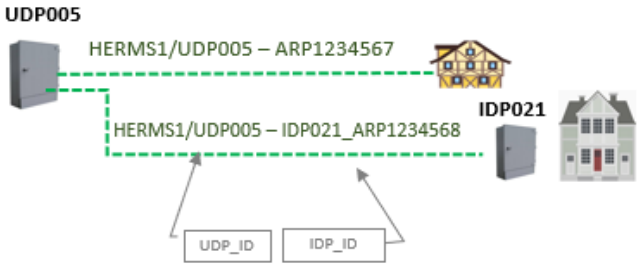


Figure 65.- Example of distribution cable naming and labelling with IDP

4.3.10 OPTICAL TERMINATION BOX (OTB)

OTBs are identified by the ADDRESS_ID (unique code assigned to each house or building) followed by an underscore and a capital letter, starting by the letter 'A'.

OTB_ID	Simplified OTB_ID	Examples: OTB_ID (Simplified OTB_ID)
<POP_ID>/<ADDRESS_ID>_ <OTB Code>	<ADDRESS_ID>_<OTB Code>	MARNG1/ARP0123456_SA (ARP0123456_SA) MARNG1/ARP0123456_SB (ARP0123456_SB)

For the registration application, Subscriber Coding:

- POP_ID/ADDRESS_ID
- POP_ID/OTB_ID if there is more than 1 subscriber

5. NETWORK DESIGN APPLICATION

This section describes, in a general way, the elements and features to use in the design.

5.1 DESIGN OVERVIEW ON KEYCOM (OFFICIAL PLATFORM)

- Keycom is the Design, Register and Checkpoint official tool (As Built)
- By default, Georeferencing: Coordinate reference system is **Google (EPSG:900913)**
- Keycom is the master of register for the Outside Plant with respect to the rest of UGG's IT systems (CTC, NRI, NCM, etc...).
- Keycom uses OSM (Open Street Maps) as cartographic base, although it adapts to others implemented or used as reference.
- Keycom uses the addresses graphical representation of LOMA. It means that LOMA is the Addresses Master which uses the EPSG:4326 (WGS 84) as Coordinate reference system.
- Keycom has a Design Help Tool: Setics, which is not mandatory, but recommended.
- Setics is a tool which helps the designer in the beginning of the design. Setics applies most of the criteria listed in this document, but not all of them, nor in all cases. Setics output must be reviewed and corrected until the achievement of the criteria.

To know more information, consult [6] UGG Design Manual – KeyCom.

5.2 DESIGN ELEMENTS

This point summarizes all the elements that can be used for the design, **indenpendently of the design tool.**

5.2.1 TELECOM PREMISES

A telecom premise is an element that identifies Cable Termination and Connection Equipment.

- POP: Cabinet for the Outside Plant Feeder Cable terminations (ODFs) where active equipments are connected (OLT) directly or through splitters, links, etc.

  Also, link cables of every POP will be connected, according to the Cluster Structure.

  We will use Types 1 to 6 with an estimated maxima **Capacity Attribute** according to the following table:

  Type 1: 1500

  Type 2: 3500

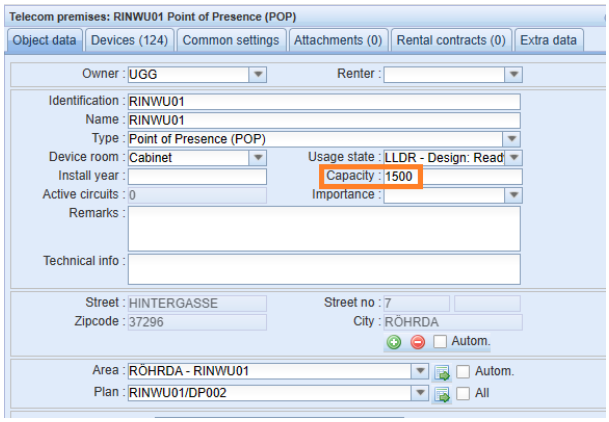
  Type 3: 2000

  Type 4: 4000

  Type 5: 1000

  Type 6: 400

  POP TYPE 1 - HEADEND: 12.000



POP TYPE 5 - HEADEND: 10.000

- DP: Intermediate cabinet that makes the connection between Feeder and Distribution. Between its devices, Outdoor and Indoor DPs Trays are included.
- UDP: Intermediate cabinet that makes the connection between Feeder and Distribution in the new DS Arch.

We will use the Types: DP, Indoor DP and UDP with a maximum Capacity Attribute estimated according to the following table:

DP:

DP-48: 48

DP-96: 96

Underground DP: 48

Indoor DP:

24 (Centralized Splitting)

65 (Distributed Splitting)

UDP:

~~Config. 1: 96 (Not Allowed)~~

Config. 2: 144

Config. 3: 192

Config. 4: 240

Config. 5: 288

Config. 7: 384

- FP: Intermediate cabinet that makes the connection between Local Backbone and Feeder in the new DS Arch. It is basically a splice box. The **Capacity Attribute** is 288.
- Subscriber: Distribution Cable Termination Element. Between its devices, OTO (1+1 connections 1 HP) and OTB (4+4 connections 4 HPs y 2+2 connections 2 HPs). The OTBs with splitters are configured in the devices too, distinguished by OTBX_S. In the design, the subscriber must be located in the center of the building, finishing the Civil Works in a Generic Virtual Handhole on the façade. Then, the conduit (CW) arrives till the façade and the cable till the subscriber. The **Capacity Attribute** for the different types of Subscribers is the following:

Subscriber:

OTO: 1

OTB 4: 4

OTB 2 + OTB 4: 6

OTB 4_S: 5

OTB 8_S: 10

OTB 24_S: 30

Suscriber Coding: POP_ID/ADDRESS_ID (or POP_ID/OTB_ID if there is more than 1 subscriber)

Device Coding:

CENTRALIZED SPLITTING					
Number of HP	Drop Cable	Nº of Telecom premises	Subscribers (Terminal Eq.) Label_id (Terminal type)	Suffix of cable	Suffix of Device
1	2 fo	1 Subscriber	<POP/ADDRESS_ID> (OTO)	None	None
2 - 4	8 fo	1 Subscriber	<POP/ADDRESS_ID> (OTB 4)	None	OTB4_A
5 - 6	12 fo	1 Subscriber	<POP/ADDRESS_ID> (OTB 6)	None	OTB4_A1 OTB2_A2
7 - 8	2 x 8 fo	2 Subscribers	< POP/ADDRESS_ID _A> (OTB 4) < POP/ADDRESS_ID _B> (OTB 4)	C1_A C2_B	OTB4_A OTB4_B
9 - 10	12 fo+ 8 fo	2 Subscribers	< POP/ADDRESS_ID _A> (OTB 6) < POP/ADDRESS_ID _B> (OTB-4)	C1_A C2_B	OTB4_A1 C1 OTB2_A2 OTB4_B
11 - 12	2 x 12 fo	2 Subscribers	< POP/ADDRESS_ID _A> (OTB 6) < POP/ADDRESS_ID _B> (OTB 6)	C1_A C2_B	OTB4_A1 C1 OTB2_A2 OTB4_B1 C2 OTB2_B2
> 12	In-Building	IDP	IDP<IDP Code>_ADDRESS_ID		
DISTRIBUTED SPLITTING					
Number of HP	Drop Cable	Nº of Telecom premises	Terminal Equipment Label_id (Terminal type)	Suffix of cable	Suffix of Splitter (Devices)
1	4 fo	1 Subscriber	<POP/ADDRESS_ID> (OTO)	None	None
2-3	4 fo	1 Subscriber	<POP/ADDRESS_ID> (OTB-4_S)	None	…_SA1
4-7	4 fo	1 Subscriber	<POP/ADDRESS_ID> (OTB-8_S)	None	…_SA1 …_SA2
8-15	8 fo	2 Subscribers	< POP/ADDRESS_ID _SA> (OTB-8_S) < POP/ADDRESS_ID _SB> (OTB-8_S)	C1_SA-B	…_SA1 …_SA2 …_SB1 …_SB2
16-22	12 fo	1 Subscriber	<POP/ADDRESS_ID> (OTB-24_S)	None	…_SA1 to …_SA6
23-30	12 fo + 4 fo	2 Subscribers	< POP/ADDRESS_ID _SA> (OTB-24_S) < POP/ADDRESS_ID _SB> (OTB-8_S)	C1_SA C2_SB	…_SA1 to …_SA6 …_SB1 …_SB2
31-37	12 fo + 8 fo	3 Subscribers	< POP/ADDRESS_ID _SA> (OTB-24_S) < POP/ADDRESS_ID _SB> (OTB-8_S) < POP/ADDRESS_ID _SC> (OTB-8_S)	C1_SA C2_SB-C	…_SA1 to …_SA6 …_SB1 …_SB2 …_SC1 …_SC2
38-44	12 fo + 12 fo	2 Subscribers	< POP/ADDRESS_ID _SA> (OTB-24_S) < POP/ADDRESS_ID _SB> (OTB-24_S)	C1_SA C2_SB	…_SA1 to …_SA6 …_SB1 to …_SB6
45-60	8 fo	IDP	<POP_ID>/IDP<IDP Code>_ADDRESS_ID	IDPxxx_Address	IDP…_S1
61-67	8 fo + 4 fo	IDP + 1 Subscriber	<POP_ID>/IDP<IDP Code>_ADDRESS_ID <POP/ADDRESS_ID> (OTB-8_S)	IDPxxx_Address C2_SA	IDP…_S1 …_SA1 …_SA2
68-75	8 fo + 8 fo	IDP + 2 Subscribers	<POP_ID>/IDP<IDP Code>_ADDRESS_ID < POP/ADDRESS_ID _SA> (OTB-8_S) < POP/ADDRESS_ID _SB> (OTB-8_S)	IDPxxx_Address C2_SA-B	IDP…_S1 …_SA1 …_SA2 …_SB1 …_SB2
76-82	8 fo + 12 fo	IDP + 1 Subscriber	<POP_ID>/IDP<IDP Code>_ADDRESS_ID <POP/ADDRESS_ID> (OTB-24_S)	IDPxxx_Address C2_SA	IDP…_S1 …_SA1 to …_SA6
83-105	8 fo + (12 fo + 12 fo)	IDP + 2 Subscribers	<POP_ID>/IDP<IDP Code>_ADDRESS_ID < POP/ADDRESS_ID _SA> (OTB-24_S) < POP/ADDRESS_ID _SB> (OTB-24_S)	IDPxxx_Address C2_SA C3_SB	IDP…_S1 …_SA1 to …_SA6 …_SB1 to …_SB6
106-120	2 x 8 fo	2 x IDP	<POP_ID>/IDP<IDP Code>_ADDRESS_ID <POP_ID>/IDP'<IDP Code>_ADDRESS_ID	IDPxxx_Address IDPxxx'_Address	IDP…_S1 IDP'…_S1

- POI and SWD: they are similar elements. They are used for connecting link cables (BH and BUL) to dark fiber or Telefonica Germany SWD.

  Between their devices, POI of 2+2 connections is included (to use for dark fiber renting or SWD as destination through dark fiber) and SWD of 48+48 connections in order to connect BH cable directly to SWD. The **Capacity Attribute** for POI and SWD are:

  POI: 2

  SWD: 48
- Tower: element that indicates the location of another provider tower (usually O2).
- Virtual Handhole: virtual element which marks the bundles joining. They are used to make connections of those microducts included in civil works sections. The correct element for Virtual Handhole is Manhole.

5.2.2 CABLES

It is a linear element (polyline) that identifies different Outside Plant cables. The ones used are, depending on the type:

- Feeder Cables (24, 48, 96, 192 fo)
- Distribution Cables (2, 4, 8, 12 fo)
- Link cables (BHR, BH, BUL, LB) (48, 96, 192, 288 fo)
- FTOS cables (12fo, 48fo, 96fo)
- Dark fibers (cables of 2fo have been created to mark those sections deployed by dark fiber)

For every cable storage, a loop must be designed as explained in 3.7.3.

5.2.3 SPLICES

A splice is an element which identifies Cables´ Boxed Splices. Depending on their capacity there are different types:

- Splice Closure 96FO: suitable for 48 and 96 fo cables.
- Splice Closure 288FO: suitable for 192 and 288 fo cables but, if it is necessary, 48fo and 96fo cables can be used with this splice type.
- Indoor Splice Closure: to connect the out cable with the indoor one. This splice is located inside the building (entrance).
- Virtual Splice Closure: without use.

5.2.4 MANHOLES

It is an element which identifies conduits connection manholes and it is a container element of Splice Closures. For physical handholes, there are several types:

- 2 sizes:
  - OC: for 1 Splice Closure or 16 storage loops.
  - TC: for 2 Splice Closure, 1 Splice Closure and up to 16 loops or 32 loops without Splice Closure.

- 2 resistance values:
  - B125: Pedestrian zones or not Rolling zones.
  - D400: Rolling zones.

- 2 cover types:
  - Cast-iron-cover
  - Concrete-cover

Regarding to Virtual Handholes, there are 4 types:

- VH Branching: For marking branching connections in Feeder, Distribution and Links Networks.
- VH Building: For marking the access point to buildings.
- VH Fence: For marking the separation between public soil and private property.
- VH Generic: For marking changes related to civil Works, without real ducts connection. VH Redundancy (which marks the access limit of a border Gemeinde between clusters) must be designed as VH Generic.

5.2.5 CONDUITS (CIVIL WORKS)

It is a linear element (polyline) which identifies the different civil works types:

- Open digs:
  - All Trenching types
  - Ploughing
- Underground routes:
  - HDD
  - Impact molling
  - Boring non-Steerable

- **Coding:**
    - <POP_ID>/_Correlative alphanumeric
    - <POP_ID>/<DC_ADDRESS_ID> (for Drop section)
- Moreover, 3 generic elements exist, only for the use with Setics:
    - Crossing, Drop route y Duct route

The FTTF conduit has been created in order to specify the section between VH Building-VH Fence **only** when this section length is lower than 2m and both virtual handholes are in the same side of the street. If the actual distance is less than 1 meter, we must represent it with a length between 1 meter and 1.5 meters, for the correct functioning of the mobility tools.

This conduit does not appear in BoQ because its valuation is considered inside the task "Home Passed to the fence" and includes the following civil works: flexible drilling, rigid drilling, mining and impact rocket/mole.

Ducts are included inside conduits (civil works), so they do not have any independent graphic representation. Depending on their size, there are several types:

- Size 50/40 mm. Capacity: 3 subducts 12/10
- Size: 16/12 mm. Capacity: 4, 7
- Size: 14/10 mm. Capacity: 2, 4, 7
- Size: 7/4 mm. Capacity: 1, 7, 12, 24

5.2.6 POINT OBJECT

It is an element which main use is for the Loop/coil (for cable storage). Moreover, the permits symbols have been migrated from Pole to Point Object.

In addition to the previous uses, the Point Object form includes other elements that can be helpful for critic points identification (Traffic warning signs, Prohibitory or restrictive signs, etc).

5.2.7 OTHER SUPPLEMENTARY ELEMENTS

In addition to the mentioned elements, which represent the physical works on site, Keycom has other complementary elements:

- Service Area indicates the DP/UDP destination area.
    - **Coding**: <POP_ID/DPXXX> or <POP_ID/IDPXXX> or <POP_ID/UD-PXXX> (In DSA, Service Area does not apply for IDPs)
- Exchange/Telecom Area: A partial LLD working perimeter is required. All elements must be included in this area. **It is very important to reference different computer systems**.
    - **Coding**: <AcronymGemeindeNCM>/<Partial LLD code of NCM>.
- Plan: Depending on its use, there are several types:
    - Setics Plan: for the Help Design tool use. Only if you join KeyCom's Setics tool.

- Plan by DP: For the Certification of works by DP.
  - **Coding**: <POP_ID/DPXXX> or <POP_ID/IDPXXX> or <POP_ID/UDPXXX>
- Plan by Drops: For marking elements belonging to the drop section.
  - In design:

    All elements between the VHF (excluded) and the Subscriber will be included:
    - Conduits (Civil Works)
    - Bundles
    - Subscribers
    - Devices (OTO / OTB / IDP-64_S)
    - Distribution Cables
    - **Coding**: <POP_ID>/DROP>
  - In Certification:

    All of the above items, and FTTF Conduits and Bundles (between VH Building and VHF) that have been built for DROP during deployment will be included in the DROP PLAN.
    - **Coding**: <POP_ID>/WorkDROP>
- Backhaul Plan: For the Certification of works exclusive to the Backhaul (or Backup Line, Redundancy BackHaul). The BackHaul plan corresponding to the Access Project must be named with "_A" (Access) at the end and with "_I" (interurban) if is related to the BH/LB project.
  - **Coding:** <POP_ID>/BH, <POP_ID>/BUL (BackUpLine) or <POP_ID>/BHR (BH of Redundancy).
- Local Backbone Plan: For the Certification of works exclusive to the Backbone network. The Local Backbone plan corresponding to the Access Project must be named with "_A" (Access) at the end and with "_I" (interurban) if is related to the BH/LB project.
  - **Coding:** <POP_ID>/LBB>.

5.3 SYMBOLOGY AND LABELLING

SYMBOLOGY
TELECOM PREMISES

Point of Presence (POP) (+ label)	
Distribution Point (DP) (+ label)	
Urban Distribution Point (UDP) (+label)	
Feeder Point (FP) (+label)	
Point of Interconnection (POI) (+ label)	
Virtual Handhole	
Virtual Handhole Branching (+ label)	
Virtual Handhole Building (+ label)	
Virtual Handhole Fence	
Handhole (+ label)	
SPLICE	
Splice Box 96 FO and Splice Box 288 FO (+ label) Virtual Splice Closure (+label)	
CONDUITS	
Ploughing 120cm (+ label)	
Ploughing 80cm	
Traditional Trenching 30x60cm Asphalt	
Traditional Trenching 30x60cm Brick	
Traditional Trenching 30x60cm Grass/Unpaved	
Trench for Historic Paving 30x50cm Historic Brick	
Trenching 30x80cm Asphalt (+ label)	
Trenching 30x80cm Brick (+ label)	
Trenching 30x80cm Grass/Unpaved (+ label)	

Trenching 40x80cm Asphalt (+ label)	
Trenching 40x80cm Brick (+ label)	
Trenching 40x80cm Grass/Unpaved (+ label)	
MINITrenching 15x45cm Asphalt	
MINITrenching 15x45cm Brick	
MINITrenching 15x45cm Grass/Unpaved	
Garden Trenching 15x40cm Asphalt (+ label)	
Garden Trenching 15x40cm Brick (+ label)	
Garden Trenching 15x40cm Grass/Unpaved (+ label)	
Horizontal Directional Drilling (HDD) 180mm (+ label)	
Horizontal Directional Drilling (HDD) 160mm (+ label)	
Horizontal Directional Drilling (HDD) 125mm (+ label)	
Horizontal Directional Drilling (HDD) 63 mm (+ label)	
Drilling with non-steerable soil displacement method 45 mm	
Impact moling 110 mm (+ label)	
Impact moling 65 mm (+ label)	
Mini-Horizontal Directional Drilling	
Boring non-steerable soil displacement Method	
MicroTrenching 8x40cm Asphalt	
NanoTrenching 2x15cm Asphalt	
FTTF	
Not normalized (+label)	
CABLES	
Backhaul (+label)	
Local backbone (+label)	
Feeder (+label)	
Distribution (+label)	
Dark Fiber (+label)	
Loop (+label)	

5.4 INVENTORY

The same rules will be followed for the inventory as for the design registration, according to the Keycom manual ([6] UGG Design Manual – KeyCom). The status of each built element will be changed to Work Built (WB).

