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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Optical cabling shared with multiple operators in buildings

Recommendation ITU-T L.82

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Summary

At this time, very high broadband network, especially FTTH (fibre to the home) deployment, is a major challenge for operators. One of the main issues is the terminal part of the network with the introduction of optical fibre cables into building up to the apartment with technical difficulties but also administrative ones. Recommendation ITU-T L.82 deals with the solutions which could be deployed to try to answer to building owners, operators and customers' needs.

This Recommendation refers to the single mode optical cabling in new and existing buildings. Clauses 5 and 6 explain the main constraints of a common optical infrastructure for several operators, offering FTTH services to customers in the same building. Then, the remainder of this Recommendation describes possible cabling solutions which could be deployed in buildings.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T L.82	2010-07-29	15

FOREWORD

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CONTENTS

Introduction

The proposed building cabling allows access to each operator to optical fibres in the building. The main goal of the concept is to be able to share the optical building cabling among different optical access providers.

The objectives are, on one hand, to reduce fibre installation and maintenance costs in the building (both at the customer premises and in the common parts) and, on the other hand, to reduce disturbance (noise, infrastructure works, dust, etc.) for inhabitants. The goal is also to avoid the possibility for an operator to somewhat "pre-empt" the optical link up to the customer in a building or to avoid cabling duplication if more than one FTTH operator is in a building.

Recommendation ITU-T L.82

Optical cabling shared with multiple operators in buildings

1 Scope

This Recommendation is effective when optical cabling in a building is shared with multiple optical access operators. Figure 1 shows a schematic representation of what could exist in a building with multiple operators' FTTH access networks, without shared cabling.

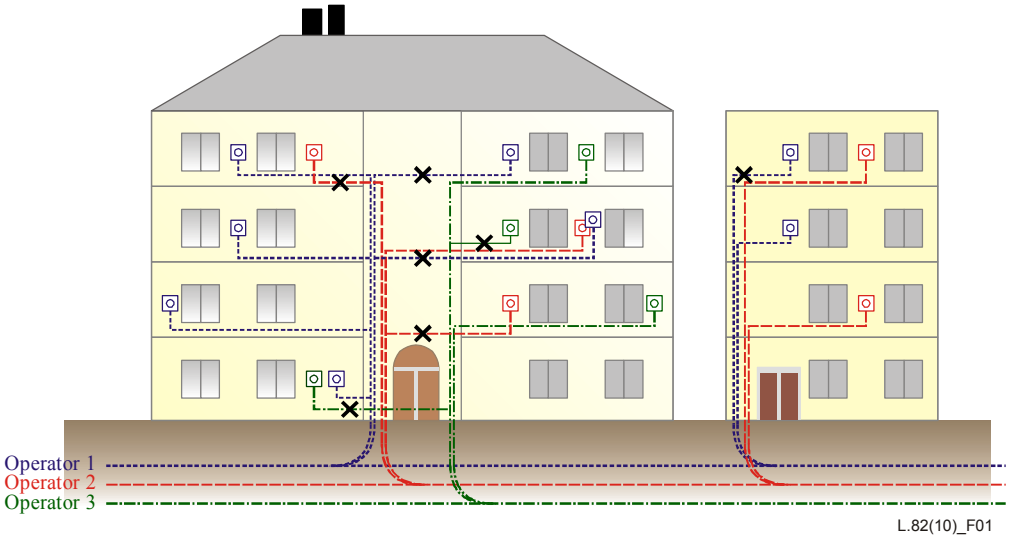

Figure 1 – Individual building cabling for each operator

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:

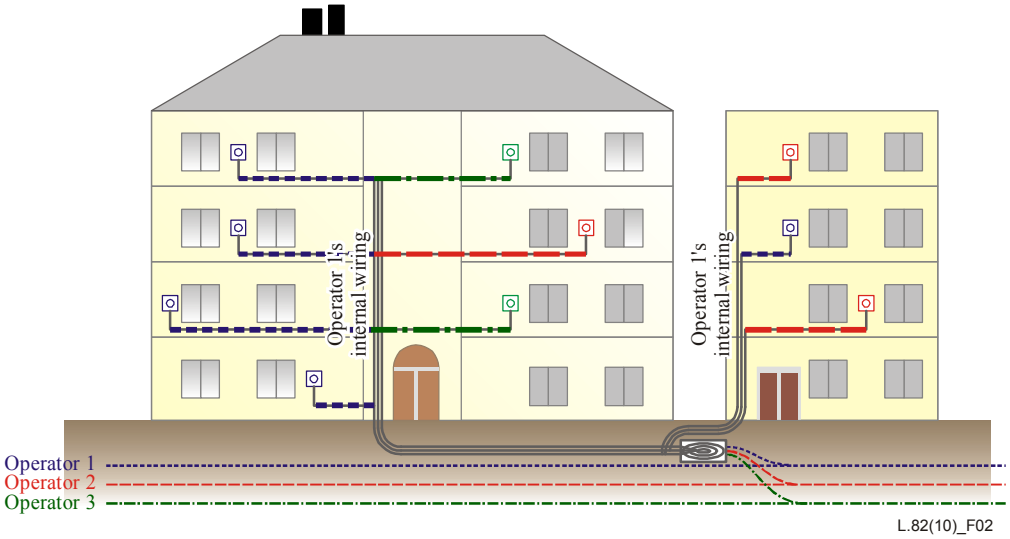

Figure 2 – Shared optical building cabling for all operators (when multiple "optical access networks" are deployed)

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.652] Recommendation ITU-T G.652 (2009), *Characteristics of a single-mode optical fibre and cable*.

[ITU-T G.657] Recommendation ITU-T G.657 (2009), *Characteristics of a bending loss-insensitive single-mode optical fibre and cable for the access network.*

[ITU-T L.12] Recommendation ITU-T L.12 (2008), *Optical fibre splices*.

[ITU-T L.36] Recommendation ITU-T L.36 (2008), *Single-mode fibre optic connectors*.

[ITU-T L.59] Recommendation ITU-T L.59 (2008), *Optical fibre cables for indoor applications*.

[ITU-T L.87] Recommendation ITU-T L.87 (2010), *Optical fibre cables for drop applications*.

3 Terms and definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 single element [b-IEC 61756-1]

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 building optical line: Optical line between the sharing point at the building basement and the customer outlet.

3.2.2 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.

3.2.3 customer outlet: Allows the connection of fibre(s) from a cable to the ONT.

3.2.4 distribution point: When it exists, the distribution point is the point where customers are connected to the vertical part of the building cabling with an individual cable (the drop cable) by splice and/or connector. The customer could be also connected extracting fibres from the riser cable and routing them to the customer premises.

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

3.2.6 drop cable: Individual cable which links up the distribution point or the sharing point to the customer outlet or the optical external network testing interface. This cable can be composed of one or more fibres.

3.2.7 optical external network testing interface: Physical point at which a subscriber is provided with access to an optical communications network.

3.2.8 shared fibre: Fibre shared between several operators, which is available temporarily for one operator.

3.2.9 sharing point: Interface between optical access networks of different operators and the optical building cabling.

3.2.10 vertical cabling: Part of the building cabling between the sharing point and the distribution point when it exists.

4 Abbreviations

This Recommendation uses the following abbreviations and acronyms:

CO Customer Outlet

ENTI External Network Testing Interface

FTTH Fibre To The Home

ONT Optical Network Termination

5 Shared building cabling

The building operator or the building owner may take the initiative in cabling a building. They should expect to give access to operators to the optical building lines with a sharing 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.

The shared building cabling combined with the sharing point should support both point-to-point and point-to-multipoint access network topologies. So, a point-to-point network should be used by all the operators between the building basement and customer outlets or the external network testing interfaces.

5.1 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.

Operators could have access to shared fibres at the sharing point. Fibres are temporarily assigned to one operator, when needed, to give access to services for customers.

The single fibre dedicated to the customer could be contained in a single drop cable or in a multi-fibres riser cable (see clause 7).

5.2 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 sharing point, which are permanently available for their own use.

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

6 Sharing point

The sharing 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 network topologies, the sharing 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 localization, number of apartments connected, owner and type of sharing point should be available for all operators.

It represents:

– a flexibility point where we can manage the allocation of customers' fibres between operators;

– a demarcation point to separate the responsibility of each operator;

– a point for optical measurements (mainly attenuation and return loss).

The sharing point should be composed of three parts (Figure 3):

– a "customer's area" for the management of fibres from riser cables or drop cables (customer module);

– "operator's areas" dedicated for each operator for the management of fibres coming from their access network. These separated areas 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 the interconnection between fibres of the building cabling and access networks with use of patchcords or pigtails.

