TELECOMMUNICATIONS ACT (CHAPTER 323)

CODE OF PRACTICE FOR INTERNAL TELECOMMUNICATION WIRING 2014

In exercise of the powers conferred by section 26(1) of the Telecommunications Act, and pursuant to regulation 4(1) of the Telecommunications (Internal Wiring) Regulations [2005], the Info-communications Development Authority of Singapore hereby issues the following Code

Table of Contents

1. PRELIMINARY

1.1 Citation and commencement

This Code may be cited as the Code of Practice for Internal Telecommunication Wiring 2013 and shall come into operation on [date].

1.2 Definitions

In this Code, unless the context otherwise requires –

"block terminal" means an object consisting of a series of electrically separated metallic points on which cables and wires are terminated;

"broadband coaxial cable system" means a wide-area wired system of coaxial cables which connect to television outlets installed within a building for the transmission of cable services;

"building" excludes any temporary building or structure;

"cable" means a cable, wire or line used or intended to be used for telecommunications;

"cable distribution system" means a network of cable trays, cable ladders, trunking, conduits, and underfloor ducts, which enable cables to be laid from one point to another point within a building or a development;

"cable service" means any telecommunication service which is provided over a broadband coaxial cable system;

"COPIF 2013" means the Code of Practice for Info-communication Facilities in Buildings issued by IDA in 2013;

"development" means a single project consisting of 1 or more buildings;

"distribution point" means the point at which local cables from either the main distribution frame room or a licensee's installation or plant terminate;

"duct" or "trunking" means an enclosed space of metallic or non-metallic construction which is used to house and conceal cables and includes spaces provided in a wall and in the skirting of walls and partitions;

"Effective Date" means the date this Code comes into operation;

"fibre interface point" means a point of interconnection between a user's internal fibre cable and any telecommunication system of a telecommunication licensee;

"fibre termination point" means the point where an optical fibre cable at a user's premises is terminated;

"IDA" means the Info-communications Development Authority of Singapore constituted under the Info-communications Development Authority of Singapore Act (Cap. 137A);

"installation or plant" includes all structures, machinery, equipment, cables, poles and lines used or intended for use in connection with telecommunications;

"interface point" means any point of interconnection between a user's telecommunication equipment and any telecommunication system of a telecommunication licensee;

"intermediate distribution frame" means a metallic frame used for the termination of telecommunication cables within a building;

"internal telecommunication wiring" means any telecommunication line, wire, cable, optical fibre, conduit or other physical medium that is located within the property boundary of a building or development for use in connection with telecommunications;

"landed dwelling-house" means any of the following types of houses used wholly or mainly for the purpose of human habitation –

(a) detached house;

(b) semi-detached house; or

(c) terrace house but does not include a strata landed dwelling-house;

"lead-in pipes" in relation to –

(a) a landed dwelling-house, means the pipes which extend outwards from the boundary of the house to enable the laying of cables from outside the property into the property; and

(b) a development consisting of buildings other than landed dwelling houses, means the pipes which extend outwards from the boundary of the development to enable the laying of cables from outside the development into the development;

"licensee" means a telecommunication system licensee as defined in section 2 of the Telecommunications Act;

"main distribution frame" means the frame on which incoming main cables and the local distribution cables within a building or development are terminated and cross-connected;

"main distribution frame room" means a room within a building or development that is used to house a main distribution frame and licensees' installation or plant;

"mixed-use building" means a building used for both residential and non-residential purposes;

"multimode optical fibre" means an optical fibre that guides two or more paths of light;

“multi-storey residential building” means a residential building, other than a landed dwelling-house (including strata landed dwelling-houses), consisting of two or more storeys used wholly or mainly for the purpose of human habitation;

“Nationwide Broadband Network” means the nationwide broadband network designed, built and deployed in Singapore by OpenNet Pte Ltd and Nucleus Connect Pte Ltd;

“non-residential building” means a building used for any non-residential purpose and includes –

(a) office towers;

(b) shophouses and shopping complexes;

(c) convention and exhibition complexes;

(d) markets and food centres;

(e) hotels, boarding houses, guest houses, service apartments, student hostels and workers’ dormitories;

(f) resort developments;

(g) factories and warehouses;

(h) utilities and telecommunication installations;

(i) business or technology park developments;

(j) airport or sea port terminals;

(k) bus terminals, bus interchanges, train stations, Mass Rapid Transit System (“MRT”) stations or Light Rail Transit System (“LRT”) stations;

(l) fire stations, police stations, civil defence buildings, military camps, prison buildings, hospitals, government offices or embassies;

(m) places of worship;

(n) libraries, museums, community clubs or centres, association buildings, sports and recreational complexes, homes for the aged and hospices; and

(o) primary schools, secondary schools, junior colleges, universities, polytechnics, foreign and specialist schools;

"optical fibre" means any filament made of dielectric materials (usually plastic or glass) that guides light;

"optical fibre cable" means an assembly comprising 1 or more optical fibres;

“optical network terminal” means a powered device, provided by a telecommunication licensee, which will connect to the fibre termination point and convert optical signal from the termination point to an electric signal for the customer premise equipment like residential gateway and modems;

"patch panel" means a hardware panel that facilitates cable termination using patch cords;

“public road” means any road over which the public has a right of way;

“relevant space and facilities” means the space and facilities provided by the developer or owner of a building pursuant to the Code of Practice for Info-communication Facilities in Buildings 2013 or any previous codes;

“SC/APC connector” means a standard connector / angle polished connector;

"single-mode optical fibre" means an optical fibre that guides one path of light;

"splice" means a permanent joining of optical fibres in a splice closure;

“strata landed dwelling-house” means a landed dwelling-house comprised in a development the strata subdivision of which is permitted under a written permission granted by the competent authority under section 14 (4) of the Planning Act (Cap. 232) or authorised by the Minister under section 21 (6) of the Planning Act;

“telecommunication equipment room” means a room within a building or a development that is used to house a licensee’s installation or plant;

“telecommunication (non-broadband coaxial cable) system” means any telecommunication system other than a broadband coaxial cable system;

“telecommunication riser” means a compartment that is used to house and distribute local cables vertically from the main distribution frame room or telecommunication equipment room to the individual storeys of a building;

“underground pipes” –

(a) in relation to a landed dwelling-house, means the pipes which extend from the boundary of the house into the house;

(b) in relation to a development consisting of strata landed dwelling houses, means the pipes which extend from the boundary of the development to the main distribution frame room or to the retaining wall of the development (as the case may be) and which extend from the main distribution room or

retaining wall to each strata landed dwelling-house within the development; and

(c) in relation to a development consisting of buildings other than landed dwelling-houses or strata landed dwelling-houses, means the pipes which extend from the boundary of the development to the main distribution frame room or retaining wall of the development (as the case may be) and which extend from the main distribution frame room to the telecommunication equipment room(s) or telecommunication riser(s) within the development; and

"user" means a person who has subscribed to any telecommunication service of a public telecommunication licensee.

1.3 Purpose of this Code

1.3.1 This Code is intended to –

(a) specify the technical standards and specifications for the performance or carrying out of telecommunication wiring work, including the wiring workmanship and practices which telecommunication wiring contractor class licensees and telecommunication wiring installer class licensees are required to comply with;

(b) support IDA's telecommunication wiring contractor and installer class licensing regime;

(c) ensure that telecommunication wiring and the wiring equipment / accessories may operate and are installed or deployed to a satisfactory standard; and

(d) ensure that the internal telecommunication wiring at a user's premises are supplied and installed by licensed contractors or installers in accordance with this Code.

1.4 Legal Effect of this Code

1.4.1 Every telecommunication wiring contractor class licensee or telecommunication wiring installer class licensee ("telecommunication wiring contractor/installer") shall comply with the applicable provisions of this Code.

1.4.2 The obligations contained in this Code are in addition to those contained in the Info-communications Development Authority of Singapore Act (Cap. 137A) ("IDA Act"), the Telecommunications Act, as well as other regulations, licences or codes of practice issued by IDA. To the extent that any provision of this Code is inconsistent with the terms of the IDA Act, Telecommunications Act, or the terms of any licence issued by IDA, the provisions of the IDA Act, Telecommunications Act or licences shall prevail. To the extent that this Code is inconsistent with the provision of any code of practice issued by IDA or its predecessor, the Telecommunication Authority of Singapore, the terms of this Code shall prevail. If any provision of this Code is held to be unlawful, all other provisions will remain in full force and effect.

1.5 Application of this Code

1.5.1 This Code is published in conjunction with the Licensing Scheme for Telecommunication Wiring Contractors and Telecommunication Wiring Installers.

1.5.2 Although the provisions and information in this Code and the associated specifications make references to telephone cables, cabling and wiring equipment, these provisions and information are also applicable to other telecommunication services which make use of the standard telephone cables and wiring equipment.

1.5.3 Technical standards and specifications for the performance or installation of structured cabling systems (based on unshielded twisted pair cables (Category 5e or better)), broadband coaxial cable systems, and optical fibre cables are set out in this Code to ensure delivery of good quality broadband services and new services over the Nationwide Broadband Network to users' premises.

1.5.4 Chapter 2 of this Code covers telecommunication wiring work for purposes of telephone wiring using twisted pair cables (Category 3 or better). Chapters 3, 4 and 5 of this Code set out the requirements for the installation, maintenance or repair of unshielded twisted pair cables (Category 5e or better), broadband coaxial cable systems and optical fibre cables respectively.

1.6 Right to Modify

1.6.1 IDA may modify this Code on its own initiative at any time.

1.7 Waiver

1.7.1 IDA may, on receipt of an application in relation to the technical standards and specifications to be complied with in this Code, waive any of the requirements specified in this Code upon and subject to such terms and conditions as it may specify.

1.7.2 Any such application shall be made in writing to IDA and shall state the nature and extent of and reasons for the proposed waiver of such requirements and shall be accompanied by such plans and particulars as may be required to support the application.

1.7.3 A waiver may, without limitation, be permanent, temporary (either for a fixed period or effective until the occurrence of a specific event) or on a one-time basis.

1.8 Cancellation

1.8.1 The Code of Practice for Internal Telecommunication Wiring 2000 ("IDA CP L1: 2000) (hereinafter referred to as the cancelled Code") is cancelled.

