

Annex A
Technical Standards for Outside Plant (OSP)
Installations

Contents

1	Purpose and Scope	4
1.1	Purpose.....	4
1.2	Scope	4
2	Definitions	5
3	Technical Standards	7
3.1	Network Design and Planning	7
3.2	Fiber Optic Standards.....	8
3.3	FOC Standards.....	9
3.3.1	Slack	9
3.4	Duct Standards.....	9
3.4.1	Duct Numbering and Color Coding.....	11
3.4.2	Duct Laying	12
3.4.3	Pre-formed Duct Bends	13
3.4.4	Protection Against Entry of Material	14
3.4.5	Cleaning and Testing	14
3.4.6	Draw Rope.....	15
3.4.7	Duct Seal	15
3.4.8	Pulled Joints	15
3.5	Minimum Number of Ducts and Fibers.....	16
3.6	Manholes / Handholes Standards.....	16
3.6.1	Manhole/Handhole Locations	17
3.6.2	Manhole/Handhole Entry	18
3.6.3	Protection of Cables and Associated Equipment	19

3.6.4	Duct Entries	19
3.7	Trenches	19
3.8	Standards for Street Cabinets (SC)	20
3.9	Access to Buildings	21
3.9.1	Access Points	21
3.10	Marker Tapes	25
3.11	Clearance from Utilities Services	25
3.12	Road Crossings	25
3.13	Active Elements	25
4	Architecture.....	26
5	Towers	28
5.1	Design Standards for Wind Speeds	28
5.2	Grounding	28
5.3	Electricity	29
6	As Built Documentation	30
6.1	Configuration Documentation	30
6.2	Database	30
7	Safety for OSP works	31

1 Purpose and Scope

1.1 Purpose

This document provides technical standards for Outside Plant (OSP) Infrastructure to enable concerned parties to design, deploy and protect telecommunications network infrastructure in public and private New Developments. These Standards have been established with the aim of ensuring that any OSP installation in New Developments is built in accordance with a common national telecommunication standard and meets international best practice. Further, these standards shall facilitate infrastructure sharing.

1.2 Scope

These Standards apply to all OSP installations in New Developments and provide guidance on the mostly used materials specifications for OSP networks. These Standards shall be observed by parties developing land. These Standards do not change any obligations imposed by other administrative authorities. Installations along roads and highways shall strictly observe the requirements set by the relevant authorities having jurisdiction. Thus, the installations shall comply with all provisions and guidelines established by these concerned 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.

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.

Fiber or Fiber Optic: means the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand or fiber.

Fiber Optic Cable (FOC): means a telecommunication cable in which one or more fibers are used as the medium to transmit large amounts of information.

Manhole: means a top opening underground chamber in which a person can enter for installation of cables or equipment, making connections or performing operations and maintenance on underground cables.

Handhole: means a top opening hole, with smaller size than a manhole, to provide access for pulling and splicing FOC.

ITU-T: means International Telecommunication Union - Telecommunication Standardization Sector.

Optical Distribution Frame (ODF): means a passive hub where FOCs of a New Development terminate, allowing connections between fibers to be made.

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

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 Technical Standards

- a) Passive Network Components in the Outside Plant shall enable the construction of, and facilitate the integration of existing, networks in New Developments that can be used to connect customers to the public Telecommunications Networks. Only future-proof technical solutions shall be implemented in order to provide for services like High-speed data or multimedia services. The network shall be designed and constructed in accordance with these national standards as well as recognized international standards.
- b) In case reference is made to international specifications (ITU-T, ISO/IEC, etc.), the latest version shall apply.

3.1 Network Design and Planning

- a) The legal requirements for reserve capacity according to Section 6 of the Rules on Access to Physical Facilities must be adhered to, so that sufficient duct capacity is constructed for current and the foreseeable future service requirements.
- b) Due consideration shall be given at the planning stage to the location of existing underground infrastructure and to the planned provision of other underground utilities to ensure the safety of both the public and other utility providers' infrastructures.
- c) The design shall take into consideration the connection of all buildings within a New Development with public networks. The design shall be based on a customer demand forecast that takes into account the various types of occupants of the New Development and the services they may require. The design process shall consider both, the short term and long term requirements of the New Development including lot density, terrain and site usage (e.g. residential, commercial, industrial, or governmental use). All infrastructures shall be based on demand forecasts of not less than 10 years to reduce delays in provision of service to customers and to avoid future disturbance to the public.
- d) All civil works route designs shall consider future developments in the area to avoid the need for any additional digging. This includes the needs of neighboring New Developments and extending routes to the boundaries of the New Development to connect to other future New Developments.

