هيئة الاتصالات وتقنية المعلومات
Communications & Information Technology Commission

Annex B - 1

Technical Standards for

In-building Physical Infrastructure (IPI) for

Multi Dwelling Units

Contents

1 Purpose and Scope

1.1 Purpose

This document provides the technical standards for In-building Physical Infrastructure for Multi Dwelling Unit (MDU) buildings to enable all building owners to design and deploy telecommunications network infrastructure in new public and private buildings.

These standards have been established with the aim of ensuring that any In-building Physical Infrastructure in New Developments is built in accordance with a common national telecommunication standard and meets international best practice.

1.2 Scope

These standards apply to all new Multi-Dwelling Unit buildings (residential, commercial, industrial, governmental, etc.). They apply to all In-building Physical Infrastructure and include the most commonly used materials specifications for In-building Physical Infrastructure.

These standards shall be observed by building owners.

These standards do not change any obligations imposed by other administrative authorities. Installations in buildings shall strictly meet the requirements set by the relevant authorities having jurisdiction. Thus, the installations shall comply with all provisions, rules and guidelines established by these authorities.

2 Definitions

New Developments: means the real estates to be developed by land and building developers, including land planning and preparation and buildings construction for residential, commercial, industrial, governmental or any other purpose.

Passive Network Components: include all the non-electric physical elements, such as buildings, sites, ducts, towers and masts, manholes, hand-holes, and cables, among others, that may serve for the provision of Outside Plant and In-building telecommunications networks.

Outside Plant (OSP): Any ICT network implemented with the aim of connecting it, or using it to connect, with the public telecommunications networks. OSP includes passive ICT networks components and any associated hardware located between a central distribution point at the border of the New Development and Access Points.

In-building Physical Infrastructure (IPI): means passive ICT networks components in a building connecting the Access Point with the Network Termination Points in the building units (also known as Inside Plant), including Network Termination Points, distribution frames, risers, telecommunications rooms and spaces, and lead-in ducts.

Access Point: means a physical point located outside the building accessible by public telecommunications networks, hosting the Optical Distribution Box (ODB), through which a connection between the Outside Plant and the In-building Physical Infrastructure is made. It is the demarcation point between Outside Plant and In-building Physical Infrastructure.

Access Area: means the physical location containing the lead-in ducts and cabling from the Access Point to the Telecommunications space / room.

Building Distribution Frame (BDF): means a distribution element between the Outside Plant and the In-building Physical Infrastructure (inside plant). The BDF allows connection of the lead-in cables from the Access Point (outside the premises) to the cables leading to each Unit.

Riser Area: means the physical location containing the vertical ducts and distribution cabling that connects each floor with the BDF.

Floor Distributor (FD): means a sub-dividing element between the BDF and the Unit Distributor / Network Termination Points located nearby or in the riser area which allows the transition from the vertical to the horizontal indoor cable. Use of Floor Distributors is optional.

Network Termination Point (NT): is the point at which the In-building Physical Infrastructure (IPI) of a building unit terminates. A building unit may have multiple NTs.

High-speed-ready: means that the Outside Plant (OSP) and the In-building Physical Infrastructure (IPI), hosting all necessary passive network elements, enable data delivery at a minimum speed of 100 Mbps.

Telecommunications Room (TR): is an enclosed architectural space designed to contain telecommunications equipment, cable terminations, and a Building Distribution Frame (BDF). This room is also used as a collocation area to house various equipment and cables used to distribute telecommunication, image and security services to each Unit.

Unit: means town house, residential apartment, office space, or any other closed entity within a building.

Multi-dwelling Unit (MDU): refers to two or more Units that are joined by a common wall or property boundary. Examples of MDUs include apartments, office and commercial premises, shopping malls and the like. An MDU may consist of multiple towers that are part of a common main building.

Single-dwelling Unit (SDU): means a structure that contains only one Unit (residence / office / commercial premise).

Unit Distributor (UD): means an element which concentrates all cables of a Unit.

Developer: means a Person developing real estate through any of the following:

- Preparing New Development sites for residential, commercial, industrial, governmental, or any other special purpose or public use (Land Developer).
- Construction of buildings (Building Developer).

Often, the owner of the real estate is also the Developer, he is responsible for observing Saudi building codes for construction and land development works.

3 Configuration

Construction of a new MDU provides an opportunity to incorporate a High-speed-ready broadband infrastructure at relatively low cost. The installations of such infrastructure have to be done in three areas: access area, riser area and the office/housing area. For a smooth implementation, the following infrastructure elements shall be taken into account at the planning stage of the building:

- Access Point
- Access Area
- Telecommunications Room
- Riser Area
- Floor Distributor

3.1 Reference Configuration

a) The following figure shows the reference configuration for In-building Physical Infrastructure (based on ISO/IEC 11 801 and ITU Rec. L.82).