1.8.2 For the avoidance of doubt, nothing in Section 1.7.1 shall exempt any internal telecommunication wiring contractor/installer from his obligation to comply with the requirements under the cancelled Code for purposes of the installation, maintenance

or repair of internal telecommunication wiring to the extent that the cancelled Code applied to him prior to the Effective Date.

1.9 Guidelines

1.9.1 The guidelines titled “Guidelines for Internal Telecommunication Wiring 2013” shall be read in conjunction with the Code. Telecommunication wiring contractors/installers should refer to the guidelines for the recommended practices in relation to the installation of telecommunication wiring.

2 TELEPHONE WIRING

This section specifies the requirements for the cabling, installation, safety and performance of telephone wiring using twisted pair cables (Category 3 or better). For the avoidance of doubt, a telecommunication wiring contractor/installer shall also ensure that telecommunication cables and other wiring equipment/accessories to be used for telecommunication wiring work comply with the specifications for telecommunication cables and ancillary accessories as set out in Appendix A (IDA TS L1-1, L1-2, L2-1, L3-1, L3-2 and L3-3), and other associated specifications as may be designated or specified by IDA from time to time.

2.1 Interface Point

The locations of the interface point for telephone wiring may be at the doorstep or at the Distribution Point ("DP") erected by the telecommunication licensee.

2.1.1 Interface Point At Doorstep

The types of premises under this category are HDB apartments, shophouses without Management Corporation, shophouses in HDB residential blocks, business and residential premises served by overhead telephone wiring (except site offices).

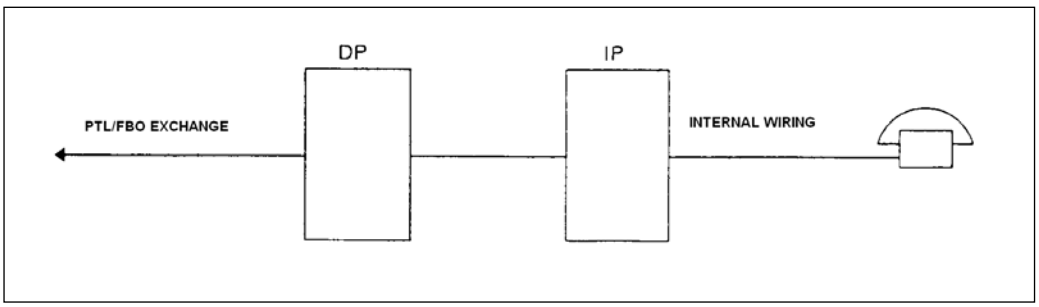

Fig.2-1 Interface Point at Doorstep

2.1.2 Interface Point At DP

The types of premises under this category are shopping centres, office complexes, factories (terrace/flatted), HDB shopping/office complexes, markets, food/hawker centres, multiple buildings within a compound (campus layout), landed dwelling houses (bungalows, semi-detached, terrace) and private and HDB apartments with concealed telephone wiring served directly from the DP in the riser duct.

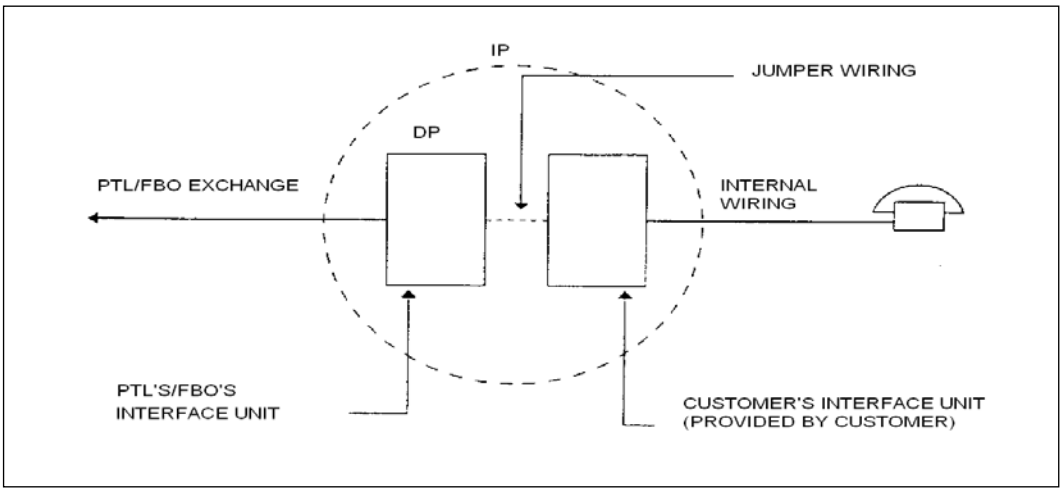

Fig.2-2 Interface Point at DP

The location of the interface point in various premises is further elaborated in the following sections.

2.2 Residential Premises

2.2.1 General

2.2.1.1 The telecommunication wiring contractor/installer shall be responsible for the installation of telephone wiring, Block Terminal ("BT") and all materials from the interface point to the residential unit. The wiring, BTs and telephone sockets installed shall comply with the specifications as listed in Appendix B.

2.2.1.2 The telecommunication wiring contractor/installer may refer to Chapter 2 of the Guidelines for Internal Telecommunication Wiring 2013 on the recommended size of telephone wiring using twisted pair cable cables and the associated block terminals to be installed, as well as typical wiring configuration for private residential premises.

2.2.2 HDB Flats

2.2.2.1 Individual HDB residential unit (which are not provided with concealed conduits for internal wiring) will have at least one telephone socket to the living room. Typically, there will be a multi-compartment Poly-Vinyl Chloride ("PVC") trunking and 20mm PVC casing that extends from the interface point to the telephone socket. The telecommunication wiring contractor/installer shall use the PVC trunking and PVC casing to install the telephone wiring.

2.2.2.2 The BT located outside the HDB unit shall be the designated interface point. For older HDB flats where there is no BT outside the unit, the interface point shall be at the doorstep.

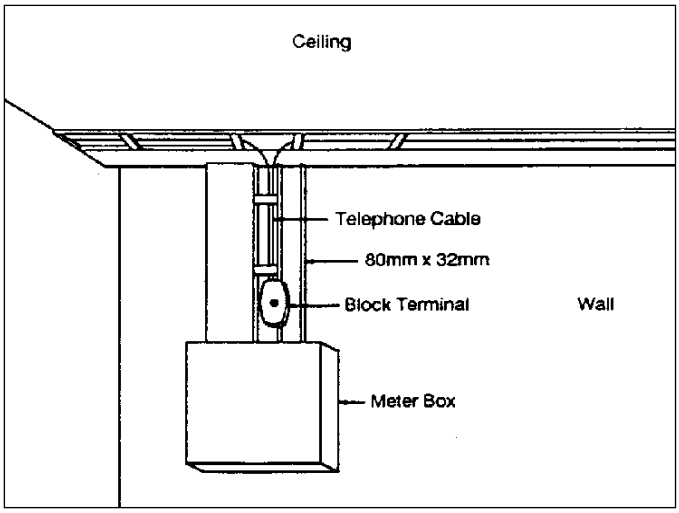

Fig.2-3 Location of Block Terminal

2.2.2.3 For those HDB flats which are provided with the riser duct, without BT, the interface point shall be the DP located within the riser duct. Each DP located in the duct usually does not serve more than three residential units.

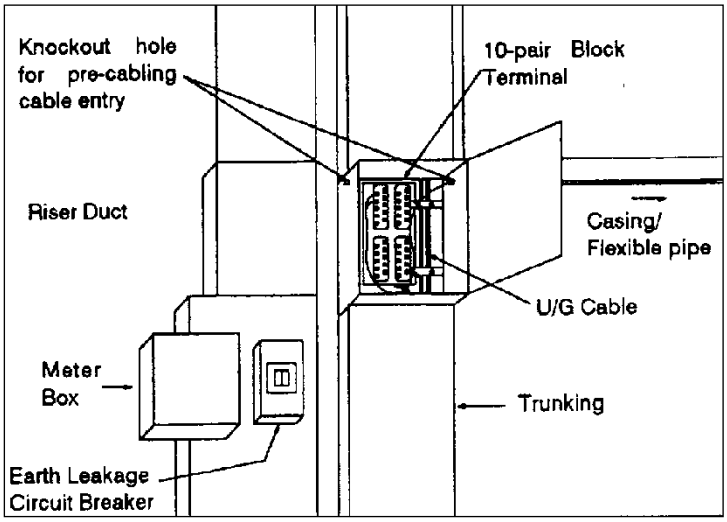

Fig.2-4 Location of DP in riser duct for HDB flats

2.2.3 Apartments/Condominiums

2.2.3.1 The interface point of an apartment/ condominium shall be the DP located in the riser duct.

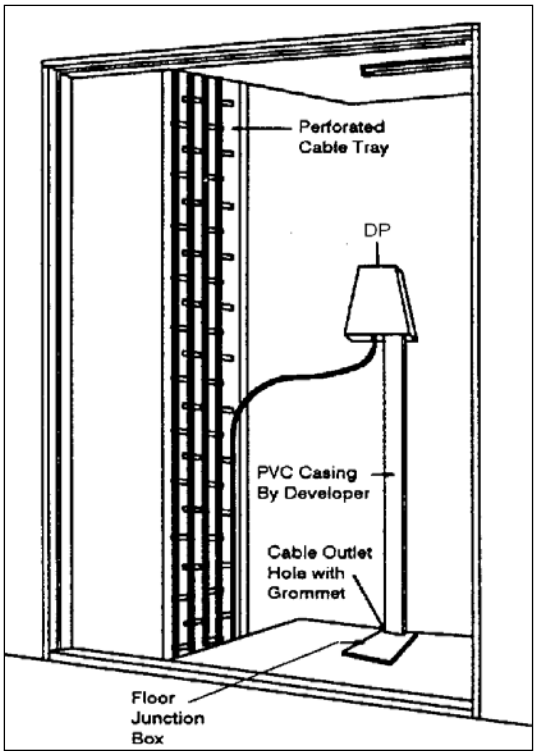

Fig.2-5 Location of DP in riser duct for Apartments/Condominiums

2.2.3.2 Where it is necessary that telephone wiring be provided to shops/offices/kiosk located in apartments/condominiums, the telecommunication wiring contractor/installer shall install telephone wiring from DP to such shops/offices/kiosk located in apartments/condominiums.

