هيئة تنظيم الاتصالات TRA
TELECOMMUNICATIONS REGULATORY AUTHORITY

United Arab Emirates

In-Building Telecommunication Network

Specification Manual

Guidelines for FTTx in new Buildings

V1.1 Released

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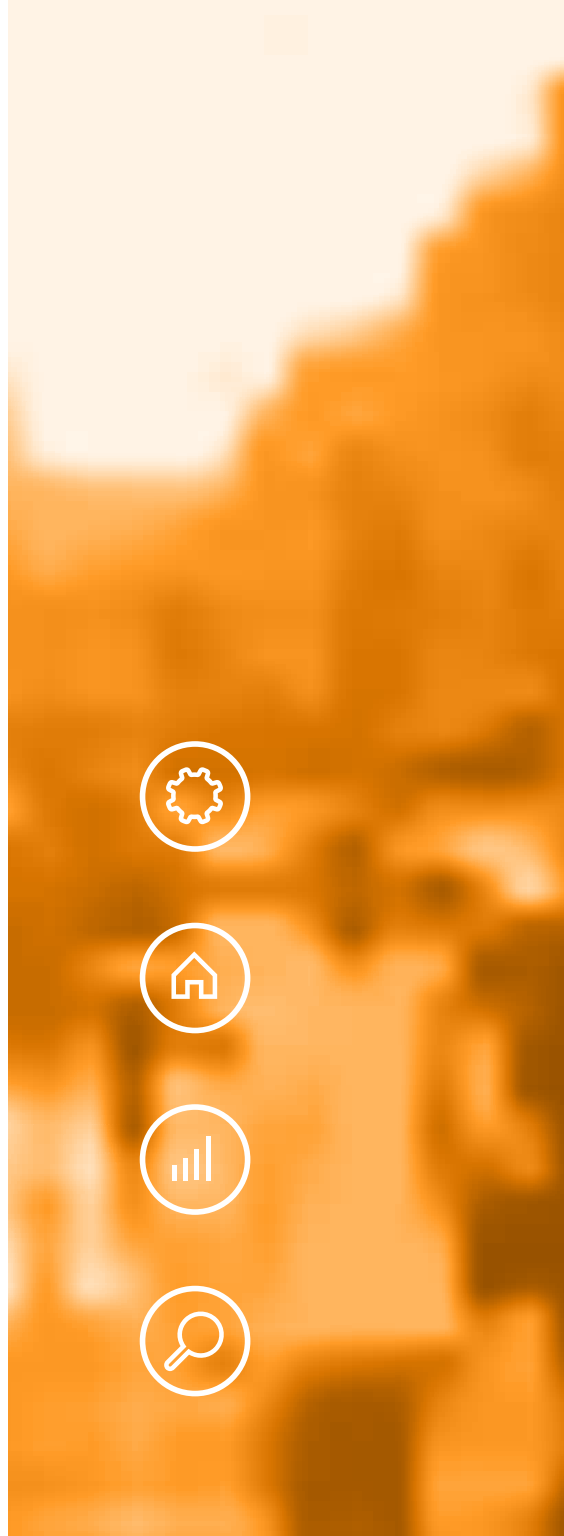
Table of Contents



Executive Summary

With the rapid evolvement of the ICT sector in the last years, the requirements of residential and businesses for modern telecommunication services have increased considerably. Modern telecommunications services are an integral and beneficial element in the life of the local community and in the national economy. Advanced telecommunications services are seen as pre-requisites for attracting and retaining long-term tenants. The infrastructure for such services must be already planned at the very early stage of the design phase of a building to guarantee a future proof approach.

The Telecommunication Regulatory Authority (TRA) is keen to constantly develop the telecom sector in the United Arab Emirates to allow fair competition between the licensees by ensuring that telecommunication infrastructure is suitable to cater for their requirements in new domestic and business developments and buildings and to foster new competition to ensure innovative and state of the art services for end-users. Therefore, TRA took the decision to introduce a common and neutral standard for in-building design infrastructure for the rollout of FTTx networks in new buildings/areas ("Greenfield") for the benefit of all stakeholder groups. This shall not only promote competition on the infrastructure level but also give the user the freedom of choice between operators, guarantee reasonable investment costs for developers by setting reasonable specifications and clear processes for municipalities and government. Moreover, this initiative will support and promote the deployment of fibre networks as key infrastructure in the ICT sector.

Based on the status quo assessment of the situation in the UAE and an international benchmark study performed to take a closer look on common approaches and best practices on an international level as well as the different needs and expectations of all stakeholders the following manual was developed.