- e) The following figure shows a schematic view of a typical network and the demarcation points between the backbone, outside plant (OSP) including feeder and distribution, and In-building Physical Infrastructure (IPI):

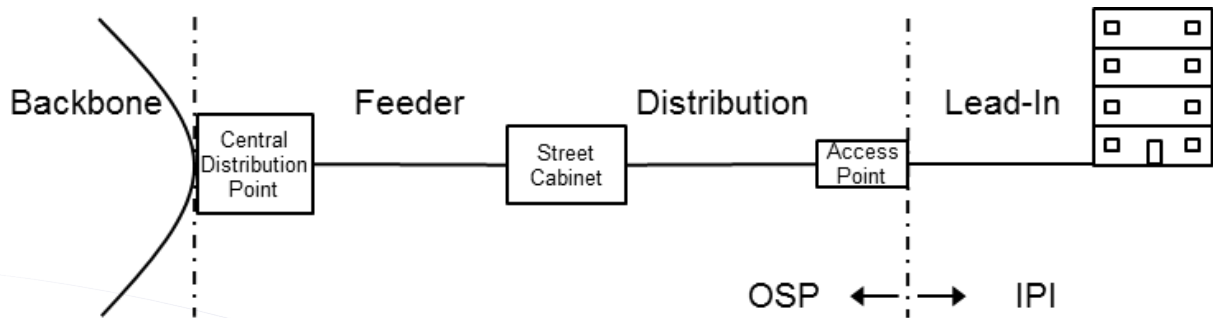


Figure 1: Network schematic and demarcation between backbone, OSP and IPI

3.2 Fiber Optic Standards

- a) The following features shall be taken into consideration when selecting Fiber Optic Cables:
- I. All Fiber Optics must meet the requirements of ITU-T Recommendations: Performance specifications for standard single mode Fiber Optics (ITU-T G.652) or improved internationally accepted standards.
 - II. Each FOC must be distinguishable from other FOCs in the same duct by means of color coding ink or non-removable label visible throughout the design life of the cable. However, the deployment of more than one cable per duct is not recommended.
 - III. Each cable shall have traceability of each optical fiber back to the original fiber manufacturers serialized fiber number and measured fiber parameters.
 - IV. Fiber Optics chosen shall have a high level of splice compatibility with Fiber Optics from other manufacturers.

3.3 FOC Standards

- a) The FOC must be circular in cross section and free from pinholes, joints, repairs and other defects.
- b) Materials used in the construction of the FOC shall not affect the physical or optical properties of the Fibers. All materials used shall be compatible with each other.
- c) FOCs shall be marked and labelled at each Manhole and at all entry and end points of the FOCs.
- d) Regarding bend-insensitiveness of single-mode Fibers for distribution networks and customer premises, ITU-T G.657 shall be followed.
- e) Upon installation, Optical Time Domain Reflectometer (OTDR) measurements shall be performed.
- f) The following minimum numbers of Fibers per FOC shall be used:

Feeder	Distribution	Lead-in
48 Fibers	12 Fibers	See: Technical Standards for In-building Physical Infrastructure [4 fibers per unit]

3.3.1 Slack

- a) The slack on the drop cables is recommended to be about 7 m in Manholes. Cables that span the inside of buildings between distribution frames are recommended to have about 7 m slack at each end.
- b) Depending on the local situation, the final length of the slack shall be subject to the specific project design that shall guarantee sufficient slack.

3.4 Duct Standards

- a) The standard ducts and bends shall be made from material consisting of High Density Polyethylene (HDPE) in accordance with internationally recognized standards. The ducts shall be ribbed inside.

- b) The standard sub-ducts (microducts) shall be made from High Density Polyethylene (HDPE), in accordance with internationally recognized standards. The sub-ducts shall be ribbed inside and be capable to accommodate FOCs or act as lead-ins to buildings / customer premises.
- c) The ducts shall be marked and labelled at each manhole and at all entry and end points.
- d) The following minimum size of ducts shall be used for all new installations:

Duct Type	Feeder	Distribution until Access Point
Minimum Dimension (inner diameter)	50 mm	20 mm
Thickness (mm)	+/-3,25	+/-2,00

- e) The ducts and bends shall be suitably marked at an interval of not more than one meter with the duct number.
- f) The duct laying shall be done in accordance to the technical standards in this document.
- g) The line of ducts installed in the ground shall be kept as straight as possible and in parallel to the center line of the road. If it needs to deviate, a proper bending radius shall be provided as per the specification of duct bending (see 3.4 h) and (0 d). All bending in duct shall be cold formed, without use of artificial heat.
- h) All ducts shall be sufficiently flexible to provide a minimum bending radius. The minimum bending radius shall be 20 x outer diameter of the duct or according to manufacturer's specification. Prefabricated bends shall have bend radii according to (0 d).
- i) The duct formation shall be maintained between manholes. The use of bundles, flatliners, sub-ducts or similar may support maintaining the duct formation and save space.
- j) Sub-ducting systems may be used to increase the utilization of primary ducts and to improve the protection provided to individual cables. Different colors shall be used to identify each sub-duct running in a primary duct.
- k) Duct size coupler may be used. In one duct span, maximum one coupler shall be used. A proof of air tightness shall be made.

3.4.1 Duct Numbering

- a) The numbering of ducts shall start from top left to bottom right. Sub duct numbering shall be from bottom to top.
- b) In case sub-ducts or pre-formed duct bundles are used, they shall conform to a uniform color code. Sub-ducts or duct bundles shall have the following colors:

Duct	Color
1	red
2	green
3	blue
4	yellow
5	white
6	grey
7	brown
8	violet
9	turquoise
10	black
11	orange
12	pink

- c) Subsequent sub-ducts shall have stripes.
- d) The following figure shows examples of the numbering scheme and color coding for sub-ducts or duct bundles.