2.2.4 Landed Dwelling Houses

2.2.4.1 The interface point for the bungalow/ /semidetached/terrace house shall be the DP, located at the gate pillar, car porch or an external wall of the house.

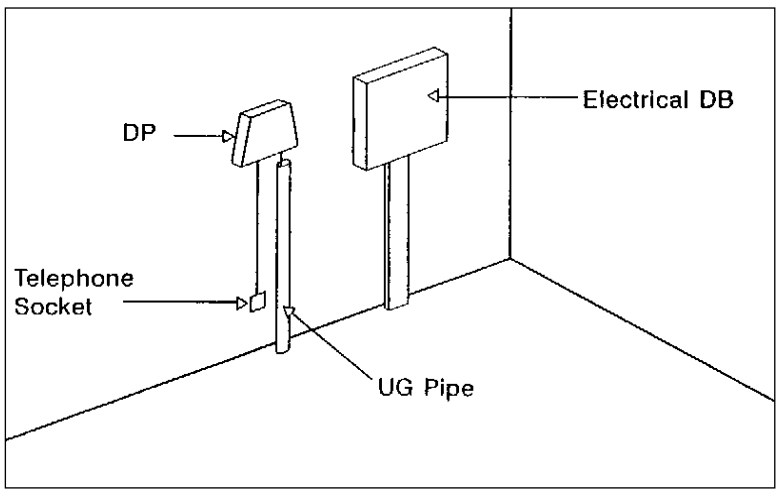

Fig.2-6 Typical location of a DP at car porch

2.2.4.2 Where telephone wiring is to be provided to landed dwelling houses, the telecommunication wiring contractor/installer shall install telephone wiring from the DP at the gate pillar to a BT inside the house.

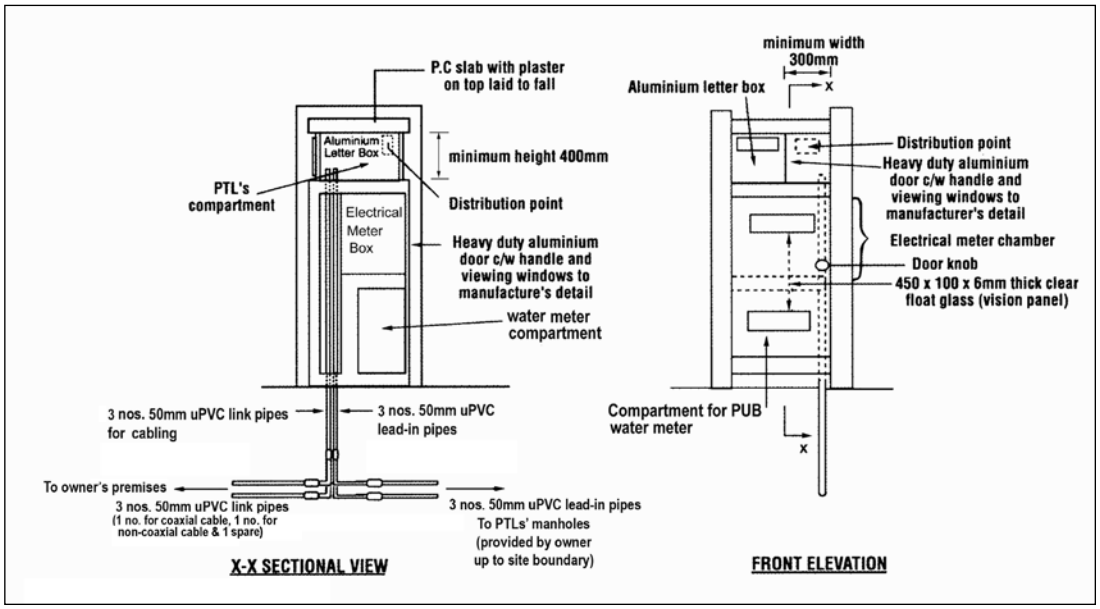

Fig.2-7 Typical location of a DP at gate pillar

2.3 Business Premises

2.3.1 General

2.3.1.1 The telecommunication wiring contractor/installer shall ensure that the BTs/Local Boxes are located in an easily accessible position in the shops or office units to facilitate future installation and maintenance works.

2.3.1.2 The telecommunication wiring contractor/installer shall install telephone wiring, BT and all materials from the interface point to the shop, office or factory units, or market/food stalls as described in the subsequent sections. Telephone wiring, BTs and telephone sockets installed shall comply with the specifications as listed in Appendix B.

2.3.1.3 The telecommunication wiring contractor/installer may refer to Chapter 2 of the Guidelines for Internal Telecommunication Wiring 2013 on the recommended size of telephone wiring using twisted pair cables and the associated block terminals to be installed.

2.3.2 Shophouses without Management Corporations

2.3.2.1 For shophouses without Management Corporations, a BT shall be erected for every unit and shall be designated as the interface point.

2.3.2.2 The telecommunication wiring contractor/installer shall install the telephone wiring between the interface point and the telephone sockets/equipment.

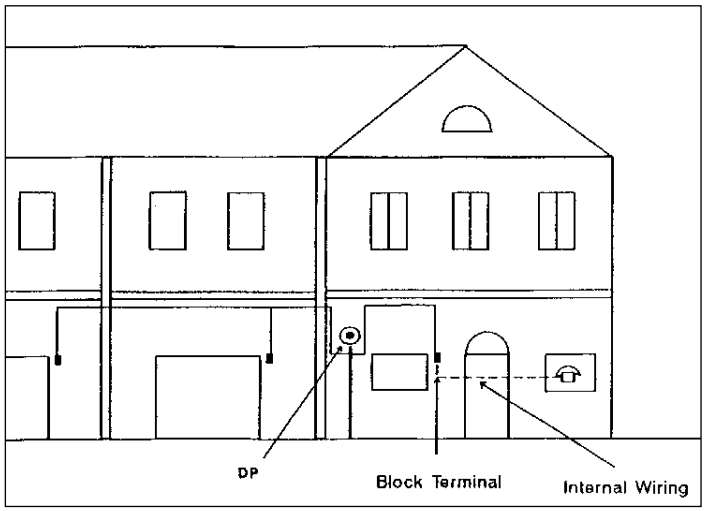

Fig.2-8 Shophouses without Management Corporations

2.3.3 Shopping Centres

2.3.3.1 The interface point for shopping centres is designated at the DP.

2.3.3.2 Where concealed conduits are provided, the telecommunication wiring contractor/installer shall ensure that telephone wiring is installed using the concealed conduits.

2.3.3.3 Where telephone wiring is to be provided to all shop units in the shopping centre during construction, the telecommunication wiring contractor/installer shall install Intermediate Distribution Frame ("IDF") at the vertical telecommunication risers to ensure adequate space for mounting of DPs/BTs for termination of the cables.

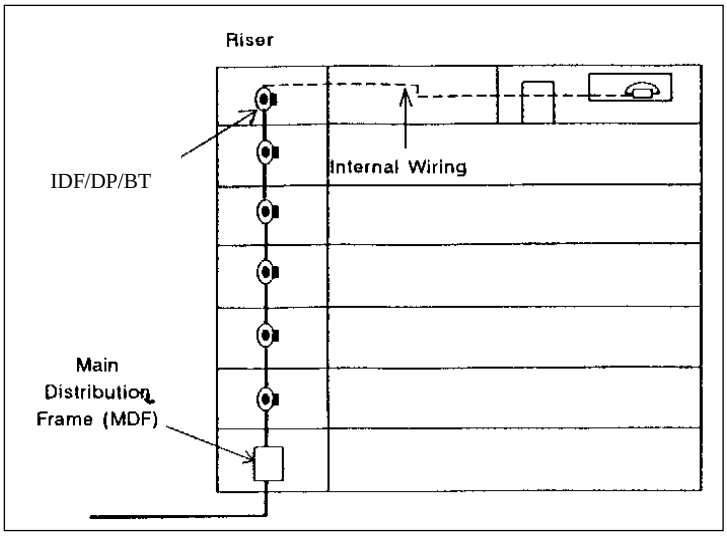

Fig.2-9 Shopping Centres

2.3.4 Office Complexes/Units

2.3.4.1 The interface point for office complexes is designated at the DP.

2.3.4.2 The telecommunication wiring contractor/installer shall ensure that telephone wiring is installed in the telephone distribution systems.

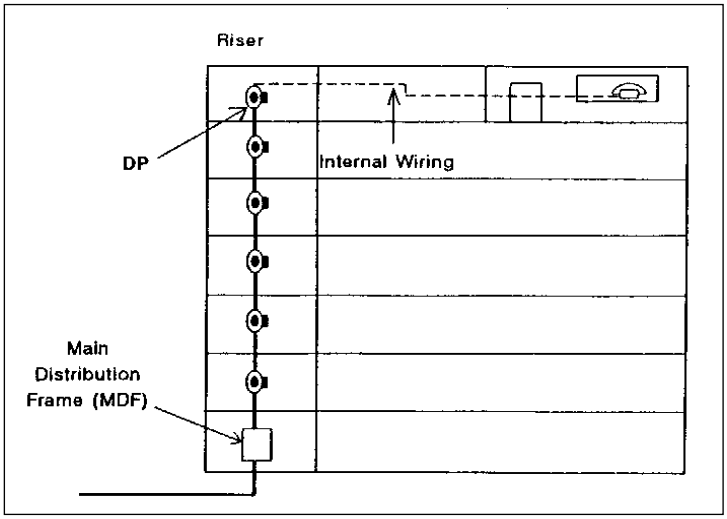

Fig.2-10 Office Complexes/Units

2.3.5 Market/Food/Hawker Centres

2.3.5.1 The interface point is designated at the DP.

2.3.5.2 Where it is necessary that telephone wiring be provided to the stalls, the telecommunication wiring contractor/installer shall install the telephone wiring from the DP to the stalls.