A common framework in the manual ensures a future proof approach with regard to in-building design of telecoms networks for FTTx deployment. The provision of more detailed planning guidelines guarantee a high quality network operated by the two licensees of today but in addition taking the appearance of a further licensee into account. With this it fosters competition by a neutral, common approach supported and justified by international best practices, tailored to the needs of the UAE.

To ensure a proper application of the manual from the beginning of a development a so called "No Objection Certificate" – NOC admission and a corresponding process is defined. In this process the focus lies on the early design stage of any new building, villa, and warehouse development in the UAE. Based on the construction drawings the professional implementation of the in-building design manual will be assessed and the NOC issued. This forms the basis to obtain a building permission for the project (covering the part of the telecom infrastructure).

In a second step, after a development is realized, clear processes for testing and acceptance of the infrastructure come in. This as well is reflected on a general level in this document.
The NOC, the respective process and the testing/completion of the in-building cabling for FTTx deployment are outlined in this manual on a general level. It is up to the licensees to agree on a detailed specification of this process
Developers are encouraged to engage with the Operators at an early stage so that any process and / or design issues may be resolved and to get it "First time right".

To keep the manual up to date and to guarantee always for the best technical and commercial approach in the future, the guidelines will be reviewed on a regular basis taking new developments and experiences into account. A close dialog with all stakeholders in parallel is the basis for constant improvement of the manual.

FTTx in new Buildings

2.1 Introduction

This guideline document was developed to enable the application of a common, system-independent FTTx pre-cabling of multi subscriber premises and the infrastructure needed in new buildings (Greenfield areas).

These guidelines

- provide access providers (licensees) with an application independent optical fibre cabling subsystem;
- serve an open market for cabling components and
- provide building developers/owners with guidance allowing the accommodation of the telecommunication infrastructure and interfaces already in the initial planning either for construction or refurbishment.

The common specification manual was developed to suit the existing/future technical requirements of both licensees in addition to new licensees in the future with the effective utilization of resources.

The main driver for this is the intention to foster competition already on the network infrastructure level and give the end user the freedom to select a network provider of choice. Such competition will stimulate the development of the telecom sector due to attractive retail pricing and innovative service creation. Therefore all measures foreseen in this manual already cater for a possible third licensee .

This effort is spent in addition to the available bit stream service agreement applicable in areas/buildings where only a single network infrastructure is available (brownfield areas) today.

The Telecommunication Regulatory Authority (TRA) started this initiative to achieve a market consensus among all relevant stakeholder like municipalities, ministries, licensees, master plan developers, building developers and property owners.

2.2 Intention and Application

These guidelines specify the FTTx optical fibre access network infrastructure within single/multi-subscriber premises (which may comprise single or multiple buildings, villas, warehouses etc.) and intends to support the deployment of optical broadband networks (for e.g. triple play services) with the current state of fibre network technology. Copper access networks are not considered.

The application is intended for new buildings/areas, whereas this may also include areas of renovation or refurbishment of existing buildings. No precautions to enforce a certain fibre technology type or version shall be made. Up to now Ethernet (ptp) and GPON (ptmp) are deployed.
All new buildings shall be equipped with physical infrastructure capable of hosting high-speed networks and access points which can be easily accessed by the network providers. The same is valid for major renovations.

Over time adaptations and/or extensions to this document may be required reflecting new needs or solutions (new technical developments, future initiatives like smart city, etc.).

The cabling within the subscriber space (home, unit, flat, apartment, single family home or similar) for onward distribution of services beyond the customer premises equipment is not in scope of this document, although some minimum requirements for CAT6 cabling are provided.

This document constitutes minimum requirements to provide a baseline for the network setup in typical cases. Nevertheless, there is no restriction to extend the implementation by mutual agreements as long as those are not contradicting other baseline requirements and hindering (possible) competition by e.g. using proprietary standards.