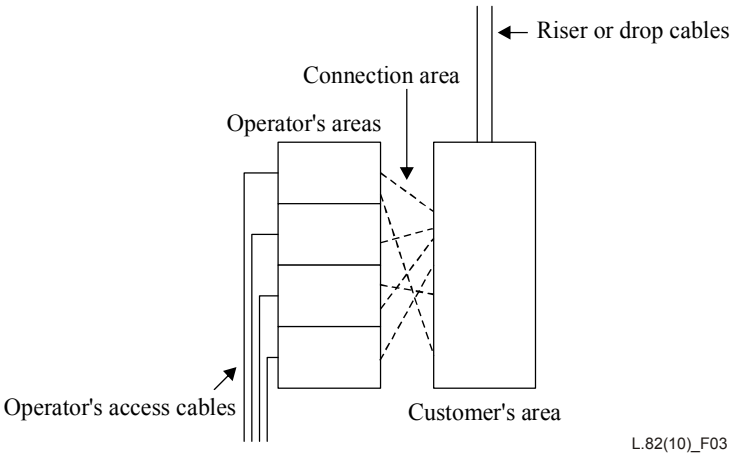

Figure 3 – Illustration of a sharing point

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

When a multi-fibres architecture is deployed in the building, the sharing 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 in case of some operators wanting to share their fibres.

The sharing point should be designed to allow:

– frequent arrangements of fibres;

– new cable installation or older cable 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).

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 sharing point should respect environmental standards (climatic, mechanical, dust, etc.) to allow indoor and outdoor settings.

7 Vertical cabling and drop

Based on operators' consensus, different cabling systems could be installed in the vertical and drop parts: easy mid span access cables, microcabling solutions, preconnectorized solutions, etc. Cables used inside the building should be compliant with [ITU-T L.59]. They have to be fire retardant low smoke no halogen.

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

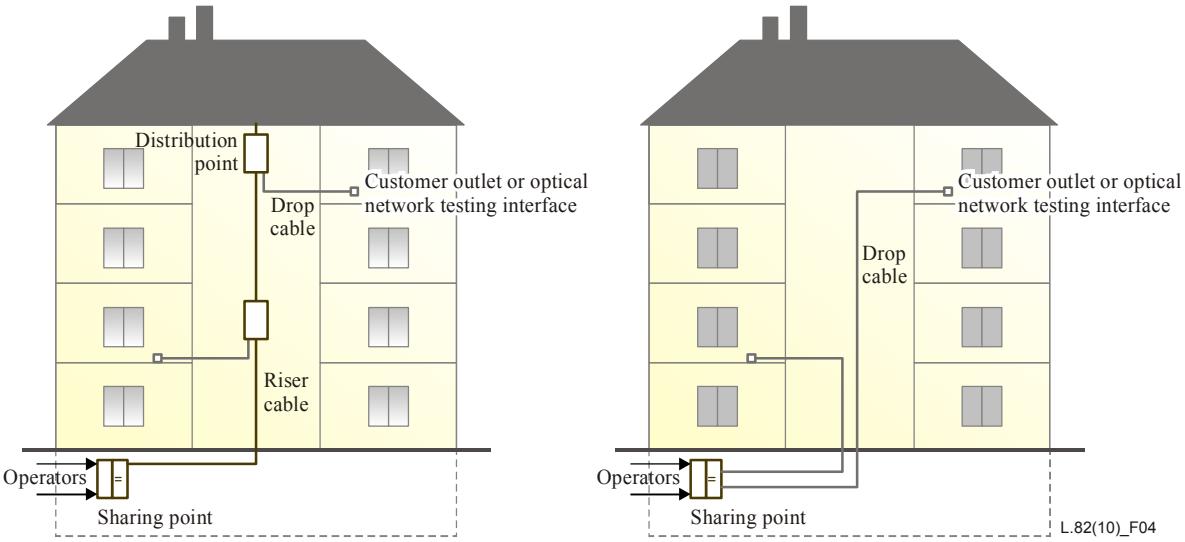

Figure 4 – Example of cabling solutions in buildings: both the riser cable or the drop cable could contain one or more fibres for each customer depending on the chosen architecture

7.1 Riser cable

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

Depending on the building configuration (number of apartments, floors, etc.), 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 sharing point, it could be pre-terminated with connector plugs.

7.2 Drop cable

Drop cables should be compliant with [ITU-T L.87].

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 3):

– from the sharing point to the external network testing interface or the customer outlet;

– from the distribution point to the external network testing interface or the customer outlet.