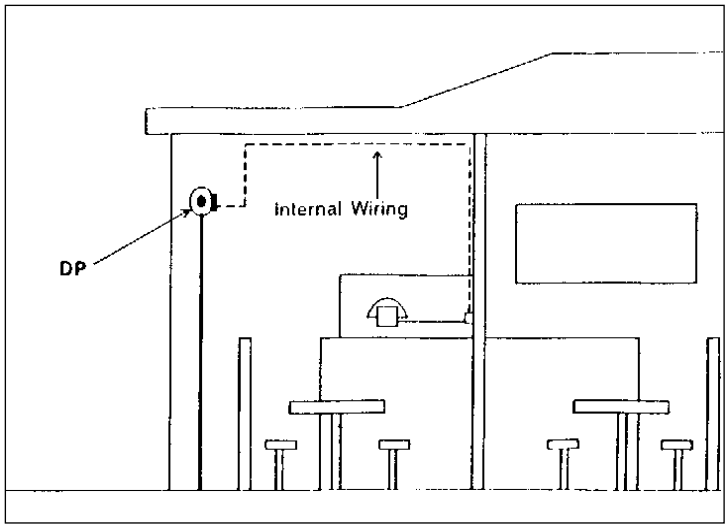

Fig.2-11 Market/Food/Hawker Centre

2.3.6 Factories (Terrace/Flatted)

2.3.6.1 The interface point is designated at the DP.

2.3.6.2 Where IDF verticals at the telecommunication risers are provided, the telecommunication wiring contractor/installer shall install the BTs on the verticals. The telecommunication wiring contractor/installer shall install telephone wiring using the cable distribution system.

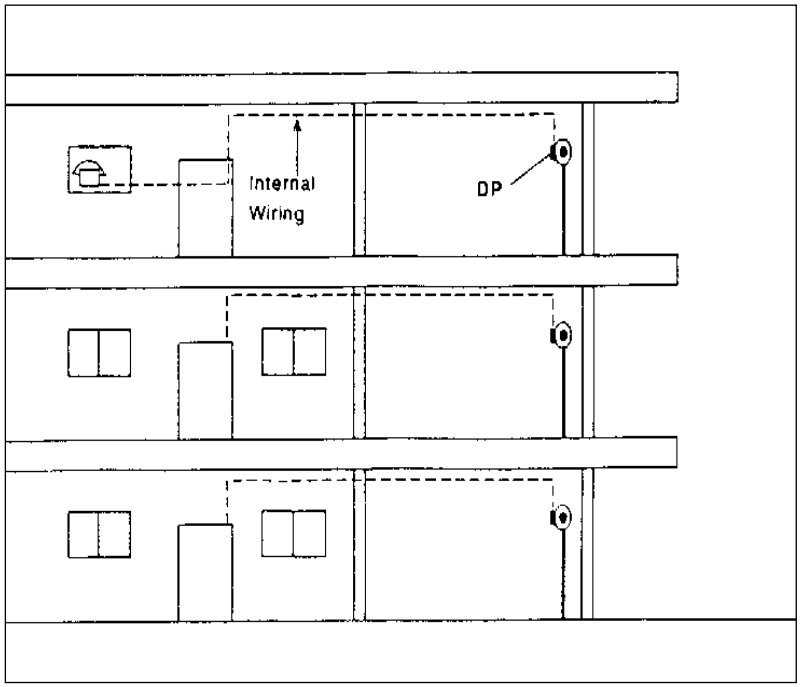

Fig.2-12 Flatted Factories

2.3.7 Multiple Buildings within a Compound (Campus Layout)

2.3.7.1 There are two types of schemes:

(a) Customer Owned And Maintain ("COAM") scheme

Under the COAM scheme, the telecommunication licensee may erect a DP which will be the interface point at only one building. The telecommunication wiring contractor/installer shall install telephone wiring from the interface point at one building to the other buildings within the property compound.

(b) Non-COAM scheme

Under the non-COAM scheme, the telecommunication licensee may erect a DP which is the interface point, at suitable locations in each building within the compound. The telecommunication wiring contractor/installer shall install telephone wiring from the interface point to the respective units/office each building.

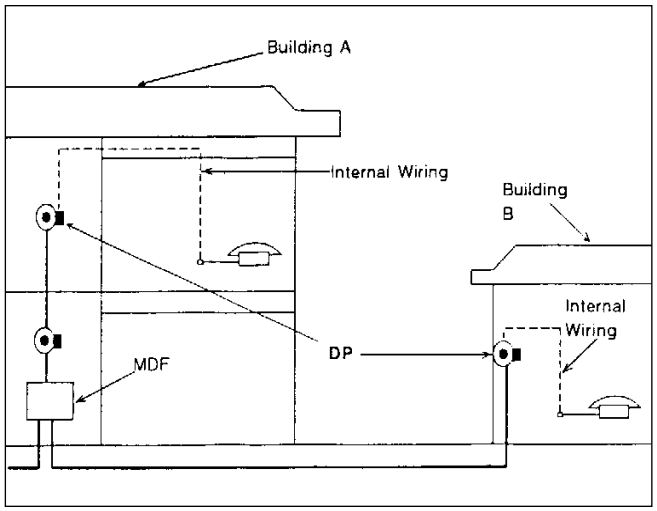

Fig.2-13 Multiple Buildings within a Compound

2.4 Installation and Termination of Telephone Wiring

2.4.1 The telecommunication wiring contractor/installer shall ensure that telephone wiring is properly installed via surface cabling or concealed cabling methods. The telecommunication wiring contractor/installer may refer to chapter 2 of the Guidelines for Internal Telecommunication Wiring 2013 on the various cabling methods.

2.4.2 The telecommunication wiring contractor/installer shall ensure that telephone wiring is properly terminated onto different terminals (e.g., quick connect terminal and screw terminal) and properly connected onto the BT or DP. The telecommunication wiring/contractor may refer to chapter 2 of the Guidelines for Internal

Telecommunication Wiring 2013 on the proper procedure and practice on termination.

2.5 Functional Tests

The telecommunication wiring contractor/installer shall conduct tests to ensure that the telephone wiring is in good condition and connections are correctly terminated. Such tests may include Continuity Test, Open Circuit Test and Insulation Resistance Test using a Tone Test Set. The telecommunication wiring/contractor may refer to chapter 2 of the Guidelines for Internal Telecommunication Wiring 2013 for the procedures to carry out Continuity Test, Open Circuit Test and Insulation Resistance Test.

2.6 Record Keeping

2.6.1 The telecommunication wiring contractor/installer shall ensure that proper records and documentation of all installations undertaken are kept, so as to enable efficiency and facilitate future installation and maintenance of the for telephone wiring. Such records shall, at the minimum, include drawings or schematics setting out the following information:

(a) layout of the cable distribution system (carrying the telephone wiring) in the development/building.

(b) the respective cable routes, sizes of cables and quantities of cables from the interface point to the telephone sockets.

(c) layout or record of the jumpering at local Distribution Cases (“Discases”) or IDF blocks in telephone risers, cable closets and telephone system equipment rooms.

(d) information to assist in the identification of the installed cables and user sockets. The information shall correspond to the actual labelling on the cables and the users sockets.

2.7 Safety Precautions and Practices

2.7.1 The following precautions shall be taken into consideration while handling or working with any telephone wiring:

(a) A pre-installation survey on the cabling route shall be carried out to ensure that the most suitable route is selected.

(b) Telephone wiring using twisted pair cables shall be segregated from electrical cables at all intersection points.

(c) Insulation sleeves shall be provided for telephone wiring crossing electrical wires.

(d) Items associated with the installation shall be placed so that they do not create a hazard to the occupants of the premises or to installation or maintenance staff.

(e) Sockets shall be placed at locations where they would not be easily damaged.

(f) Only materials that comply with IDA "Specifications for Telecommunication Cables and Ancillary Accessories" can be used.

(g) Suitable tools shall be employed in installation work.

(h) As soon as work is completed at any access point, all internal fittings, the covers and fixing screws shall be properly secured.

3 UNSHIELDED TWISTED PAIR CABLES (CATEGORY 5E OR BETTER)

3.1 General

3.1.1 This section specifies the requirements for the cabling, installation, safety and performance of unshielded twisted pair cable(s) (Category 5e or better). For the avoidance of doubt, a telecommunication wiring contractor/installer installing unshielded twisted pair cable(s) (Category 5e or better) shall also comply with the installation practices and cabling materials stipulated in the respective standards listed below:

Standards	Description
ISO 11801	Communications Cabling Systems for Commercial Premises
TIA/EIA 568C series	Commercial Building Telecommunications Cabling Standard
TIA/EIA 568-C.2	Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components (includes Transmission Performance Specifications for 4-Pair 100 Ohm Category 5e or Category 6 Cabling)
IEC 60603-7	Modular Connector physical dimensions, mechanical and electrical characteristics
EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
EIA/TIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces

Table 3-1 Applicable Standards on the Installation of Unshielded Twisted Pair cable(s) (Category 5e or better)

3.1.2 A telecommunication wiring contractor/installer shall ensure that unshielded twisted pair cables (Category 6 or better) are used when these cables are intended to carry Nationwide Broadband Network services as described in Section 3.4.2 of this Code.

3.1.3 A telecommunication wiring contractor/installer shall ensure that unshielded twisted pair cables (Category 5e or better) are properly installed via surface cabling or concealed cabling method.

3.2 Installation of Unshielded Twisted Pair Cables

3.2.1 The telecommunication wiring contractor/installer shall ensure that each unshielded twisted pair cable (Category 5e or better) from the RJ45 patch panel to the RJ45 outlet is properly installed in accordance with the relevant standards described above.

3.2.2 All unshielded twisted pair cables (Category 5e or better) shall be fully tested for continuity prior to installation and any cable found to be defective shall be replaced.

3.2.3 All unshielded twisted pair cables (Category 5e or better) shall not share the same conduit, channel or sleeve with electrical cables.

3.2.4 The unshielded twisted pair cable (Category 5e or better) tensile rating shall not exceed the rating as specified in the cable specifications to avoid disruption to the conductor gauge and wire twist.

3.2.5 The bending radius of the unshielded twisted pair cable (Category 5e or better) shall not be less than 4 times the overall diameter of the cable to ensure that the transmission performance is not degraded.