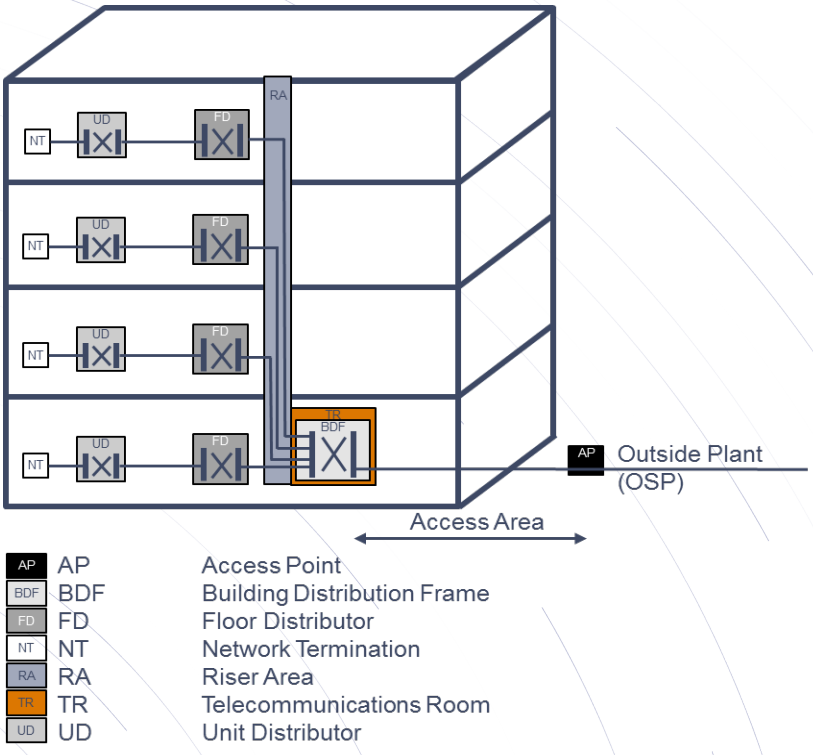

Figure 1: Reference configuration for In-building Physical Infrastructure

b) There shall be at least one Access Point per MDU. Access Points shall be accessible to public Telecommunications Networks. Access Points are the demarcation point between Outside Plant and In-building Physical Infrastructure. Access Points are connected to the Telecommunications Room through two or more lead-in duct(s).

c) Each building in a New Development shall be equipped with a Telecommunications Room. This room includes the BDF, where - via the Access area and the lead in ducts / cables – the outside and inside cabling is mounted. In addition the Telecommunications Room serves as collocation area for equipment required by public Telecommunications Networks. This equipment is also connected to the BDF. The BDF allows connections between cabling coming from outside of the building with the inside cabling and collocated equipment.

d) In MDUs a vertical riser area shall be provided between BDF and each floor. Each floor may contain a Floor Distributor to connect between vertical and horizontal cabling. Each Unit is equipped with one or more Network Terminations, which are connected to the Unit Distributor. The Unit Distributor is then connected to the Floor Distributor.

3.2 Options for the Internal Cabling

The reference configuration allows for two options of the internal cabling.

3.2.1 Floor Distributor Topology

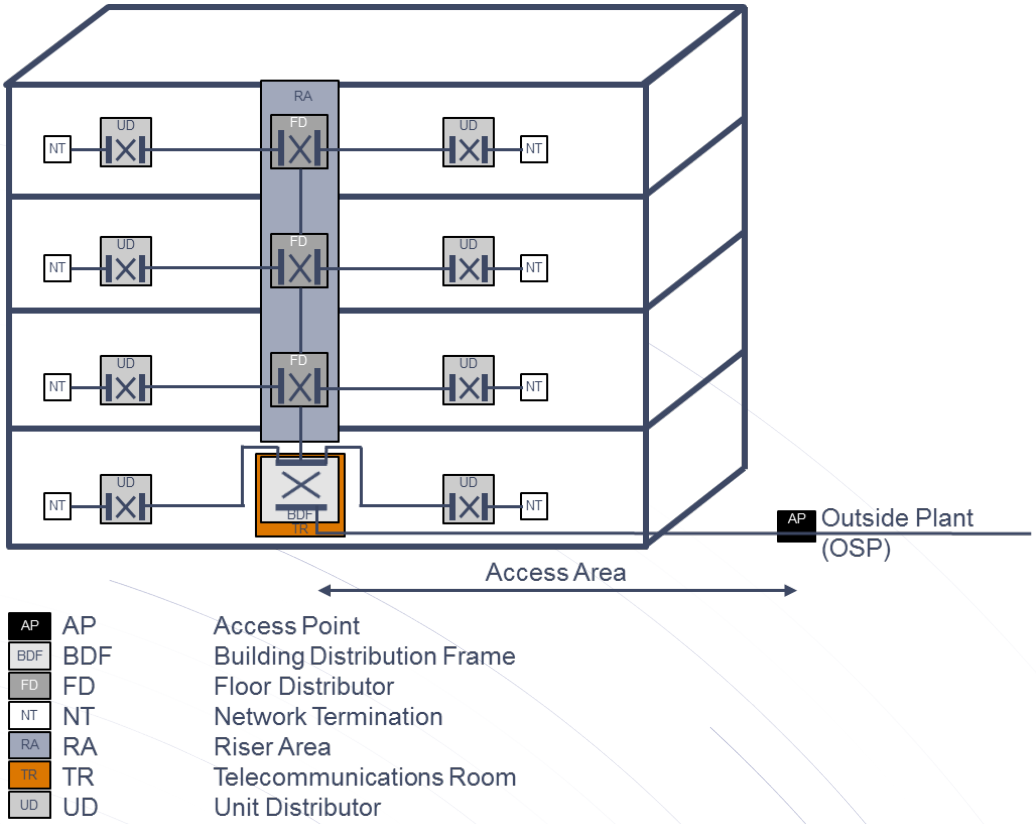

Figure 2: Option 1 – Floor distributor topology configuration for In-building Physical Infrastructure

a) The floor distributor topology represents the reference configuration. It is the preferred solution for MDU. A Floor Distributor is installed in each floor of the building. Each Unit Distributor connects directly to the Floor Distributor that is connected to the Building Distribution Frame.

b) The Floor Distributor topology is normally used for buildings with more than 10 Units as it limits cable lengths and capacity in the riser area.

c) The Floor Distributors allow for higher flexibility of the In-building Physical Infrastructure. Further, this configuration potentially reduces the length of the cables as connections

between Floor Distributors are possible. On the other hand, it requires additional investments for infrastructure elements (Floor Distributors). Further, Floor Distributors represent a potential source of faults.