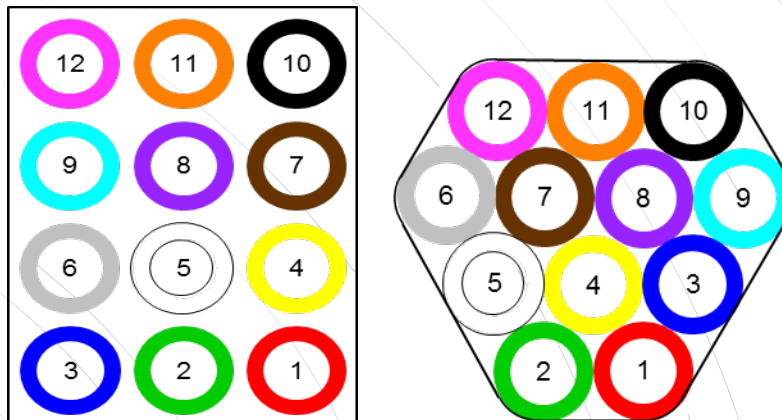


Figure 2: Examples of a numbering and color scheme of sub-ducts or duct bundles

- e) Cables placed in ducts shall be racked in the manhole in a sequential order from the floor up. In any case, lower joint locations shall be used first.

3.4.2 Duct Laying

- a) HDPE ducts are typically delivered on cable drums and are fitted with a connector or socket at one end to join the lengths. Each duct length has a socket at one end that will accept the barrel of the duct.
- b) Suitable collar ducts may also be used to connect short lengths of duct which have no socket.
- c) Ducts shall be placed in the center of the trench and shall be straight and in correct alignment.
- d) Ducts may be laid as a single duct or in a multi-duct formation. Multi-ducts shall be laid in rectangular formation.
- e) When multi-duct formations are installed in one trench, the largest ducts shall be installed at the bottom of the trench.
- f) Duct length shall be measured precisely on site between the two manholes and shall be cut to required sizes on site.
- g) When pulling sub-ducts, the lowermost outside available primary duct should be selected. The sub-ducts should be extended 10 cm beyond the primary duct into the Manhole.
- h) For empty lots on a route, ducts shall be laid up to the property boundary. The ducts must be properly closed with an identification marker placed over them. The ducts shall be extended to the customer wall or to the telecommunications room when the lot is developed.
- i) The Developer providing the OSP infrastructure shall coordinate the location of the ducts at the property boundary and the placement of the lead-in ducts with the owner of the land.

3.4.2.1 Laying and Jointing

Single Ducts

- a) The duct sections shall be jointed together in compliance with the manufacturers jointing system and shall result in a continuous smooth internal surface free from sharp edges and protrusions. The duct shall be laid on the trench bottom and the spigot end and the inside of the socket of the ducts to be jointed shall be thoroughly cleaned.
- b) The spigots and sockets of a duct are so designed that, taking into account all manufacturing tolerances, the spigot will start to engage with the socket at a point between $1/3$ and $2/3$ of the socket depth. Two spigot markings are provided on the duct to show the maximum and minimum insertion depths. The minimum marking must be at least level with the socket.
- c) When jointing short lengths of duct together with a collar duct the spigot ends shall be given a liberal coating of a suitable sealing compound and then fitted into the collar so that they butt together at the midpoint.

Multi-way

- a) The jointing of ducts, sub-ducts and duct bundles shall be as outlined above.
- b) The first layer of ducts (or duct bundles) shall be laid on the prepared trench bottom so that their outer surfaces touch each other. Spacers at a distance of 2 meters shall be used to keep the duct formation in the correct position. Concrete or earth free from stones shall be placed to fill the spaces between the ducts and the next layer of duct when the latter is bedded down.

3.4.2.2 Alternative Method of Jointing and Laying

Provided space permits, ducts may be joined above ground and fed into the trench from one end.

3.4.3 Pre-formed Duct Bends

- a) All bends must be of the same material as the duct or duct bundles to which they connect.

- b) Pre-formed bends shall be used for all types of short run ducts. Ducts in the short run may be bent with less than 10 degrees only. Pre-formed duct bends shall only be used at the end of duct lengths for building or Manhole entries or house lead-ins. Pre-formed duct bends may be used for duct routes between Manholes.
- c) No more than two ninety degree (or equivalent) bends shall be installed in the duct between any two manholes.
- d) Minimum curve bend radii for ducts between two manholes:

Duct Type	Long Run (> 100 m)	Short Run (< 100 m)
100 mm	5 000 mm	800 mm
50 mm	800 mm	300 mm
25 mm	not applicable	300 mm

Preferably, to change the direction of a 100 mm duct in a long run, combinations of bends with angles of: 30° x 5m radius or 45 ° x 5m radius shall be used.

3.4.4 Protection Against Entry

A suitable plug shall be inserted in the ends of each bore (or "way") of a duct to prevent the ingress of water and/or other foreign matter. The plugging mechanism or material shall be readily removable to allow for future sub-duct or cable installation.

3.4.5 Cleaning and Testing

- a) On completion of the duct line or bundles (including compaction of the backfill and prior to surface reinstatement like asphaltting) between any two Manholes, or sites thereof, a cylindrical brush followed by a UPVC mandrel shall be passed once through each "way" to test the installed duct and to remove any foreign matter that may have entered. The mandrel shall have a minimum diameter of 80% of the internal duct diameter.
- b) If any defect is discovered during these operations, the defect shall be repaired.
- c) After all operations are completed, including the repair of the duct where necessary, the joints of all ducts shall be tested to ensure that they are forming an effective seal (e.g. air tightness test, foam sponge, mandrel, pressure tests). Any defects shall be repaired.