Regarding to the FTTF, during the update in Keycom in the asbuilt phase, there will be 2 situations:

Case 1) If the subscriber (private section) is being built at the same time as the general network, the section between VH Building-VH Fence will be included in the DROP PLAN and included in the Installation and Maintenance section inside the BoQ.

Case 2) If the subscriber (private section) is not being built at the same time as the general network so, the distribution is built before the Subscriber, the section between VH Building -VH Fence will be included in the DP PLAN and included in the FTTF section inside the BoQ.

6. NETWORK DESIGN DELIVERABLES AND TEMPLATES

Network design process is finished when the network is adequately documented, and the review and acceptance process is completed. This section explains what the adequate outcome documentation is, to be produced and loaded into the IT systems for any project type.

As commented before, in the LLD phase, every Gemeinde will have 2 projects associated within the process: Access Project and BH/LB Project.

1) The **Access Project** comprises the access network design, as well as the BH/LB/Spare network inside this access network (including the end-to-end cables). The needed partials LLD will be created according to the rules explained in 3.7.1. In this project 2 BoQs will be delivered: Access BoQ and BH/LB-Access BoQ (this last BoQ includes the materials used in BH/LB/Spare inside the access network). See 6.3 for an exhaustive explanation.
2) The **BH/LB project** comprises the needed interurban network design to connect the POPs of a Gemeinde to the ones of the higher hierarchy. It could comprise feeder network sections shared with BH/LB in case they were built by interurban specialist companies (this case would be notified by UGG to the LLD provider before the LLD). It always has a unique partial LLD and 1 BoQ (or 2 in case interurban feeder sections are included in this project. In this case, an Access BoQ and a BH/LB BoQ should be delivered in this partial LLD). By default, in this project, a manhole OC has to be designed, outside the urban area, a maximum 100m after the plot limit of the last served address in the access network, (the Technical Office must provide this info to the company that carries out this project with the help of the HLD) being the first point to be designed in this LLD. In case these BH/LB links use dark fiber, each Gemeinde must ensure the continuity of the link.

6.1 ACCESS NETWORK PROJECTS

The following design deliverables must be provided:

- **Address List**, the list of target addresses in the area including the DP/UDP from which the service will be provided. The format and attributes are defined in an Excel spreadsheet template. This Address List is uploaded to LOMA, so it must contain all the addresses of the Gemeinde. The necessary data for LOMA must be included, as well as Distance to the Active POP (OLT), Status, DP_ID/UDP_ID and POP_ID. The field ´Distance to the POP´ represents the distance (in meters) from the address to the Active POP. In case of belonging to a Passive POP, the Local Backbone must be added. In case this distance exceeds 15 kilometres, the distance of all addresses must be indicated.
- **Keycom project** with: POP, UDPs/DPs, FPs, feeder and distribution networks, BH/LB/Spare bundles inside the access network, BH/LB end-to-end cables and splices. The design access project must be complete, including all necessary network elements and proper dimensioning inside the access network. The format of the deliverables and the attributes of each element are defined in 1.3 [6] UGG Design Manual – Keycom.
- **Civil Works drawings in PDF format**. This PDF printout specifies all the planned network routes, planned construction techniques, surface types, location of network elements (including handholes if required). Labels for POP, DP/UDP and junctions are required. All civil works inside the access network have to be included in this blueprint.
- **Cable Drawings**: Showing equipment and cables. The required labels will be included to be able to follow the cable routing. Feeder, distribution and BH/LB cables are delivered in separate blueprints.

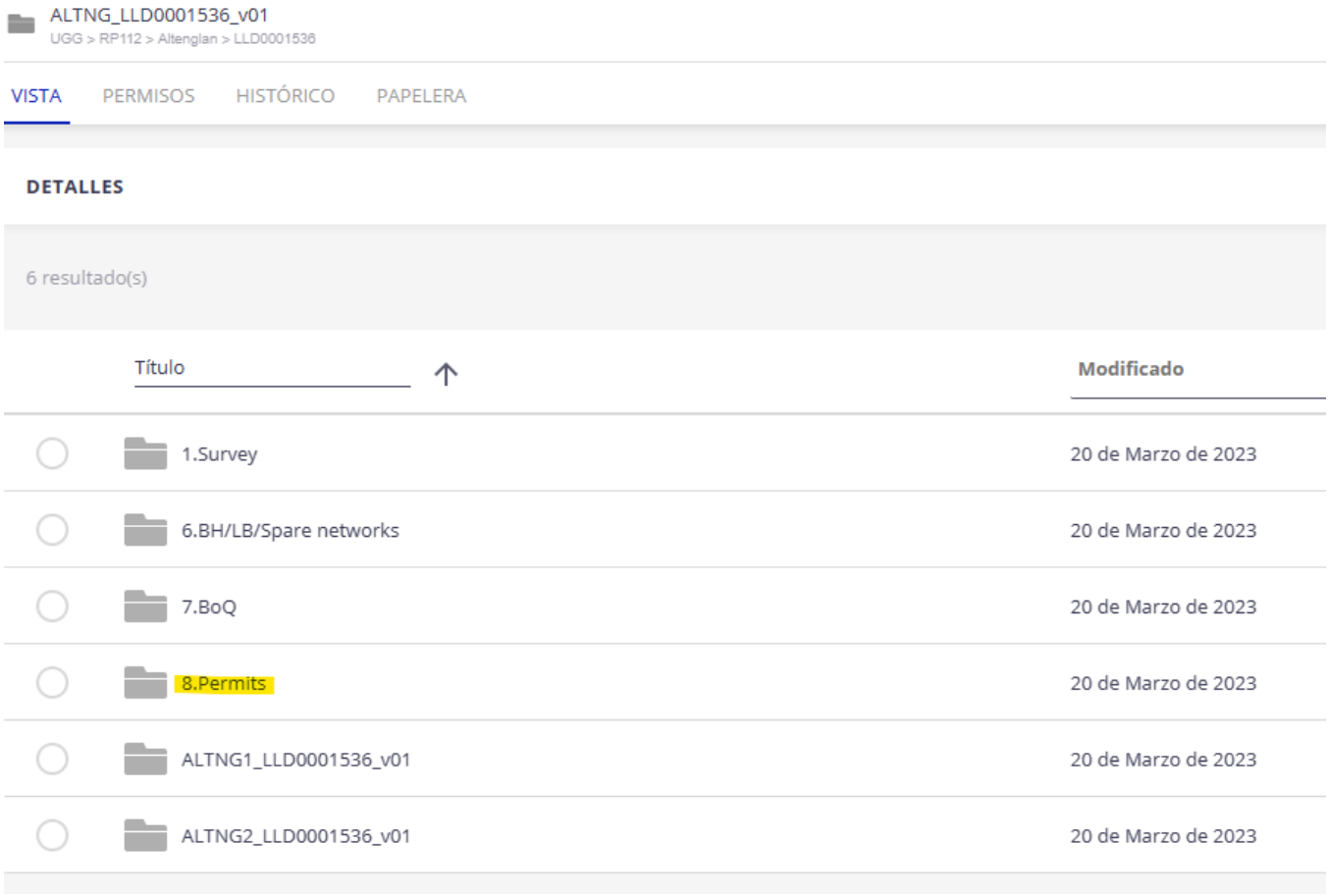
These last ones cables (BH/LB) must be printed in the same document for the CS Arch.and in different blueprints for the DS Arch..

- **Feeder and Distribution Infrastructure drawings** in PDF format (both networks must be delivered in the same blueprint and placed inside the Distribution Network folder), including labels about bundle capacities, branching VH and network elements. Section numbers and position of the bundle inside the trench are required. It must be organized by UDP/DP Plan. POP will be included in a separate sheet only if it is not included in any service area. Estimated demarcation points (VH) and private property routes for each address are also represented. For the new DS Arch., the LB bundles must be printed in this document, together with feeder and distribution bundles.
- **BH/LB/Spare Infrastructure drawings** in PDF format. A unique blueprint must be delivered with the civil works inside the access where these types of bundles run. Labels about bundle capacities, branching VH and network elements are required, as well as section numbers and position of the bundle inside the trench. For the new DS Arch., the LB bundles must not be printed in this document. They should be together with Feeder and Distribution as declared before.
- **Feeder Network Scheme** in PDF format, network schematics showing the POP, DPs, feeder bundles capacity (in case of CS Arch.). For the DS Arch., POP, FPs, UDPs must be included, together with LB/Feeder bundles capacity.
- **ODF connections** in PDF format, connections in OPV/IPV for all outside plant cables finished in ODF.
- **Cluster Scheme and Splicing cards** matching every link cable with its microduct inside the link bundle. Both can be delivered in the same document, which must be done by the company that designs the most hierarchical Gemeinde (Aggregator POP). If there are modifications in Gemeinden that are not of the Aggregator POP this document will be updated by the company that designs the Gemeinde in which the modifications occur. The Technical Office must coordinate it and its updating with the help of the designer company. Regarding the DS Arch., the splicing card of the different LBBs must be made in a format similar to the Feeder Splicing Chart. (template exists)
- **Feeder Network Splicing cards** in Excel format, route between POP/FP and DPs/UDPs (and eventually in other intermediate splicing boxes). VH Branching, ducts connections and cables occupancy (+ length) must be included. Regarding the DS Arch., several UDPs can share trays inside the ODF (depending on dragged fibers). Fibers illuminated in the POP per UDP must be indicated.
- **Distribution Network Splicing cards** in Excel format, for UDPs/DPs and assignment to homes. It is recommended to include the service area of one UDP/DP per sheet. Empty/Vacant lots must be also included in splice cards as they have a microduct assigned in distribution bundles. This microduct can be assigned **by location order, or at the end** of the usable capacity of the bundle. Empty lots do not have any port in the UDP/DP/POP assigned. For the DS Arch., relation between UDPs (without trays), microducts in distribution bundles, cables (+length) and homes. In the LLD design, no distribution cable (including IDPs or PtP) will have tray allocated in UDP

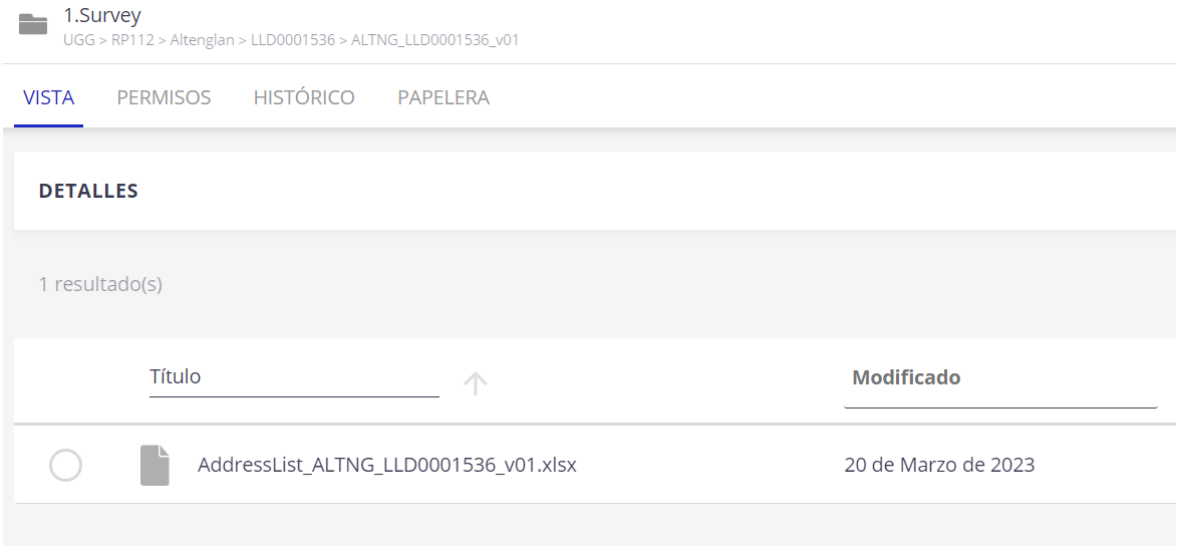
- **Permit plan** in PDF format, showing the civil works drawings, the planned trenching widths and depths, road crossing depths, standard cross-sectional views and a list (excel file) with the permits needed in construction (LLD only) inside the access network. During the first revision of the LLD (v1), the Technical Office together with the LLD provider company will undertake the forecasting of permits that will be required in construction, requesting them during this first version in order to get them before the construction phase.

- **UDPs/DPs Location Request** in Excel/PDF format, filling all the necessary information to speed up the DPs location process with the Gemeinde.
- **Bill of Quantities**, including the required materials and the expected construction services for the access network. The format is defined in the Excel spreadsheet template and allows for direct calculation of the total construction cost. A complete explanation can be found in 6.3. For every partial LLD, the BoM of the Exchange area downloaded from Keycom must be delivered too.
- **Outside Plant Vertical (OPV)** in Excel format, linking every HOME_ID with its resources in external plant ODF (POP), for the CS Arch. As there is not assignment between ODF ports and home_ids in the DS Arch., it must not be delivered for this type of architecture.
- All drawings shall include a pre-defined title box with the Company name and logo, drawing name, project type, Municipality, scale, compass rose, version, date and author. A specific map legend has to be also included, showing all the symbols utilized in the drawing. Legends in German are accepted.
- A guide map (index) showing the entire area will be included in the PDF blueprints, followed by a series of detailed drawings at a recommended scale of 1:2000.
- DIN A3 is the standard page size for all PDF drawings. DIN A0 or DIN A1 can also be used for single-page drawings.
- All linear elements (bundles and cables) shall include the *estimated* section length.

For every partial LLD delivered, the folders and documents encoding must follow the following criteria. The partial LLD folder will be named as "GemeindeAcronym_PartialLLDCode_v0X" (i.e. ALTNG_LLD0001536_v01") and it must be located just under the "01_LLD_OldVersion" in case the LLD is not technically approved or inside the "02_LLD_ApprovedVersion" once it is approved. The Technical Office must move the approved version to the "02_LLD_ApprovedVersion" folder in DOMA. All partial LLDs must contain one subfolder by POP (also in case they have only one) which the corresponding documentation (named as "POP_ID_PartialLLDCode_v0X"), except survey, link networks (BH/LB/Spare) and BoQ which are common to the partial LLD. Partial LLDs that comprise Gemeinden fed by UDP/DP must be indexed by the POP_ID where the Gemeinde is connected to when the POP_ID is needed in the following encodings.



Inside the Survey folder the address list file must be placed with the following code: *"AddressList_GemeindeAcronym_partialLLDCode_v0X.xlsx"*, i.e *"AddressList_ALTNG_LLD0001536_v01.xlsx"*.



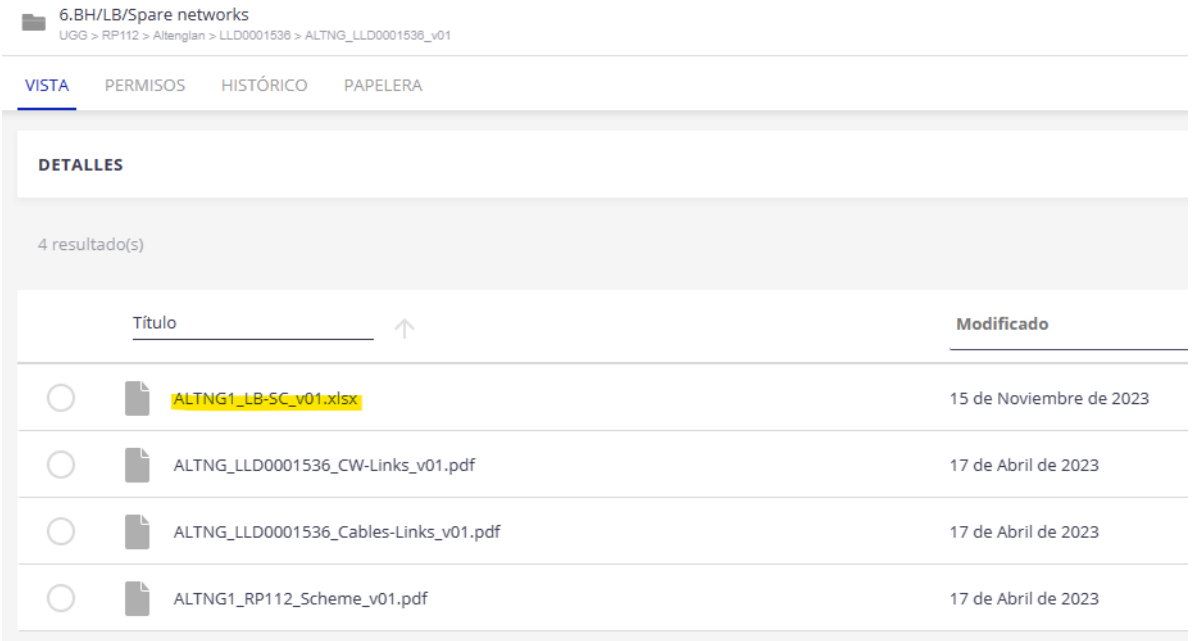
At the same level, the folder for the links routes must be created (BackHaul, Local Backbone and Spare routes) with the following documents inside:

+Civil works of BH/LB/Spare inside the access network in the same blueprint with the labels of the own civil work, BH/LB/Spare bundles and OC/TC manholes. It must be encoded as follows: *"GemeindeAcronym_PartialLLDCode_CW-Links_v0X.pdf",* i.e *"ALTNG_LLD0001536_CW-Links_v01.pdf"*. In the DS Arch., LB bundles must be printed together with Feeder and Distribution.

+End-to-end BH/LB cables blueprint with loops, SCs and OC/TC manholes. All cables must be included in the same blueprint with the previous elements labelled (in case of CS Arch.). The document name is: *"GemeindeAcronym_PartialLLDCode_Cables-Links_v0X.pdf",* i.e *"ALTNG_LLD0001536_Cables-Links_v01*.pdf" (for the CS Arch.). For the DS Arch. the BH cables must be printed separated from LB cables, in a document with the following name: *"GemeindeAcronym_PartialLLDCode_BH-Cables _v0X.pdf"*, while LB cables in a document named as: *"GemeindeAcronym_PartialLLDCode_LB-Cables _v0X.pdf"*.

+Cluster Scheme: one per Aggregator POP in the cluster, encoded in the following way: *"AggregatorPOP_ID_ClusterCode_Scheme_v0X.pdf"*, i.e *"ALTNG1_RP112_Scheme_v01.pdf",* being ´v0X´ the version of the Cluster Scheme, not the version of the Cluster structure (this last one must be indicated inside the Cluster Scheme document).