Dimensional and mechanical characteristics of the cable must 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 asks for the 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.

7.3 Distribution point

The link between riser cable(s) and drop cables could be located at the distribution 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 distribution box or a distribution system. In the second case, it could be made by only a breakout box.

7.3.1 Distribution box

The distribution 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 distribution boxes are installed in the vertical part of the building at floor levels. Their location depends on the 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 distribution box can serve several floors.

For riser cables with single elements dedicated to a single customer, small distribution 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.

7.3.2 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 the 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.

7.3.3 Distribution system

A distribution 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" a distribution box at floor level.

The distribution system could include:

– breakout boxes and 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 miniaturized 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 necessarily 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 a distribution system is shown in Figure 5.

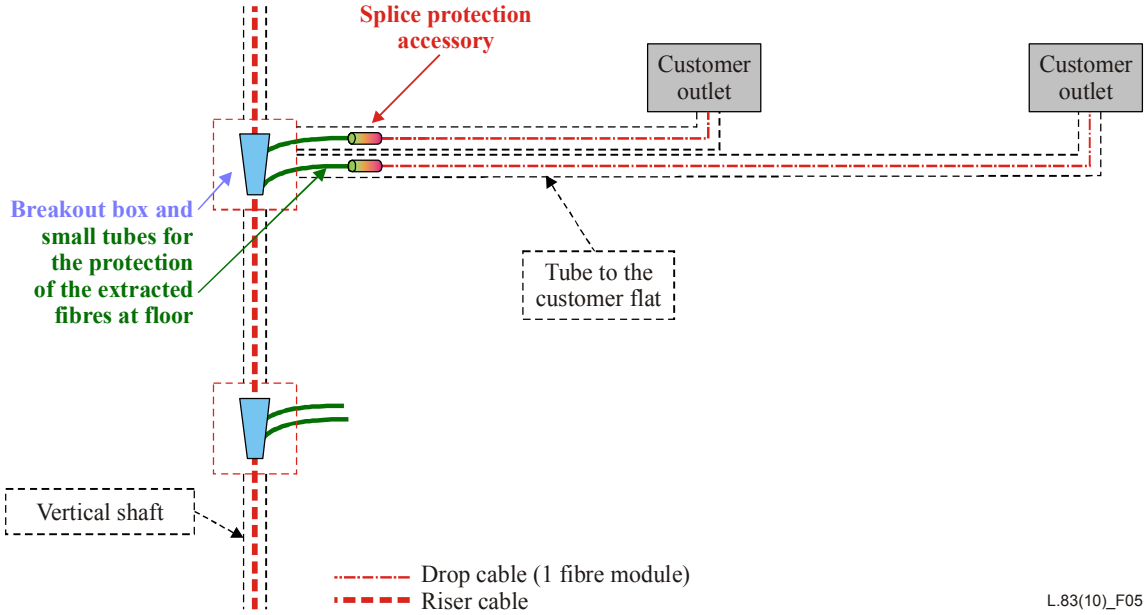

Figure 5 – Example of a distribution system

When the distribution 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.