3.4.6 Draw Rope

The use of draw ropes is an option to support future deployment of FOC or subducts by pulling. In case draw ropes are used, they should conform to the following specifications:

- a) Draw ropes shall be threaded through and left in every bore (duct way) with sufficient surplus to enable future cabling or subducting operations. Draw ropes may be jointed together to make up the necessary length between jointing chambers/Manholes.
- b) For lead in ducts, the rope shall be attached to the duct seal rope anchor or the plug pressure anchor eye.
- c) Under no circumstances shall a rope be fitted through a duct seal.
- d) Draw rope for any duct shall be rated at a minimum of 550 kg.

3.4.7 Duct Seal

- a) When ducts (including sub-ducts and duct bundles) need to be sealed, they shall be sealed within each Manhole/Handhole, so as to prevent the ingress of water between the outside of the duct and the Manhole/Handhole and the ingress of gas, water and vermin through the ducts.
- b) Breakthrough into a building/customers' premises shall be performed carefully, in compliance with good engineering practices and any conditions or specifications regarding rights of way or works instructions issued.
- c) All duct sections between a building and the first Manhole shall be gas-tight and watertight.

Lead-in ducts into customers' premises shall be sealed at the end within the Manhole and building / customers' premises. Uncabled ducts ending in a street cabinet shall have a suitable plug.

3.4.8 Pulled Joints

In case a duct joint or joints have pulled apart, short lengths of ordinary or split duct may be inserted in the duct line and satisfactory joints established.

3.5 Minimum Number of Ducts and Fibers

- a) The final design shall take into account the specific needs of residential, governmental, commercial, industrial, or special purpose New Developments. The following minimum requirements shall be met in any case:
- b) At least 2 x 2 ducts (two of them being reserve capacity) shall be installed in the feeder and distribution networks. The use of sub-ducts is encouraged.
- c) Ideally, FOC with 144 fibers each shall be used in the design. Ideally, only one (1) FOC shall be installed in one duct. If more than one (1) cable is planned to be installed in one duct, the use of sub-ducts or duct bundles is recommended.

Quantity	Feeder	Distribution until Access Point	[Lead-in]
Ducts	min 2 (+ 50% of total installations shall remain reserve capacity = 2 reserve)	min 2 (+ 50% of total installations shall remain reserve capacity = 2 reserve)	[min 1 (+ 50% of total installations shall remain reserve capacity = 1 reserve)]
Fibers	48 Fibers	12 Fibers	See: Technical Standards for In-building Physical Infrastructure [4 fibers per unit]

3.6 Manholes / Handholes Standards

- a) Manholes/Handholes shall be capable of shared access for more than one public Telecommunications Network.
- b) Manholes/Handholes shall be covered by a flat lid having a lock with unique head.
- c) The load carrying capacity of the lid and the Manhole shall not be less than 40 tons or defined in the project design taking into account the road classification.
- d) Preferentially, Manhole/Handhole lids shall be labeled with the owner of the public Telecommunications Network name(s).
- e) Any FOC joint shall be housed inside a Manhole.

- f) In case the cable is pulled in, the pulling of the cable shall be hand assisted at each Manhole or Handhole. Irrespectively of the installation technique, the cable shall not be
- g) All Manholes shall be provided with access shafts not less than 1200mm in height from the finishing surface to the top of the manhole roof. Manholes shall have a width of not less than 1200 mm and a length of not less than 1200 mm. The opening size of the access shaft shall be at least 600 x 600mm or 600 mm diameter. Under normal conditions, such manhole can serve the minimum number of ducts in the distribution network.
- h) Handholes shall be provided with access shafts not less than 800mm in height from the ground surface to the top of the Handhole roof. It shall have a width of 600 mm and a length of 600 mm. The opening size of the access shaft shall be at least 600 x 600mm.
- i) All Manholes shall have galvanized pulling-eyes. These are usually galvanized steel bars shaped to form an eye for the attachment of cable pulling equipment used in placing cables in ducts and Manholes. Pulling-eyes are installed opposite each duct entry at 300 mm above and below the top and bottom ducts and on the duct face entry line.
- j) All Manholes/Handholes shall be pre-cast and from an approved supplier. They shall have serial numbers for identification.
- k) The Manhole cover shall be installed so as to be level with the asphalt surface.
- l) Selecting the size of a Manhole is based on the number of ducts that will pass through it. Usually, at the beginning of a route bigger manholes are selected.
- m) Under normal conditions, a Handhole can serve the minimum number of ducts in the distribution network. The number of ducts that are served by Handholes shall normally not exceed 4 ducts. The final number shall be defined in the final design.

3.6.1 Manhole/Handhole

- a) Place Manholes to the degree possible in line with the main duct structure to minimize offsets in the duct run.
- b) A Manhole / Handhole shall be installed near the location of an optical distribution frame. Duct termination can also be integrated in the ODF housing.

- c) A Manhole shall be installed within 5 m of where a duct changes direction by an angle equal to or greater than 90 degrees.
- d) The first Manhole shall be placed at the beginning of a New Development. A Manhole shall be installed at the end of a route where significant elapsed time is expected between stages of a new development.
- e) Ducts should not be installed in runs greater than 250 meters without transitioning through a handhole to allow the use of pulling techniques for cable installation. The span length may be longer considering the installation technique (blowing, etc.) and shall be determined in the project design.
- f) The following areas are considered as hazardous. In these areas, placement manholes shall be avoided:
 - o In traffic lanes
 - o On the blind side of a curve
 - o On a hill or in a wadi
 - o The central boulevard strip of a divided highway
 - o Road cross sections
- g) Handholes must not be subjected to vehicular traffic.
- h) Where the location is in proximity to a street intersection, select a location on the side of the duct run that connects to the FBPs core network and on the side of the intersection which will not conflict with future street widening. This will allow for better layouts of the radii for branch routes or ducts to the side streets. Further, it should be located to allow the necessary space for cable placing operations. Normally, 30 meters or more from the intersection is desirable.