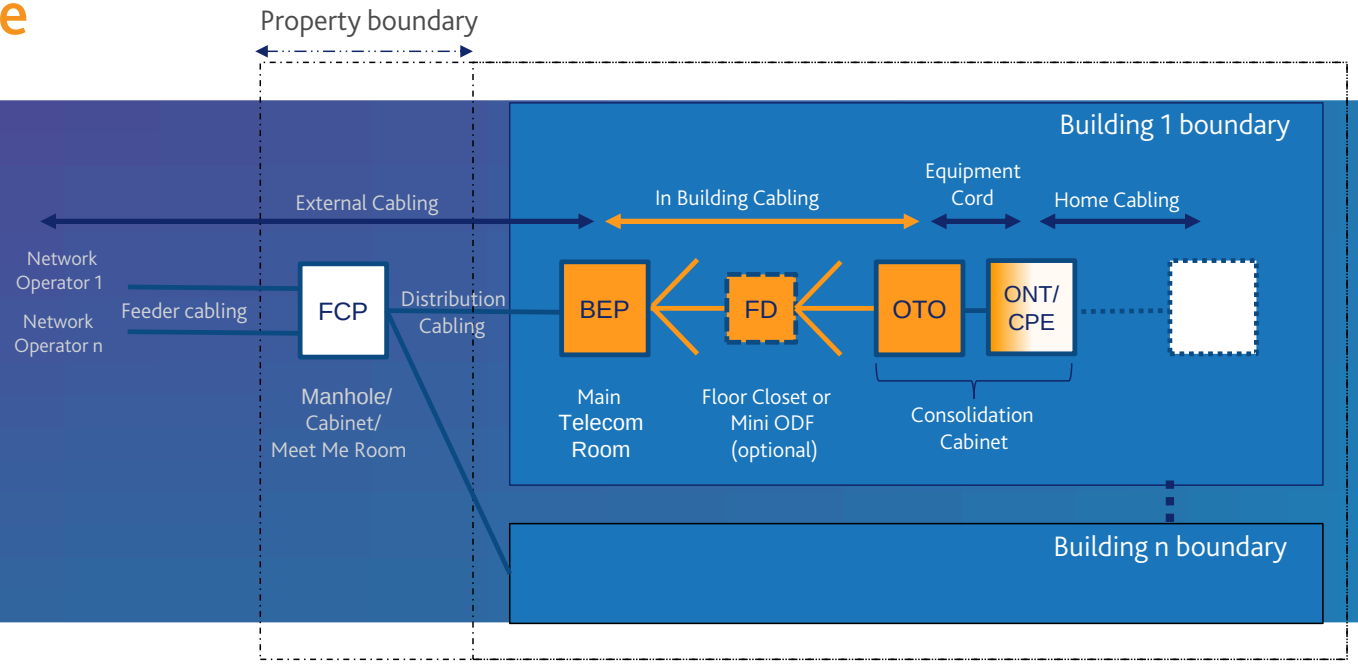
With this a standardized network setup is pre-agreed by stakeholders allowing seamless interworking of all network parts. Further it will unload all planning and establishment efforts for most regular cases.

Fore sure special buildings or development areas (e.g. sport arenas, hospitals …) may need further in-deep respectively individual agreements beyond of that.

Sharing of essential infrastructure elements like rooms, ducts, cable trays and cabling is one of the aspects in focus to optimize the involved investments for all parties to guarantee an effective utilization of resources. Moreover, all parties shall constantly try to optimize the in-building design by e.g. utilizing unused space in rooms for other functions like mobile applications where applicable. With this a balance between possible and future proof requirements and investments at a reasonable level can be guaranteed.

2.3 Reference **Architecture**

Following general model shall apply.



2.3.1 Model

A reference model is an abstract framework or domain-specific ontology consisting of an interlinked set of clearly defined concepts in order to encourage clear communication. A reference model can represent the component parts of any consistent idea, from business functions to system components, as long as it represents a complete set. This frame of reference can then be used to communicate ideas clearly among members of the same community.

2.3.2 Terms and Definitions

FCP Fibre Concentration Point (FCP)
In the Fibre Concentration Point a feeder cable will eventually be converted to smaller distribution cables. At this stage the feeder cable fibres are separated and spliced into smaller groups for further routing via distribution cables.
The FCP may be located within the property boundary or outside of the property.
In case of GPON Splitters may be located at this point.

BEP Building Entry Point (BEP)
The interface between the drop cabling (optical access network) and the in-building network. The BEP is located inside a building. At the BEP the transition from outdoor to indoor cable is performed. The type of transition may be a splice or a removable connection.
In case of GPON Splitters may be located at this point.

FD Floor Distributor (FD)
An optional element between the BEP and the OTO located in the riser zone which allows the transition from the vertical to the horizontal indoor cabling.

OTO Optical Telecommunication Outlet (OTO)
A fixed connecting device where the fibre-optic indoor cable terminates. The optical telecommunications outlet provides an optical interface to the equipment cord of the ONT/CPE.

ONT Optical Network Terminal (ONT)
The ONT terminates the FTTx optical network at the subscriber premises and includes an electro-optical converter. The ONT and CPE may be integrated.

2.4 Best Practice Approach

- Avoid duplication to achieve optimized investments
- Consider future safe rollout including extension option
- Ensure open network access without substantial additional investment
- Technical implementation choice for service providers
- Rapid provisioning for customers
- Switching between providers without on-site intervention
- Allow for customer provider choice

2.5 Securing Competition The possibility of a further licensee

For in-building cabling the use of a multi-fibre cable is mandated to satisfy the requirement for competition on the one hand and to optimizing investments on the other hand. At least one dedicated fibre from each competing operator's OLT accesses each home. Additional spare capacity shall be foreseen which eventually can be used for a possible new licensee in the future.