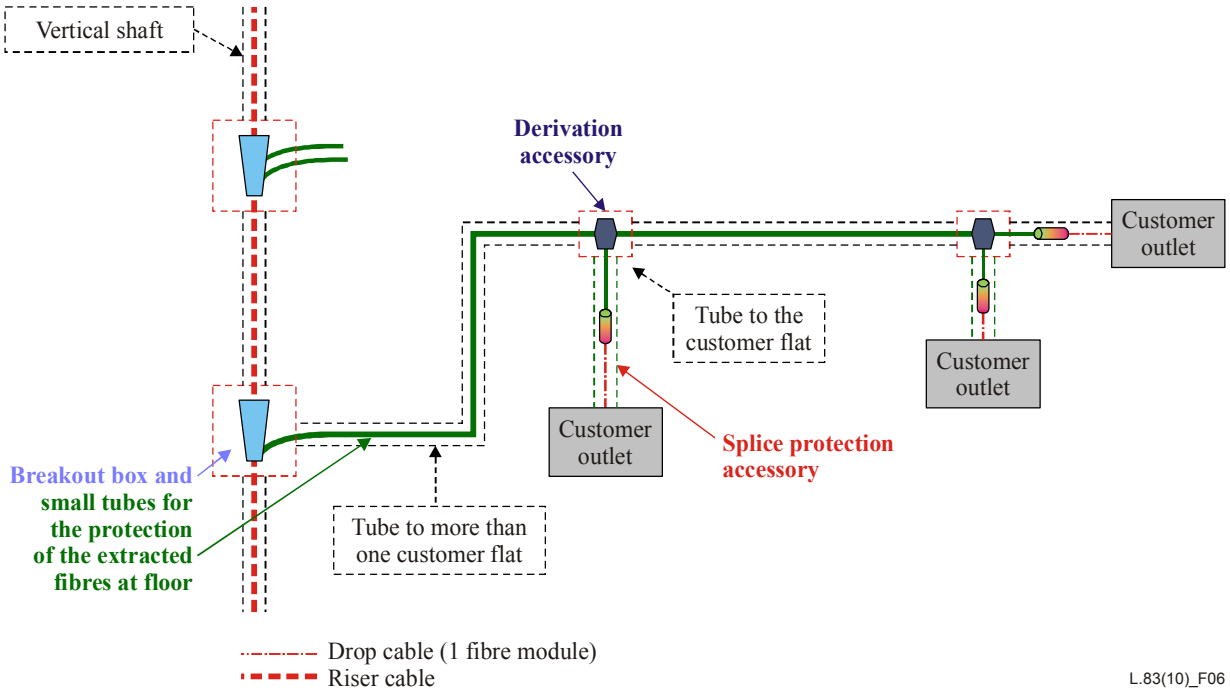

Figure 6 – Example of a distribution system and derivation accessory in the case of initial sharing of customer tube

8 Optical termination

The connection of a drop cable (or a single element extracted from the riser cable) fibre with the optical network termination at the customer premises could be accomplished through a customer outlet and/or an optical external network testing interface. Figure 7 illustrates typical configurations.

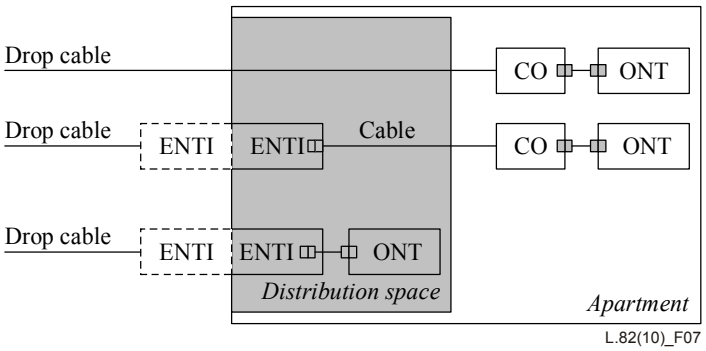

Figure 7 – Illustration of typical cabling configurations at the customer premises

8.1 Customer outlet

The customer outlet allows the connection of fibre(s) from a cable to the ONT. It is installed inside the apartment at a convenient place regarding the apartment configuration and customer requirements. In the case the distribution space is not present, the customer outlet can represent a demarcation, measuring and testing point.

The fibre(s) from the 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 customer outlet.

8.2 Optical external network testing interface

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

The connection of fibres from the drop cable with the ONT is done the same way as with the optical outlet with connector plugs. It could also be an interface between the drop cable and the customer outlet when the ONT is not located in the distribution space.

9 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 should also 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. Attenuation values are defined in [ITU-T L.36] for optical connectors and [ITU-T L.12] for splices.

10 Fibres

Single mode optical fibres described in [ITU-T G.652] and [ITU-T G.657] 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 [ITU-T G.657] should be preferred, especially for the drop part of the building cabling where fibres should have more bend constraints. It could allow a faster installation, a higher margin for the optical budget and also a possible reduction of boxes size.

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 minimize insertion losses for each connection. When ITU-T G.652 and ITU-T G.657 fibres are used at the same time, choice of ITU-T G.657A would be then preferred for bending loss insensitive fibres.

11 Connectors

Connectors could be used in the sharing point, the customer outlet, the external network testing interface, the distribution box and customer premises equipment 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) is the most commonly used in building cabling by operators who deploy FTTH. LC connector could also be employed to increase the density of materials.

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 which guaranty 60 dB (mated) or 55 dB (unmated) for return losses [ITU-T L.36].

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

Connectors can be mounted on fibres at the factory but also on 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 ITU-T Recommendation.