3.6.2 Manhole/Handhole

- a) Ducts shall only enter a Manhole/Handhole at the narrow ends i.e. those faces of the pit with the least surface area. They shall enter the Manhole/Handhole at right angles to the walls. No change of direction shall occur.
- b) A minimum separation shall be kept between ducts at the entrance to the Manhole/Handhole.

- c) The duct shall extend some space into the Manhole.
- d) Ducts shall exit a Manhole in a standard formation and enter the subsequent Manhole with each duct in the same relative location.

3.6.3 Protection of Cables

- a) During the cutting of duct entries into a Manhole/Handhole, all reasonable measures shall be taken to protect existing cables and associated equipment.
- b) All movement of cables shall be carried out in a controlled manner such that all cables are evenly supported throughout their length.
- c) Under no circumstances shall cables, joints and equipment be used for climbing, standing or sitting on. Plant or materials shall not be supported on cables or associated equipment at any time.
- d) Sufficient pumping capacity shall be made available and operated to ensure that when cables are removed from their bearers they shall not be immersed in water at any time.
- e) All cables shall be protected by shielding as necessary against mechanical damage.

3.6.4 Duct Entries

- a) New duct entries into existing Manholes/Handholes or other buildings shall be cut by core drilling techniques only. Where the duct enters the chamber the finish shall be flush and smooth. No protrusions shall remain that may cause damage to cables.
- b) Existing cables and/or equipment shall be protected prior to drilling operations.

3.7 Trenches

- a) Digging and trenching works are regulated by local authorities. The instructions issued by these authorities must be followed.

- b) Trench excavations shall start only after determination of the Manhole/Handhole locations.
- c) The trench shall be as narrow as possible to minimize the costs. The trench shall be cleaned by removing stones and loose material. The bottom surface shall be leveled and compacted before installing ducts and Manholes/Handholes.
- d) Depending on the regulations of other authorities, typical trenches in the distribution network are 500 mm from the ground level / 600 mm from asphalt level. Typical trenches for drop cables are 400 mm from the ground level / 500 mm from asphalt.
- e) Backfilling and reinstatement of the surface shall be as per the regulations and standards of local authorities and as required by the respective permits.

3.8 Standards for Street Cabinets (SC)

- a) From SCs drop cables are laid to the Access Points in front of a building.
- b) The SC design shall be based on the following criteria:
 - o The SC shall contain at least two compartments. One compartment shall be for entrance of cables coming from the last manhole. The remaining compartment(s) shall be dedicated for the patching (fiber termination and cross-connection).
 - o The SC shall allow to serve multiple public Telecommunications Networks.
 - o The Street cabinet shall include spare capacity for the OSP.
 - o The cable distance from the SC to the furthest customer building shall be within 500 meters. The distance may be extended to best meet the project design in rural areas.
 - o The total number of building terminations in one SC shall be up to 1728. It may be reduced to up to 864 terminations to best meet the project design.
 - o Customer buildings can normally be connected from the SC without route diversity.
- c) Protection posts may be installed according to local/municipal standards.

3.9 Access to Buildings

The access point provides the connection between Outside Plant and In-building physical infrastructure. The optical distribution box in the access point to be provided by Service Provider. Access point space allocation and the lead-in ducts shall be provided by the building developer. 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 service provider and the building developer. 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.

3.9.1 Access Points

- a) The Access Point is the demarcation between Outside Plant and In-building Physical Infrastructure, its space is to be provided by the owner of the building. The Access Point shall be easily accessible for all public Telecommunications Networks and also protected against potential damage. A lockable cover is preferred. The Access Point is hosting the Optical distribution box (ODB), provided by the service provider, and must be able to accommodate at least 4 fibers to each unit. Optical distribution boxes (ODB) are joint boxes built to allow the installation of underground duct and cable to the customer's premises. For SDUs, the space provided by the Building Developer for the Access Point shall be on the building or property wall. For MDUs, the access point may be placed underground or on the building or property wall. Each plot shall have at least one associated exclusive Access Point.

- b) The location of an Access Point depends on the location of the external line plant and shall be coordinated with the property owner. The size or type of an Access Point largely depends on the number of entry ducts to the building.
- c) The maximum distance from the Access Point to the customers' premises shall not exceed 200 meters.
- d) An Access point shall be constructed at a maximum distance of 1 meter from the property boundary.
- e) Where applicable, an earth rod shall be provided at an Access Point. The required earth resistance shall not exceed 5 Ohms.
- f) Public Telecommunications Networks shall share the entry into buildings by sharing the Manholes, Handholes, Street Cabinets, Access Points, lead-ins, and the area in the Telecommunications Room / Space.

3.9.1.1 Access Points for SDU

- a) If the OSP is constructed before the building, the OSP termination at each property should be realized with a marker.
- b) Building owners may provide appropriate space, in coordination with OSP developer, inside the wall for the Access Point so that the ODB can be mounted flush to the wall, see figure(3).