3.3 Termination of Unshielded Twisted Pair

3.3.1 All unshielded twisted pair (Category 5e or better) shall be terminated into the RJ45 patch panel, RJ45 outlets or connectors using suitable tools and methods.

3.3.2 Each RJ45 outlet shall be installed with a faceplate and shall incorporate a shutter to prevent ingress of contaminants.

3.3.3 The wiring pin/pair assignments of the unshielded twisted pair cable (Category 5e or better) to the RJ45 patch panel/RJ45 outlet shall be based on the configuration in either EIA/TIA T568A (Table 3-2) or EIA/TIA T568B (Table 3-3).

Pin	Pair	Wire	Colour
1	3	1	White-orange
2	3	2	Green
3	2	1	White-green
4	1	2	Blue
5	1	1	White-blue
6	2	2	Orange
7	4	1	White-brown
8	4	2	Brown

Table 3-2 Configuration in EIA/TIA T568A

Pin	Pair	Wire	Colour
1	2	1	White-orange
2	2	2	Orange
3	3	1	White-green
4	1	2	Blue
5	1	1	White-blue
6	3	2	Green
7	4	1	White-brown
8	4	2	Brown

Table 3-3 Configuration in EIA/TIA T568B

3.3.4 Where there are multiple unshielded twisted pair cables (Category 5e or better) being deployed within the same premises, the telecommunication wiring contractor/installer shall ensure that the same pin/pair assignment be used for all unshielded twisted pair cables (Category 5e or better) to the RJ45 patch panel/ RJ45

outlets (i.e., all connections shall be based on the configuration in EIA/TIA T568A or all connections shall be based on configuration in EIA/TIA T568B).

3.3.5 The faceplate for RJ45 outlets shall be made from impact resistant, flame-retardant and UL-rated thermoplastic.

3.3.6 All RJ45 outlets shall be labelled to correspond to the pairing outlets at the RJ45 patch panel.

3.4 Installation of Unshielded Twisted Pair Cables in Residential Units

3.4.1 For the purpose of obtaining Nationwide Broadband Network services operating at 100Mbps speed or above, an optical fibre cable will be provided by the Nationwide Broadband Network Company ("NetCo") or the building developer/owner[1] into each residential unit. The optical fibre cable is laid into individual residential unit and terminated onto a fibre termination point (which may be located in a closet or utility room).

3.4.2 The telecommunication wiring contractor/installer shall comply with the requirements related to the provision of internal telecommunication wiring (in respect of unshielded twisted pair cables (Category 6 or better)) as set out in Chapters 4 to 7 of COPIF 2013.

3.4.3 The telecommunication wiring contractor/installer shall install an RJ45 patch panel near the fibre termination point and the RJ45 patch panel shall be considered as the interface point. The telecommunication wiring contractor/installer shall lay unshielded twisted pair cables (Category 6 or better) from the RJ45 patch panel to the RJ45 outlets in each room. There shall be at least one RJ45 outlet installed beside the TV outlet. This is illustrated in Fig. 3.1.

[1] For residential units that are constructed prior to the COPIF 2013 requirements, the NetCo will lay the optical fibre cable into the individual residential unit. For residential units that are constructed based on COPIF 2013 requirements, the developer or owner will lay the optical fibre cable into the individual residential unit.

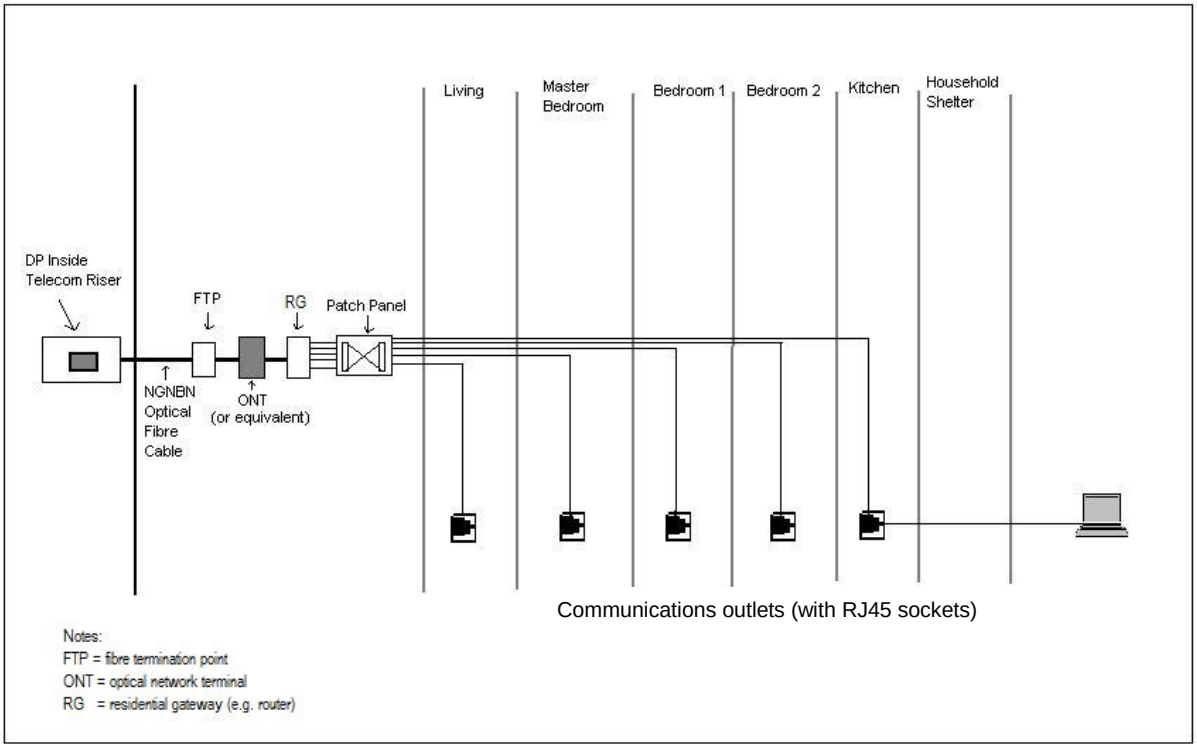

Fig. 3-1 Typical Configuration in a Single Residential Unit

3.4.4 If only one unshielded twisted pair cable (Category 6 or better) is to be installed in a residential unit, an RJ45 outlet (in lieu of an RJ45 patch panel) shall be installed near the fibre termination point. The RJ45 outlet installed near the fibre termination point shall be considered as the interface point. The unshielded twisted pair cable (Category 6 or better) cable shall extend from the RJ45 outlet near the fibre termination point to another RJ45 outlet at the desired location (e.g., living room).

3.4.5 Fig. 3-2 and Fig. 3-3 illustrate the typical configuration in a HDB/condominium residential unit and a landed dwelling house.