+ Regarding the DS Arch., the LBB splicing card must be made in a single Excel per POP or Partial LLD, with one sheet per ODF. The encoding will be "POP_ID_LB-SC-v0X", for example "ALTNG1_LB-SC-v01.xlsx"

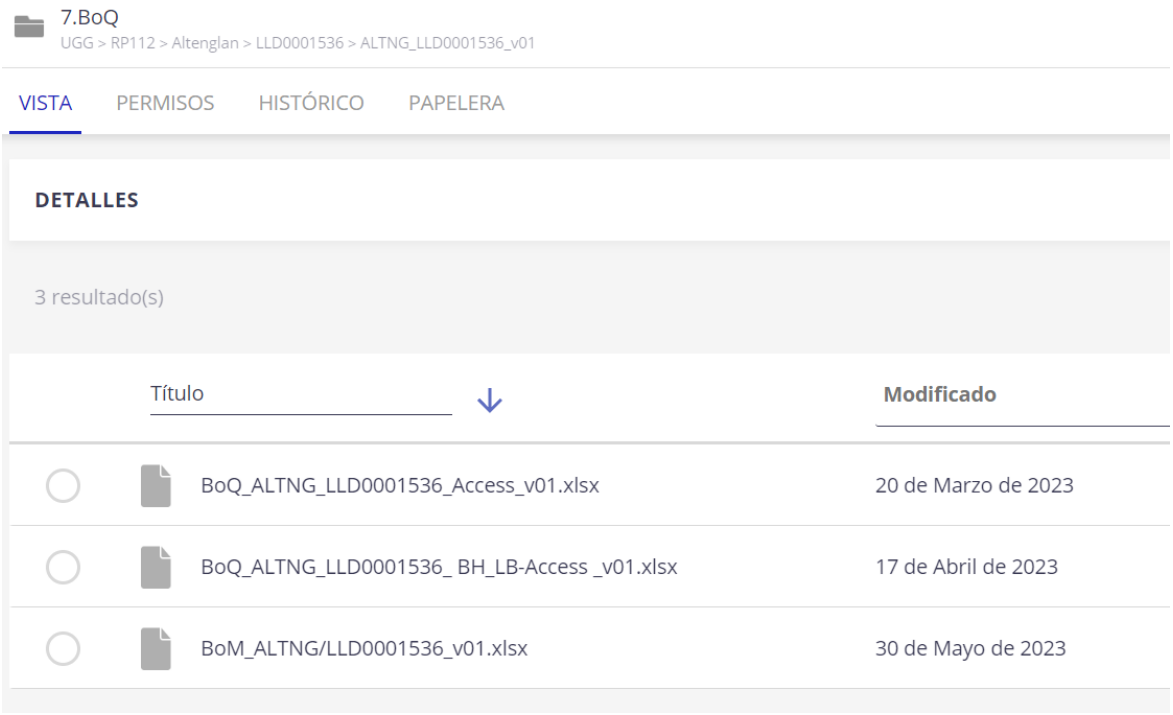


Regarding BoQ files, they must be placed inside the BoQ folder and encoded depending on the info they contain (Access, BH/LB inside the Access or BH/LB outside the access).

+Access BoQ: *"BoQ_GemeindeAcronym_PartialLLDCode_Access_v0X.xlsx",* i.e *"BoQ_ALTNG_LLD0001536_Access_v01.xlsx"*

+BH/LB-Access BoQ (BH/LB/Spare networks inside the access network): *"BoQ_GemeindeAcronym_PartialLLDCode_BH_LB-Access_v0X.xlsx"*, i.e *"BoQ_ALTNG_LLD0001536_ BH_LB-Access _v01.xlsx"*

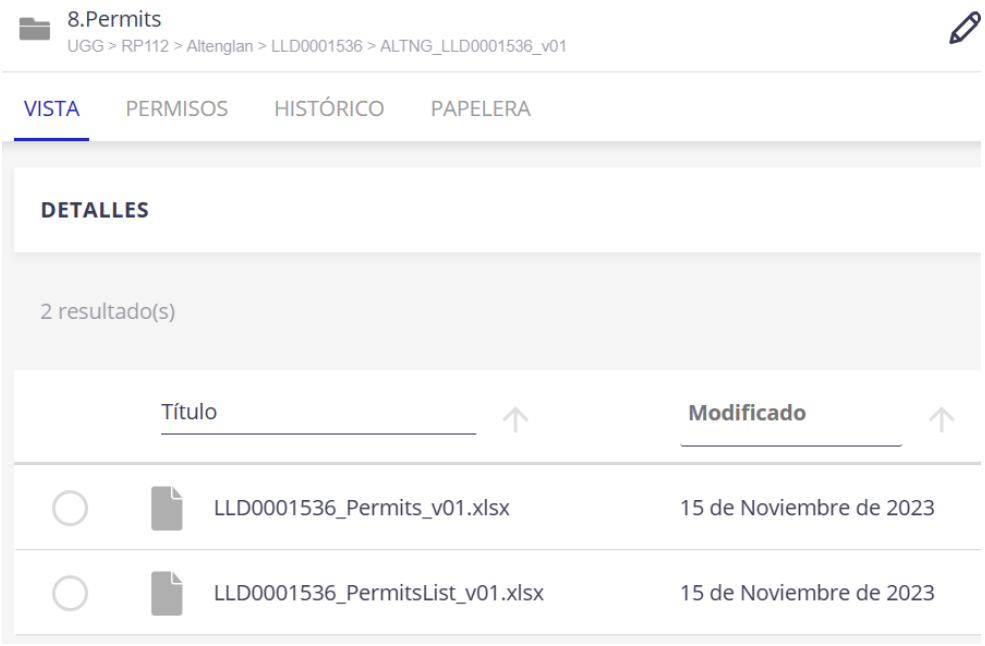
+Exchange Area BoM from Keycom: *"BoM_ExchangeAreaCode_v0X.xlsx"*, i.e *"BoM_ALTNG/LLD0001536_v01.xlsx"*.



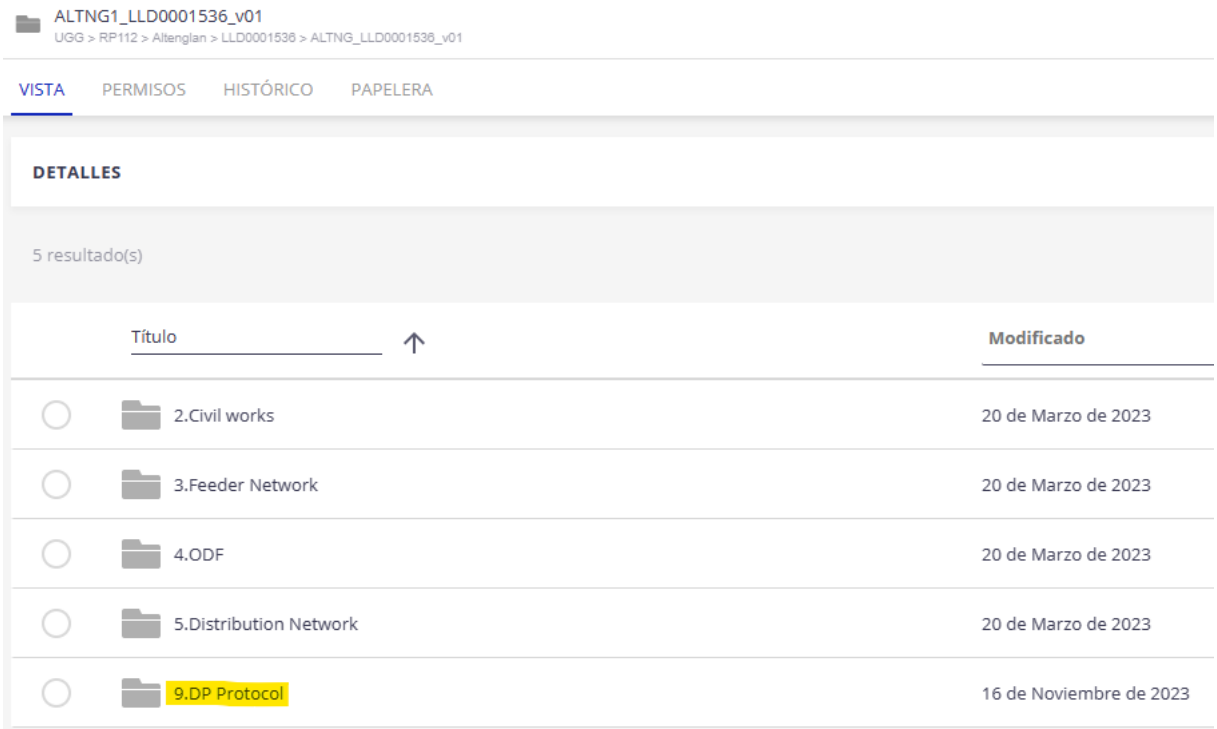
The Permits folder must contain the access permits and the excel list with those permits. These documents are encoded in the following way:

+Permits identification blueprint: *"PartialLLDCode_Permits_v0X.pdf"*, i.e *"LLD0001536_Permits_v01.pdf"*.

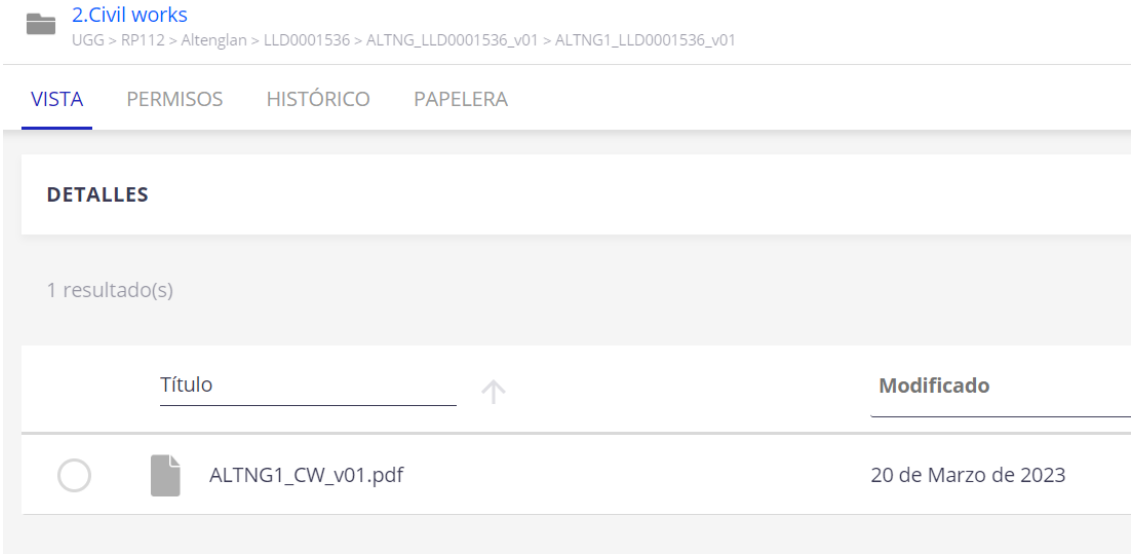
+Permits identification list: *"PartialLLDCode_PermitsList_v0X.xlsx"*, i.e *"LLD0001536_PermitsList_v01.xlsx"*.



Inside every POP folder the folders related with access civil works, feeder network, ODF, distribution network and permits must be created, as shown in the following image.



The civil works blueprints must be placed inside the Civil works folder, with the following name: *"POP_ID_CW_v0X.pdf"*, i.e *"ALTNG1_CW_v01.pdf"*

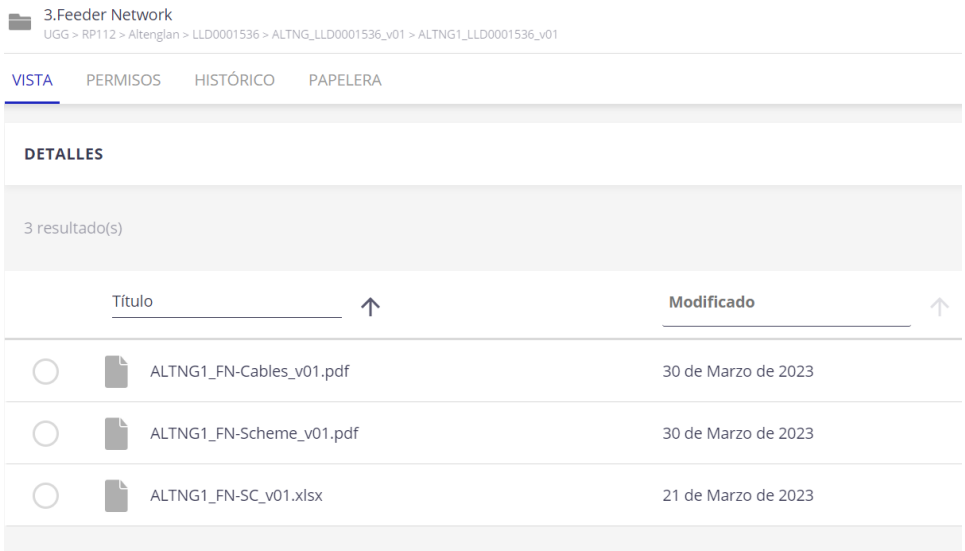


The feeder network documentation is placed inside the Feeder network folder in the following way:

+Feeder network splice card encoded as *"POP_ID_FN-SC_v0X.xlsx"*, i.e *"ALTNG1_FN-SC_v01.xlsx"*. It must be a single Excel per POP or Partial LLD, with one sheet per ODF.

+Feeder network scheme encoded as "*POP_ID_FN-Scheme_v0X.pdf*", i.e "*ALTNG1_FN-Scheme_v01.pdf*"

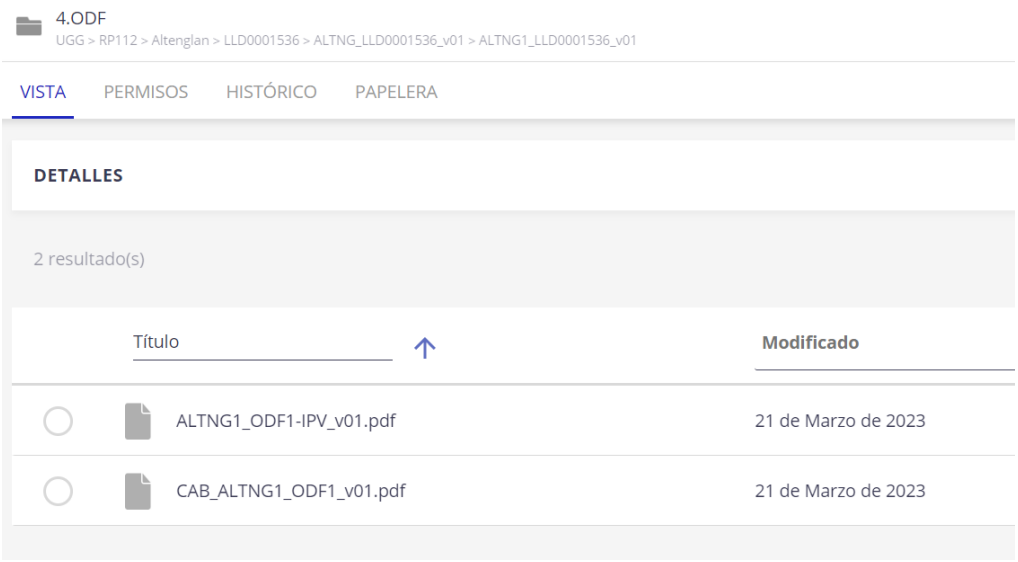
+Feeder network cables blueprint encoded as "*POP_ID_FN-Cables_v0X.pdf*", i.e "*ALTNG1_FN-Cables_v01.pdf*"



The ODF folder must contain 2 documents: the table with the relation between every UDP/DP with the ODF external plant tray where it is connected and the table with the ODF internal plant. Both documents are encoded as follows:

+External plant ODF: *"CAB_POP_ID_ODFX_v0X.pdf"*, i.e *"CAB_ALTNG1_ODF1_v01.pdf"*.

+Internal plant ODF: *"POP_ID_ODFX-IPV_v0X.pdf"*, i.e *"ALTNG1_ODF1-IPV_v01.pdf"*

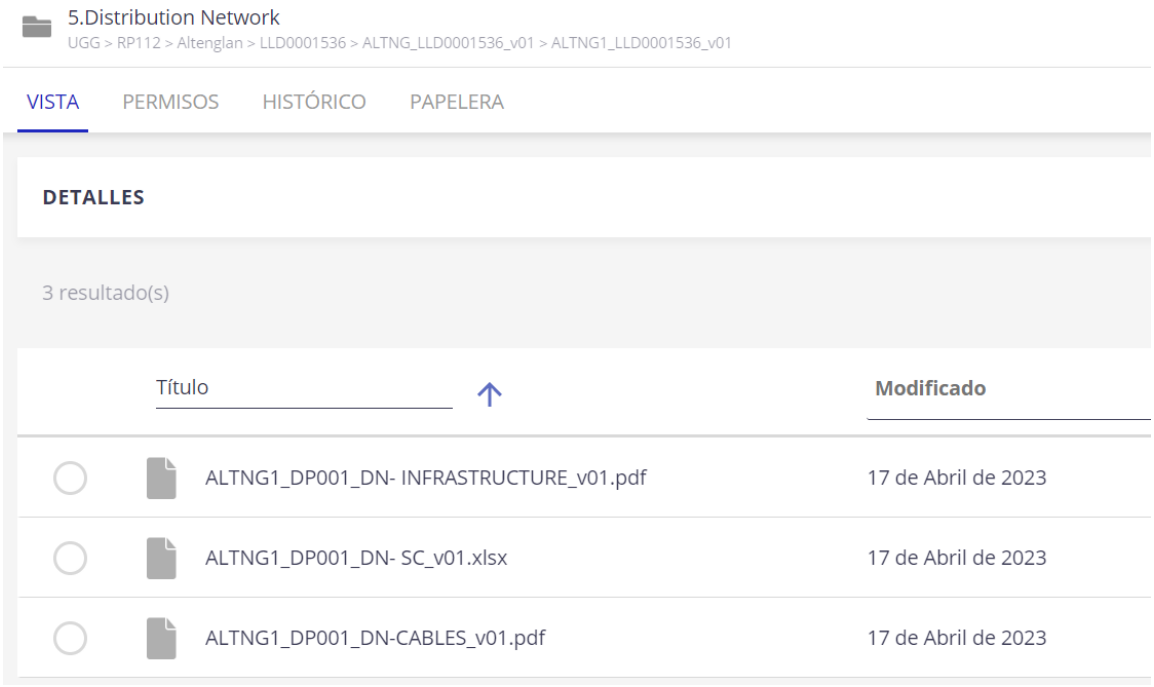


Regarding the Distribution Network the documents must be delivered in the following way:

+Distribution network cables blueprint: *"POP_ID_UDP/DP00X_DN-CABLES_v0X.pdf"*, i.e *"ALTNG1_DP001_DN-CABLES_v01.pdf" or "ALTNG1_UDP001_DN-CABLES_v01.pdf"*

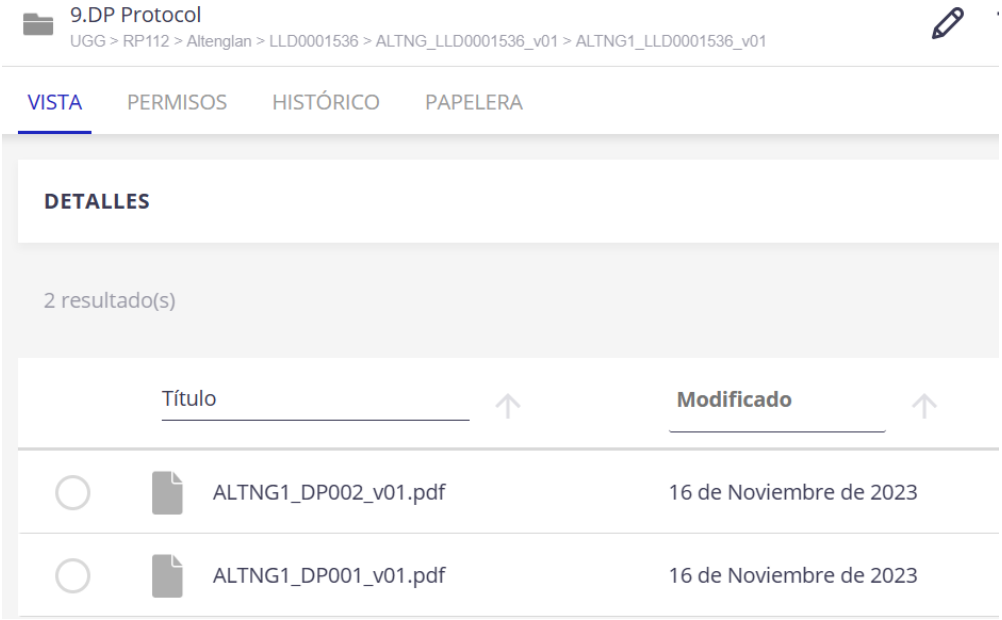
+Distribution network infrastructure blueprint: *"POP_ID_UDP/DP00X_DN-INFRASTRUCTURE_v0X.pdf"*, i.e *"ALTNG1_DP001_DN- INFRASTRUCTURE_v01.pdf" or "ALTNG1_UDP001_DN- INFRASTRUCTURE_v01.pdf"*

+Distribution network splice card: *"POP_ID_UDP/DP00X_DN-SC_v0X.xlsx"*, i.e *"ALTNG1_DP001_DN- SC_v01.xlsx" or "ALTNG1_UDP001_DN- SC_v01.xlsx"* (In DS Arch.: Configuration sheet + Distribution sheet) . In CS Arch., this document can be delivered with all the UDP/DPs (one UDP/DP per sheet). In that case the encoding must be: *"POP_ID_DN-SC_v0X.xlsx"*, i.e *"ALTNG1_DN- SC_v01.xlsx"*.