3.2.2 Star Topology

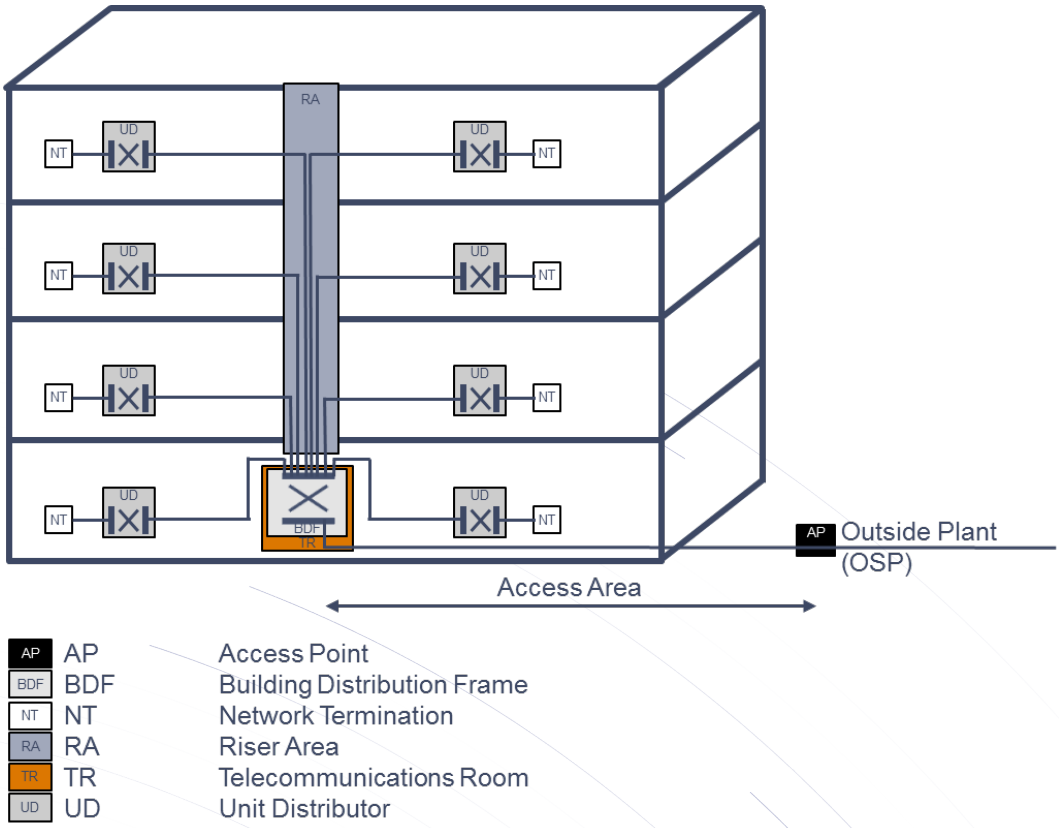

Figure 3: Option 2 – Star topology configuration for In-building Physical Infrastructure

a) The star topology deviates from the reference configuration as it lacks a Floor Distributor. Each Unit Distributor connects directly to the Building Distributor Frame.

b) Such configuration is normally used for up to 10 Units in a building as it requires longer cable lengths and considerable capacity in the riser area.

c) The advantage of star topology configuration lies in the elimination of the interface of the Floor Distributer. Such configuration saves costs and reduces sources of error (Floor Distributer). On the other hand, the riser area must be capable of accommodating larger conduits, sleeves, etc. as more cables are needed.

4 Main Requirements

4.1 General Requirements

a) All MDU shall be equipped with a High-speed-ready In-building Physical Infrastructure, from the Access Point up to the NTs. Planning and design of the In-building Physical Infrastructure shall be executed by Persons specialized in such planning and design.

b) In-building Physical Infrastructure in MDU shall be future-proof.

c) It is highly recommended that only components that have been tested and accepted by internationally accredited and recognized laboratories are used.

d) In-building Physical Infrastructure shall have capacity to provide at least four fiber connections per Unit from the Access Point to the Telecommunications room. From the Telecommunications Room there are at least four connections (fibers, coaxial, or twisted pair Ethernet) to the Unit Distributor (UD). From UD there is one connection to each NT.

e) For international specifications (ITU-T, ISO/IEC, etc.), the latest version shall apply.

4.2 Requirements for Mobile Services

a) In-building Physical Infrastructure may be used to facilitate mobile network coverage.

b) It is recommended to coordinate during the planning stage with mobile Service Providers to identify whether a building is suitable as a location to host masts. In this case a fiber connection is required between the Access Point and the mast, a Network Termination at the mast shall be made available according to the requirement of the mobile Service Provider(s).

c) To facilitate good indoor coverage for mobile services, indoor antenna systems and repeaters may be installed within the building. In this case, early coordination with mobile operators is mandatory to ensure service provision. In addition, coordination with mobile operators is useful to identify the proper locations for such indoor antenna systems and repeaters.

d) Adequate power sources, cooling systems, firefighting systems, etc. shall be provided in accordance with the project design requirements.

5 Specific Requirements for In-building Infrastructure Elements

This chapter includes recommendations for IPI design. The final design shall take into account the size of the development and possible further enhancements.

5.1 Internal Cabling

a) The internal cabling shall be based on international standard ISO/IEC 11801 Edition 2.2.

b) Fiber Optic Cable (FOC) shall preferably be used for internal cabling. If twisted pair copper cable is used, the internal cabling shall at least conform to Category 6 in accordance with ISO/IEC TR 11801 Edition 2.21. Category 7 in accordance with ISO/IEC TR 11801 Edition 2.2 shall be the preferred solution.

c) Splicing of FOC shall be avoided. Splice attenuation shall not exceed 0,15 dB, and be typically at 0,01 dB. Return loss shall not be measurable.

d) For FOC, either SC/APC connectors (IEC 61754-4) or LC/APC connectors (IEC 61754-20) shall be used.

e) The dimensioning of the In-building Physical Infrastructure shall be according to the number of units in the building and the associated number of connections (4 connections per unit) including a suitable reserve capacity.

f) The In-building Physical Infrastructure shall be designed to meet the projected service requirements at the floor level and shall have built-in flexibility to meet the growing needs of tenants.

[1] International Standard ISO/IEC 11801: Information technology – Generic cabling for customer premises

5.1.1 Bend Radius

a) The internal cabling shall take into account the specified minimum bend radii for the respective cables used.

b) The bend radii are defined in ITU-T G657 A1/A2/B2/B3. The minimum bend radius ranges from A1 at 10 mm to B3 at 5 mm.

c) The smaller the radius the higher the bending loss. Thus, bigger radii shall be preferred.