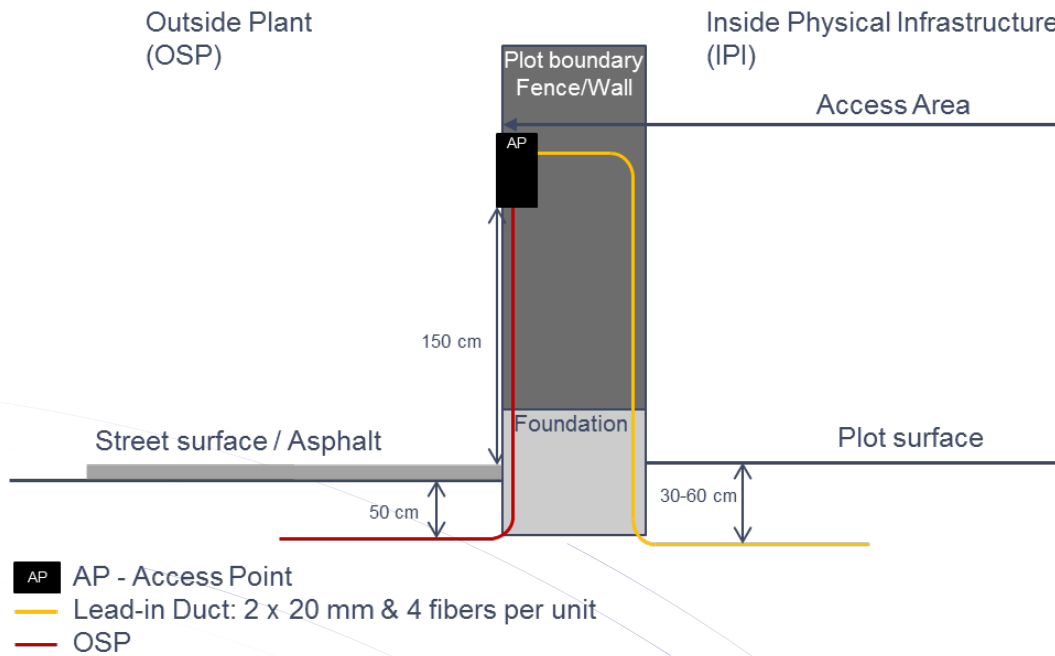


Figure 3: Access Point mounted flush inside wall with Lead-in ducts

- c) If the building is constructed before an OSP is available, OSP developer shall utilize any network termination prepared and deployed by the Building Developer on the wall or at the building borders, i.e. pavements as shown in figure(4).

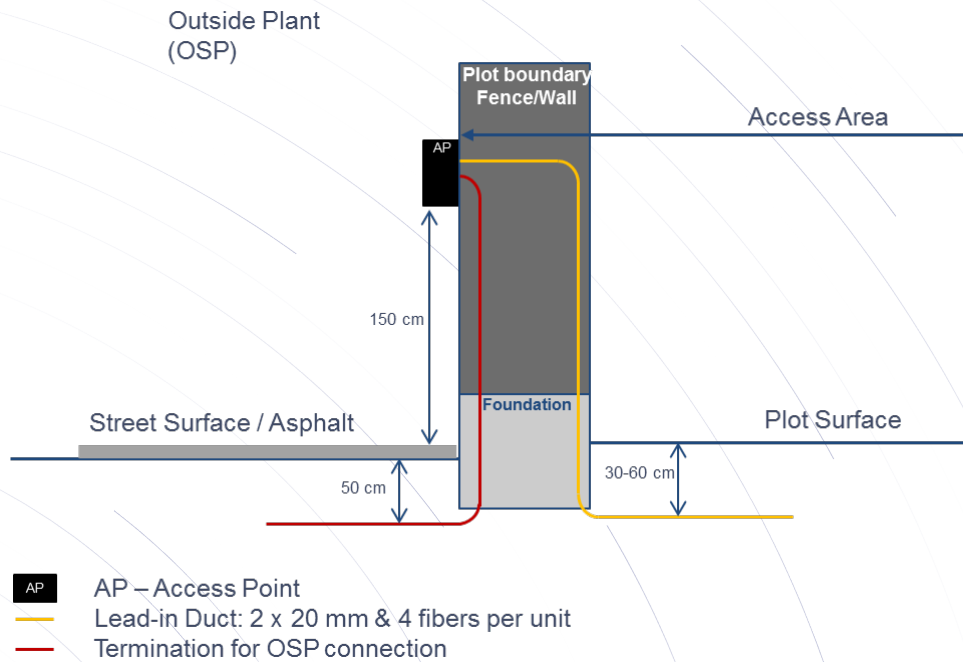


Figure 4: Access Point wall mounted

- d) In case the ODB is not mounted flush inside the wall and no termination for OSP connection deployed by the building developer , a u-guard shall be installed on customer wall to protect the poke out duct, see figure(5).