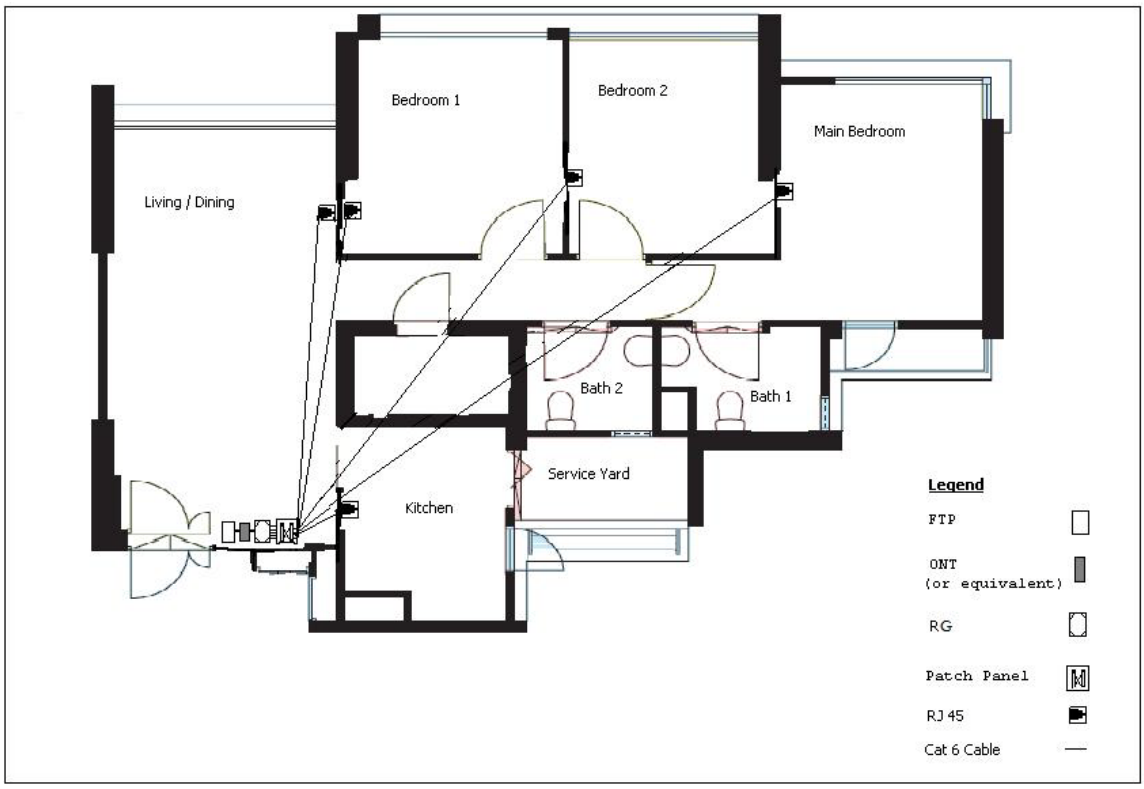

Fig. 3-2 Typical Configuration for a HDB or Condominium Residential Unit

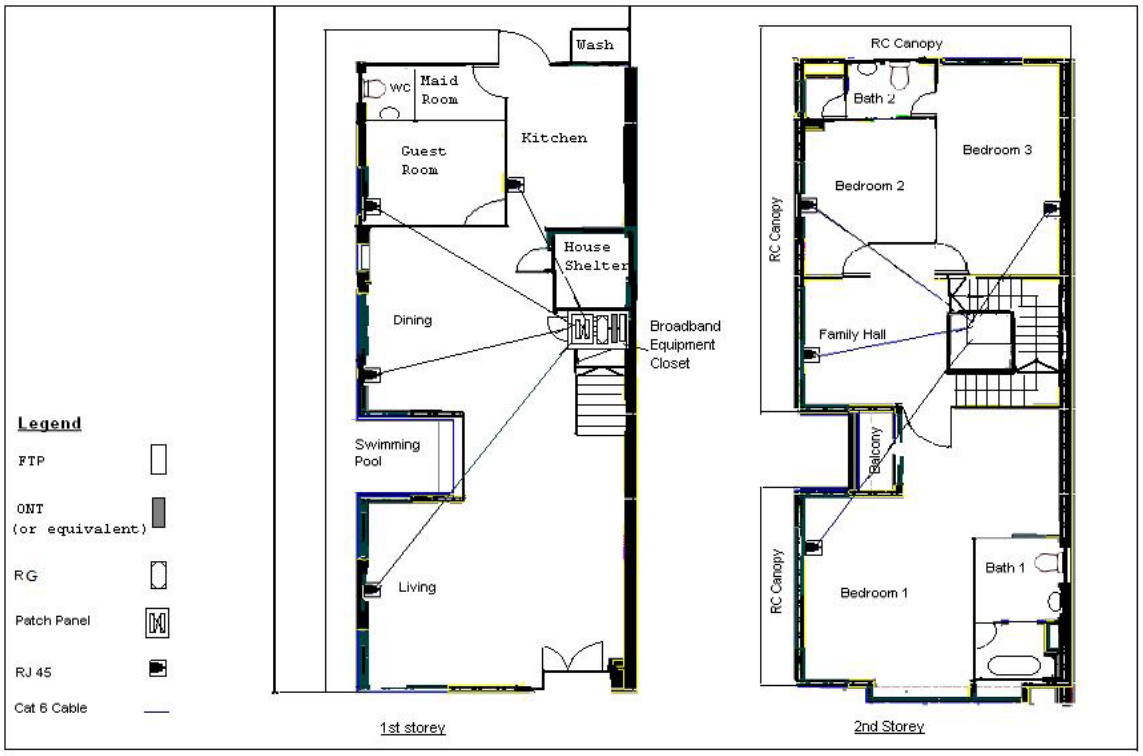

Fig. 3-3 Typical Configuration for a Landed Dwelling House

3.4.6 The length of each unshielded twisted pair cable (Category 6 or better) between the RJ45 patch panel (or the RJ45 outlet near the fibre termination point) and the pairing RJ45 outlet in each room shall not exceed 90 m.

3.4.7 Where an unshielded twisted pair cable (Category 5e or better) and its associated RJ45 outlet is used as a conventional telephone circuit (like a Telephone Wiring under Section 2), preventive measures shall be taken to prevent wrong connections between telephone and broadband services. This is because the unshielded twisted pair cable (Category 5e or better) and its associated RJ45 outlet (used as a telephone line) will operate at a higher voltage and current and may cause damage to broadband equipment (e.g., a gigabit Ethernet line card) if it is connected directly to it. For example, where a certain RJ45 outlet is designated as a conventional telephone circuit, it shall be clearly labelled and plugged in with an RJ45-to-RJ11 converter (or adaptor) to prevent accidental connection to broadband equipment.

3.5 Installation of Unshielded Twisted Pair Cables in Non-residential Units

3.5.1 Typically, unshielded twisted pair cables (Category 5e or better) will be laid from a central or aggregation point (e.g., server / IT room / communication room) to respective workstations/cubicles/rooms within the unit. The unshielded twisted pair cable (Category 5e or better) at the central or aggregation point shall be considered as the interface point and such cable may be terminated into an RJ45 patch panel, RJ 45 outlets or connectors at the said central or aggregation point.

3.5.2 The telecommunication wiring contractor/installer shall install unshielded twisted pair cables (Category 5e or better) (including RJ45 patch panel/RJ 45 outlets where necessary) between the interface point and the RJ45 outlets at designated workstations / cubicles via surface cabling or concealed cabling.

3.6 Cable Specifications

3.6.1 The unshielded twisted pair cables (Category 5e or better) installed shall meet the requirements stated in this section.

3.6.2 Each unshielded twisted pair cable (Category 5e or better) shall consist of 4 twisted-pairs of wires and shall be protected with an outer sheath of PVC or thermoplastics insulation. Each twisted-pair wire shall be a 100 ohm balanced solid copper wire with PVC or thermoplastic insulation.

3.6.3 Cable Construction:

Conductor: Solid plain copper - between 23 to 24 AWG
Insulation: Solid Polyethylene or PVC
Outer sheath: Flame Retardant Polyethylene or PVC
Cable Overall Diameter: 6.35 mm Max.
Insulation thickness: 1.22 mm Max.
Maximum pulling strength: 110N

Colour Code:
Pair No. 1: White-Blue & Blue

Pair No. 2: White-Orange & Orange
Pair No. 3: White-Green & Green
Pair No. 4: White-Brown & Brown

Electrical Characteristics @20˚C;

The typical electrical characteristics of unshielded twisted pair cable (Category 5e or better) at 20˚C are as follows:

DC resistance [Ω/100m]	9.38 Max.
Characteristic impedance [Ω]	100±15% (0.772 to 250 MHz)
Mutual capacitance [nF/100m]	5.6 Max.
Capacitance unbalance [pF/100m]	330 Max.

Table 3-4 Electrical Characteristic for unshielded twisted pair cable (Category 5e or better)

3.6.4 All unshielded twisted pair cables (Category 5e or better) shall meet or exceed the transmission performance specifications in accordance with TIA/EIA 568-C.2 for Category 5e or Category 6.

3.7 Test Procedures for Unshielded Twisted Pair Cables

3.7.1 The telecommunication wiring contractor/installer shall perform the following tests in accordance with TIA/EIA568-C.2 standards on the installed unshielded twisted pair cables (Category 5e or better):

(a) Wire Map test;

(b) Length test;

(c) Insertion loss test; and

(d) Near-end crosstalk (“NEXT”) loss pair-to-pair test.

3.7.2 The Wire Map test will check whether the unshielded twisted pair cable (Category 5e or better) is properly laid and terminated (into RJ45 outlet(s) and/or into an RJ45 patch panel) at both ends and will identify spilt pair problems and connectivity issues.

3.7.3 The Length test will check whether the length of installed unshielded twisted pair cable (Category 5e or better) falls within the acceptable length in accordance to the standards.

3.7.4 The Insertion loss test will check whether the signal loss at different signal frequencies falls within an acceptable range in accordance with the standards.

3.7.5 The NEXT loss test will check whether the unwanted signal coupling from a transmitter (at the near-end) into neighbouring unshielded twisted pair cables (Category 5e or better) (at the near-end) at different frequencies are within the acceptable range in accordance with the standards.

3.7.6 The unshielded twisted pair cable (Category 5e or better) is considered to be properly installed if results from the tests are within the acceptance value under TIA/EIA568-C.2 standards.

3.8 Record Keeping

3.8.1 The telecommunication wiring contractor/installer shall ensure that proper records and documentation are kept of all installations undertaken, so as to enable efficiency and facilitate future installation and maintenance of the unshielded twisted pair cables (Category 5e or better)). Such records shall, at the minimum, include drawings or schematics setting out the following information:

(a) the layout of the cable distribution system (carrying the unshielded twisted pair cables (Category 5e or better)) in the development/building.

(b) the respective unshielded twisted pair cables (Category 5e or better) routes, sizes of cables and quantities of cables from the interface point to the respective RJ45 outlets and/or RJ45 patch panels.

(c) information to assist in the identification of the installed unshielded twisted pair cables (Category 5e or better), the RJ45 patch panel and the RJ45 outlets. The information shall correspond to the actual labelling on the unshielded twisted pair cables (Category 5e or better), RJ45 patch panel and RJ45 outlets.

3.9 Safety Precautions and Practices

3.9.1 The following precautions shall be taken into consideration while handling or working with any unshielded twisted pair cables (Category 5e or better):

(a) A pre-installation survey on the cabling route shall be carried out to ensure that the most suitable route is selected with the safety aspects being taken into consideration.

(b) Unshielded twisted pair cables (Category 5e or better) shall be segregated from electrical cables at all intersection points.

(c) Insulation sleeves shall be provided for unshielded twisted pair cables (Category 5e or better) crossing electrical wires.

(d) Items associated with the installation shall be placed so that they do not create a hazard to the occupants of the premises or to installation or maintenance staff.

(d) RJ45 outlets shall be placed at locations where they will not be easily damaged.

(e) Only materials that comply with technical specifications as specified in this Code can be used.

(f) Proper tools shall be employed in installation work.

(g) As soon as work is completed at any access point, all internal fittings, covers and fixing screws shall be properly secured**.**

4 BROADBAND COAXIAL CABLE SYSTEM

4.1 General

4.1.1 This section specifies the requirements for the cabling, installation, safety and performance of broadband coaxial cable system ("BCS"). For the avoidance of doubt, a telecommunication wiring contractor/installer installing BCS shall also comply with Chapters 4 to 7 and Chapter 14 of COPIF 2013.

4.1.2 The telecommunication wiring contractor/installer carrying out installation of a broadband coaxial cable system may be required to install additional passive and active devices such as filters, decoders, reverse signal path amplifiers, interdiction equipment, etc, where required, in order to ensure good signal quality at user' premises.

4.1.3 The telecommunication wiring contractor/installer shall ensure that broadband coaxial cables are properly installed via surfaced cabling methods and concealed cabling methods.

4.1.4 With reference to Fig. 4-1, in this section –

"head end" means a facility with equipment that are connected between receiving antennae or other signal sources and the remainder of the cabled distribution system to process the signals to be distributed. The head end may, for example, include antennae amplifiers, frequency converters, combiners, separators and generators; and

"feeder" means a transmission path forming part of a cabled distribution system. Such a path may consist of a metallic cable, optical fibre, waveguide, or any combination of them. By extension, the term is also applied to paths containing one or more radio links.