In an Ethernet (ptp) architecture, the operators connect their OLTs/Fibre switches directly to the dedicated fibres allocated to them.
In the GPON (ptmp) architecture, all the competing operators provide their own GPON splitter, co-locating them in a common location (e.g. Meet Me Room, Main Telecom Room). In addition, operators provide their own feeder fibre connecting the OLT to the splitter. In the units of the end user a consolidation cabinet shall at least be able to house 2 ONTs in parallel.

Therefore, each operator has its own dedicated end-to-end FTTx network with full service delivery control

This scheme allows for seamless service provisioning without necessary intervention in the building in case of an end user switches his contract from one service provider to the other. It even is possible to derive services from both (respectively more) operators in parallel. In case of more than two licensees the user has to choose which (max) two operators should be installed in the home/office consolidation cabinet as they can hold in any case the ONT/CPEs of two operators in parallel. However, this does not mean that there can't be a third operator used in parallel because an installation outside of the cabinet can be envisaged. This hassle-free choice for the end user will stimulate competition on the level of service delivery performance.

The dimensioning of required spaces for the telecommunication equipment satisfying the above scheme need to be optimized through sharing.

With sharing of rooms, floor spaces, ducts, cable trays, racks and cables the cost impact of parallel GPON network infrastructure elements (especially the splitters) is regarded overall as marginal.

The foreseen MTR room sizes in this manual already cater for the need of a possible third licensee. That means that already with this manual sufficient rack space is foreseen to introduce a third licensee without the need of any change to this manual. The same holds true as already outlined above for the cabling itself.

2.7 Common Master Plan developments

2.7.1 Process

To optimize the overall process among the licensees a lead operator shall be nominated on a per project basis. The lead operator for a specific project shall be the single point of contact between the licensees and all other stakeholders like developers, building or property owners, municipalities or ministries and accordingly shall take responsibility of coordination.

The lead operator will assist the property developers through a "No Objection Certificate" (NOC) process that includes OSP design drawing validation, ISP design drawing validation, validating ISP material to be from the pre-approved manufacturer list and site inspections during implementation. Although electronic communication systems like email and online platforms are used widely for this task, there are merits in having also face to face discussions with the lead operator if needed. Therefore operators are encouraged to foresee physical presence in an area/emirate if this would ease over all processes.

Master plan Developers/Building developers are encouraged to engage with lead operator at an early stage so that any process and/or design issues may be resolved. If property developers or tenants have special requirements that may not be covered by these guidelines it is necessary to engage with lead operator's design teams at an early stage of development planning, to enable seamless delivery of premium telecommunications services at launch.

2.7.2 The NOC

NOC stands for "No Objection Certificate" and is issued by the lead operator for any Greenfield development (within Master Plans) confirming the compliance of the design drawings with the standards and requirements of the in-building design manual of TRA.

The lead operator of a project will assist Master plan property developers/building developers through a "No Objection Certificate" (NOC) process that includes design drawing validation, material samples checking and site inspections during implementation and final validation through testing,

The in-building design manual of TRA is the sole reference to all consultants and contractors during their NOC's submissions for Greenfield projects for Common and Non-Common Master plan development or existing Master plan.

Master plan Developers/Building developers are encouraged to engage with the lead operator at an early stage through the NOC process so that any process and / or design issues may be resolved. If property developers or tenants have special requirements that may not be covered by the common TRA manual it is necessary to engage with the design teams of the lead operator at an early stage of development planning, to enable seamless delivery of premium telecommunications services at launch.

2.7.3 Acceptance after project realization

As outlined the NOC is issued at the beginning of a development. But once the building is realized, the handover of the in-building telecommunication infrastructure (e.g. the cabling, splitters …) to the lead operator to facilitate services has to take place. Therefore, testing of the built telecom infrastructure in the building has to be performed and documented by the master plan developer/building developer. End-to-end testing may be performed by each of the licensees for their network.

As a result, the lead operator issues a completion respectively acceptance certificate for the master plan developer/building developer to obtain the completion certificate for the whole building.

2.7.4 Responsibilities

For any Greenfield project, which fall under the common Master Plan development in the UAE, one of the licensees will be assigned as the lead operator to the project and accordingly will take responsibility of coordination with the master plan developer/building developer for common infrastructure requirements. The lead operator will assist the master plan developers/building developer through a "No Objection Certificate" (NOC) process that includes OSP design drawing validation, ISP design drawing validation, validating ISP material to be from the pre-approved manufacturer list and site inspections during implementation.

