ETSI TS 101 573 V1.1.1 (2012-09)

Access, Terminals, Transmission and Multiplexing (ATTM);
General engineering of optical building cabling

Reference
DTS/ATTM-02017

Keywords
cable, intelligent homes & buildings, optical

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

Introduction

The present document is effective when the optical cabling in a building is shared between multiple optical access operators.

Figure 1 shows a schematic representation of what could exist in a building with multiple operators' FTTH access networks, in two distinct situations:

a) without shared cabling by using or not using a building distribution point (see figure 1);

b) With shared cabling between the building distribution point and the ENTI (see figure 2).

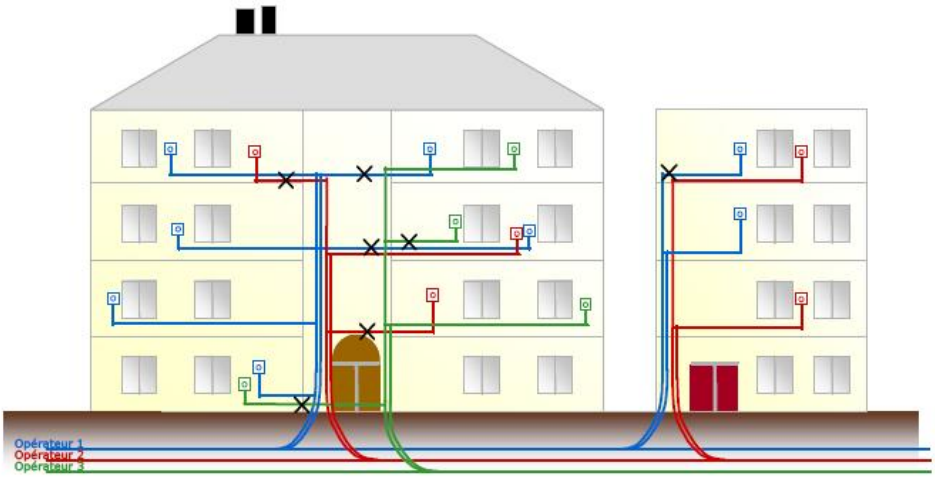

Figure 1: Individual building cabling for each operator

Many cables and boxes could be installed in common parts in this assumption which can cause permanent disturbance for inhabitants. Besides, saturation of infrastructures could be reached with a strong impact on reliability of existing and new cables and on maintenance issues.

A challenge for operators in that case could be to try to provide the condition for optical cabling sharing inside the building, as shown in figure 2.

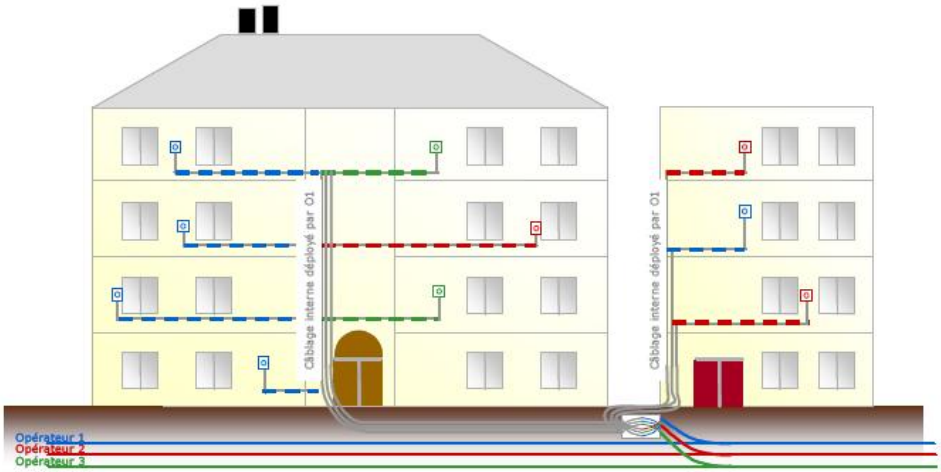

Figure 2: Shared optical building cabling for all operators (when multiple "optical access networks" are deployed)

1 Scope

The present document specifies the optical cabling in a building when it is shared between multiple optical access operators.