5.2 Access Point

The Access Point is the demarcation between Outside Plant and In-building Physical Infrastructure (see Article 3). The Access Point shall be easily accessible for public Telecommunications Networks and protected against potential damage. A lockable cover is preferred. The Access Point hosts the Optical distribution box (ODB) and shall be able to accommodate at least 4 fiber connections per unit in the building. The optical distribution box in the access point to be provided by the Service Provider. The necessary physical facilities and space for the Access Point is to be provided by the Building Developer. Building Developers shall provide appropriate space on or inside the wall or in the ground such that the physical facilities including the ODB can be situated. Since OSP and IPI may be constructed at different timescales, coordination between the entities responsible for OSP and IPI concerning the location of the access point may be required.

a) If the OSP is constructed before the building, the OSP termination at each property should be realized with a marker. The OSP termination shall be provided by the OSP developer in a way that lead in ducts can be joined in the process of building construction. During building planning and construction, the location for the access point shall be coordinated between the building developer and service provider. The process shall be aligned with the construction of other utilities.

b) If the building is constructed before an OSP is available, the location for the access point shall be marked clearly and coordinated between building developer and the OSP developer as far as possible. A temporary terminal of the lead-in ducts shall be deployed with the view to be integrated into the access point when the OSP becomes available.

5.3 Lead-in Duct

a) The fiber cables that connect the Access Point to the Telecommunications Room must be protected. Therefore, lead-in ducts shall be provided by the Developer of the Building from the Access Point to the Telecommunications Room.

b) Lead-in ducts shall be laid at a depth of about 300-600 mm and protected against damage, considering any local municipal rules.

c) The lead-in ducts shall meet the following functional requirements:

- At least one (1) [plus one (1) reserve] lead in-duct(s) shall be installed per building. Duct systems with subducts should be used.
- The inner diameter of each lead-in (sub-)duct shall be at least 20 mm and specifically defined in the project design.
- For MDUs with more than 30 units at least 50 mm (sub-)ducts shall be used.
- The ducts shall be sealed at each end.
- The location of lead-in ducts shall be clearly marked above ground for ease of locating.
- Lead-in ducts shall be assigned exclusively for Telecommunications Services.

Standards: Lead-in Duct	
Minimum Dimension (inner diameter)	[SDU and] MDU < 30 units: 20 mm MDU > 30 units: 50 mm]
Quantity	min 1 (+1 reserve)
Thickness (mm)	+/-2.00 (for 20 mm ducts) +/-3.25 (for 50 mm ducts)

- No right-angled sharp bends should be installed throughout the duct length, except one wide-angle, long radius bend (factory made) at the terminating end of the duct, inside the main telecom room. Alternatively, at the location of the sharp angle bend, a cable pull-box of minimum size 600mm (L) X 600mm (W) X 800mm (D) must be provided.

d) The standard lead-in ducts shall be made from High Density Polyethylene (HDPE), unplasticized polyvinyl chloride (uPVC) or better material, in accordance with internationally recognized standards. The lead-in ducts shall be ribbed inside and be capable to accommodate FOCs. A continuous and strong draw rope shall be installed in the (sub-)ducts and shall remain for additional cable installations.

5.4 Telecommunications Room

a) Each MDU with more than 30 units shall be equipped with a Telecommunications Room. Multiple Telecommunications Rooms shall be interconnected by separate cable trays (200 mm x 50 mm) or equivalent.

b) The Telecommunications Room shall meet the following requirements:

- Good lighting, clean, dry, proper ventilation and air circulation.
- 24/7 secured access for staff of service providers of public Telecommunications Networks.
- Properly accessible for adding or removing equipment and tools.
- Master lock for the entrance door.
- No windows,
- Must not be beneath or next to kitchens, washrooms, garbage areas, swimming pools and other wet areas and the surrounding walls shall have no concealed water/drainage pipes and air-conditioning ducts passing through.
- Dedicated spaces not shared with other functions (such as electrical or mechanical).
- Air conditioned to maintain the temperature at 25 °C ± 10 °C; with humidity 40%-60%.
- All metal parts must be earth bonded with resistance of less than 1 ohm.
- Extra space for future network equipment additions.
- Space for collocating equipment of at least three providers of public Telecommunications Networks, with a minimum of two square meters for each provider of a public Telecommunications Network. The final project design shall take into account the size of the building and the number of units as well as possible enhancements.
- Power supply with at least 10 A/C sockets (240 volt, 20 amp) with a dedicated circuit breaker.
- A raised floor system is recommended.
- Further, an emergency light, a smoke detector, and a fire alarm including a hand held CO_2 fire extinguisher of minimum 10 kg capacity are recommended.

c) In an MDU with less than 30 Units the installation of a separate Telecommunications Room may not be economical. In this case telecommunications space shall be provided to accommodate the Building Distribution Frame and other equipment. This space can be collocated with technical equipment for other utility infrastructures with proper clearance between different infrastructures.

5.5 Building Distribution Frame (BDF)

The Building Distribution Frame allows arbitrary connections between in-building cabling and outside plant cabling. The BDF shall have sufficient space to accommodate 4 connections to each unit.

5.6 Riser Area

a) A riser area shall be provided for all multi-storied buildings. The riser area shall be able to accommodate at least 4 connections to each unit (UD). 15 % reserve capacity in the riser area shall be provided for manipulation purposes.

b) Any cables that are installed in the riser area shall be easily replaceable in case of damage or faults. Cables shall be placed in cable risers, conduits, sleeves, tubes, etc.

c) The following principles shall apply:

- Riser areas shall be accessible at any time.
- The installations shall be done using the shortest route and preferably as vertical as possible.
- Riser areas shall not be located inside units or air shafts.
- The diameter of the conduit pipes shall be at minimum 25 mm.

5.7 Floor Distributor

a) Floor Distributors shall be located close to the riser area. Floor Distributors shall be installed at a minimum height of 600 mm from finished floor level. The space for the floor distributor shall be dry an clean.

b) In general, a floor distributor should not require active elements.

c) In case active elements are required, a power supply must be provided.

d) Each Unit of a floor shall be connected with a 20 mm conduit pipe with the Floor Distributor.

e) A star topology shall be used for the cabling on each floor. Looping of the horizontal cabling from Unit to Unit is prohibited.