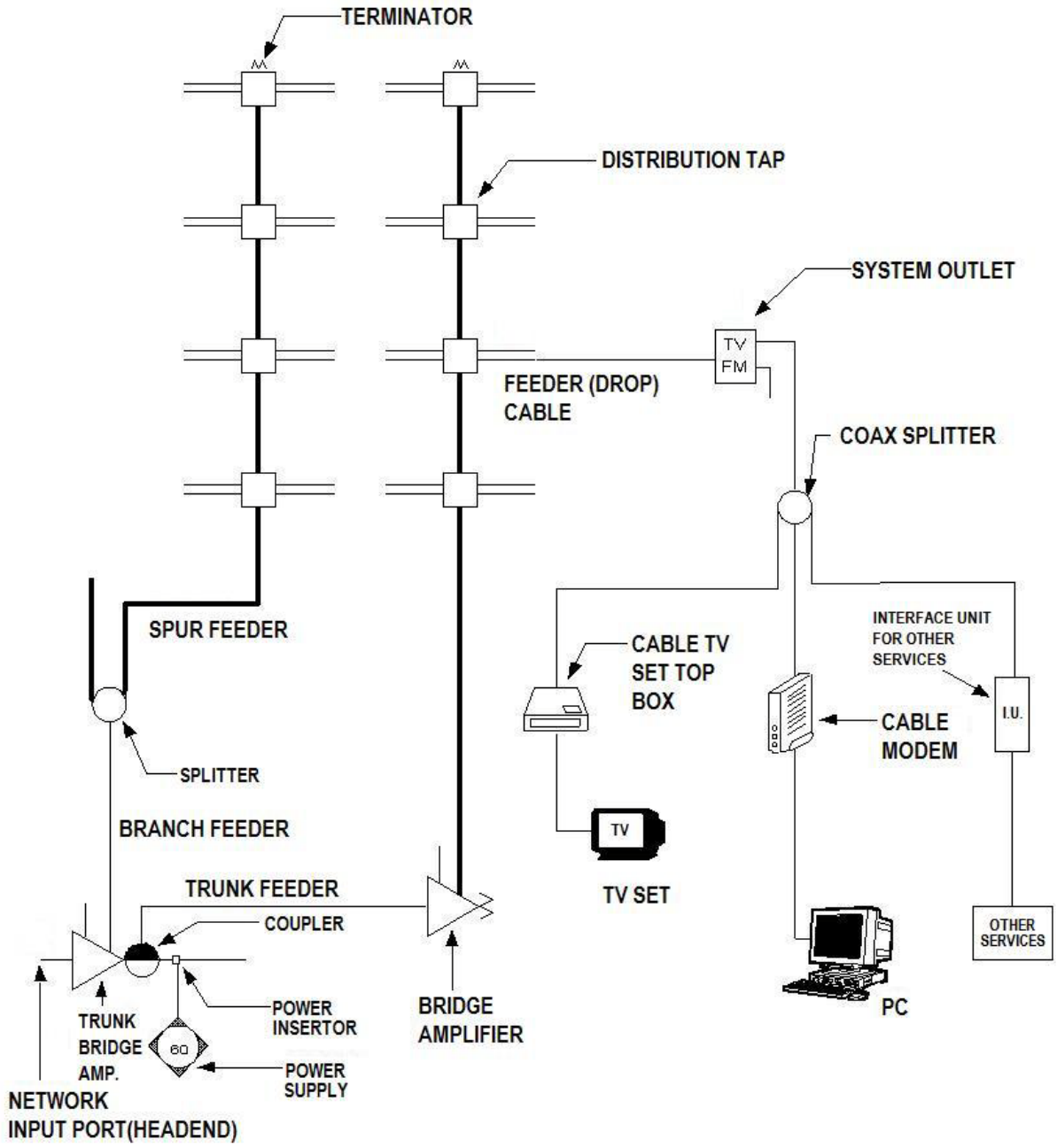

Fig. 4-1: Principal items of equipment employed in a BCS system

4.2 Performance requirements for broadband coaxial cable system

4.2.1 General

The telecommunication wiring contractor/installer shall ensure that installed broadband coaxial cable system complies with the performance requirements as set out in Chapter 14 of COPIF 2013. The telecommunication wiring contractor/installer may also refer to chapter 3 of the Guidelines for Internal Telecommunication Wiring 2013 on the additional performance requirements that the broadband coaxial cable system should meet.

4.3 Interface Point

Where the broadband coaxial cables within a residential building are provided and maintained by the developer or building owner into each residential unit, the interface point is at the point of interconnection between the coaxial cables and the telecommunication licensee.

4.4 Installation of BCS in Residential Units - Development Consisting of 2 or More Strata Landed Dwelling-Houses and 1 or More Multi-Storey Residential Buildings

4.4.1 The telecommunication wiring contractor/installer shall comply with the requirements related to the provision of BCS, provision of coaxial cables in underground pipes and provision of internal telecommunication wiring (in respect of coaxial cables) as set out in Chapters 6 to 7 and Chapter 14 of COPIF 2013.

4.5 Installation of Coaxial Cable in Residential Units - Landed Dwelling-Houses

4.5.1 The telecommunication wiring contractor/installer shall comply with the requirements related to the provision of coaxial cables in underground pipes and provision of internal telecommunication wiring (in respect of coaxial cables) as set out in Chapters 4 to 5 and Chapter 14 of COPIF 2103.

4.6 Coaxial Cables

4.6.1 The telecommunication wiring contractor/installer shall ensure that coaxial cables installed comply with the requirements related to cables as set out in Chapter 14 of COPIF 2013.

4.7 Safety, Installation Practices And Procedures, Workmanship

4.7.1 The telecommunication wiring contractor/installer shall comply with the requirements related to safety, installation practices and procedures and workmanship as set out in Chapter 14 of COPIF 2013.

4.8 Other technical details

4.8.1 The telecommunication wiring contractor/installer shall test the completed broadband coaxial cable system to ensure that it complies with the requirements set out in this section. The telecommunication wiring contractor/installer may refer to chapter 3 of the Guidelines for Internal Telecommunication Wiring 2013 on the methods of measurement and the Appendices of the Guidelines for Info-communication Facilities in Building on the testing procedures for broadband coaxial cable systems.

4.8.2 The telecommunication wiring contractor/installer may also refer to chapter 3 of the Guidelines for Internal Telecommunication Wiring 2013 on some of the standards related to broadband coaxial cable systems and the typical broadband coaxial cable system schematic diagram for strata-landed dwelling houses and multi-storey residential buildings for the installation of broadband coaxial cable systems in these buildings.

5 OPTICAL FIBRE CABLES

5.1 General

5.1.1 Optical fibre cables have lower attenuation, ultra wide bandwidths, better electromagnetic interference immunity, better data security, and less electromagnetic emissions and crosstalk problems as compared to twisted-pair copper cables.

5.1.2 This section specifies the requirements for the cabling, installation, safety and performance of optical fibre cables for purposes of connection to the Nationwide Broadband Network. For the avoidance of doubt, a telecommunication wiring contractor / installer installing optical fibre cable in residential units / developments shall also comply with Chapter 15 of COPIF 2013.

5.1.3 The telecommunication wiring contractor/installer shall ensure that optical fibre cables are properly installed and installed via surface cabling and concealed cabling methods. The telecommunication wiring contractor/installer may refer to the industrial practices on the installation of optical fibre cables as set out under the IDA's Reference Document for the Next Generation Nationwide Broadband Network - Optical Fibre Deployment, Parts 1 to 5 ("IDA RD OFD").

5.2 Single-Mode Optical Fibre Cables

5.2.1 Single-mode optical fibre cable is generally deployed for high bandwidth communication. For purposes of this Code, only single-mode optical fibre cables which are compliant with:

(a) the specifications in sub-category G.652.D in the ITU-T Recommendation for installation in underground pipes; or

(b) the G.657 Category A specifications in the ITU-T Recommendations for installation as internal telecommunication wiring with a lower bending radius of 15mm shall be used.

5.3 Minimum Bending Radius Requirements

5.3.1 Sharp bends in optical fibre cables may cause significant signal losses and mechanical failure and thus reduce the life span of such optical fibre cables.

5.3.2 During the installation of optical fibre cables, the telecommunication wiring contractor/installer shall ensure that the bending radius of each optical fibre cable shall exceed the minimum bending radius as specified in the technical specifications provided by the optical fibre cable manufacturer. In the absence of such technical specifications, the telecommunication wiring contractor/installer shall ensure that the bending radius of each optical fibre cable shall, at the minimum, be at least 20 times the diameter of the optical fibre cable.

5.4 Cable Tensile Strength Requirements

5.4.1 Excessive tensile load may increase optical loss and residual strain in the optical fibre cable. The telecommunication wiring contractor/installer shall minimise the cable tensile stress that is caused by tension in suspended vertical cable runs and tightly bundled cables by ensuring that the cable tensile stress on the G.652.D and G.657 Category A optical fibre cables do not exceed the ratings specified in the ITU Recommendations G.652.D and G.657 Category A specifications or the manufacturer's specifications respectively, whichever are more stringent.

5.5 Use of Optical Fibre Connectors

5.5.1 An optical fibre connector mechanically couples and aligns the cores of optical fibre cable so that light can pass between different optical fibre cables and from the optical fibre cable to an active equipment such as an optical network terminal.

5.5.2 A SC/APC connector, which is a SC connector with the end face of the optical fibre cable polished at an angle, shall be used for the termination of optical fibre cables. Such connector is designed to have low reflections even when its output end is not connected. To avert high insertion loss, SC/APC connectors shall be connected to other SC/APC connectors.

5.5.3 To ensure proper installation and so as to achieve low insertion loss and high return loss, a factory-made fibre cable assembly which is pre-terminated in a SC/APC connector shall be used for splicing with the installed optical fibre cable at the end points. Such cable assembly shall be installed in accordance with the requirements specified in Appendix C to this Code.

5.5.4 As dirt at the end face of the ferrule (i.e., the ceramic ring or cap in a optical fibre connector that ensures that the fibre being connected are accurately aligned) prevents the end face of an optical fibre cable from coming into full contact with that of another optical fibre cable, the ferrule shall be cleaned before each connection to remove dirt and to prevent high insertion loss.