The proposed building cabling allows access to each operator to optical fibres in the building for multi-dwelling units (MDU). The main goal of the concept is to be able to share the optical building cabling among different optical access operators.

The present document details the different architectures of a shared optical cabling and each element of the building cabling.

These elements are the distribution point, the indoor building cabling and the optical termination at the customer premises.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] CENELEC/IEC EN 60794-2 series: "Optical fibre cables - Part 2: Indoor optical fibre cables".

[2] CENELEC EN 50399: "Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results".

[3] CENELEC/IEC EN 60794-2-20: "Optical fibre cables - Part 2-20: Indoor cables - Family specification for multi-fibre optical distribution cables".

[4] ITU-T Recommendation L.87 (2010): "Optical fibre cables for drop applications".

[5] ETSI TS 102 873: "Access, Terminals, Transmission and Multiplexing (ATTM); Optical External Network Testing Interface".

[6] CENELEC/IEC EN 61755-1: "Fibre optic connector optical interfaces - Part 1: Optical interfaces for single mode non-dispersion shifted fibres - General and guidance".

[7] CENELEC/IEC EN 60793-2-50: "Optical fibres - Part 2-50: Product specifications - Sectional specification for class B singlemode fibres".

[8] CENELEC/IEC EN 61754-4: "Fibre optic connector interfaces - Part 4: Type SC connector family".

[9] CENELEC/IEC EN 61754-20: "Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 20: Type LC connector family".

[10] CENELEC/IEC EN 61754 series: "Fibre optic connector interfaces".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

building operator: operator who installs and is responsible for the maintenance of the vertical and/or horizontal cabling in the building and gives an access to it to the other operators

building optical line: optical line between the distribution point at the building basement and the customer outlet

customer outlet: allows the connection of fibre(s) from a cable to the ONT

dedicated fibre: fibre dedicated for only one operator, which is available permanently for this operator

NOTE: The fibre may be part of an indoor cable or of a blowing-based microducts.

distribution point: point that allows the connection of the outdoor cable (feeder and / or drop) to the indoor (in-house or building) cable

NOTE: The type of connection may be a fusion splice or other optical connection.

drop cable: individual cable which links up the distribution point to the optical external network testing interface (ENTI)

NOTE: This cable can be composed by one or more fibres.

floor distributor: if exists, is situated on one floor and distributes fibres or indoor cables on one or across the floor(s) to each customer/ individual apartments

outdoor drop cable: outdoor cable that comes into the building, ending at the distribution point

optical External Network Testing Interface (ENTI): physical point at which a subscriber is provided with access to an optical communications network

NOTE: This is actually the optical connector adapter in the customer outlet.

shared fibre: fibre shared between several operators, which is available temporarily or permanently for one operator.

vertical cabling: part of the building cabling between the distribution point and the floor distributor (when it exists.) or the ENTI

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

APC	Angled Physical Contact
ENTI	External Network Testing Interface
FTTH	Fibre To The Home
LC	Lucent Connector
MDU	Multi Dwelling Unit
ONT	Optical Network Termination

PON	Passive Optical Network
SC	Subscriber connector
UPC	Ultra Physical Contact

4 Shared building cabling

The building operator or building owner may take the initiative in cabling a building. They should expect to give the access to telecom operators to the optical building lines with a distribution point at the building basement. The number of operators should be limited by a maximum, for practical deployment reasons and based on the real needs of the market.

The "building operator" deploying the building optical cabling could be in charge of the installation and/or maintenance of this sharing point. Usually this is the first operator who comes in.

The shared building cabling combined with the distribution point should support both Point to Point and Point to Multipoint access network topologies. So, a Point to Point cabling shall be used by all telecom operators between the building basement and customer outlets or External Network Testing Interfaces (ENTI).

4.1 Single fibre architecture (one fibre for each customer, shared among different operators)

Choice could be made to deploy only one fibre per customer in the vertical part of the building and to share it between the different operators. This choice could be made by the building operator or by the owner of the building, depending on free room in the vertical shaft or may be subject of co-operation contracts between operators.

Telecom operators could have access to shared fibres at the distribution point. Each fibre is temporarily assigned to one operator when needed to give access to its services for customers.