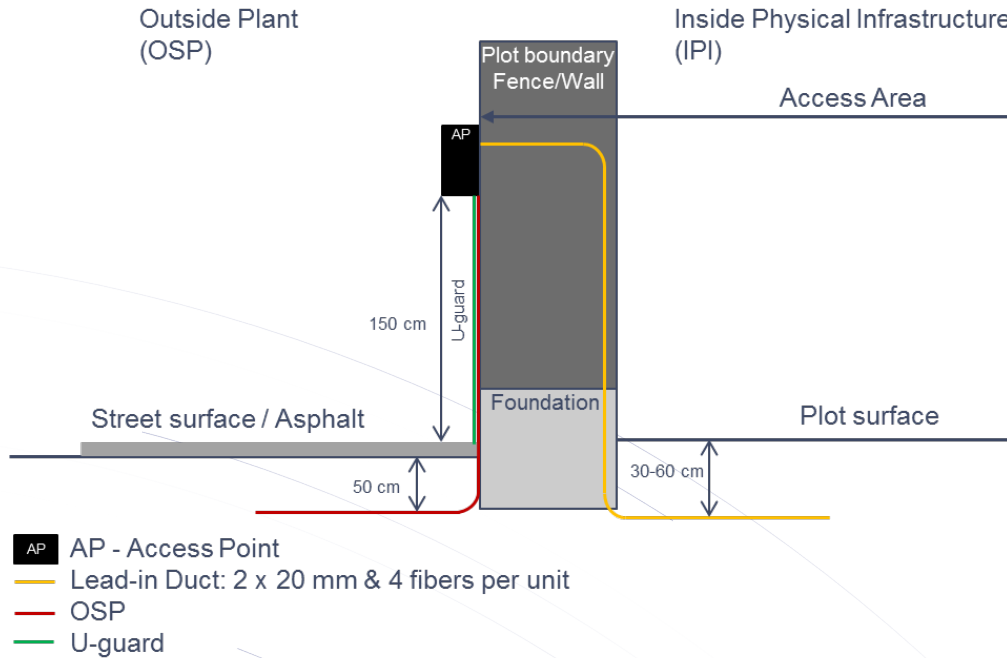


Figure 5: Access Point with u-guard and Lead-in Duct

- e) The length of the u-guard shall be of 1.5 meter from the finished surface of the ground.
- f) There shall be no gap between the u-guard and the ODB on the customer wall.
- g) The signal from the optical line termination to the ODB shall be at -22 dB (with a minimum at -7 dB).

3.10 Marker Tapes

- a) A colored plastic tape of minimum 0.1 mm thickness and a minimum width of 300mm shall be laid in a continuous manner above each duct structure at a depth of 300mm below ground level.
- b) The tape shall be continuously and indelibly marked in Arabic and in English with appropriate wording (such as: CAUTION, TELECOM CABLE, Contact Number: XYZ ABC MNO)
- c) The lettering shall be in suitable font size and color.
- d) Complete continuity of such tape shall be ensured. Any displacement of the tape during backfilling shall be avoided.

3.11 Clearance from Utilities Services

- a) All types of ducts and cables laid directly in the ground shall be kept well clear of water mains, service pipes, sewers, subways, manholes, joint boxes or other plant belonging to other utilities.
- b) The standard clearances as specified by the concerned authority shall be strictly followed.

3.12 Road Crossings

Ducts in a road crossing shall be locatable e.g. through the use of (permanent) marking on the curb on both sides of a road, or coordinates that record survey points.

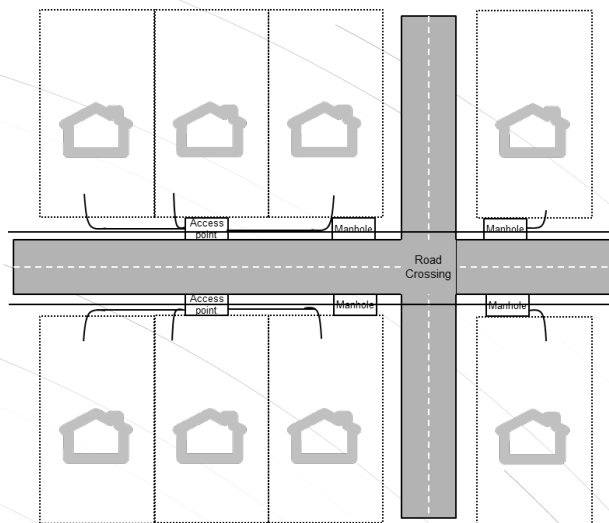
3.13 Active Elements

Unless explicitly stated and for mobiles sites only, no dispositions for active equipment in the OSP (e.g. electricity) are to be provided.

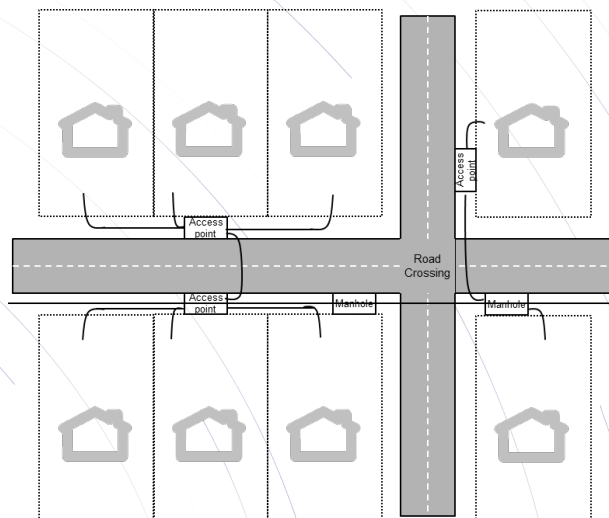
4 Architecture

- a) For fixed networks, the preferred technical solution is a point-to-point network architecture with four connections (fiber optics) per unit (dwelling or office). The network architecture shall allow network sharing and access.
- b) Any network architecture shall support both point-to-point and point-to-multipoint access network topologies.
- c) The following duct architectures shall be used:

- I. **Dual Side of the Street:** ducts are placed on both sides of the street. Road crossings are generally to be placed at road intersections.