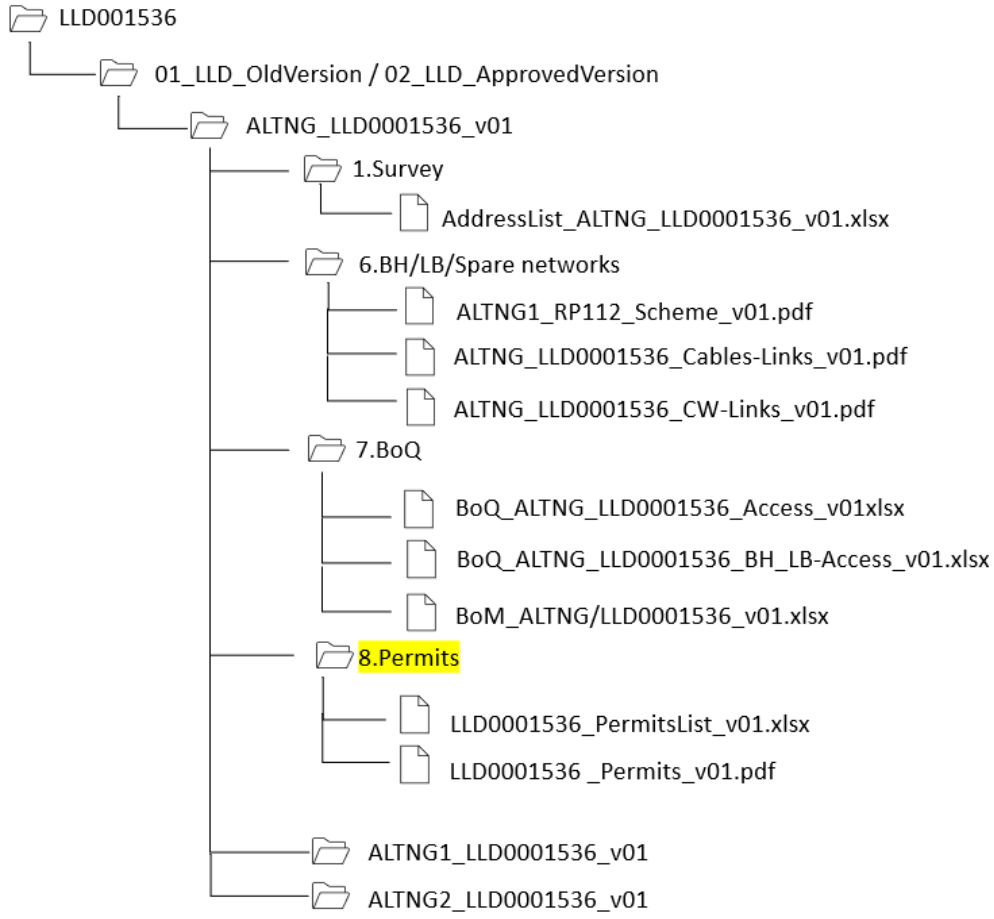


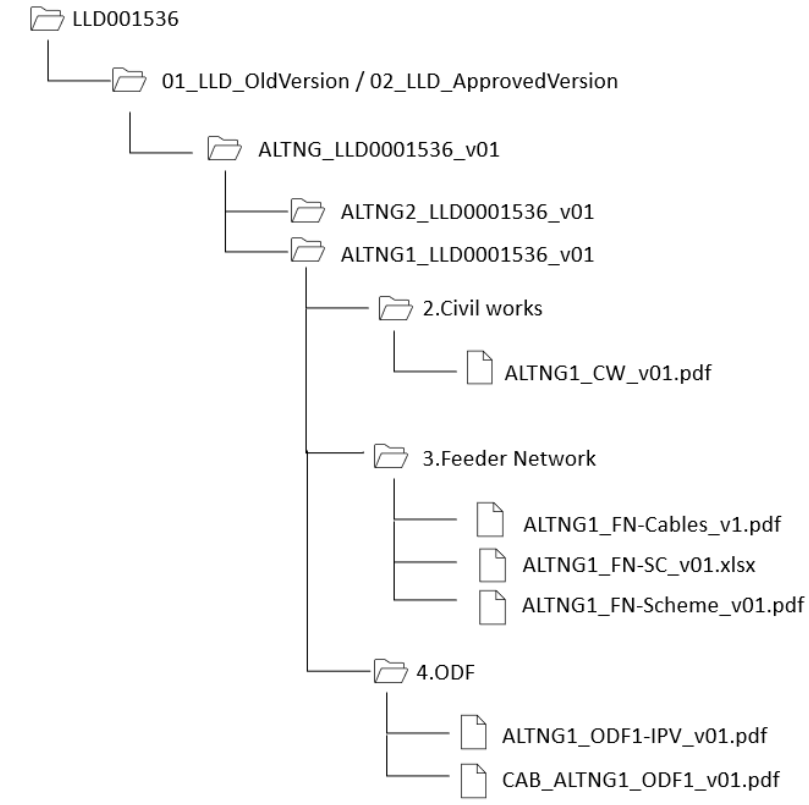
Finally, the DP Protocol folder must contain the protocol document for each DP/UDP. These documents are encoded in the following way:

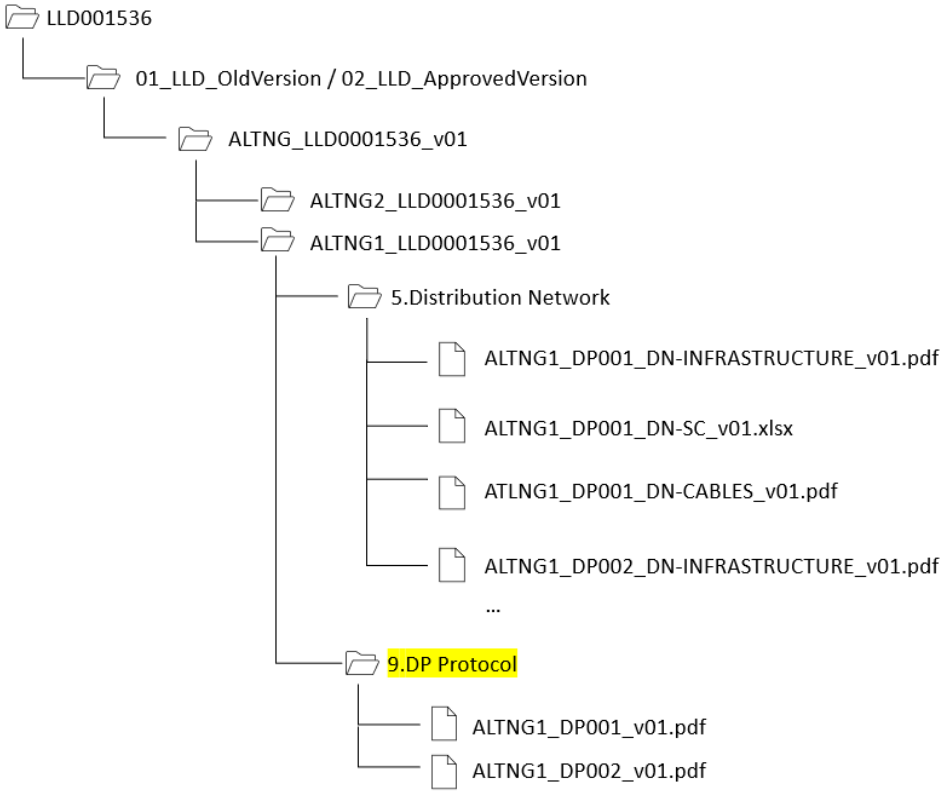
+*UDP*/DP Protocol (for POP): *"POP_ID_UDP/DP-Protocol_v0X.pdf"*, i.e *"ALTNG1_DP-Protocol_v01.pdf", "ALTNG2_DP-Protocol_v01.pdf" or "ALTNG1_UDP-Protocol_v01.pdf".*



As summary, the following images show the complete structure of the LLD based on the CS Arch..




LLD001536
01_LLD_OldVersion / 02_LLD_ApprovedVersion
ALTNG_LLD0001536_v01
ALTNG2_LLD0001536_v01
ALTNG1_LLD0001536_v01
2.Civil works
ALTNG1_CW_v01.pdf
3.Feeder Network
ALTNG1_FN-Cables_v1.pdf
ALTNG1_FN-SC_v01.xlsx
ALTNG1_FN-Scheme_v01.pdf
4.ODF
ALTNG1_ODF1-IPV_v01.pdf
CAB_ALTNG1_ODF1_v01.pdf


LLD001536
01_LLD_OldVersion / 02_LLD_ApprovedVersion
ALTNG_LLD0001536_v01
ALTNG2_LLD0001536_v01
ALTNG1_LLD0001536_v01
5.Distribution Network
ALTNG1_DP001_DN-INFRASTRUCTURE_v01.pdf
ALTNG1_DP001_DN-SC_v01.xlsx
ATLNG1_DP001_DN-CABLES_v01.pdf
ALTNG1_DP002_DN-INFRASTRUCTURE_v01.pdf
...
9.DP Protocol
ALTNG1_DP001_v01.pdf
ALTNG1_DP002_v01.pdf

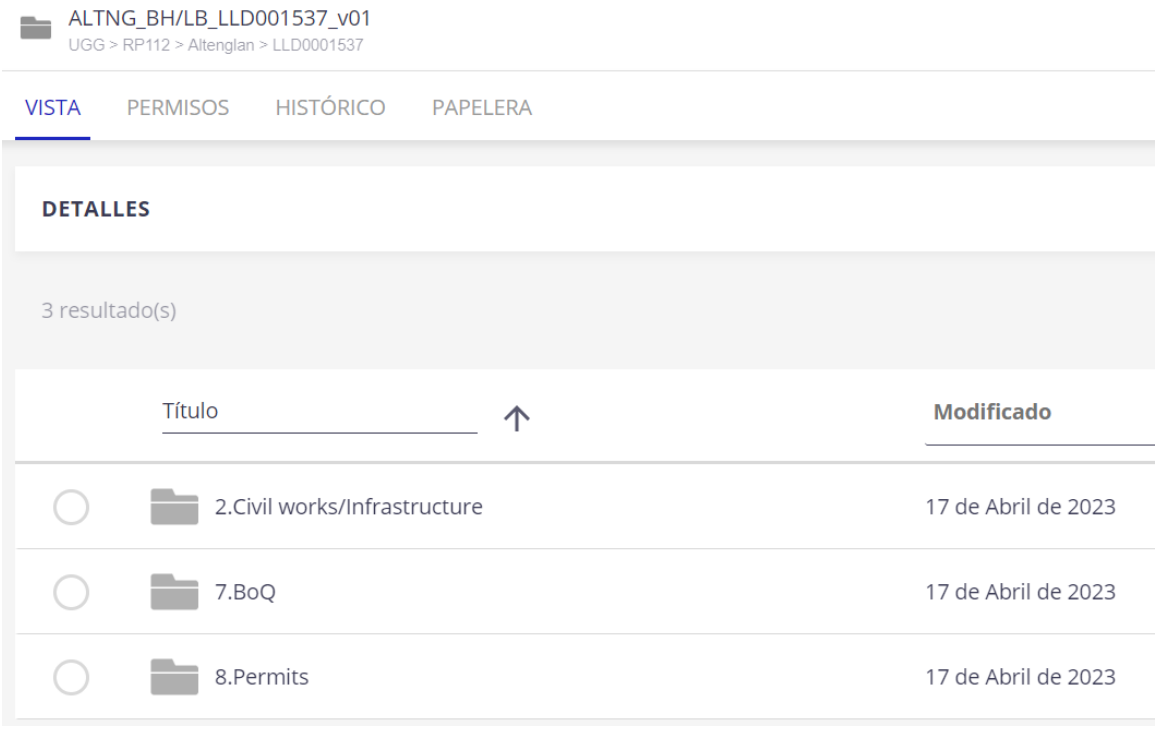
6.2 BACKHAUL AND LOCAL BACKBONE PROJECTS

The following design deliverables must be provided:

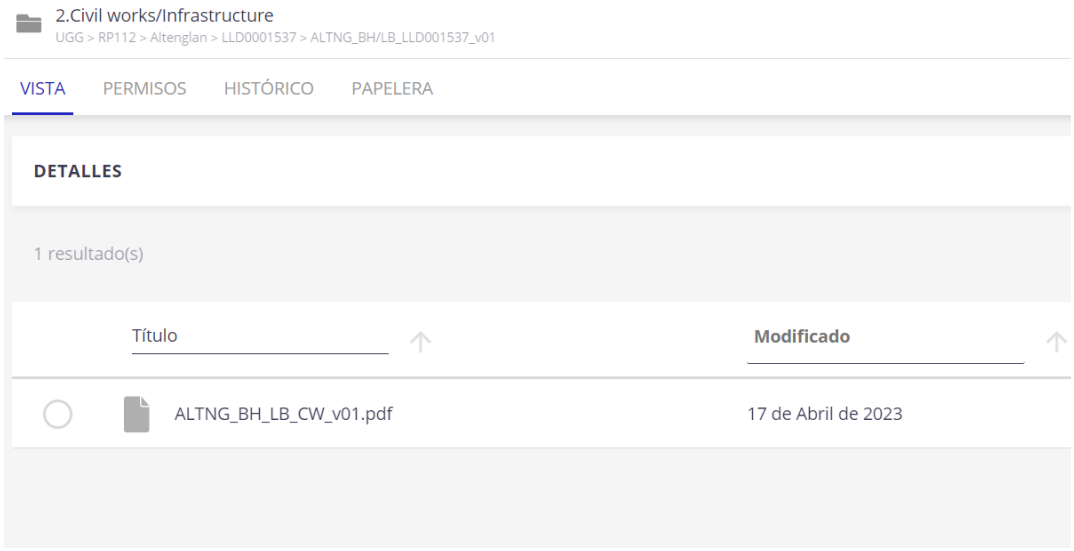
- **Keycom project** with: POPs (designed in the Access Project), POI, BH/LB bundles, civil works and manholes related with the interurban sections. The design project must be complete, including all necessary network elements and proper dimensioning. The format of the deliverables and the attributes for each element are defined in 1.3 [6] UGG Design Manual – Keycom.
- **Civil Works drawings in PDF format**. This PDF printout specifies all the planned network routes, planned construction techniques, surface types, location of network elements (including manholes if required), and ducts. Labelling and Legend are required, according to civil works, POP, POI, SWD branching virtual handholes and manholes OC/TC (more information in 5.3). Bundles are included also in this blueprint with the help of the labels.
- **Bill of Quantities**, including the required materials and the expected construction services for the BH/LB network of the interurban area. The format is defined in the Excel spreadsheet template and allows for direct calculation of the total Backhaul or Local Backbone exclusive construction cost. A complete explanation can be found in 6.3. For this partial LLD, the BoM of the BH/LB Plan downloaded from Keycom must be delivered too.
- **Permit plan** in PDF format, showing the civil works drawings, the planned trenching widths and depths, road crossing depths, standard cross-sectional views and a list (excel file) with the permits needed in construction (LLD only) for all link routes (Backhaul and Local Backbone). They are indispensable for the LLD approval. During the first revision of the LLD (v1), the Technical Office together with the LLD provider company will undertake the forecasting of permits that will be required in construction, requesting them during this first version in order to get them before the construction phase.
- All drawings shall include the pre-defined title box with the Company name and logo, drawing name, project type, Municipality, scale, compass rose, date and author. A specific map legend is also included, showing all the symbols utilized in the drawing. Legends in German are accepted.
- A guide map (index) showing the entire area will be included in the PDF blueprints, followed by a series of detailed drawings at a recommended scale of 1:2000.
- DIN A3 is the standard page size for all PDF drawings. DIN A0 or DIN A1 can also be used for single-page drawings.

For every partial LLD related to the BH/LB interurban routes, the folders and documents encoding must follow the following criteria. The partial LLD folder will be named as "GemeindeAcronym_BH/LB_PartialLLDCode_v0X" (i.e. "ALTNG_BH/LB_LLD001537_v01") and it must be located just under the "01_LLD_OldVersion" in case the LLD is not technically approved or inside the "02_LLD_ApprovedVersion" once it is approved. The Technical Office must move the approved version to the "02_LLD_ApprovedVersion" folder in DOMA.

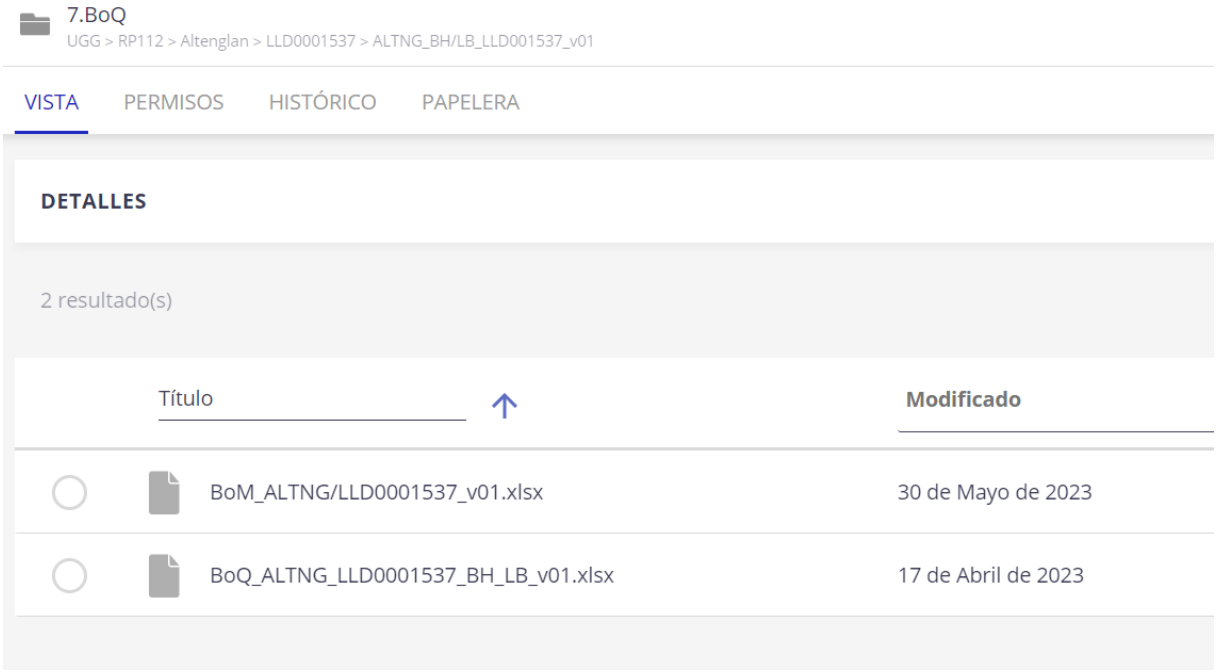
Inside the partial LLD folder, the folders related with interurban BH/LB civil works, BoQ and Permits must be created, as shown in the following image.