The single fibre dedicated to the customer could be contained in a single fibre drop cable or in a multi-fibres riser cable (see clause 6).

4.2 Multi-fibres architecture (more than one fibre for each customer, dedicated to single operators or shared among them)

Choice could be also made to deploy a multi-fibres architecture based on the installation of minimum 2 fibres per apartment, in which a fibre is dedicated to each operator.

Operators could have access to dedicated fibres at the distribution point, which are permanently available for their own use.

It could be also possible to give access to shared fibres with this architecture.

5 Distribution point

The Distribution Point is the interface between optical access networks of different operators and the optical building cabling. It should be compatible with Point to Point or Point to Multipoint optical access network architectures.

Depending on building, area and networks topologies, the Distribution Point could be used for one building when the building size is sufficient, but could also be shared between several buildings. It could be installed inside or outside buildings. Information about the localisation, number of apartment connected, owner and type of Distribution Point should be available for all operators.

It represents:

- a flexibility point where the building operator can manage the allocation of customers' fibres between telecom operators
- a demarcation point to separate the responsibility of each operator among telcos and with building operators
- a point for optical measurements (attenuation and return loss), if optical connections available and demountable

The Distribution Point should be composed of three parts (figure 3):

- a "customer's area" for the management of fibres from riser cables or indoor cables (customer module)
- "operator's area" dedicated for each operator for the management of fibres coming from their access network. This separated area could be sort of modules with connectors or splice trays for example. They should be able to accept potential splitters. When it is not possible splitters could be installed in another box
- a "connection area" for interconnection between fibres of the building cabling and access networks with use of patchcords or pigtails

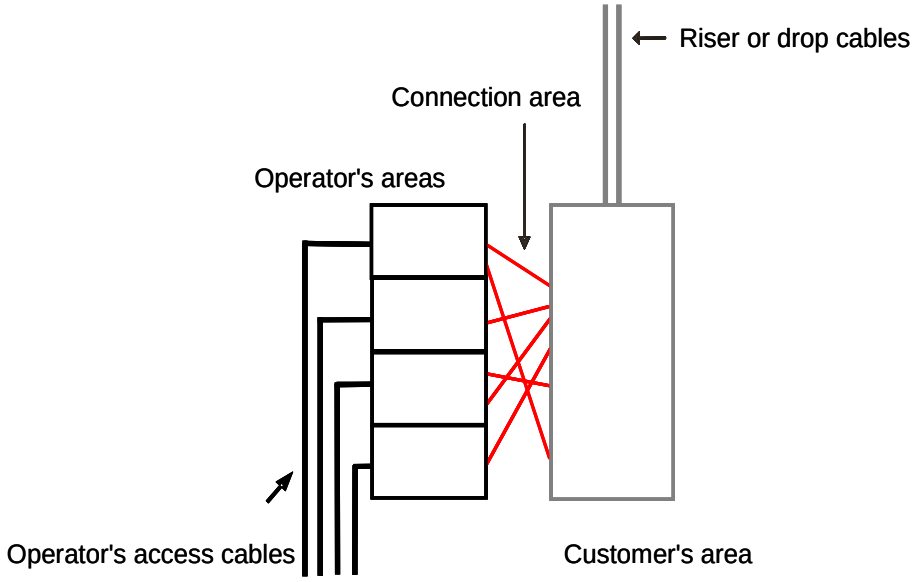

Figure 3: Illustration of a Distribution Point

In case of a single fibre sharing architecture, the Distribution Point should allow an "any to any" cross-connection between shared fibres of the building cabling and fibres from access networks of each operator.

When a multi-fibres architecture is deployed in the building the Distribution Point should allow, for each operator which has a dedicated fibre in the building, the connection of its own building cabling fibres with fibres from its access network. The sharing point could give both access to dedicated fibres and shared fibres if the operator wants to share its fibres.

The Distribution Point should be designed to allow:

- frequent arrangements of fibres
- new cables installation or older cables replacement
- add-on or replacement of optical splitters when splitters are considered inside the sharing point (for PON access networks)
- splicing operations (fusion or mechanical).