Appendix I

Answers to the questionnaire "Optical cabling shared with multiple operators in buildings"

(This appendix does not form an integral part of this Recommendation)

This appendix presents answers to the questionnaire on "Optical cabling shared with multiple operators in buildings" sent to collect opinions, information and experiences about optical building cabling. Some of the countries which answered the questionnaire already share the optical building cabling but not all.

Is optical building cabling already shared with other operators in your country?
The optical building cabling is already shared with other operators in Estonia, Kyrgystan, Republic of Korea, Switzerland, Ukraine. It is not already shared in Bosnia Herzegovinia, Cambodia, Cyprus, Dominican Republic, Japan, Lithuania, Moldavia, Netherlands, Peru, Philippines, Czech republic, Thaïland, Turkey, Vietnam
Did your country (national regulation authority) start discussion with operators about shared building cabling?
In Korea, a guideline for certification of very high speed ICT network in building was legislated by the Korea Communications Commission. Shared building cabling method is described in the guideline. In Turkey, discussion has just started. In Switzerland, COMCOM and OFCOM have been very active organizing round-table discussions with operators to discuss many aspects of the FTTH roll-out including the in-building cabling. An industry working group under the chairmanship of OFCOM has produced technical guidelines for the in-house installation of FTTH networks. These guidelines ensure that the installation supports sharing by several network operators. The first edition of the guidelines is available. Work is progressing on a second edition. Operators are encouraged to follow it. In Vietnam, the Ministry of Industry and Communication is drafting the national standards for telecom building cabling system and Telecom infrastructure sharing.
Have you defined the type of optical connector which could be used in Cross-Connecting Point (shared point at the basement of building), Distribution Box (at floors) and optical outlet (or optical ENTI)?
Cyprus: SC/PAC for pilots Estonia: not defined but preference for SC Kirgyztan: FC and LC Japon (NTT): SC/PC Philippines (Globe Telekom): SC Switzerland: LC/APC for the optical outlet Turkey (Turk Telecom): SC and LC Ukraine: FC, LC, SC Vietnam: FC, LC, SC/PC or SC/UPC There is sometimes national standardization
Have you defined a maximum optical attenuation/minimum optical return loss between apartment and building basement?
No in general. In Switzerland, a maximum attenuation is not specified but can be deduced from: basement distribution box + socket 0.8 or 0.9 dB (fusion splice: 0.15, mechanical splice 0.25, LC connector 0.5). RL = 60 dB

Have you defined the type of fibre in vertical cabling, especially in the drop and customer patchcord?
BH Telecom in Bosnia Herzegovinia: G.657A. NTT in Japan: G.652 (vertical cabling) and G.657A1 (indoor cables, namely horizontal cabling to each apartment). KT Corporation in Korea has defined the type of fibre. They have also defined the telecommunication Pipe Shaft to accommodate the fibre. In Switzerland: G.657A for cables, the fibre of the customer patchcord is not specified. Turk Telekom in Turkey: G.652D and G.657. JSC Ukrtelecom in Ukraine: G.652D and G.657A in vertical cabling + G.657A for drop. Ministry of Communication in Vietnam: G.652 for FTTH homes, small offices, G.657 for building offices depending on customers/project requirements.
Have you defined the need for optical ENTI and/or optical customer outlet implementation inside or outside the apartment?
In Japan, the customer outlet is installed in the apartment to accelerate the "do it yourself" by customers. If there is an ENTI outside (on the wall outside), there is also an optical outlet inside. In Kyrgystan, they are installed inside. In Switzerland, there is only an optical outlet inside the apartment (living room, office, wall box). In Turkey, the optimum point is defined according to apartment cabling. In Ukraine the ENTI is outside, the customer outlet inside. In Vietnam, it depends on customers' requirements.
Do you think it is useful to install an optical outlet in apartment (for example in the living room) if optical ENTI is already installed at entrance of apartment?
Cyprus replies it is useful only for new buildings. NTT (Japan) thinks it is useful to install an optical outlet inside the flat to accelerate "Do It Yourself" by customers. In Switzerland there is no ENTI, only an optical outlet. In Turkey there is no need for optical outlet because there is no fibre inside the apartment (copper cat 5/6)
Have you defined where to stop drop installation: outside or inside the apartment?
In most of cases, when it is defined, it is inside the apartment. Sometimes, it can depend on building owners, existing network provider, new entrant, etc.

Bibliography

[b-IEC 61756-1] IEC 61756-1 (2006), *Fibre optic interconnecting devices and passive components – Interface standard for fibre management systems – Part 1: General and guidance*.

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