To have a sound and smooth process it is important for master plan developers/building developer as well as municipalities to have a single point of contact for each project. Moreover, as some municipalities are streamlining the whole process of obtaining a building permit not only with regard to telecoms issues, it is of great importance to have a defined single point of contact at the licensees.

2.8 Non-Common Master Plan developments

2.8.1 NOC Process

In case of Non-common Master Plan developments or existing Master Plans, Building developers should approach the Operators from design stage of the project to initiate "No Objection Certificates" (NOC) process that include design drawing validation, material samples checking and site inspections during implementation and final validation through testing,

The in-building design manual of TRA is the sole reference to all consultants and contractors during their NOC's submissions for Greenfield projects (for Common and Non-Common Master Plan developments or existing Master Plans)

Master plan Developers/Building developers are encouraged to engage with the Operators at an early stage through the NOC process so that any process and / or design issues may be resolved. If property developers or tenants have special requirements that may not be covered by the common TRA manual it is necessary to engage with the design teams of the operators at an early stage of development planning, to enable seamless delivery of premium telecommunications services at launch

2.8.2 Acceptance after project

As outlined the NOC is issued at the beginning of a development. But once the building is realized, the handover of the in-building telecommunication infrastructure (e.g. the cabling, splitters …) to Operators to facilitate services has to take place. Therefore, testing of the built telecom infrastructure in the building has to be performed and documented by the master plan developer/building developer. End-to-end testing may be performed by each of the licensees for their network.

As a result the Operators issues a completion respectively acceptance certificate for the master plan developer/building developer to obtain the completion certificate for the whole building.

2.8.3 Responsibilities

For any Greenfield project, which fall under the Non-common Master Plan developments or existing Master Plans in the UAE, the operators will take responsibility of coordination with the master plan developer/building developer for common infrastructure requirements. The operators will assist the master plan developers/building developer through a "No Objection Certificate" (NOC) process that includes OSP design drawing validation, ISP design drawing validation, validating ISP material to be from the pre-approved manufacturer list and site inspections during implementation.

To have a sound and smooth process it is important for master plan developers/building developer as well as municipalities to have a single point of contact for each project. Moreover, as some municipalities are streamlining the whole process of obtaining a building permit not only with regard to telecoms issues, it is of great importance to have a defined single point of contact at the licensees.

3 Planning Guidelines

This document covers the following building types:

- Villa complexes,
- Residential towers and groups of residential towers,
- Commercial towers and groups of commercial towers,
- Shopping malls,
- Groups of shops and retail outlets,
- Hospitals, hotels and other bulk service applications and
- Warehouses and sheds.

Note
However the above-mentioned buildings types are not limited.

The document is structured to cover all aspects of infrastructure for:

- Meet-me-room spaces (MMR)/Plot (Fibre Concentration Point),
- Civil infrastructure and Entry ducts,
- Telecom rooms,
- Indoor Mobile service and roof-top rooms,
- Building pathways,
  Outside plant (OSP) cables and
- Inside plant (ISP) cables.

3.1 Meet-Me-Room (MMR)

In any project or a master plan development, which includes villas, buildings or mix of both, the property owner/master plan developer will provide one plot of 10 X 10 meter or more than one plots of 10 X 10 meter to the lead operator and build a dedicated standalone facility called MMR, where the OSP cables coming from the buildings or villas will be terminated. The number and size of MMRs located in each project is to be decided by the lead operator based on the geographical size of the project as well as the total number of users to be served.
Refer to the conceptual schematic representation of common passive infrastructure Appendix-1 Figure 1, Appendix-1 Figure 2 and Appendix-1 Figure 3.

MMRs will be purely passive rooms with no major electromechanical requirements. Passive telecommunication equipment can be located in the MMR depending on the design requirements. Based on the allotted plot area to the lead operator, the developer will discuss in detail on plot layout with the lead operator.

Please refer to Appendix-7 - MMR Specifications for detail MMR layouts, which describes the following section layouts:

- Architectural layouts - Appendix-7- Architectural
- Structural layouts - Appendix-7- Structural
- Electrical layout - Appendix-7- Electrical
- Mechanical layout - Appendix-7- Mechanical

3.2 Lead-In Ducts

The building developer must provide lead-in ducts for main and redundant route from the main telecom room to the plot boundary. The exact connection points at the plot boundary will depend on whether the lead operator's network already reaches the plot. Special need like possible redundancies and multiple connection of a building are up to individual agreement.

- **Scenario 1** – Duct network already exists
- The building/villa owner/contractor will be responsible to connect to the Operator's duct systems.
- The Operators will identify the location and quantity of their lead- in ducts.