NOTE: It should be noted that the non-standardized dimensions of the mechanical splice protectors are not compatible to dimensions of the fusion splice protectors, therefore it is advisable to avoid the mechanical splices in the distribution point.

The customer's area should be dimensioned for all customers at day one. It could be useful to have the possibility to install operator's areas only when needed with a modular solution.

The Distribution Point should consider the environmental impact (climatic, mechanical, dust …) to allow indoor and outdoor installation.

6 Indoor cabling

Based on operators' consensus, different cabling systems could be installed in the indoor part:

- easy mid span access cables
- microcabling solutions
- pre-connectorized solutions, etc.

Cables used inside the building should be compliant with EN 60794-2 [1] series.

The reaction to fire of the cables shall comply to EN 50399 [2].

Figure 4 shows examples of cabling solutions in a building, both applicable to the single fibre or multi-fibres architecture.

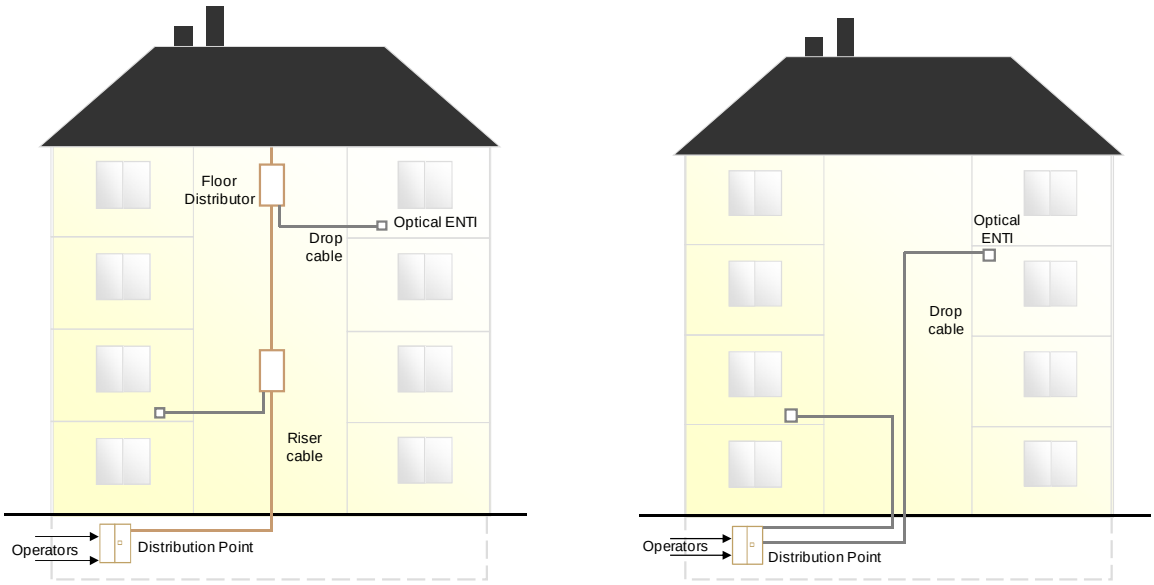

Figure 4: Example of cabling solutions in buildings: The indoor cables may contain one or more fibres for each customer depending on the chosen architecture

6.1 Riser cable

The riser cable(s) should be dimensioned to connect all customers premises in the building.

Depending on the building configuration (number of apartments, floors…), type of sharing architecture (single fibre or multi-fibres), a riser cable could be based on single elements of one or several fibres (4, 8 or 12 fibres for example) to serve Distribution Points.

In order to reduce the time for installation of the cable extremity in the distribution point, it could be pre-terminated with connector plugs.

6.2 Drop cable

Drop cables should be compliant with requirements given in EN 60794-2-20 [3] and recommendations in ITU-T Recommendation L.87 [4].

Only one single drop cable could be used for each customer. It can contain one single mode fibre (case of a single fibre sharing architecture) or several single mode fibres (multi-fibres architecture).

Depending on building architectures, drop cables could be laid (see figure 4):

- from the Distribution Point to the External Network Testing Interface or the Customer Outlet
- from the Floor Distributor to the External Network Testing Interface or the Customer Outlet

Dimensional and mechanical characteristics of the cable shall be adapted for different building configurations. The drop cable can be pulled in existing sleeves but also stuck or stapled along the walls, or installed in a conduit. Techniques of blown cables/fibres in microducts can also be used.