5.8 Unit Distributor

a) Each Unit (dwelling or office) shall have a Unit Distributor installed at a central and accessible location in case more than one NT is installed in the Unit. The Unit Distributor shall connect each NT with a conduit pipe of 20 mm. It shall be located where the distance to the farthest NT within the Unit does not exceed 90 meters.

b) The conduit pipes and the Unit Distributor shall be able to handle all possible cables:

- Fiber cables (G657.A1/A2)
- Twisted pair Ethernet cables
- Coaxial cables (75 Ohm resistance)

c) Different ICT technologies shall be segregated to accommodate for operational issues. Each type of cable must have its separate Unit Distributor.

d) In case active elements are required, a power supply must be provided.

5.9 Network Termination

a) Each Unit shall have at least 4 connections to the BDF. For business customers a higher number of connections may be designed if demand is expected.

b) Each residential room (except the wet rooms such as: bathrooms and laundry rooms) or office room shall be equipped with at least one Network Termination (NT). An electrical power source shall be available nearby an Optical NT.

5.10 Installations

a) Installations shall be executed by qualified personnel only according to manufacturers' specifications using the proper tools and testing equipment to ensure quality, high performance of the system and that it meets expected standards.

b) Cables for ICT shall be installed separately from electrical cabling. When installing ICT infrastructure in parallel to other installations, all regulations regarding noise protection, fire protection, or the security of electrical installations must be followed.

c) All materials shall be flame retardant, low smoke and zero halogen emissions.

5.11 Testing

a) The testing for FOC must conform to ISO/IEC TR 14763-3 and to the relevant ITU specifications.

b) The testing for balanced cabling installations (CAT6 etc.) must conform to IEC 61935-1 and to the relevant ITU specifications.

5.12 Documentation

a) All infrastructure components must be clearly and uniquely labeled. Labels on components must match the label in the documentation and as-built drawings.

b) The building records shall include the following:

- Building location information (e.g. building number and way number).
- A list of all NT's and their locations in the building.
- A list of all distributors and the connections.
- Labeling of all infrastructure components.
- Contact information.
- As-built drawings.

c) All above documents must be kept in the Telecommunications Room / Space.

d) The above documents must be updated as soon as changes to the building records have occurred.

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Annex B - 1

Technical Standards for

In-building Physical Infrastructure (IPI) for

Multi Dwelling Units

Contents

1 Purpose and Scope

1.1 Purpose

This document provides the technical standards for In-building Physical Infrastructure for Single Dwelling Units (SDU) to enable all building owners to design and deploy their telecommunications network infrastructure in public and private SDUs.

These standards have been established with the aim to ensure that any In-building Physical Infrastructure in a SDU is built in accordance with a common national telecommunication standard and meets international best practice.

1.2 Scope

These standards apply to all new Single Dwelling Unit buildings (residential, commercial, industrial, governmental, etc.). They apply to all In-building Physical Infrastructure and include the most commonly used materials specifications for In-building Physical Infrastructure.

These standards shall be observed by building owners.

These standards do not change any obligations imposed by other administrative authorities. Installations in buildings shall strictly meet the requirements set by the relevant authorities having jurisdiction. Thus, the installations shall comply with all provisions, rules and guidelines established by these authorities.

2 Definitions

New Developments: means the real estates to be developed by land and building developers, including land planning and preparation and buildings construction for residential, commercial, industrial, governmental or any other purpose.

Passive Network Components: include all the non-electric physical elements, such as buildings, sites, ducts, towers and masts, manholes, hand-holes, and cables, among others, that may serve for the provision of Outside Plant and In-building telecommunications networks.

Outside Plant (OSP): Any ICT network implemented with the aim of connecting it, or using it to connect, with the public telecommunications networks. OSP includes passive ICT networks components and any associated hardware located between a central distribution point at the border of the New Development and Access Points.

In-building Physical Infrastructure (IPI): means passive ICT networks components in a building connecting the Access Point with the Network Termination Points in the building units (also known as Inside Plant), including Network Termination Points, distribution frames, risers, telecommunications rooms and spaces, and lead-in ducts.

Access Point: means a physical point located outside the building accessible by public telecommunications networks, hosting the Optical Distribution Box (ODB), through which a connection between the Outside Plant and the In-building Physical Infrastructure is made. It is the demarcation point between Outside Plant and In-building Physical Infrastructure.

Access Area: means the physical location containing the lead-in ducts and cabling from the Access Point to the Telecommunications space / room.

Building Distribution Frame (BDF): means a distribution element between the Outside Plant and the In-building Physical Infrastructure (inside plant). The BDF allows connection of the lead-in cables from the Access Point (outside the premises) to the cables leading to each Unit.

Riser Area: means the physical location containing the vertical ducts and distribution cabling that connects each floor with the BDF.

Floor Distributor (FD): means a sub-dividing element between the BDF and the Unit Distributor / Network Termination Points located nearby or in the riser area which allows the transition from the vertical to the horizontal indoor cable. Use of Floor Distributors is optional.

Network Termination Point (NT): is the point at which the In-building Physical Infrastructure (IPI) of a building unit terminates. A building unit may have multiple NTs.

High-speed-ready: means that the Outside Plant (OSP) and the In-building Physical Infrastructure (IPI), hosting all necessary passive network elements, enable data delivery at a minimum speed of 100 Mbps.

Telecommunications Space (TS): is space designed to contain telecommunications equipment of different public Telecommunications Networks, cable terminations, and distribution frames. As various equipment and cables that are used to distribute telecommunication, image and security services to each dwelling Unit are often installed in the Telecommunications Space. The Telecommunications Space may also include other infrastructure.

Unit: means town house, residential apartment, office space, or any other closed entity within a building.

Multi-dwelling Unit (MDU): refers to two or more Units that are joined by a common wall or property boundary. Examples of MDUs include apartments, office and commercial premises, shopping malls and the like. An MDU may consist of multiple towers that are part of a common main building.