Inside the Civil works/Infrastructure folder the civil works blueprint must be placed with the following code: *"GemeindeAcronym_BH_LB_CW_v0X.xlsx",* i.e *"ALTNG_BH_LB_CW_v01.pdf"*.



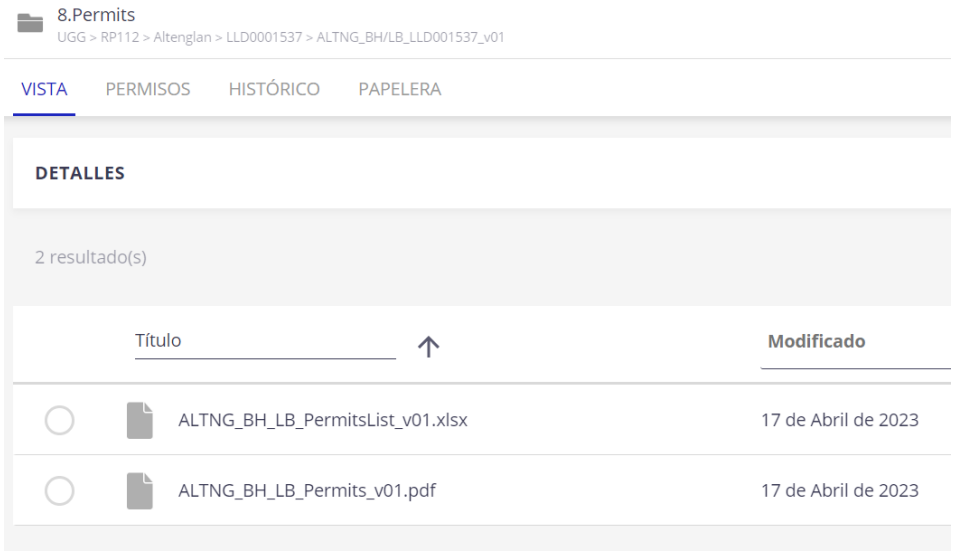
The BoQ folder contains a unique BoQ corresponding to all the interurban areas accounted in the BH/LB project of the Gemeinde, encoded as: "*BoQ_ GemeindeAcronym_PartialLLDCode_BH_LB_v0x.xlsx*", i.e "*BoQ_ALTNG_LLD0001537_BH_LB_v01.xlsx*". In case that feeder sections are accounted in this project an Access BoQ must be delivered with the following name (this case will be an exception and would be notified by UGG previously): "*BoQ_GemeindeAcronym_PartialLLDCode_Access_v0x.xlsx*", i.e "*BoQ_ALTNG_LLD0001537_Access_v01.xlsx*". The code for the BoM downloaded from Keycom is the following: *"BoM_ExchangeAreaCode_v0X.xlsx",* i.e *"BoM_ALTNG/LLD0001537_v01.xlsx"*.



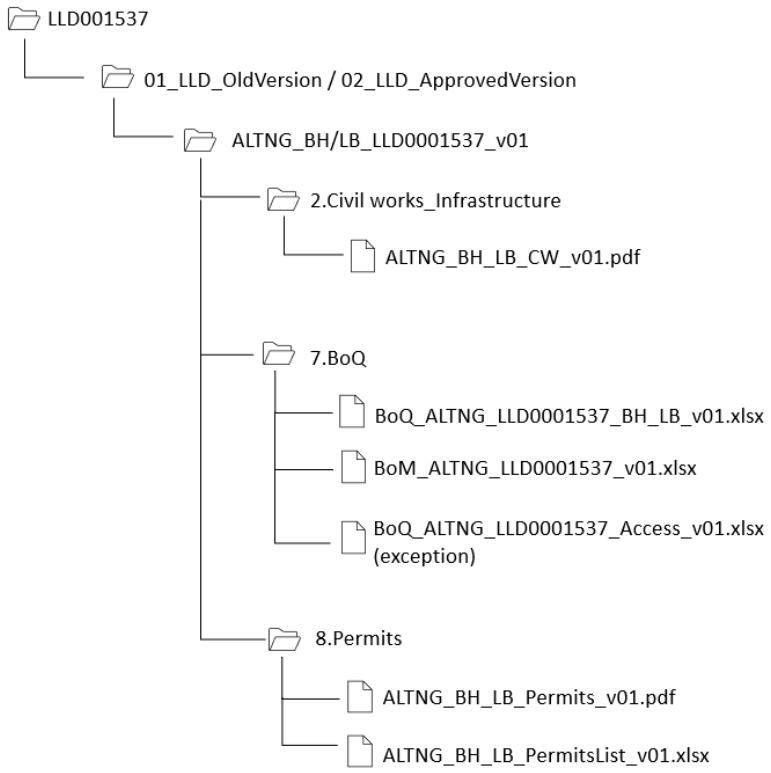
Finally, the BH/LB blueprint permits and the excel list must be placed inside the Permits folder, encoded as: "*GemeindeAcronym_BH/LB_Permits_v0X.pdf*", i.e "*ALTNG_BH/LB_Permits_v01.pdf*".

+Permits identification blueprint: *"GemeindeAcronym_BH_LB_Permits_v0X.pdf"*, i.e *"ALTNG_BH_LB_Permits_v01.pdf"*.

+Permits identification list: *"GemeindeAcronym_BH_LB_PermitsList_v0X.xlsx"*, i.e *"ALTNG_BH_LB_PermitsList_v01.xlsx"*.



As summary, the complete structure of the BH/LB project related to this example would be the following:



6.3 BILL OF QUANTITIES

As explained in 3.7.1, in the LLD phase, every Gemeinde will have 2 independent projects: Access Project and BH/LB Project. The Access Project will have always 2 BoQs: "Access BoQ" and "BH/LB-Access BoQ "(Gemeinde served by DP will have only Access BoQ), while the BH/LB Project will have one BH/LB BoQ.

+ Access BoQ-> Everything related to feeder, distribution and civil works up to the deployment limit of the Gemeinde has to be included in this BoQ. In the FTTF part, the sections (civil works and bundles) from VH Building to VH Fence have to be included. In the task "Home passed to fence" all served buildings must be considered. In this BoQ, BH/LB/Spare bundles and cables must not be included (for both architectures).

This BoQ could be delivered in the BH/LB project too only if this project is assigned to an interurban specialist company (different from the Access Construction Company) and if feeder sections are assigned to them. In this case, it would include the feeder network bundles, civil works and intermediate manholes.

+ BH/LB-Access BoQ ->In this BoQ only those BH/LB/Spare bundles inside the access network must be included, together with cables, splices and POP terminations. The extra civil work and bundles between the OC manhole for interurban connection and the last served address is included in this BoQ too. The LB of the DS Arch. must be treated as the LB of the CS Arch., in terms of BoQ.

+ BH/LB BoQ -> civil works, bundles and manholes of the interurban area are included in this BoQ.

For BH/LB-Access BoQ and BH/LB BoQ, the task "Backhaul Network Design (LLD)" counts the linear km of BH/LB for every project (civil works length). This task includes km of civil works where there is at least 1 Bundle of BH/BUL/BHR/LBB (no Spare routes)

The duct 1x7/4mm must be valued in BoQ in the following way in design:

-The first duct 1x7/4mm used in the civil work of type *"Mini-Horizontal Directional Drilling"* must not be valued in BoQ as it is included inside the civil work task. Only the ducts from the 2nd on must be included in BoQ but in the task "Duct Delivery and installation 1X7/4" inside the *"FTTF"* section of BoQ.

-The first duct 1x7/4mm used in the civil work of type *"Boring from distribution network till customer wall (non-steerable Soil Displacement Method)"* must not be valued in BoQ as it is included inside the civil work task. Only the ducts from the 2nd on must be included in BoQ but in the task "Duct Delivery and installation 1X7/4" inside the *"INSTALLATION AND MAINTENANCE"* section of BoQ.

-All the ducts of type 1x7/4mm used in civil works different from the previous ones must be valued in BoQ from the 1st on, in the section *"FTTF"* or *"INSTALLATION AND MAINTENANCE"* depending on if it is placed in between Virtual Handhole Building- Virtual Handhole Fence or between Virtual Handhole Fence-façade.

6.4 SUMMARY TABLE

This table shows a summary of the design deliverables introduced in the previous chapter, classified per project phase:

Deliverable	Format	Access Project	BH/LB Project
Address List	Excel sheet	Including all the addresses of the Gemeinde and addresses discarded for technical or business-related reasons. Moreover, the following fields of the address_list must be filled in: Distance to the OLT, Status, UDP/DP_ID and POP_ID.	NO
Keycom Project	Keycom	Design loaded in the system, including all the layers and attribute values defined for the Access Project.	Design loaded in the system, including all the layers and attribute values defined for BH/LB Project.
Bill of Quantities	Excel sheet	Budgetary BOQ, applying preliminary material and services quantities. 2 BoQs will be delivered in this project. For every partial LLD, the BoM of the Exchange area downloaded from Keycom must be delivered too.	Detailed BOQ for the interurban sections. For this partial LLD, the BoM of the BH/LB Plan downloaded from Keycom must be delivered too.
Civil Works Drawings	PDF	Printout of the CW information from the LLD Project (in geographical grid). Includes labels for POP, UDP/DP, Branching VH. All civil works inside the access must be included in the same blueprint.	Printout of the Civil works and bundles information for the interurban sections, including manholes. It includes CW and manholes labels.
Infrastructure Drawings	PDF	Printout of the Bundles information from the LLD project. For the CS Arch., Feeder and Distribution infrastructure must be delivered in the same blueprint (by DP) while BH/LB (both) infrastructure inside the access is delivered in another blueprint. They must include labels for POP, DP, branching VH, and bundles with capacity and position. Regarding the DS Arch., Local Backbone, Feeder and Distribution infrastructure must be delivered in the same blueprint (by UDP) while BH infrastructure inside the access is delivered in another blueprint. They must include labels for POP, FP, UDP,	Included in civil works blueprint.

		branching VH, and bundles with capacity and position.	
Cable Drawings	PDF	Printout of the Cables and Equipment layers from the LLD Project. For the CS Arch., Feeder, Distribution (by DP) and BH/LB cables must be included in separated blueprints. These last ones cables (BH/LB) are in included in the same document. They should include labels for POP, DP, branching VH, splices, loops and cables. Regarding the DS Arch., Local Backbone, Feeder, Distribution (by UDP) and BH cables must be included in separated blueprints. They should include labels for POP, FP, UDP, branching VH, splices, loops and cables.	NO
Feeder Network Scheme	PDF	For the CS Arch., single-line diagram showing the POP, DPs, feeder bundles capacity. Regarding the DS Arch. POP, FPs, UDPs must be included, together with LB/Feeder bundles capacity.	NO
ODF connections	PDF	Connections in OPV/IPV for all outside plant cables finished in ODF.	NO
Cluster Scheme and Splicing Cards	Excel Sheet	Printout matching every link cable (Backbone, BackHaul, Backup Line, Redundancy BackHaul) with its corresponding microduct inside the bundle. Regarding the DS Arch., a specific LBB splicing chart is required.	NO
Feeder Network Splicing Cards	Excel Format	Route between POP and UDPs/DPs (and eventually in other intermediate splicing boxes). VH Branching, ducts connections and cables occupancy (+ length) must be included. Regarding the DS Arch., several UDPs can share trays inside the ODF (depending on dragged fibers). Fibers illuminated in POP per UDP must be indicated.	NO

Distribution Splicing Cards (UDP/DP)	Excel sheet	For the CS Arch., relation between POP, feeder cables, DPs (trays), VH Branching, microducts in distribution bundles, distribution cables (+length) and homes. For the DS Arch., relation between UDPs (without trays),VH Branching, microducts in distribution bundles, cables (+ length) and homes.	NO
Permit Plan	PDF	Permit plan in PDF format, showing the civil works drawings, the planned trenching widths and depths, road crossing depths, standard cross-sectional views and a list (excel file) with the permits needed in construction (LLD only) for the access network. They are indispensable for the LLD approval.	Permit plan in PDF format, showing the civil works drawings, the planned trenching widths and depths, road crossing depths, standard cross-sectional views and a list (excel file) with the permits needed in construction (LLD only) for the interurban sections. They are indispensable for the LLD approval.
UDPs/DPs Location Request	Excel sheet/PDF	This sheet must be delivered with the LLD v1 in order to have the confirmation of UDPs/DPs location as soon as possible.	NO
Outside Plant Vertical (OPV)	Excel sheet	This sheet links every HOME_ID with its resources in external plant ODF (POP), for the CS Arch.. It must be delivered after the LLD technical approval. As there is not assignment between ODF ports and home_ids in the DS Arch., it must not be delivered for this type of architecture.	NO

6.5 AS BUILT DELIVERABLES

The as-built deliverables have to be defined by the UGG construction area. To review the registration, the documents to deliver must be similar to the LLD documents. For the asbuilt update in Keycom the [6] UGG Design Manual – KeyCom must be used, and it will be also necessary to upload a shape file into Keycom (as a layer) with the geo-reference points taken from field in order to compare the asbuilt upload with the own field information. These files must be uploaded to DOMA as well.

ANNEX 1 - MATERIALS AND COMPONENTS

Basic characteristics of the main network components used for the OSP network design.

OPTICAL CABLES FOR MICRO-DUCTS

Fiber Count	Tubes x Fibers	External diameter	For micro-ducts	Fiber Type
12	1 x 12	6,5 mm	14/10	ITU G.652.D
24	2 x 12	6,5 mm	14/10	ITU G.652.D
36 *	3 x 12	6,5 mm	14/10	ITU G.652.D
48	4 x 12	6,5 mm	14/10	ITU G.652.D
72 *	6 x 12	6,5 mm	14/10	ITU G.652.D
96	8 x 12	6,5 mm	14/10	ITU G.652.D
144 *	12 x 12	8,2 mm	16/12	ITU G.652.D
192	8 x 24	8,2 mm	16/12	ITU G.652.D
288	9 x 12 + 15 x 12	9,5 mm	16/12	ITU G.652.D

LOOSE TUBE COLOR CODING (DIN/VDE 0888)

1 to 12 tubes

No.	1	2	3	4	5	6	7	8	9	10	11	12
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

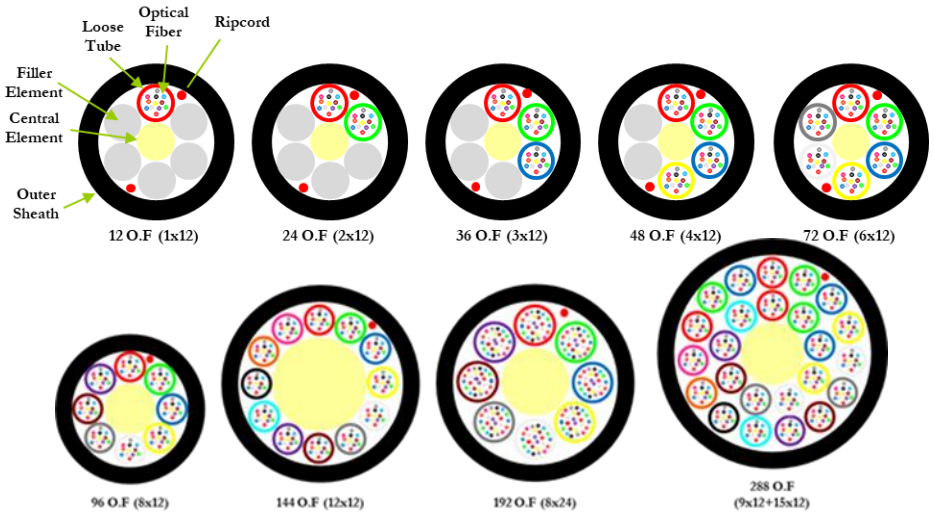
FIBER OPTIC COLOR CODING (DIN/VDE 0888)

12 to 24 fiber optics per tube

No.	1	2	3	4	5	6	7	8	9	10	11	12
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

No.	13	14	15	16	17	18	19	20	21	22	23	24
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Natural	Orange	Pink
	-	-	-	-	-	-	-	-	-		-	-

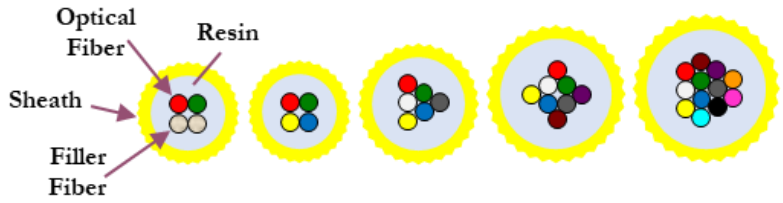
**Use not allowed (not considered in BoQ).*

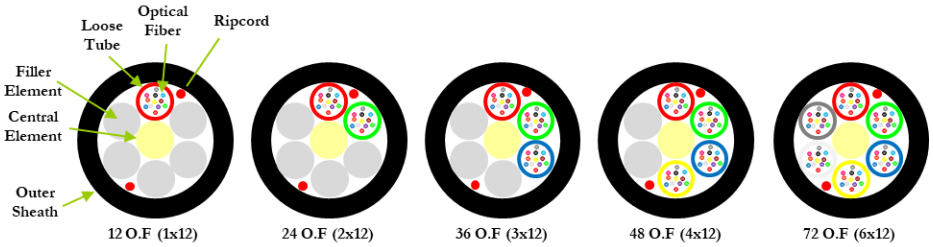


OPTICAL FIBER UNITS FOR DROP CONNECTION

Fiber Count	External diameter	For micro-ducts	Fiber Type
2	< 1,65 mm	7/4	ITU G.657.A2
4	< 1,65 mm	7/4	ITU G.657.A2
6 *	< 1,65 mm	7/4	ITU G.657.A2
8	< 1,65 mm	7/4	ITU G.657.A2
12	< 1,65 mm	7/4	ITU G.657.A2

**Use not allowed (not considered in BoQ).*





FIBER OPTIC COLOR CODING (DIN/VDE 0888)

No.	1	2	3	4	5	6	7	8	9	10	11	12
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

RISER CABLES

Capacity (number of fibers)	Outer diameter (mm)	Number of micromodules	Fibers per micromodule
16	7.6 ± 0.4 mm	4	4
24	7.6 ± 0.4 mm	6	4
32	7.6 ± 0.4 mm	8	4
48	7.6 ± 0.4 mm	6	8

FIBER OPTIC COLOR CODING

No.	1	2	3	4	5	6	7	8
Colour	Red	Green	Blue	Yellow	Grey	Violet	Brown	Orange

MICROMODULE COLOR CODING

No.	1	2	3	4	5	6	7	8
Colour	Red	Green	Blue	White	Grey	Violet	Brown	Orange

DUCTS, MICRO-DUCTS AND BUNDLES

Outer / inner diameter (mm)	Compatible cables	Bundles	Application
50 / 40	-	-	Duct for direct buried applications
18 / 14 *	288	2, 4, 7	Local Backbone
16 / 12	144, 192,288	2*, 4, 7	Local Backbone
14 / 10	12 to 96	1, 2, 4, 7	Feeder Network
12 / 10	12 to 96	-	Installation inside ducts
7 / 4	2 to 12 (f.u.)	1, 7, 12, 24	Distribution Network – Drop connection