Installation of the drop cable could be made at day one (for example in case of new buildings), or only on demand when a customer ask for service (existing buildings).

The drop cable could be pre-terminated with connector plugs, at only one end or at both ends. This would significantly reduce the cost and skill-set required for installation of the drop cable. It could also be interesting for quality reasons. On the other hand, the use of pre-terminated solutions at both ends involves that a number of given lengths of the drop cable have to be chosen in order to cover the possible path lengths in the building. Moreover the management of the over-length of cable is needed.

6.3 Floor Distributor

The link between riser cable(s) and drop cables could be located at the floor distributor Point.

Fibres of the vertical cable are connected to fibres of drop cables by splices or/and connectors, or directly routed to the customer premises. In the first case the Distribution Point could be made by a floor distributor Box or a floor distributor System. In the second case it could be made by a simple breakout box.

6.3.1 Floor Distributor box

The floor distributor Boxes should be designed to allow splices and/or connectors (with pre-connectorized solutions or field mountable connectors for instance). They should allow the management of fibres.

The floor distributor Boxes are installed in the vertical part of the building at floors levels. Their location depends on distribution boxes capacity, cables modularity, number of floors and customers per floor, installation facilities (existence or not of a vertical shaft, width and depth of the vertical shaft). A distributor box can serve several floors.

For riser cables with single elements dedicated to a single customer small floor distributor boxes dedicated for only one customer can be used. These boxes should be only installed when laying the drop cable instead of at initial time when laying the riser cable.

6.3.2 Floor Distributor Breakout box

A breakout box could be used to break out and distribute the single elements from the riser cable into small protective tubes without need of any splice. With the term "element" one fibre or a group of fibres is indicated. The protected single elements can be routed directly from the riser cable to the customer premises or to an intermediate point with splice.

6.3.3 Floor Distributor System

A floor distributor System could be used when there is not enough free space in the vertical shaft or it is not possible to obtain the permission to install "at sight" distribution box at floor level.

The floor distributor system could include:

- breakout boxes + small tubes to extract and protect the single elements
- protection accessories which allow to protect the splice between the fibres from the riser cable and the fibres from the drop cable with a miniaturised solution.

Both the breakout box and the splice(s) protection accessory could be physically separated and located in different points at floor level (as an example the breakout box is necessary located in the vertical shaft on the riser cable but the splice protection accessory could be located inside the tube to the customer flat). An example of Distribution System is shown in figure 5.

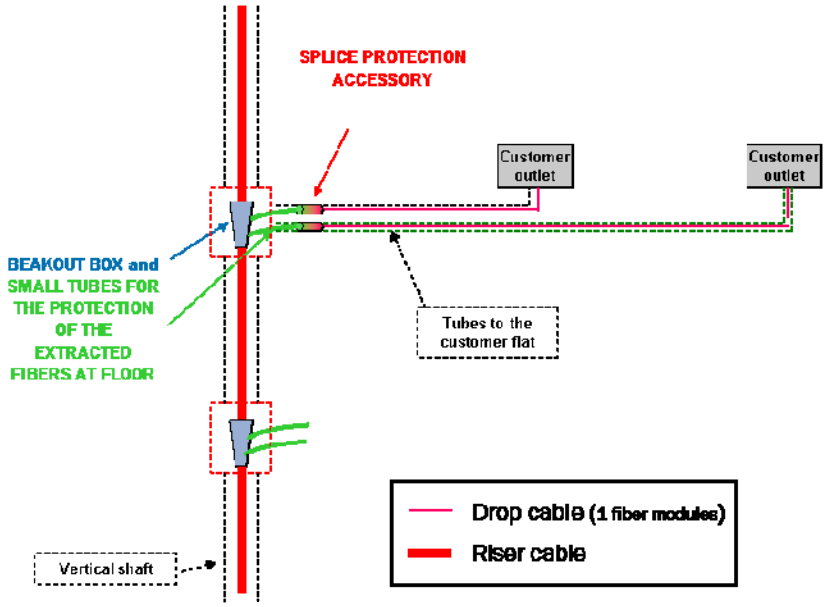

Figure 5: Example of a Distribution System

When the floor distributor system is dedicated for only one customer, the installation of the distribution system could be made partially at initial time, installing the breakout box, but the splice protection accessory could be installed only when the customer is connected with the drop cable.