- **S**cenario 2 – Duct network is still to be built
- The building developer will be responsible to extend the lead-in duct to 1m outside the plot boundary. The building developer is responsible for locating and clearly identifying lead-in ducts.

It should be noted that the Operators may have different connection points for the specific development. In all cases the building developer will be responsible for the maintenance and repair of lead-in ducts.
The lead-in ducts will be reserved for the use of the Operators. The quantity and size of these ducts are detailed in Appendix-6 - Summary Table ISP Specification.

The main and redundant lead-in duct specifications are as follows:

a) Made from black uPVC or HDPE;
b) The uppermost part of ducts to be buried to a depth of 600mm below the finished ground level;
c) Sloping away from the building;
d) Protected by concrete when running under permanent paved surfaces;
e) Sealed at each end to prevent the ingress of any materials such as water, sub-soil, gas, or pest;
f) An entry/pull box must be installed for any right-angled or sharp bends in the lead-in duct(main and redundant) route;
g) If required, at the entry to the main telecom room, a wide-angle long radius bend (factory made) may be provided; alternatively an entry boxes (for main and redundant route) may also be provided; and
h) All ducts must include a draw rope made of twisted mildew and resistant polypropylene; minimum outside diameter of 6mm; minimum tensile strength of 2400lbs/1000kg.

3.2.1 Lead-In Ducts – Building Entry

Where main and redundant lead-in ducts cannot be routed directly into the main telecom room, Hot-Dip Galvanized (HDG) slotted steel cable trays must be provided as an alternative. These trays must be easily accessible in common areas to facilitate any future provision of additional cables. However, if these trays are in an area accessible to the public and are less than 4.8 m above the floor, the trays must be covered.

A cable tray of minimum dimensions 300 mm x 100 mm (W x H) with Heavy Duty Return Flange (HDRF) will be required for each plot entry point (main and redundant).

3.2.2 Lead-In Ducts – Entry Box

Entry boxes are required for the Operators to install their cables through the main and redundant lead- in duct inside the plot. The type and size of entry/pull boxes will depend on the characteristics of the building development. The details for entry boxes are included in the text below and summarized in Appendix-6 - Summary Table ISP Specification.

The quantity and location of the entry boxes will depend on the main and redundant route from the main telecom room to the Operator networks. Entry boxes must be included wherever the duct system has right-angle or sharp bends where there are other factors that might restrict cable pulling.

The following specifications must be followed:

a) Constructed of reinforced concrete;
b) Fitted with a ductile iron frame and cover;
c) Minimum load rating 400 kN;
d) Cover to be marked 'Telecoms';
e) An earth rod must be provided with a resistance of less than 5 ohms.

3.3 Inside Plant Common Infrastructure Specifications (ISP)

3.3.1 Telecom Spaces

3.3.1.1 Telecom Rooms – general

Different telecom rooms will be required in a development depending on the characteristics of the buildings. The following room types are required and the details of these rooms are included in the text below and summarized in Appendix-2 Table 2 and Appendix-6 - Summary Table ISP Specification.

The height measurement specified are the minimum finished clearance after considering allowances for overhead cable trays and any other obstructions. A minimum headroom access of 300 mm is required above the tray.

The following room types are covered:

- Meet-Me-Room;
- Main telecom room;
- Floor telecom space;
- Indoor Mobile service and roof-top rooms.

In multi-story buildings, the telecom rooms must be vertically aligned and linked by a shared containment system. This containment system must not reduce the minimum requested room space.

All telecom rooms must be dedicated and accessible for the operators. The rooms must be easily accessible to the operator's personnel 24 hours a day and secured from unauthorized entry.

Telecom rooms must not be in close proximity to any sources of the following:

a) Heat;
b) Moisture;
c) Corrosive atmospheric or environmental conditions;
d) High voltages;
e) Radio frequency interference (RFI);
f) Electro-magnetic interference (EMI).

The rooms must not be directly beneath or next to wet areas such as:

a) Showers;
b) Washrooms;
c) Swimming pools;
d) Garbage areas.

If for any reason it is proposed that any part of a telecom room will be located below any kind of water source this must be raised at the design stage. This situation will require a floor (Attic slab) drain fitted with an automatic submersible pump to counter any risk of water ingress. The rooms must be clean and free from any of the following items unless otherwise specified in this document.

a) Equipment;
b) Utility pipes;
c) Cables;
d) Sprinkler systems;
e) Windows;
f) Pest;

In case of pest it should be noted that rodents often gnaw cables resulting in cable damage and possibility of service disruption. Special attention must be given to prevent pest entering telecom spaces and pathways. This should be through the use of best practiced pest control methods. An additional measure could involve the installation of covers to cable trays; if this is the case these covers must be removable to allow for the installation of additional cables.