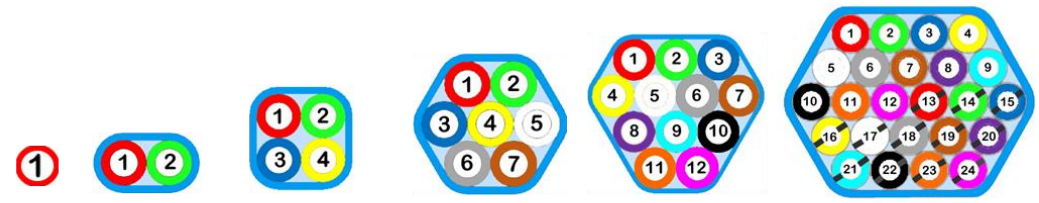
**Use not allowed (not considered in BoQ).*

DUCTS COLOR CODING (DIN/VDE 0888)

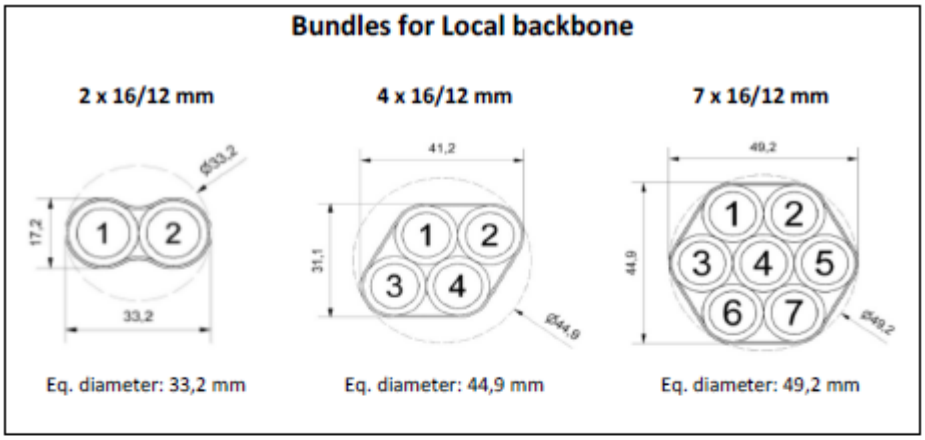
1 to 24 micro-ducts

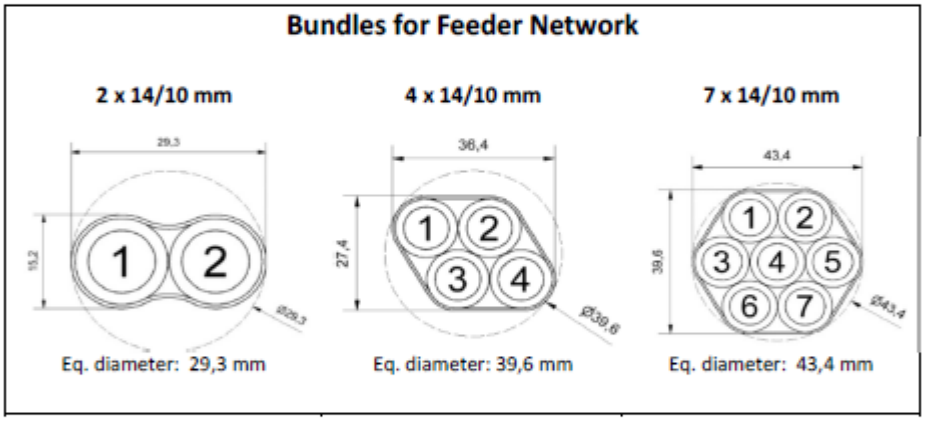
No.	1	2	3	4	5	6	7	8	9	10	11	12
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

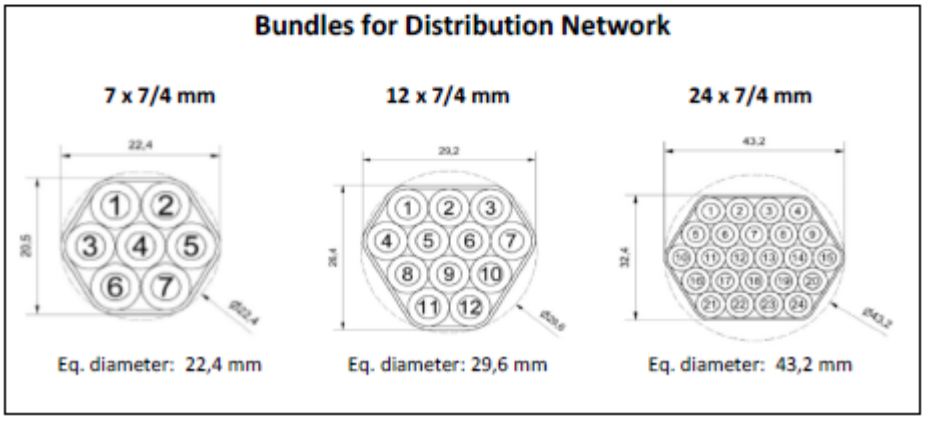
No.	13	14	15	16	17	18	19	20	21	22	23	24
Colour (stripped)	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink



1 way 2 way 4 way 7 way 12 way 24 way


Bundles for Local backbone
2 x 16/12 mm
4 x 16/12 mm
7 x 16/12 mm
Eq. diameter: 33,2 mm
Eq. diameter: 44,9 mm
Eq. diameter: 49,2 mm


Bundles for Feeder Network
2 x 14/10 mm
4 x 14/10 mm
7 x 14/10 mm
Eq. diameter: 29,3 mm
Eq. diameter: 39,6 mm
Eq. diameter: 43,4 mm

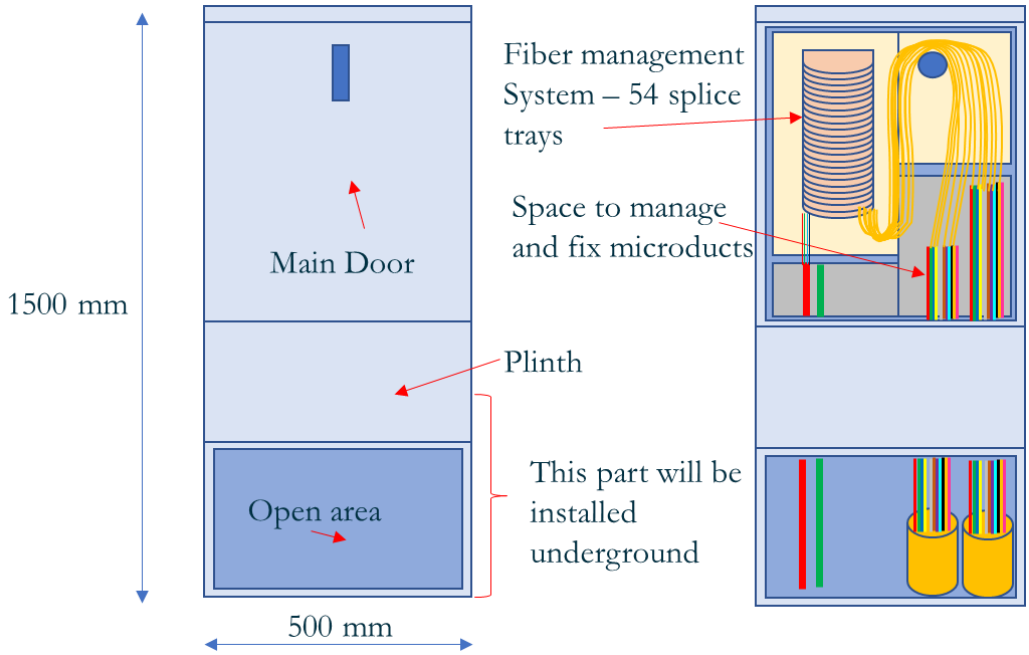

Bundles for Distribution Network
7 x 7/4 mm
12 x 7/4 mm
24 x 7/4 mm
Eq. diameter: 22,4 mm
Eq. diameter: 29,6 mm
Eq. diameter: 43,2 mm

URBAN DISTRIBUTION POINT (UDP)

Parameter	Value
Dimensions (HxWxD)	998 mm x 754 mm x 310 mm, without including the underground portion
Micro-ducts (minimum)	2 x 14 mm and 48 x 7 mm.
Fiber management trays	144 in total
Tray splicing capacity	Up to 6 fusion splices per tray (typically only 2 will be used)

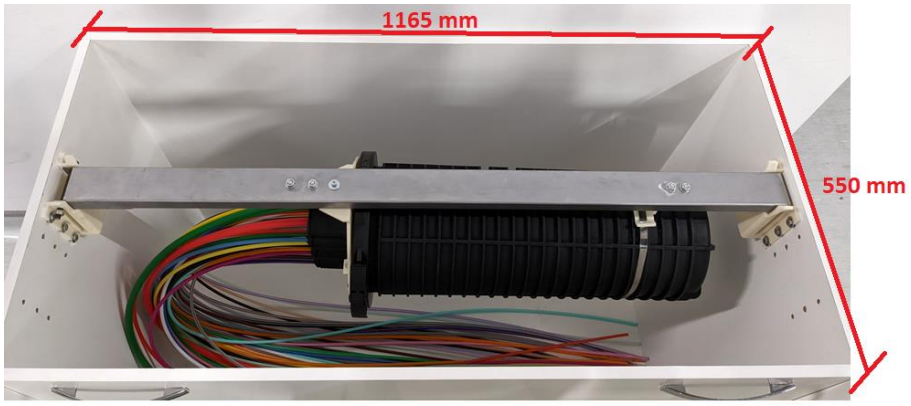
OUTDOOR DISTRIBUTION POINT (DP-48)

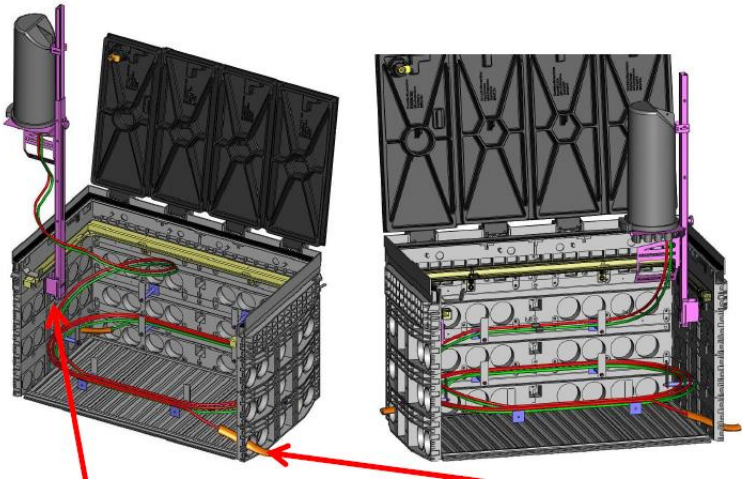
Parameter	Value
Dimensions (HxWxD)	1700 mm x 550 mm x 320 mm, including the underground portion
Micro-ducts (minimum)	2 x 14 mm and 48 x 7 mm.
Fiber management trays	54 in total, 48 for customers + 6 for future use
Tray splicing capacity	Up to 6 fusion splices per tray (typically only 2 will be used)



UNDERGROUND DISTRIBUTION POINT (DP-48)

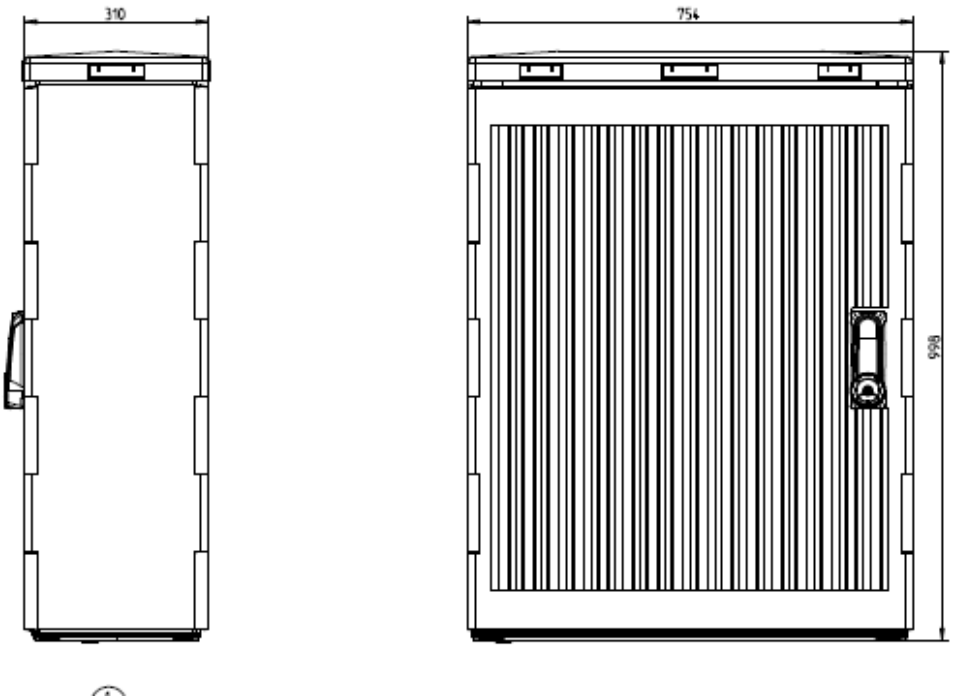
Parameter	Value
Dimensions (HxWxD)	1700 mm x 550 mm x 320 mm, including the underground portion
Micro-ducts (minimum)	2 x 14 mm and 48 x 7 mm.
Fiber management trays	54 in total, 48 for customers + 6 for future use
Tray splicing capacity	Up to 6 fusion splices per tray (typically only 2 will be used)





OUTDOOR DISTRIBUTION POINT (DP-96)

Parameter	Value
Dimensions (HxWxD)	1398 mm x 754 mm x 310 mm
Micro-ducts (minimum)	2 x 14 mm and 96 x 7 mm.
Fiber management trays	108 in total, 96 for customers + 12 for future use
Tray splicing capacity	Up to 6 fusion splices per tray (typically only 2 will be used)



INDOOR DISTRIBUTION POINT, BUILDING NETWORK TERMINATION BOX (BTB) AND IN-DOOR SC

Parameter	Value
Dimensions (HxWxD)	550 x 360 x 180 mm
Micro-ducts	2 x 14/10 mm
Fiber management trays	28 in total, 24 for customers + 4 for other uses
Tray splicing capacity	Up to 6 fusion splices per tray (typically only 2 will be used)
In-Out cables	Up to 2 input cables, max. external diameter 6.5 mm. Accepts pass-through cable. (in and again out after segregation of some fibers) Up to 24 bi-fiber cables for on-demand installation, 3x6 mm section Up to 4 riser cables, max. external diameter 8 mm (only as BTB)

CONNECTORIZED DP	Value
Dimensions (HxWxD)	550 x 360 x 180 mm
Micro-ducts	2 x 14/10 mm
Fiber management trays	28 in total, 24 for customers + 4 for other uses
Tray splicing capacity	Up to 6 fusion splices per tray (typically only 2 will be used)
Connectors	24 x LC/APC duplex connectors
In-Out cables	Up to 2 input cables, max. external diameter 6.5 mm. Accepts pass-through cable. (in and again out after segregation of some fibers) Up to 24 bi-fiber cables for on-demand installation, 3x6 mm section

OPTICAL TERMINATION BOX / FLOOR DISTRIBUTION BOX

Parameter	Value
Dimensions (HxWxD)	212 x 126 x 50 mm
Fiber management trays	1 splice tray
Tray splicing capacity	Up to 24 fusion splices, in two rows of 12 splices
Capacity as OTB	4 upgradeable to 6 LC/APC duplex adapters (6 HP)
Capacity as FDB	4 upgradeable to 8 LC/APC duplex adapters (8 HP)

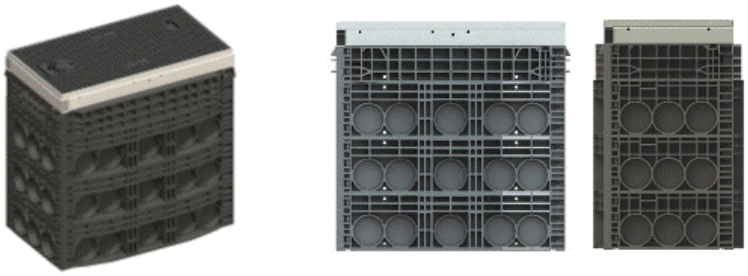


HANDHOLES

SIZE	Internal dimensions (mm)	External Dimensions (mm)	Min Clearance Height (mm)
OC (Accommodates one splicing closure)	550 x 1165	750 x 1300	900
TC (Accommodates two splicing closures)	800 x 1165	995 x 1300	900

LOAD RESISTENCE	Installation conditions
A-15 (kN) *	Installable exclusively in pedestrian or bicycles paths, and green spaces.
B-125 (kN)	Installable in pavements, pedestrian areas, car parks or similar surfaces.
D-400 (kN)	Installable in road carriageways and other permanent traffic surfaces.

** Used not allowed (not included in BoQ)*

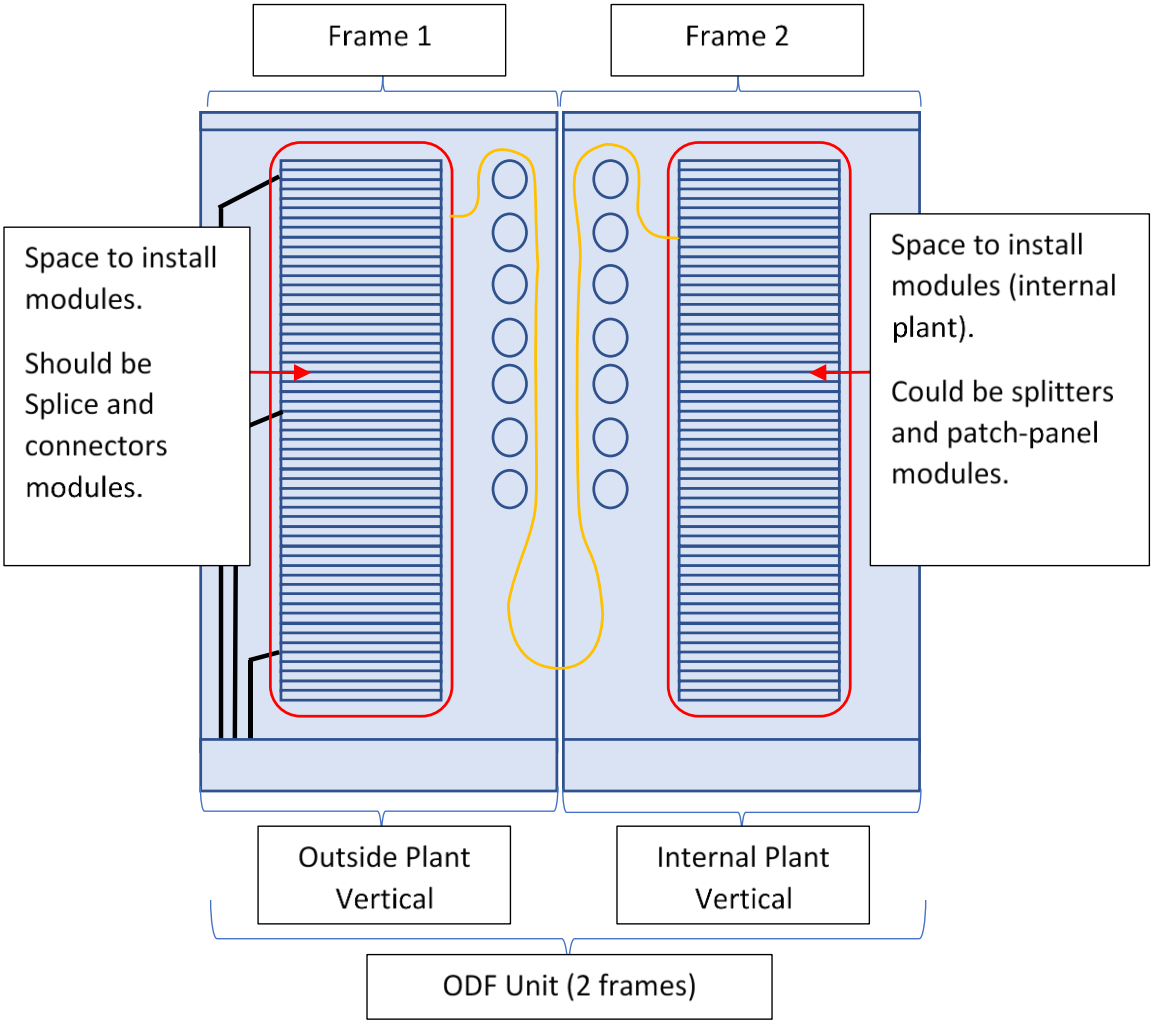


OPTICAL SPLICING CLOSURES

Parameter	Value
Dimensions (H x Φ)	470 mm x 280 mm
Cable entries	10 (8 for end cables and 1 double for pass through cables).
Fusion splicing capacity	288 or 96 (2 different model variants). 12 splices per tray.