Several customers could be served by one single tube over several meters from the riser cable to an additional derivation point and then have their own tube entering the flat: an example is shown in Figure 6, in which at this derivation point the connection among the protective small tubes is made by using an appropriate accessory.

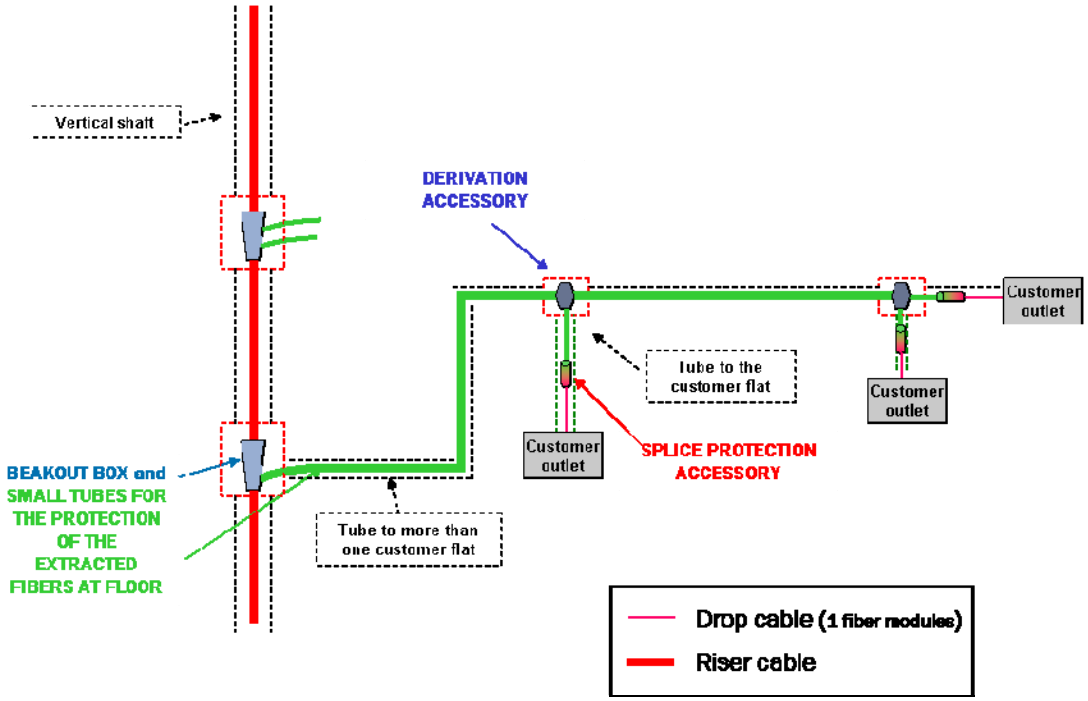

Figure 6: Example of a floor distributor System + derivation accessory in the case of initial sharing of customer tube

7 Optical termination

The connection of a drop cable (or a single element extracted from the riser cable or from the riser cable itself) fibre with the Optical Network Termination at the customer premises could be accomplished through an optical External Network Testing Interface. Figure 7 illustrates typical configurations.

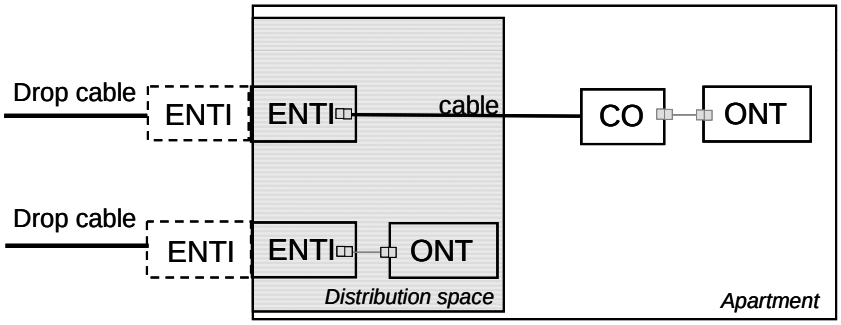

Figure 7: Illustration of typical cabling configurations at the customer premises