Single-dwelling Unit (SDU): means a structure that contains only one Unit (residence / office / commercial premise).

Unit Distributor (UD): means an element which concentrates all cables of a Unit.

Developer: means a Person developing real estate through any of the following:

- Preparing New Development sites for residential, commercial, industrial, governmental, or any other special purpose or public use (Land Developer).
- Construction of buildings (Building Developer).

Often, the owner of the real estate is also the Developer, he is responsible for observing Saudi building codes for construction and land development works.

3 Reference Configuration

a) Construction of a new SDU provides an opportunity to incorporate a High-speed-ready broadband infrastructure at relatively low cost. The installations of such infrastructure have to be done in three areas: access area, riser area and the office/housing area. For a smooth implementation, the following infrastructure elements shall be taken into account at the planning stage of the building:

- Access point
- Access area
- Telecommunications Space (containing the UD)
- Riser area

b) The following figure shows the reference configuration for In-building Physical Infrastructure (based on ISO/IEC 11 801 and ITU Rec. L.82).

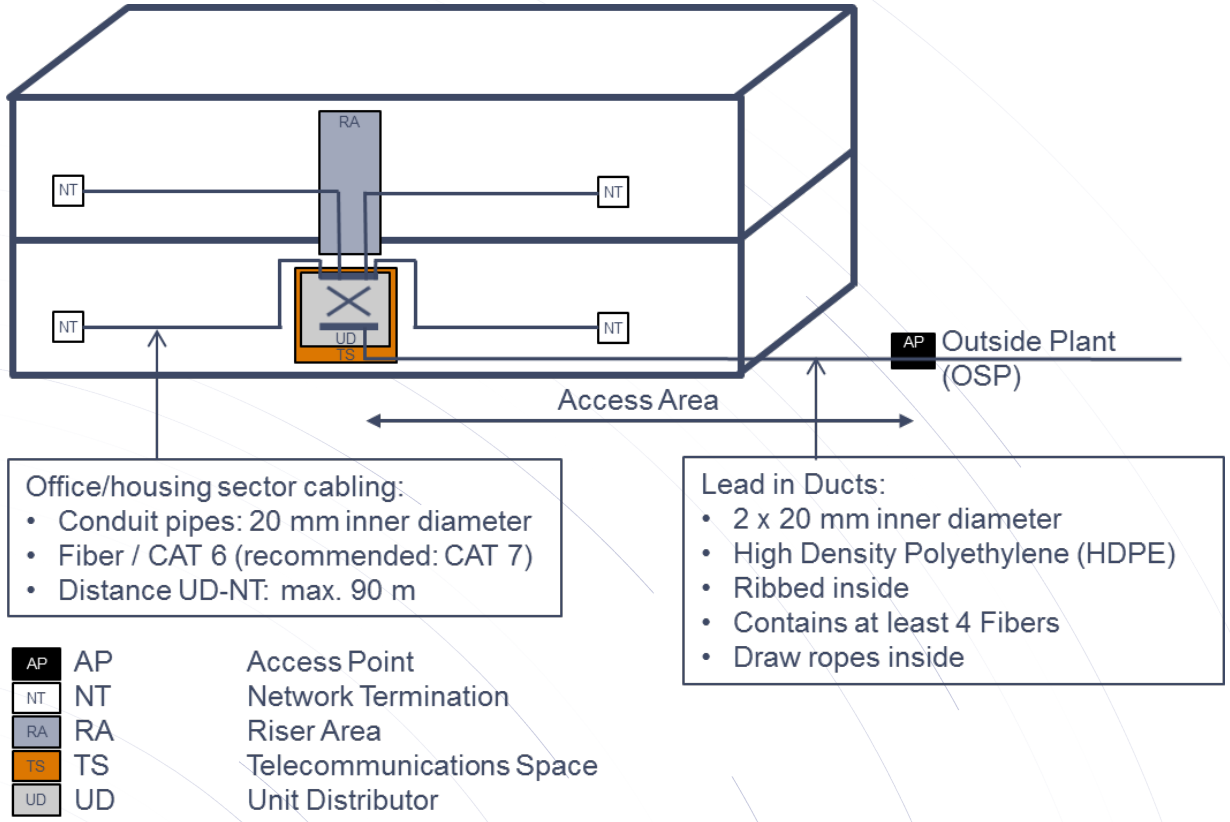

Figure Error! Bookmark not defined.**: Reference configuration for In-building Physical Infrastructure**

c) There shall be at least one Access Point per SDU. Access Points shall be accessible to public Telecommunications Networks. Access Point are the demarcation point between Outside Plant and In-building Physical Infrastructure. Access Points are connected to the Telecommunications Space through two or more lead-in duct(s).

d) The SDU shall be equipped with a Telecommunications Space. This space includes the UD, where via the access area and the lead in ducts / cables the outside and inside cabling is mounted. In addition, the Telecommunications Space serves as collocation area for equipment required by public Telecommunications Networks. This equipment is also connected to the UD. The UD allows connections between cabling coming from outside of the building with the inside cabling and equipment from public Telecommunications Networks.

e) For SDU, at least one Network Termination at the Telecommunications Space must be installed. Each room may be equipped with one or more Network Terminations, which are connected to the Unit Distributor.

f) The internal cabling shall be a star configuration where all cables directly terminate at the UD. The advantage of star topology configuration lies in the elimination of the interface of the Floor Distributer. Such configuration reduces sources of error.

4 General Requirements

a) All SDU shall be equipped with a High-speed-ready In-building Physical Infrastructure, from the Access Point up to the NT(s). Planning and design of the In-building Physical Infrastructure shall be executed by Persons specialized in such planning and design.

b) In-building Physical Infrastructure in SDUs shall be future-proof.

c) It is highly recommended that only components that have been tested and accepted by internationally accredited and recognized laboratories are used.

d) In-building Physical Infrastructure shall have capacity to provide at least four fiber connections per SDU (from the Access Point to the Unit Distributor (UD)). From UD there is one connection to each NT.

e) For international specifications (ITU-T, ISO/IEC, etc.), the latest version shall apply.