5.6 Fusion Splicing of Optical Fibre Cables

5.6.1 Fusion splicing shall be employed for optical fibre cables used to connect to the Nationwide Broadband Network as this will ensure minimal reflection loss and insertion loss. The optical fibre splices performed via fusing splicing shall not exceed the maximum optical attenuation and minimum return loss as specified in the ANSI/EIA/TIA-568-C.3 when measured in accordance with ANSI/EIA/TIA-455. The telecommunication wiring contractor/installer may also refer to the recommendations under ITU-TL.12 on the splicing procedure, and optical and mechanical tests to be performed for the spliced joints.

5.6.2 The spliced region of the optical fibre cable shall be protected by either treating the spliced region using the recoating process or inserting a splice protection sleeve over the spliced region so as to protect the spliced joint from breaking.

5.7 Installation of Optical Fibre Cables

5.7.1 The telecommunication wiring contractor/installer shall ensure that the optical fibre cables installed can be distinguished from one another (e.g., via a colour coding system) and are labelled in a consistent manner to facilitate the ease of identification (e.g., a labelling system).

5.7.2 The telecommunication wiring contractor/installer shall not install optical fibre splitters so as to prevent additional propagation loss.

5.7.3 The telecommunication wiring contractor/installer shall ensure that all access points to the optical fibre cables, including splice enclosures and connectors, are easily accessible and are properly labelled to facilitate future installation and maintenance.

5.7.4 The telecommunication wiring contractor/installer shall test all optical fibre cables for continuity before and after cable installation and any cables found to be defective shall be replaced.

5.8 Installation of Optical Fibre Cables in Residential Developments

5.8.1 Where optical fibre cables from the telecommunication risers(s) to residential units are installed by the telecommunication wiring contractor/installer, a minimum of one (1) 2-core optical fibre cable shall terminate into:

(a) fibre interface point (which shall be similar to a fibre termination point) located within the telecommunication riser or common corridor at each storey (for the case of multi-storey building) or the gate pillar (for the case of landed dwelling house) at one end of the cable. The fibre interface point shall be the interface point; and

(b) fibre termination point within the residential unit at the other end**.**

For the avoidance of doubt, the fibre interface point and fibre termination point installed shall comply with requirements set out in Chapter 15 of COPIF 2013.

5.8.2 The telecommunication wiring contractor/installer shall comply with the requirements related to the provision of optical fibre cables in underground pipes and provision of internal telecommunication wiring (in respect of optical fibre cables) as set out in Chapters 4 to 7 and Chapter 15 of COPIF 2013.

5.9 Installation of Optical Fibre Cables in Non-Residential Units

5.9.1 Typically, an optical fibre cable may be laid between the telecommunication riser or such location (e.g., MDF room) where a telecommunication service provider would terminate its network, and a designated location within the unit (e.g., server / IT room / communication room). The optical fibre cable at the telecommunication riser or such other locations shall be considered as the interface point and such cable may be terminated with a SC/APC connector or fibre interface point.

5.9.2 The telecommunication wiring contractor/installer shall install optical fibre cables (including fibre interface points and fibre termination points) between the interface point and the fibre termination point at the designated location with the units. For the avoidance of doubt, the fibre interface point and fibre termination point installed shall comply with requirements set out in Chapter 15 of COPIF 2013.

5.10 Safety Requirements

5.10.1 The telecommunication internal wiring contractor/installer shall ensure that the optical fibre cable from the telecommunication riser or gate pillar to each residential unit shall be designed, constructed and installed to present no hazard or danger, be it for normal usage or under fault conditions, to users, personnel working on or inspecting the system, or to any other person.

5.10.2 The telecommunication wiring contractor/installer shall ensure that the grounding system and bonding of metal enclosures (if any) containing active telecommunication equipment are carried out in accordance with the Energy Market Authority's requirements.
http://www.ema.gov.sg/media/files/codes_of_practice/electricity/transmission_code.pdf

5.11 Record Keeping

The telecommunication wiring contractor/installer shall ensure that proper records and documentation are kept of all installations undertaken, so as to enable efficiency and facilitate future installation and maintenance of the optical fibre cabling system. Such records shall, at the minimum, include drawings or schematics setting out the following information:

(a) the layout of the cable distribution system (carrying the optical fibre cable) in the development/building;

(b) the respective optical fibre cable routes, sizes of cables and quantities of cables from the interface point to the fibre termination points and/or fibre patch panels (if any);

(c) the fibre patch cords at local fibre patch panel in telecommunication risers, closets and user’s telecommunication system equipment rooms (if any); and

(d) information to assist in the identification of the installed cables, patch panels and fibre termination points. The information shall correspond to the actual labelling on the optical fibre cables, patch panels and fibre termination points.

5.12 Test Criteria for Optical Fibre Cables

5.12.1 The telecommunication wiring contractor/installer shall carry out the necessary tests, as set out in Chapter 15 of COPIF 2013, upon completion of installation of optical fibre cables to confirm that the cables meet the technical specifications.

5.12.2 Upon the completion of optical fibre testing, the telecommunication wiring contractor/installer shall keep records of the test results for all fibre termination points installed and tested in the building.

APPENDIX A

SPECIFICATIONS FOR TELECOMMUNICATION CABLES AND ANCILLARY ACCESSORIES

I.1 IDA TS L1-1 : 2000 Specification for High Count PVC Cable

I.2 IDA TS L1-2 : 2000 Specification for Low Count PVC Cable

I.3 IDA TS L2-1 : 2000 Specification for 4-Way Modular On Wall Socket

I.4 IDA TS L3-1 : 2000 Specification for 2-Pair Block Terminal

I.5 IDA TS L3-2 : 2000 Specification for 4-Pair Block Terminal

I.6 IDA TS L3-3 : 2000 Specification for 5-Pair Block Terminal

APPENDIX B
TELEPHONE CABLES

TYPES OF CABLES

B.1 **The types of cables used for telephone installation works are listed in the table below:**

Type of Cable	Use
4-wire Grey PVC cable	Internal cabling *
6-wire Grey PVC cable	Internal cabling, switching telephone system
8-wire Grey PVC cable	Internal cabling, switching telephone system
10-wire Grey PVC Cable	Local cabling **, executive/secretary system
10-pair Grey PVC Cable	Local cabling
20-Pair Grey PVC Cable	Local cabling, executive/secretary system
40-Pair Grey PVC Cable	Local cabling
80-Pair Grey PVC Cable	Mass local cabling
100-Pair Grey PVC Cable	Mass local cabling

Table B-1: Types of cables and their uses

Notes: Internal cabling - Refer to cabling from distribution case to individual socket position.

Local cabling - Refer to cabling from riser to distribution case.

B.2 COLOUR CODE OF TELEPHONE CABLES

B.2.1 COLOUR CODE FOR LOW COUNT (4, 6, 8, 10-WIRE) PVC CABLES

Cable Size	4-Wire		Pair Count	6-Wire		8-Wire		10-wire	
				a-Wire	b-Wire	a-Wire	b-Wire	a-Wire	b-Wire
Remarks: 1. For 4-Wire cables, blue and orange comprise the first element (Pair). 2. Base colours are in capital letters. Small letters represent helix or ring markings on the base colour. 3. NA - Not applicable	a-Wire	BLUE	1	WHITE - blue	BLUE - white	WHITE - blue	BLUE - white	WHITE - blue	BLUE - white
	b-Wire	ORANGE	2	WHITE - orange	ORANGE - white	WHITE - orange	ORANGE - white	WHITE - orange	ORANGE - white
	c-Wire	GREEN	3	WHITE - green	GREEN - white	WHITE - green	GREEN - white	WHITE - green	GREEN - white
	d-Wire	BROWN	4	NA	NA	WHITE - brown	BROWN - white	WHITE - brown	BROWN - white
			5	NA	NA	NA	NA	WHITE - grey	GREY - white

Table B-2: Colour Code for Low Count (4, 6, 8 and 10-wire) PVC Cables

B.2.2 COLOUR CODE FOR HIGH COUNT (10, 20, 40, 80 AND 100-PAIR) PVC CABLES

Counting Block	Colour Block	Element No.	Colour of Wire Insulation	
			a-wire	b-wire
1	W H I T E	1 2 3 4 5	WHITE-blue WHITE-orange WHITE-green WHITE-brown WHITE-grey	white-BLUE white-ORANGE white-GREEN white-BROWN white-GREY
	R E D	6 7 8 9 10	RED-blue RED-orange RED-green RED-brown RED-grey	red-BLUE red-ORANGE red-GREEN red-BROWN red-GREY
	B L A C K	11 12 13 14 15	BLACK-blue BLACK-orange BLACK-green BLACK-brown BLACK-grey	black-BLUE black-ORANGE black-GREEN black-BROWN black-GREY
	Y E L L O W	16 17 18 19 20	YELLOW-blue YELLOW-orange YELLOW-green YELLOW-brown YELLOW-grey	yellow-BLUE yellow-ORANGE yellow-GREEN yellow-BROWN yellow-GREY
2	Same as above			
3	Same as above			
4	Same as above			
5	Same as above			

Table B-3: Colour Code for High Count PVC Cables

Remarks

i. For the above table, an element refers to 1 pair.

ii. The cabling sequence will be from centre to the outside.

iii. Where sub-units of either 5 or 10-element are used, it shall be used throughout.

iv. For a 20-element unit made up of 5-element sub-units, the elements of the first sub-unit shall be sequenced 1 to 5, the second 6 to 10, the third 11 to 15 and the fourth 16 to 20.

v. For a 20-element unit made up of 10-element sub-units, the elements of the first sub-unit shall be sequenced 1 to 10 and the second 11 to 20.

vi. The base colour is shown in capital letters. Colour for ring or helix is shown in small letters.

APPENDIX C

REQUIREMENTS ON CABLE ASSEMBLY PRE-TERMINATED IN AN SC/APC CONNECTOR

Item	SC/APC
Insertion loss	≤ 0.2dB
Return loss	≥ 60dB
Working Temperature	-25C° to + 75 C°
Storing Temperature	- 40 C° to + 85 C°
Apex offset	<50µm
Radius	5mm -12mm
Fibre Height	-100mm
End-face angle	8 ±0.3
Endurance	500 times
Standard	IEC61754/ GR326/ YD1258.3