OPTICAL DISTRIBUTION FRAME

Parameter	Value
Frame Dimensions (HxWxD)	2200 mm x 1050 mm x 300 mm
Unit Dimensions (HxWxD)	2200 mm x 2100 mm x 300 mm
Number of Modules per frame	56
Capacity per module	48 FO
Max. fibers per OSP frame	2.688 FO


Frame 1
Frame 2
Space to install modules.
Should be Splice and connectors modules.
Space to install modules (internal plant).
Could be splitters and patch-panel modules.
Outside Plant Vertical
Internal Plant Vertical
ODF Unit (2 frames)

ANNEX 2 - CONSTRUCTION ITEMS AND CONSTRUCTION CONSTRAINTS

For updated information and details check document [4] - Civil Works for fiber deployment.

For the interurban sections the LAYJET technology can be used in construction. In this case, its valuation must be added to the LLD design (for more information consult the LAYJET technical normative).

The following civil works items can be considered in the HLD and LLD designs, according to the last BoQ version:

Civil Works	Use
Drilling with non-steerable soil displacement method 45mm diameter	-For crossing streets with only 1 bundle with a maximum diameter of 45mm and for the private section when 1 indoor DP is installed inside the building (applicable only to CS Arch.).
Horizontal Directional Drilling (HDD) 63mm diameter	-1 duct of 50mm outer diameter or 1 bundle. Mandatory for crossing the street with one bundle of 14/10mm. It happens when an address is served with indoor DPs (applicable only to CS Arch.).
Horizontal Directional Drilling (HDD) 125mm diameter	-2 or 3 ducts of 50mm outer diameter or 2 or 3 bundles.
Horizontal Directional Drilling (HDD) 160mm diameter	-4 ducts of 50mm outer diameter or 4 bundles. Only by request of the road administration to be crossed. For crossing rivers and railways, the use of HDD 160mm is allowed.
Horizontal Directional Drilling (HDD) 180mm diameter	-up to 7 ducts of 50mm outer diameter or up to 7 bundles. Only by request of the road administration to be crossed. For crossing rivers and railways, the use of HDD 180mm is allowed.
Ploughing 80cm	See the following explanations
Ploughing 120cm	
Traditional Trenching 30x60cm: Asphalt	Number of bundles between 5-12 (both included) or for all rolling surfaces independently of the number of bundles.
Traditional Trenching 30x60cm: Bricks	
Traditional Trenching 30x60cm: Grass/Unpaved	
Trench for Historic Paving. 30x50cm Surface: Historic Brick	It will be used if Gemeinden requests it.
Trenching 30x80cm: Asphalt	It will be used when Gemeinden or Road Administration request it.
Trenching 30x80cm: Bricks	
Trenching 30x80cm: Grass/Unpaved	
Trenching 40x80cm: Asphalt	Number of bundles between 13-20 (both included)
Trenching 40x80cm: Bricks	
Trenching 40x80cm: Grass/Unpaved	
Micro Trenching 8x40cm: Asphalt	See the following explanations
Nano Trenching 2x15cm: Asphalt	

Mini Trenching 15x45cm: Asphalt	Number of bundles <=4
Mini Trenching 15x45cm: Bricks	
Mini Trenching 15x45cm: Grass/Unpaved	
Impact moling 110 mm	-to cross streets with up to 3 bundles avoiding HDD or Trench.
Impact moling 65 mm	- to cross streets with only 1 bundle avoiding HDD or Trench.
Supplement for asphalt reinstatement (20cm Thickness)	If Road Administration requests it.
Supplement for deeper trenching (5 additional cm of depth per meter of trenching)	It must be used only if it is necessary and from 80cm of depth on.
Supplement for trenching in rocky terrains (Hardness 6 and 7)	This type of soil should be avoided, looking for alternative routes. The use of this supplement must be notified before the construction phase, through the LLD design (its use must be detected during the Kick-off/survey phase).
Perimeter SideWalk	Outside the POP a 100cm wide perimeter has to be built.
Mini Horizontal Directional Drilling (mini-HDD) 32mm diameter	- To avoid underground obstacles. - In design, it will be used in the section between Virtual Handhole Building and Virtual Handhole Fence. The use of another civil work must be justified. However, as stated in 5.2.5 if the distance between both virtual handholes is less than 2m the conduit FTTF must be used in design.
Non-steerable soil Displacement Method	For customer connections (Drop section).
Garden Trenching 15x40cm Surface: Asphalt	It must be used in the section between the VH Fence and the façade when it is greater than 30m or if there are significant turns.
Garden Trenching 15x40cm Surface: Bricks	
Garden Trenching 15x40cm Surface: Grass/Unpaved	

The **use of mini-trenching (width 15 cm)** is only accepted when the number of bundles installed on it is equal to or lower than 4:

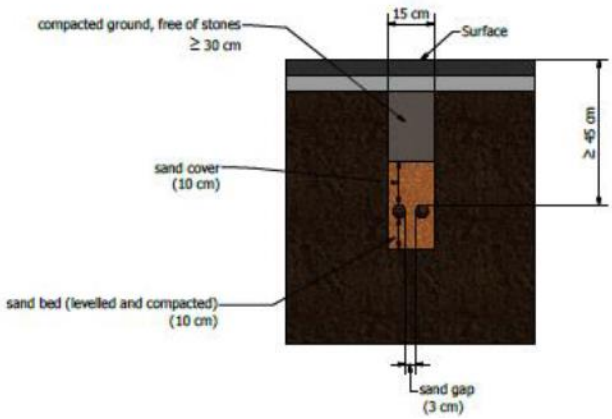


Figure 66.- Trench for 2 bundles

Width: 15 cm, Depth: 60 cm (aprox.)

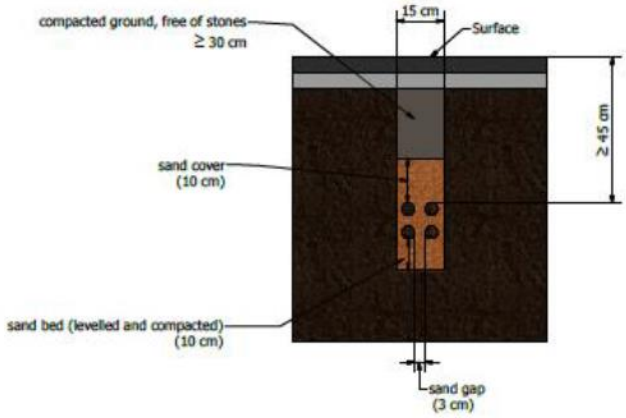


Figure 67.- Trench for 4 bundles

Width: 15 cm, Depth: 68 cm (aprox.)

A **traditional trench (width 30 cm)** is required to install more than 4 bundles, up to 12 bundles:

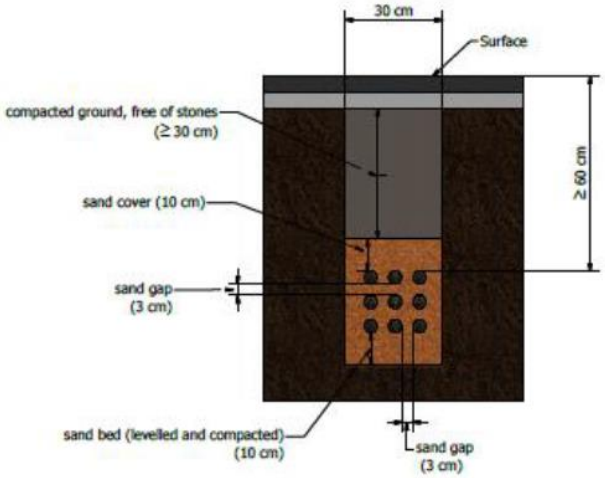


Figure 68.- Trench for 9 bundles

Width: 30 cm

Depth: 90 cm (aprox.)

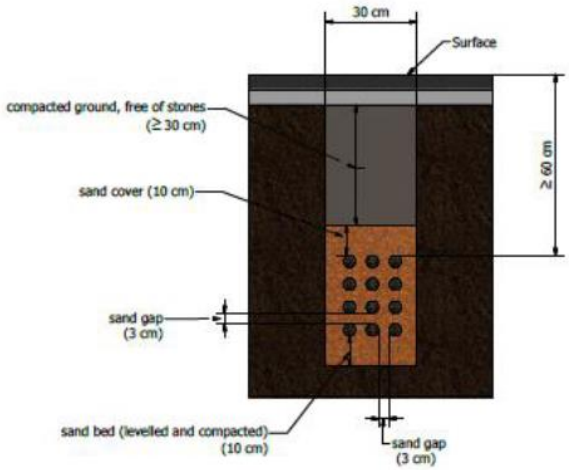


Figure 69.- Trench for 12 bundles

Width: 30 cm

Depth: 96 cm (aprox.)

Traditional trenching is always required for network sections **running along the road (rolling surface),** without considering the number of bundles to be installed inside. For all rolling surfaces (asphalt, brick and grass) traditional trenching must be used. For **rolling asphalt in interurban areas**, if there is no option to use an alternative route, HDD (only one) is recommended, and it should be used before Trenching asphalt. A surface is considered as rolling if there is permanent vehicle traffic. If the surface is not rolling, it must be used between 5-12 bundles (both included).

Trench for Historic Paving 30x50cm will be used always as Gemeinden´s request.

Trenching 30x80cm will be used always if Gemeinden or Road Administration request it.

Trenching 40x80cm will be used when the number of bundles inside is between 13-20 (both included). Also, it is used if Gemeinde requests it. From 13 bundles on and in sidewalks where width is less than 1m parallelism of civil works and bundles distribution, between 2 sidewalks, can be planed as an alternative solution.

In certain cases, the lack of space or the need to share it may require adapted designs.

Micro Trenching 8x40cm: Asphalt and **Nano Trenching 2x15cm: Asphalt** are pending definition of use. UGG will notify when their used is defined.

Ploughing (laying of buried duct plow) can be used in backhaul or backbone network sections when (1) there is no paved path surface, (2) there are no significant obstacles in the ground, and (3) there are no external systems or infrastructures, or their location is very well known. Ploughing is typically used outside the population centers, with one 50 mm duct + one multi-duct bundle. Ploughing, as is deeper than Minitrenching Grass/Unpaved, must be proposed in cases of depth requests (80-120cm).

Road crossings will be preferably designed using drilling (see below) when the number of ducts to install is up to 3, or traditional trenching when the number of ducts to install is 4 or more. For specific requests, crossing will be carried out with more than 1 drilling (63mm or 125mm), while HDD 160mm and HDD 180mm will be used under request of the road administration to be crossed. As summary, these are the priorities:

1º) HDD (63mm or 125mm).

2º) Impact moling (with security regarding other services).

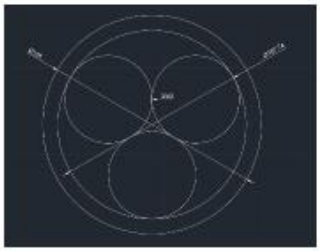
3º) Trenching: 60cm with authorisation and 80cm by request.

Horizontal Directional Drilling (HDD) with **63 mm** boring diameter is used for placing one duct of 50 mm outer diameter or 1 bundle. Mandatory for crossing the street with one bundle of 14/10mm. It happens when an address is served with indoor DPs (applicable only to CS Arch.).

Horizontal Directional Drilling (HDD) with **125 mm** boring diameter is used for placing 2-3 ducts of 50 mm outer diameter or 2-3 bundles.

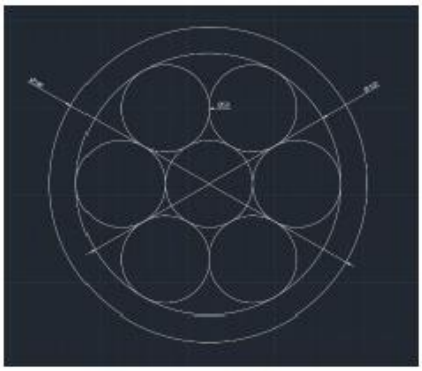
Horizontal Directional Drilling (HDD) with **160 mm** boring diameter is used for placing 4 ducts of 50mm outer diameter or 4 bundles. Only by request of the road administration to be crossed. For crossing rivers and railways, the use of HDD 160mm is allowed.

Horizontal Directional Drilling (HDD) with **180 mm** boring diameter used for placing up to 7 ducts of 50mm outer diameter or up to 7 bundles. Only by request of the road administration to be crossed. For crossing rivers and railways, the use of HDD 180mm is allowed.



Boring of 125 mm

Boring of 160 mm



Boring of 180 mm

Drilling with non-steerable soil displacement - 45 mm: is used for crossing streets with only 1 bundle with a maximum diameter of 45mm and for the private section when 1 indoor DP is installed inside the building (applicable only to CS Arch.).

Impact moling 65 mm will be used for crossing streets with only 1 bundle, avoiding trench or HDD when there is no risk to affect other services.

Impact moling 110 mm will be used for crossing streets with up to 3 bundles, avoiding trench or HDD when there is no risk to affect other services.

Supplement for asphalt reinstatement will be used if the Gemeinden requests it.

Supplement for deeper trenching must be used only if it is necessary and from 80cm of depth on.

Supplement for trenching in rocky terrains should be avoided, looking for alternative routes. The use of this supplement must be notified before the construction phase, through the LLD design (its use must be detected during the Kick-off/survey phase).

Perimeter SideWalk will be built outside the POP (100cm wide perimeter).

Soil Displacement method is used for customer connections. Requires two 1-meter pits, and it is applicable normally when the customer is on the same side of the street than the distribution bundle.

For the **drop connection infrastructure**, the following items are used to provide estimations at network design time:

- **Drilling with non-steerable soil displacement:** in all the cases, from the sidewalk itself to the façade of the house or building.

- **Mini-Horizontal Directional Drilling**: In design, it will be used in the section between Virtual Handhole Building and Virtual Handhole Fence. The use of another civil work must be justified. However, as stated in 5.2.5 if the distance between both virtual handholes is less than 2m the conduit FTTF must be used in design.

Garden trenching 15x40cm must be used in the section between the VH Fence and the façade when it is greater than 30m or if there are significant turns.

These items will be re-evaluated at network execution time, trying to find optimal routes, minimizing the impact of third parties and reducing the total cost.

During conversations with the Gemeinde, there are points that need to be clarified as civil works requirements, depths, land supplements, POP and DP locations, … in order to consider them in the design, BoM and BoQ.

POSITION OF BUNDLES INSIDE THE TRENCH

The micro-duct bundles must have a defined position inside the trench that, whenever possible, should be kept along the whole route.

The position of bundles inside the trench are assigned consecutive numbers, going from left to right on each row, and from bottom to top rows, as shown in the examples.

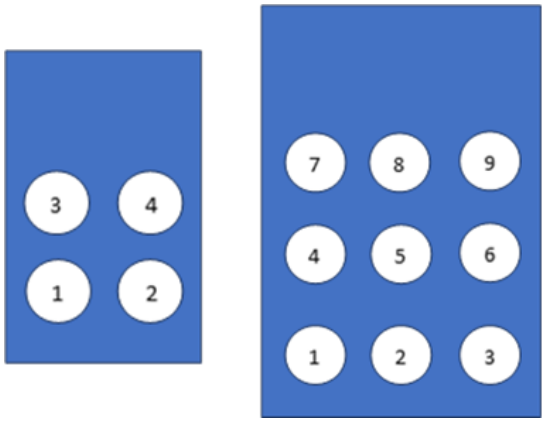


Figure 70.- Positions of Ducts

The "direction" of the trench is considered always from the POP to the field, that is:

• For Local Backbone: Direction Active POP to Passive POP in case of CS Arch. or Headend/Active-Headend POP to Feeder Point in the new DS Arch..

• For Feeder Network: Direction POP to DP in case of CS Arch. or Feeder Point to Urban DP in the new DS Arch..

• For Distribution Network: Direction UDP/DP to customer premises (*exceptions may occur)

Some techniques like HDD or soil displacement drilling do not allow by nature to assign positions to the bundles.

When bundles from different network sections are installed on the same trench, the following order of installation is used (from the bottom to the top):

1. Backhaul/Backup Line
2. Local Backbone
3. Feeder Network
4. Distribution Network

When bundles from the same network section are installed on the same trench, the order of installation is as follows:

1. Backhaul and Local Backbone: in alphabetical order of the bundle_Id
2. Feeder: According to the Feeder BUNDLE_ID (from low to high)
3. Distribution: According to the Distribution BUNDLE_ID (from low to high)

ANNEX 3 – SURVEY GUIDELINES

SURVEY SCOPE

Surveys are used to collect or verify on-site specific technical and operational information about a fiber deployment project which cannot be identified solely through a desktop analysis.

Surveys are planned once during the regular UGG deployment process, as part of the Low Level Design (LLD).

In addition to this standard survey, more specific surveys or walk-throughs can be planned on demand, typically with the Local Authorities or other infrastructure owners.

The **Low Level Design Survey** is done by the Design Company or Construction Company. The content is more specific, focusing on constructive details and civil works constraints:

- Validate the technical feasibility of the project/scope.
- Validation of assumptions and existing HLD information.
- Updated list and location of target addresses and the number of homes per address
- Location of network elements
- Planned methods of construction based on the surface/soil types (survey mobile app allows to load directly into keycom the type of surface to have it as reference for the LLD design), possible use of supplements, …
- Operational constraints (i.e., work signage, impact on road traffic, storage of materials…).
- Permits needed in construction (i.e., bridge or river crossing, other infrastructures). They must be requested with the first LLD version.
- Environment, Health & Safety (EH&S) reports and Risk Assessment (i.e., damages to existing infrastructure, protection of workers…)
- Precise identification of the public or private domain wherein the build project is located (i.e., right owner, street name, side of the road, use of carriage or foot way, etc). Identify additional private or public permits required for the construction phase. We recommend the use of a parcelled cartographic base.