- II. **Single Side of the Street:** the duct is placed on only 1 side of a street with road crossings used to reach lots on the other side of the street.



- d) Combinations of the two architectures are also allowed.
- e) To provide for diversity, at least two alternative feeder duct runs should be provided to connect the distribution network.
- f) Usually up to 4 but not more than 10 lots are connected to a local Access Point. Further, usually up to 10 Access Points are connected back into a local network splicing point (Manhole). And about 5 local network splicing points are connected to a street cabinet. The exact configuration of physical infrastructure shall be determined during the project design.
- g) Street cabinets shall be connected with feeders having 50 mm ducts from the boundary of the New Development. At the boundary of the new development, an ODF and an associated Manhole shall be placed.
- h) Road crossings shall be served with sufficient extra reserve capacity.
- i) In a new business, industrial or governmental development, the feeder ducts shall run in rings rather than a simple branch configuration and shall pass by each potential building/premises.
- j) In the event of a tower / mast to be served, it shall be possible to configure network rings which originate and terminate at the mobile tower to provide for diversity.

5 Towers

- a) The tower /mast and any fenced area shall be designed to accommodate at least three mobile service providers or according to business needs.
- b) The towers/masts shall be of sufficient height to meet the mobile service providers' technical requirements.
- c) At all tower/mast, the design of all buildings and related structures shall use materials, colors, textures, screening, and landscaping that will blend the tower facilities to the natural setting and building environment.
- d) All material utilized for antenna support shall be hot dip galvanized or stainless steel and of a gauge that conforms to the telecommunications industry's standards of practice.
- e) The space requirements for the site area shall be coordinated with all mobile operators.

5.1 Design Standards for Wind Speeds

The following design standards shall be adhered:

- Basic design wind speed: 144 km/h
- Operational wind speed: 120 km/h
- Survival wind speed: 180 km/h
- Allowable tilt/twist: 1.0 degree at 120 km/h

5.2 Grounding

- a) Any tower/mast must include solid grounding.
- b) When designing the grounding system the following four (4) interrelated requirements shall be met:
 - I. Lightning protection: to maintain all equipment at the same potential during a lightning impulse;
 - II. Radio frequency interference for noise induction control: to establish the lowest possible impedance among all equipment;

- III. Electrostatic control: to reduce electrostatic discharge problems;
- IV. Personnel safety: to maintain a minimum voltage difference between any two metallic objects which personnel might contact simultaneously.

c) There shall be two grounding pits: one for the tower/mast base and one for the equipment.

5.3 Electricity

A sufficient electric power source shall be available on site, or within a distance of no more than 300m.

6 As Built Documentation

6.1 Configuration Documentation

- a) The owner of the installations must ensure that accurate records of the as-built work are established and continually maintained. Any changes made during construction must be updated in the original "to-build" plan. The drawings shall accurately indicate the location of the installations, cable types and labeling. The updated 'as-built' plan shall be used as the basis for the complete documentation of the network.
- b) The documentation of original design including any deviations of it as the "as-built" network shall contain at least the following information for each section and cable:
 - Civil infrastructure
 - Name and address of the construction company
 - Construction approval details
 - Accurate location data (including GPS coordinates)
 - Accurate as-built trench lengths
 - Manufacturer and model of all items
 - Duct space records
 - Mast support information (guys, anchors, etc.).
 - Cables
 - Manufacturer
 - Number of cables
 - Number of fibers
 - Routing of cables
 - Routing of fibers
 - Manufacture and installation date of the cable used
 - Optical Time Domain Reflectometer (OTDR) measurement results.
- c) The as-built documentation needs to be kept up-to-date in order to enable operations and maintenance work.

6.2 Database

The Rules on Access to Physical Facilities require detailed and accurate records for newly deployed telecommunication facilities. These documentation requirements shall be followed.

7 Safety for OSP works

- a) Any accident and incident and hazard during the construction shall be avoided.
- b) A suitable number of expert personnel and adequate equipment and construction material is to be used to provide for:
 - o Safety of employees
 - o Safety before start of work
 - o Safety during progress of work
 - o Safety of public and private property
 - o Adequate tools and equipment at work area.
- c) All efforts shall be undertaken to safeguard the workers from any injury and damage or loss of properties by complying with national and international standards on safety of OSP works.
- d) Any workers must wear suitable protective clothing.
- e) Safety of the public and of property must be ensured (by the use of warning signs, traffic barriers, fencing, etc.). Any noise and pollution in the work shall be kept to a minimum.
- f) Open trenches must be secured and adequate warning signs provided.
- g) Safe and secure working conditions shall be ensured. Any unsafe acts or conditions shall be corrected immediately.
- h) Rules and regulations of all relevant authorities for safety and security must be followed.
- i) Unannounced inspections and evaluations of the safety precautions and procedures in the work area shall be performed from time to time to ensure proper application of safety rules and procedures.
- j) Safety glasses with side shields and protective gloves shall always be worn during FOC installations. Fiber optic splinters shall be treated in the same way as glass splinters.
- k) All fiber pieces shall be placed in a properly marked container for disposal. The work area must be thoroughly cleaned when the work is done.



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