5 Specific Requirements for In-building Infrastructure Elements

5.1 Internal Cabling

a) The internal cabling shall be based on international standard ISO/IEC 11801 Edition 2.2.

b) Fiber Optical Cables (FOC) shall preferably be used for internal cabling. If twisted pair copper cable is used, the internal cabling shall at least conform to Category 6 in accordance with ISO/IEC TR 11801 Edition 2.2[2]. Category 7 in accordance with ISO/IEC TR 11801 Edition 2.2 shall be the preferred solution.

c) Splicing of FOC shall be avoided. Splice attenuation shall not exceed 0.15 dB, and be typically at 0.01 dB. Return loss shall not be measurable.

d) For FOC, either SC/APC connectors (IEC 61754-4) or LC/APC connectors (IEC 61754-20) shall be used.

e) From the Access Point to the UD, at least four (4) fiber connections shall be installed.

f) The In-building Physical Infrastructure shall be designed to meet the projected service requirements at the floor level and shall have built-in flexibility to meet the growing needs of occupants.

5.1.1 Bend Radius

a) The internal cabling shall take into account the specified minimum bend radii for the respective cable in use.

b) The bend radii are defined in ITU-T G657 A1/A2/B2/B3. The minimum bend radius ranges from A1 at 10 mm to B3 at 5 mm.

c) The smaller the radius the higher the bending loss. Thus, bigger radii shall be preferred.

[2] International Standard ISO/IEC 11801: Information technology – Generic cabling for customer premises

5.2 Access Point

ب) The Access Point is the demarcation between Outside Plant and In-building Physical Infrastructure (see Article 3). The Access Point shall be easily accessible for public Telecommunications Networks but also protected against potential damage. A lockable cover is preferred. The Access Point is hosting the Optical distribution box (ODB) and shall be able to accommodate at least 4 fiber connections to the SDU. The optical distribution box in the access point to be provided by the Service Provider. The necessary physical facilities and space for the Access Point is to be provided by the Building Developer. Building Developers shall provide appropriate space on or inside the wall such that the physical facilities including the ODB can be situated. For mounted flush configuration, see figure (5), coordination with the Service Provider is potentially required regarding the space dimensions. Often, the space should be of at least 30(L) x 30(W) x 12(D) cm. The wall mounted configration shall be always applicable.

a) If the OSP is constructed before the building, the OSP termination at each property should be realized with a marker. The OSP terminal shall be provided by the OSP developer in a way that lead in ducts can be joined in the process of building construction. During building planning and construction, the location for the access point shall be coordinated between the building developer and service provider. The process shall be aligned with the construction of other utilities.

b) If the building is constructed before an OSP is available, the location for the access point and the termination for OSP connection, see figure (5 and 6), shall be provided by the Building Developer and marked clearly, coordination between building developer and the OSP developer shall be as far as possible. A temporary terminal of the lead-in ducts shall be deployed with the view to be integrated into the access point when the OSP becomes available.