In order to move equipment into and out of telecom rooms no access from outside of the building to these rooms must be less than 1000mm x 2100mm (W x H).

Floor Loading of telecom room shall be 10kNm2 (distributed load).

3.3.1.2 General Electromechanical (EM) requirements for Main Telecom Room (MTR) – Residential Buildings

- 4 x 13A Twin Socket distributed on the walls of the MTR;
- One number of AC and DC Earth bars;
- A/C Unit – to maintain the temperature at 24°C;
- Provide 2 x 32A TP isolator fed with dedicated feeder from essential power supply (EDB) if required by the operator during the NOC process;
- 2 nos. handheld CO2 cylinder extinguishers to be provided inside the room;
- Room should be provided with adequate lighting with minimum of 200 Lux at table level;
- Room shall be compliant with the fire and safety requirements like smoke detector, fire alarm, emergency light etc. as per local authority standards. Any water sprinklers must be avoided.

Also refer to Appendix-5 - Summary Table EM Specification, for consolidated EM requirements.

3.3.1.3 General Electromechanical (EM) requirements for Main Telecom Room (MTR) – Commercial and Mixed Used Buildings

All the telecom rooms, with the exception of the floor telecom space, must be provided with an air conditioning system to maintain the temperature at 21°C ± 1°C and the relative humidity at 50% ± 10%.

The following design principles must be followed while designing air conditioning system for commercial and Mixed Used buildings only.

a) 4 x 13A twin sockets fed from the essential power supply with dedicated 20A circuit breaker;
b) 2 number of AC & DC earth bars connected to the dedicated earth pits with resistance less than 1ohm;
c) Provide 2 x 40A TP isolator fed with dedicated feeder from essential power supply (EDB);
d) Dedicated A/C system (ducted split FCU) with duty & standby units with proper interlocking, to maintain the room temp. at 21°C ± 1°C;
e) Heat dissipation can be considered at 300 Watts/sq. meter. + 3kW per rack;
f) 2 nos. handheld CO2 cylinder extinguishers to be provided inside the room;
g) Room should be provided with adequate lighting with minimum of 200 Lux at table level;
h) Room shall be complying with the fire and safety requirements like smoke detector, fire alarm, emergency light etc. as per local authority standards. Any water sprinklers have to be avoided;
i) Raised flooring system requirement shall be advice during design NOC stage by Operators.

Also refer to Appendix-5 - Summary Table EM Specification, for consolidated EM requirements.

3.3.1.4 Main Telecom Room

A main telecom room must be provided on the ground floor or basement floor. This room will be used for the termination of telecom cables and to house telecom equipment both now and in the future. The location has to be chosen giving maximum freedom for the developer to save e.g. expensive floor space or cater esthetic requirements e.g. at the entry level of a building.

The minimum room dimensions will depend on the function and features of the building. The doors to this room must be open outwards and have a minimum opening of 1000mm x 2100mm (W x H).

Refer to the standard MTR sizes with respective number of tenants per building in Appendix-1 Figure 4, Appendix-1 Figure 5, Appendix-1 Figure 6 and Appendix-1 Figure 7.

The detailed specifications of these rooms are included in the text below and summarized in Appendix-2 Table 2 and Appendix-6 - Summary Table ISP Specification

Rack and ODF elevations details are provided in, Appendix-1 Figure 8 and 9

3.3.1.5 Telecom Rooms – Floor Telecom Room

Floor telecom room with minimum of 2m (W) x 1m (L) x 3m (H) spaces must be provided on all the floors of multi-tenant buildings (residential/commercial buildings) for the routing or splicing or termination of telecom cables.

The floor telecom room must be provided with two doors that open outwards with a total minimum opening of 1500mm x 2100mm (W x H).

Refer to the FTR sizes with wall mount mini ODF (splice cabinet) mounting detail in Appendix-1 Figure 13 and Appendix-1 Figure 14. Refer to the mini ODF (Splice cabinet) detail in Appendix-1 Figure 15.

3.3.1.6 Telecom Rooms – Safety and general Fit-out

All telecom rooms must comply with all municipality and national authority standards and regulations; such as those issued by civil defense and utility companies. Notwithstanding this, it is expected that following will be provided:

a) All main telecom rooms must be fitted with smoke detectors connected to the building management system;
b) All telecom spaces must be fitted with normal and emergency lighting;
c) All containment openings of telecom rooms must be sealed with a regulation fire retardant material;
d) All doors of telecom rooms to be of solid wood core or steel construction, fire retardant with a minimum rating of 2 hours;
e) All doors of telecom rooms must be outward opening with an automatic door closer system fitted on the hinged edge;
f) All doors of telecom rooms to be labelled with both du / Etisalat telecom room, Refer to the Appendix-3 - du and ETC Telecom room label;
g) The room must be free from contaminants and pollutants.