7.1 Optical External Network Testing Interface (optical ENTI)

The optical ENTI is defined in TS 102 873 [5]. It is a demarcation, measuring and testing point and allows isolation of customer's in-house cabling from the building's cabling. It would be installed at the entrance of each apartment outside or inside the apartment. When installed inside it should be in a distribution space (collocated near the home distributor).

The ENTI allows the connection of fibre(s) from a drop cable to the ONT.

The fibre(s) from the drop cable could be spliced with pigtail(s) or terminated with field mountable connectors when the cable is not already pre-terminated with optical plug(s). A patchcord (fibre optic cable terminated with connectors on both ends) is then used to connect the ONT to the ENTI.

8 Optical budget and return loss

In order to be used by any operator, independently of the transmission technology chosen, the building operator or the building owner should guarantee for the optical lines they provide:

- a maximum attenuation between the two ends of the line
- a minimum return loss

Considering that the attenuation due to short fibre length is not significant, a theoretical value of the attenuation could be calculated by taking into account the numbers, type of connections (connectors, fusion splices or mechanical splices) and type of fibres connected. It also should be noted that cable bending can also contribute significantly to the total power budget.

This value could vary a lot according to the building cabling architecture. Connection attenuation and return loss values are defined in standards EN 61755-1 [6] for optical connectors. For mechanical and fusion splices following table shall be used.

Table 1: attenuation and return loss for both mechanical and fusion splices

Characteristic	Mechanical splice	Fusion splice
Max. attenuation	0,25 dB	0,15 dB
Return loss	> 60 dB	> 60 dB

9 Fibres

Single mode optical fibres described in EN 60793-2-50 [7], categories B1.3 and B6 should be used for cables (riser cables, drop cables), patchcords and pigtails at the different parts of the building cabling depending upon users' environmental conditions and technical requirements.

Bending loss insensitive single mode optical fibres EN 60793-2-50 [7], category B6 should be preferred, especially for the drop part of the building cabling where fibres should have more bend constraints. It could allow a faster and safer installation, and also a possible reduction of boxes sizes.

In cases of limited optical budget, care should be taken to use for the whole cabling fibres which are compatible for connection in order to minimise insertion losses for each connection. When EN 60793-2-50 [7], categories B1.3 and B6 fibres are used at the same time, choice of EN 60793-2-50 [7], category B6a would be then preferred for bending loss insensitive fibres.

10 Connections, connectors and cords

Connectors could be used in the distribution point, the external network testing interface, the distribution box and customer premise equipments with different environmental conditions. They could be manipulated by qualified technicians in the sharing point for example but also by the customer at the outlet. They have to be reliable over a long time period, with low insertion losses.

The SC connector (SC/APC or SC/UPC) according to EN 61754-4 [8] is the most commonly used in building cabling by operators who deploy FTTH. LC connector according to EN 61754-20 [9] could also be employed to increase the density of materials. Other connectors if standardised in EN 61754 [10] series can be used too.

Depending on their location it could be useful to use connectors and/or adaptors with an integrated dust and laser safety protection.

For the connections between the ENTI and ONT following aspects for the terminated cords shall be considered:

- means for disconnecting the connector without destroying the ENTI box by accidental tensile load
- means for preserving dust to interfere with connection while connector is open

- means for sure connecting/disconnecting in the premises environment
- cord cables to withstand severe environmental impact in the premises

In order to be compliant with services which require high quality transmission (and therefore low reflection losses), it could be recommended to use Angled Physical Contact (APC) connectors with specified return loss of 60 dB (mated) or 55 dB (unmated).

Connectors can be mounted on fibres at the factory but also in the field. Main features of field mountable connectors in terms of types, fields of application, configurations and technical aspects should be defined in a future document.

History

Document history		
V1.1.1	September 2012	Publication