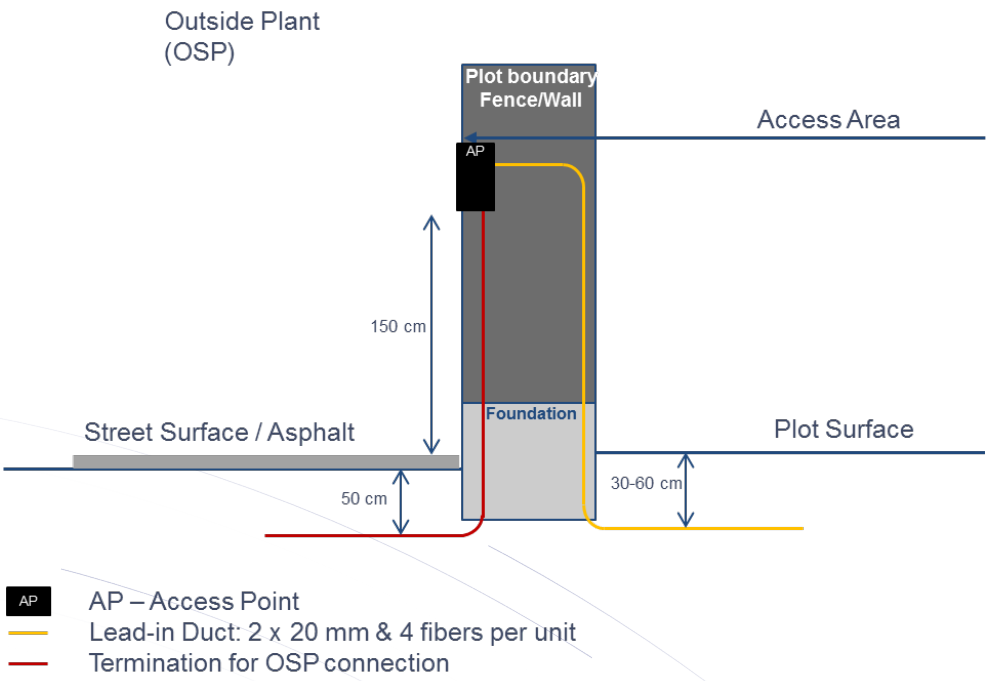

Figure 5: Access Point -mounted flush- with Lead-in Duct

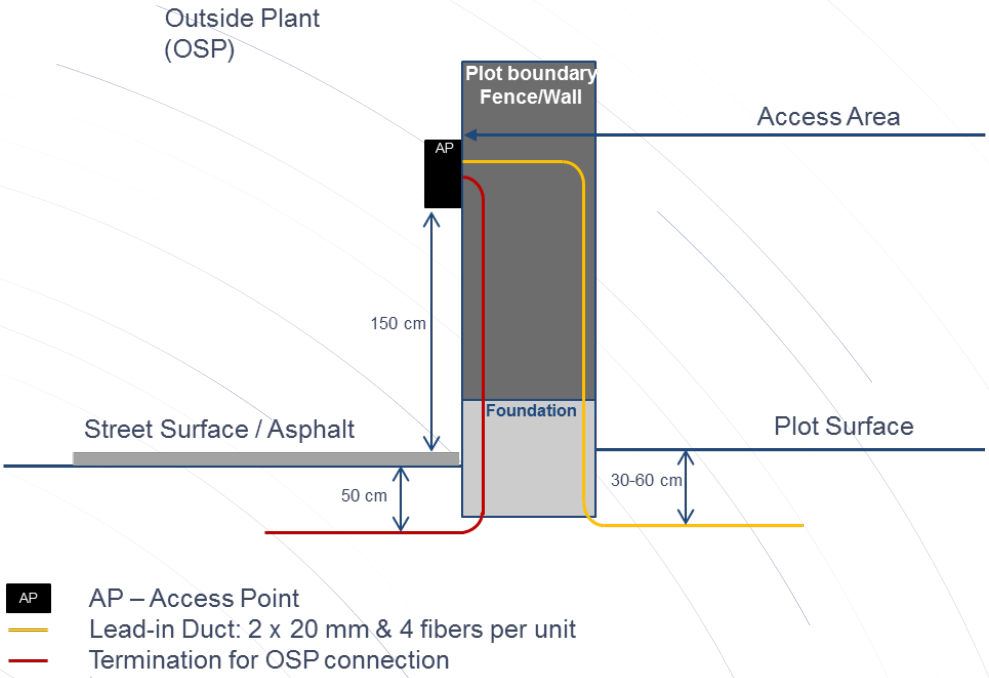

Figure 6: Access Point –wall mounted- with Lead-in Duct

5.3 Lead-in Duct

a) The fiber cables that connect the Access Point to the Telecommunications Space must be protected. Therefore, lead-in ducts shall be provided by the Developer of the Building from the Access Point to the Telecommunications Space.

b) Lead-in ducts shall be laid at a depth of about 300-600 mm and protected against damage, considering any local municipal rules.

c) The lead-in ducts shall meet the following functional requirements:

- At least one (1) [plus one (1) reserve] lead in-duct(s) shall be installed.
- The inner diameter of each lead-in ducts shall be at least 20 mm.
- The ducts shall be sealed at each end.
- The location of lead-in ducts shall be clearly marked above ground for ease of locating.
- Lead-in ducts shall be assigned exclusively for Telecommunications Services.
- No right-angled sharp bends should be installed throughout the duct length, except one wide-angle, long radius bend (factory made) at the terminating end of the duct, inside the main telecom space. Alternatively, at the location of the sharp angle bend, a cable pull-box of minimum size 600mm (L) X 600mm (W) X 800mm (D) must be provided.

d) The standard lead-in ducts shall be made from High Density Polyethylene (HDPE) or plasticized polyvinyl chloride (uPVC), in accordance with internationally recognized standards. The lead-in ducts shall be ribbed inside and be capable to accommodate FOCs. A continuous and strong draw rope shall be installed in the ducts and shall remain for additional cable installations.

5.4 Telecommunications Space

a) The Telecommunications Space shall meet the following requirements:
   - Central, accessible, dry, and clean location. It shall be located where the distance to the farthest NT within the Unit does not exceed 90 meters.
   - Good lighting, proper ventilation and air circulation.
   - Space of 60 x 60 cm.
   - All metal parts must be earth bonded with resistance of less than 1 ohm.
   - Space for collocating equipment of at least three public Telecommunications Networks.
   - Power supply (240 volt).

b) The space can be nearby technical equipment for other utility infrastructures with proper clearance between different infrastructures.

5.5 Unit Distributor

a) The Unit Distributor shall be installed at the Telecommunications Space in case more than one NT is installed in the Unit. The Unit Distributor shall connect each NT with a conduit pipe of 20 mm.

b) The conduit pipes and the Unit Distributor shall be able to handle all possible cables:
   - Fiber cables (G657.A1/A2)
   - Twisted pair Ethernet cables
   - Coaxial cables (75 Ohm resistance)

c) Different ICT technologies shall be segregated to accommodate for operational issues. Each type of cable must have its separate UD.

d) In case active elements are required, a power supply must be provided.

5.6 Floor Distributor

a) Floor distributors may be located on the second floor of a SDU. Floor Distributors shall be installed at a minimum height of. 600 mm from finished floor level. The space for the floor distributor shall be dry an clean.

b) In general, a floor distributor should not require active elements.

c) In case active elements are required, a power supply must be provided.

d) Each room of a floor shall be connected with a 20 mm conduit pipe with the Floor Distributor.

e) A star topology shall be used for the cabling on each floor. Looping of the horizontal cabling from room to room shall be avoided.

5.7 Network Termination

ج) For SDU, at least one Network Termination at the Telecommunications Space must be installed. It is recommended that each residential room (except the wet rooms such as: bathrooms and laundry rooms) or office room is equipped with at least one Network Termination (NT). An electrical power source shall be available nearby an Optical NT.

5.8 Installations

a) Installations shall be executed by qualified personnel only according to manufacturers' specifications using the proper tools and testing equipment to ensure quality, high performance of the system and that it meets expected standards.

b) Cables for ICT shall be installed separately from electrical cabling. When installing ICT infrastructure in parallel to other installations, all regulations regarding noise protection, fire protection, or the security of electrical installations must be followed.

c) All materials shall be flame retardant, low smoke and zero halogen emission.

5.9 Testing

a) The testing for FOC must conform to ISO/IEC TR 14763-3 and to the relevant ITU specifications.

b) The testing for balanced cabling installations (CAT6 etc.) must conform to IEC 61935-1 and to the relevant ITU specifications.

5.10 Documentation

a) All infrastructure components shall be clearly and uniquely labeled. Labels on components must match the label in the documentation and as-built drawings.

b) The building records shall include the following:

- Building location information (e.g. building number and way number).
- A list of all NT's and their locations in the building.
- A list of all distributors and the connections.
- Labeling of all infrastructure components.
- Contact information.
- As-built drawings.

c) All above documents shall be kept in the Telecommunications Space.

d) The above documents shall be updated as soon as changes to the building records have occurred.


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