UGG provides a mobile app to do the survey. The main advantage of this tool is the interaction between the field work and UGG apps like Keycom and LOMA.

There are not specific **deliverables** coming out from the survey activities. The information gathered by surveyors from the field needs to be reviewed and processed in the office, and backed-up with other data sources. A survey database will act as repository of all input gathered during the survey process, including all ancillary documents (photos, drawings, sketches, etc). Once the survey file has been reviewed in the office it has to be uploaded to the master UGG database (LOMA) in the correct format (also possible through LOMA mobile). These addresses will be reviewed by the LOMA data quality team and if all of them are correct they will be dumped to Keycom (design tool) in order to be able to start de design.

After processing and approval, the survey information is incorporated to LOMA in a unified standard format, regardless the application or templates used for doing it. The list of addresses and validated equipment locations are added into the designs. The surface types are used to calculate the most economical routes, and included as attributes of the planned routes. The rest of the survey information could be provided as separate

design deliverables, such as permit plans, H&S documents, traffic control plans, notifications to third party infrastructure owners, etc.

SURVEY CONTENTS AND GUIDELINES

Based on the survey scope we can classify the activities into these three main categories:

Address and Demand Surveys: confirm and provide information about streets, addresses, number, type, classification and access point to the houses and building in the area, and a preliminary homes distribution of the building (which will be completed during the in-building survey when applicable).

Network (or Route) Surveys: check and provide the information about the planned route surfaces and available infrastructure, as well as on geographical/environmental/geological information and reinstatement conditions.

In-Building (or In-House) Surveys: provide the required information for the infrastructure installation inside the subscriber buildings (i.e., fiber riser, access to homes, secondary engineering and civil works, etc).

Specific **technical recommendations and considerations** for the surveyors are provided in the next paragraphs for each type of survey:

ADDRESS SURVEYS

- Proper count of the number of addresses and the number of home units per address in a target area is a key quality factor for the elaboration of the survey, network design and business case.
- Until the address data provided by the UGG systems (LOMA) as input to the network design phase is accurate enough, special care must be taken during the survey phase to provide precise data (street names, numbers, number of HP, classification, etc) from the field.
- The **most common mistakes** made during the survey phase are:
  - Missing Addresses:
    - Residential empty lots must be considered but without HPs.
    - Non-residential buildings located along the network route are not included
    - Buildings with house number complements (e.g. 16A) are not considered as separate addresses
    - Addresses not visible from the street, located behind other buildings and accessible only through a lane or courtyard, are skipped.
  - Missing Home Units:
    - In many cases buildings that are apparently Single Dwelling Units have additional residential (a second family) or non-residential (a family business) units. The number of mailboxes must be checked in all the cases.
    - For Multi-Dwelling Units verify the number of front-door mailboxes or the number of doorbell buttons in the main entrance.
- The Excel template is generated by LOMA and it has to be completed with the field information. Once it has been filled out it must be uploaded to LOMA. This document will be part of the design deliverables.

NETWORK SURVEYS

- In urban areas field surveyors must identify the surface type (grass, asphalt, brick) on both sides of the street, and the width of the sidewalk (<1m. or >1m.) to enable network designers to choose the lowest cost trenching methodology that can be used on each section of the streets. The rolling zones must be also observed as they are important to decide the type of trenching. A surface is considered as rolling if there is permanent vehicle traffic.
- Surveys for interurban areas must be also done before starting the LLD design. Surveyors must select the best side of the road to lay the planned infrastructure. Priority must be given to Minitrenching Grass/Unpaved whenever possible, checking the additional conditions (minimum section length, access conditions, …) required to use this technique. Other options by priority order are trenching on unpaved surface or trenching on bricks. If these ones are not possible, HDD 125mm is an option. Trenching on asphalt should be avoided in these routes. The number of road crossings will have to be minimized, especially on Land or Kreis – owned roads. Regarding to interurban sections the different alternatives in terms of road types (primary, secondary, ...) must be analysed before defining the route.

  The minimum depths in these interurban sections are:

  - For secondary roads or where the Gemeinde is responsible (always Minitrenching Grass is the first option):
    - 45cm with previous authorisation
  - For all roads, including secondary roads (Ploughing is the first option if Minitrenching Grass cannot not be used). Before designing with Ploughing it has to be sure that can be used in construction:
    - 60cm with previous authorisation (ideal).
    - 80cm with previous authorisation (default normative).
    - 120cm (in certain cases due to requests)
- Reading and understanding the laws and regulations (at the Land, Kreis and Gemeinde levels) applicable to each deployment is key to select routes that are technically feasible.

IN-BUILDING SURVEYS

- Before carrying out these types of surveys is necessary to read the document 1.3 [5] MDU Design Technical Ammendment.
- All buildings >3 HP will require a specific in-building survey.
- Before doing the survey a permit from the building owner/s must be granted to carry out the activity.
- A sketch with the vertical and horizontal distribution of homes per floor
- The existing vertical and horizontal infrastructure (if any), the network entry point and the common facilities available to install the BDP or DP, etc.

Address Identifiers (ADDRESS_ID) are proprietary 10-character unique names, assigned by LOMA to each address in the Country.

Address Identifiers are composed by the capital letter 'A' followed by two capital letters representing the State (Länder), and then 7 digits from 0 to 9.999.999.

Home Identifiers (HOME_ID) are proprietary 13-character unique names, assigned by LOMA.

Home Identifiers are composed by the ADDRESS_ID, followed by the 3-digit Unit Number field

Homes have also the following additional attributes, required to identify the location of the home inside the building, that are captured and documented as part of the in-building survey:

ATTRIBUTE		Examples
HOME_ID	<ADDRESS_ID><3-digit SEQUENCE NUMBER>	ARP1234567001
STAIRCASE_ID	1 capital letter. Staircase IDs are assigned clockwise, from left to right looking from the building main entrance. The first staircase is labelled "A", and so on. See figures below for further assignment details.	A (first staircase)
FLOOR_ID	2-4 letters or digits. See valid codes in the figures below.	OG1 (first floor)
DOOR_ID	1 or 2 digits, assigned from left to right (clockwise) starting from the first door on the left of the staircase. See assignment criteria examples in the figures below.	1 (first door)

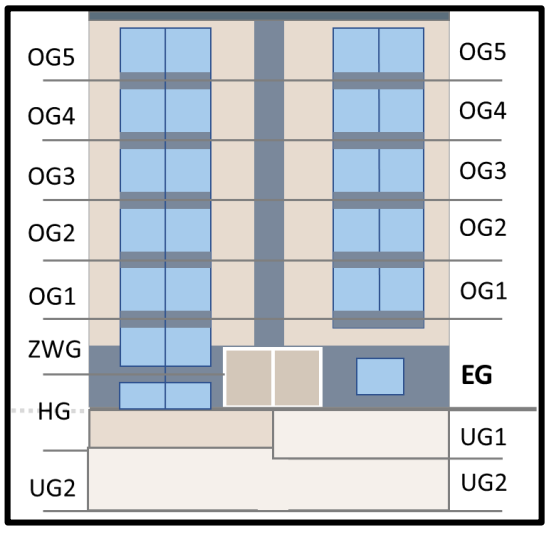


Figure 71.- Floor IDs assigned to most common building plants

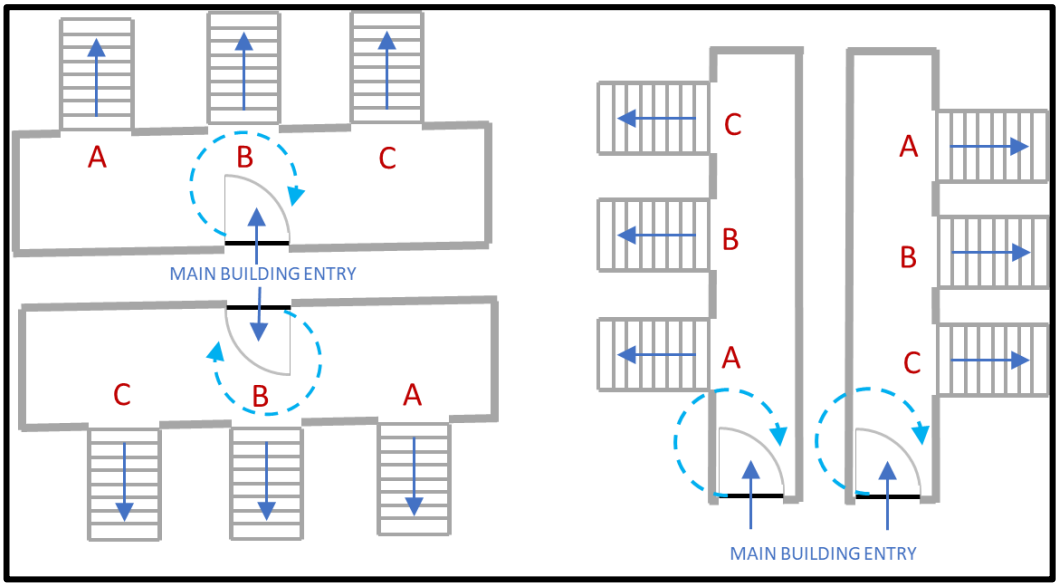


Figure 72.- Examples of assignment of Staircase IDs

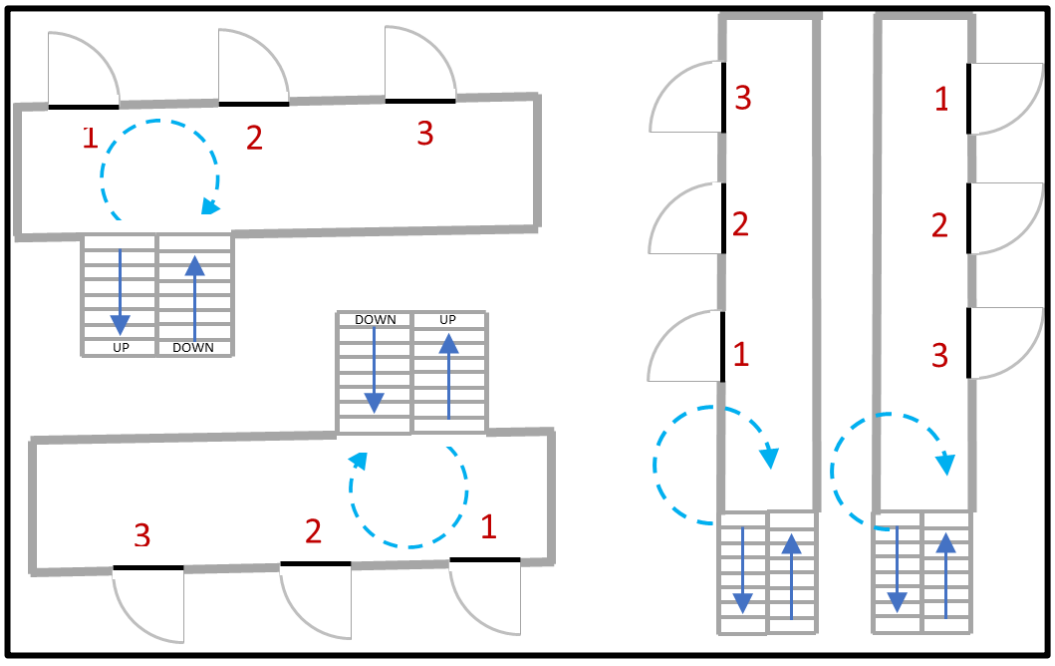


Figure 73.- Door ID assignment examples

GENERAL SURVEY GUIDELINES

- Personal and private data are very strictly protected in Germany by the European General Data Protection Regulation (EU 2016/679) and the New Germany Privacy Act (BDSG or Bundesdatenschutzgesetz). In particular these recommendations must be strictly observed:
    - Personal data (person name, phone number or email address) must never be stored in any part of the survey information.
    - Photographs including people are not allowed.
    - Access to private properties is forbidden. To check the typology of a house or building the surveyor can walk through the public part of the property, until reaching the mailboxes and/or front door bell, never trespassing this point.
- Companies in charge of any survey activity for UGG will provide surveyors with a presentation letter signed by the Company representatives. The letter must be written in German, describing the type of activity that surveyors are carrying out, and proving contact phone and email of the representatives.
- Surveyors will dress a high-visibility vest and other safety clothing and footwear.
- All employees must wear during the working time a visible Company ID card, including name and photograph.
- If asked, surveyors should not provide any additional information to residents other that the information (nature of the works, objectives and dates) contained in the presentation letter. Pay special attention to not disclose the name of the infrastructure owner (UGG) or other network operators renting UGG infrastructure.
- Address and Network-related surveyors shall require the following specific expertise and/or trainings:
    - Basic German language skills
    - Knowledge of EH&S regulation: usually, OSP supervisor or surveyors have a basic EH&S certification although this is not a legal requirement in most jurisdictions.
    - Basic knowledge and practical experience of CAD drawing software or alternative software.
    - Real estate experience
    - Practical knowledge of construction techniques (core drilling, special engineering…)
- In-Building surveyors shall require the following expertise and/or trainings:
    - Advanced German language skills
    - Technical and practical knowledge of MDU infrastructure design and installation.
    - Practical knowledge of architecture & structural building and engineering services.
    - Extensive knowledge about fire extinguishing.
    - Real estate experience is preferred.

CONVERSATIONS WITH THE GEMEINDE

During conversations with the Gemeinde (MOU meeting and Kick off) there are some important points that need to be clarified before starting with the survey and design:

- POP/s FPs and UDP/DPs locations, always trying to satisfy our deployment rules (civil works, Feeder Network length, …).
- Specific depths and civil works requests.
- Difficult access zones, bridges, private accesses, public permits, other services, etc.
- Urbanistic plan and future expansion areas.
- Areas deployed by other operators and type of technology deployed (fiber, copper, …).

PERMITS

As mentioned in previous points, permits needed in construction must be identified in design in order to speed the up their request process. They must be identified in the survey phase and delivered with the permits blueprint and excel file list in the LLD v1. Some permits examples are the following (not all):

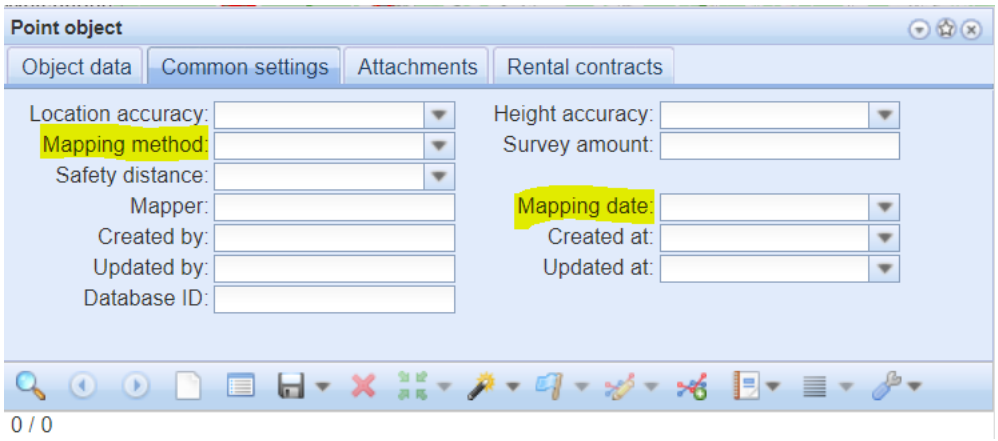
Type of Permit	Avr. Time (aging)
Aufbruchgenehmigung / Civil Work Permit	14 days
Aufbruchgenehmigung Nachtrag / Civil Work Permit Amendment	
Aufbruchgenehmigung Verlängerung / Civil Work Permit Extension	
Autobahnquerung / Autobahn Crossing	2 Month / 40 days
Bahnquerung / Railway Crossing	2-3 Month
Baugenehmigung / Building Permit	3 Month / 60 days
Brücke- und Gewässerquerung / Bridge- and River Crossing	3 Month / 60 days
Denkmalschutzfreigabe / Heritage Protection Release	3 Month / 60 days
Kampfmittelfreigabe / Ordnance Release	3 Month / 60 days
Naturschutzfreigabe / Natural Protection Release	3 Month / 60 days
Privater Vertrag / Private Contract	2 Month / 40 days
Standortsicherung / Location Easement	1 Month / 20 days
VAO / Traffic Regulation	14 days
VAO Nachtrag / Traffic Regulation Amendment	
VAO Verlängerung / Traffic Regulation Extension	
Wasserschutz / Water Protection	3 Month / 60 days
Other	

Figure 74.- Examples of Permits

Permits can be identified though the survey mobile app, dumping the info directly to Keycom. These are the permits that can be identified in Keycom together with the approximate time needed to get them.

Permits	>2 months	>3 months
Autobahn Crossing		
Railway Crossing		
Bridge- and River Crossing		
Heritage Protection Release		
Ordenance Release		
Natural Protection Release		
Private Contract		
Water Protection		
Underpasses		

Once the permits are identified and uploaded to Keycom, their status and the request date must be filled in Keycom in the following fields, if it has not been data through the mobile app.



ANNEX 4 - ACRONYMS

Acronyms	
B2B	Business to Business
BDB	Building Distribution Box
BH	Backhaul
BHR	Redundancy Backhaul
BUL	Backup Line
BNG	Broadband Network Gateway
BOM	Bill of Materials
BOQ	Bill of Quantities
BOS	Bill of Services
CO	Central Office
CPE	Customer Premises Equipment
CS Arch.	Centralized Splitting Architecture
DN	Distribution Network
DP	Distribution Point
DP-48	Distribution Point which serves a maximum of 48 HPs
DP-96	Distribution Point which serves a maximum of 96 HPs
DS Arch.	Distributed Splitting Architecture
EH&S	Environment, Health & Safety
FN	Feeder Network
FO	Fiber Optic
FP	Feeder Point
FTOS	Fiber for future other services
FTTB	Fiber to the building
FTTH	Fiber To The Home
FTTS	Fiber To The Site (BS or BTS: Base Transceiver Station)
GIS	Geographical Information System
GPON	Gigabit-capable Passive Optical Network
HLD	High Level Design
IDP	Indoor Distribution Point
IPV	Internal Plant Vertical
ISP	Inside Plant
KPI	Key Performance Indicators
L2AGG	Layer 2 Aggregation Node

Acronyms	
LB	Local Backbone
LLD	Low Level Design
MBU	Multiple Business Unit
MDU	Multi-Dwelling Unit
N/A	Not Available of Not Applicable
ODF	Optical Distribution Frame
OLT	Optical Line Termination
ONT	Optical Network Terminal
OPV	Outside Plant Vertical
OSP	Outside Plant
OTB	Optical Termination Box
OTO	Optical Termination Outlet (OTB for SFU/SDU)
PtMP, P2MP	Point to Multipoint
PtP, P2P	Point to Point
POI	Point Of Interconnection
PON	Passive Optical Network
POP	Point of Presence
RFP	Request For Proposal
ROW	Right Of Way
SC/APC	Standard Connector/ Angled Physical Contact
SBU	Single Business Unit
SDU	Single Dweling Unit
SFU	Single Family Unit
SLA	Service Level Agreement
SWD	Switcher Distributed
TBA	To Be Added
TBC	To Be Completed
TBD	To Be Defined
UGG	Unsere Grüne Glasfaser
UDP	Urban Distribution Point
VHF	Virtual Handhole Fence
VHR	Virtual Handhole of Redundancy