If the building developer has any concerns over safety, especially fire protection and suppression systems, this should be raised with the Operators at the design stage.

The walls, floor, and ceiling must be finished so as to minimize dust and static electricity and the walls and ceilings must be painted with a primer and light colored finish coat.

3.3.2 Roof-Top and Mobile Service Room

3.3.2.1 Roof-Top Room

Roof-top rooms must be provided on the roof of all multi-tenant buildings, which are up to G+10 floors or less. The specifications are detailed in Appendix-2 Table 4 and drawings are provided in Appendix-1 Figure 16.

Also refer to Appendix-1 Figure 17 and Appendix-1 Figure 18 for cross connect cabinet mounting detail (inside Roof-Top room) and cross connect cabinet- elevation layout respectively.

The following design principles must be followed while designing a Roof-top room for buildings with G+10 floors or less:

a) The dedicated 3m x 3m x 3m roof-top room shall be provided on the roof of the building;
b) The roof-top room shall be connected to building riser through 300mm x 50mm vertical cable tray;
c) The doors of this room shall open outwards and have a minimum opening of 1000mm x 2100mm (WxH);
d) The following electromechanical must be provided while designing roof-top room:

- 4 x13A twin sockets fed from the essential power supply with dedicated 20A circuit breaker;
- 2 number of AC & DC earth bars connected to the dedicated earth pits with resistance less than 1ohm;
- Add 2 x 63A TP isolator fed with dedicated feeder from essential power supply (EDB);
- Dedicated A/C system (ducted split FCU) with duty & standby units with proper interlocking, to maintain the room temp. at 21°C ± 1°C;
- Heat dissipation can be considered at 36kW for roof-top Room;
- 2 nos. handheld CO2 cylinder extinguishers to be provided inside the room;
- Room should be provided with adequate lighting with minimum of 200 Lux at table level;
- Room shall be compliant with the fire and safety requirements like smoke detector, fire alarm, emergency light etc. as per local authority standards. Any water sprinklers must be avoided.

Roof-top room design consideration:

a) The floors of the roof-top rooms must have a minimum distributed load rating of 10kN/m2;
b) Openings must be provided to the room to allow for cables to connect to external antennas. These openings must be 600mm x 400mm (W x H), 500mm below the room ceiling in walls facing the building's roof-top area;
c) Space must be reserved on the roof-top of the building for the installation of mobile-service antennas. This setup may vary from building to building scenario, but this will be typically at the corners of the building or on any raised structure on the roof-top. The exact details will be advised at the design NOC stage with the Operators.

3.3.2.2 Mobile-Service Room (more than G+10 floors)

Mobile-service rooms must be provided in all multi-tenant buildings, which are above G+10 floors. The mobile service room must be provided for every 10 floors, starting from the basement/ground floors.

The specifications are detailed in Appendix-2 Table 4 and drawings are provided in Appendix-1 Figure 16.

Also refer to Appendix-1 Figure 17 and Appendix-1 Figure 18 for cross connect cabinet mounting detail (inside mobile service room) and cross connect cabinet - elevation layout respectively.

The following design principles must be followed while designing mobile service room for building, with more than G+10 floors:

a) The dedicated 3m x 3m x 3m space shall be provided for every 10 floor, starting from basement or ground floor;
b) The location of the mobile service room must be close to the floor telecom Room (FTC);
c) The mobile service room shall be connected to building riser through 300mm x 50mm vertical cable tray;
d) The doors to this room shall open outwards and have a minimum opening of 1000mm x 2100mm (W x H).
e) The following electromechanical must be provided while designing mobile service rooms.

- 4 x 13A twin sockets fed from the essential power supply with dedicated 20A circuit breaker;
- 2 number of AC & DC earth bars connected to the dedicated earth pits with resistance less than 1ohm;
- Provide 2 x 63A TP isolator fed with dedicated feeder from essential power supply (EDB);
- Dedicated A/C system (ducted split FCU) with duty & standby units with proper interlocking, to maintain the room temp. at 21°C ± 1°C;
- Heat dissipation can be considered at 26KW for mobile service room;
- 2 nos. handheld CO2 cylinder extinguishers to be provided inside the room;
- Room should be provided with adequate lighting with minimum of 200 Lux at table level;
- Room shall be compliant with the fire and safety requirements like smoke detector, fire alarm, emergency light etc. as per local authority standards. Any water sprinklers must be avoided.

f) The floors of the mobile-service rooms must have a minimum distributed load rating of 10kN/m2.

3.4 Home and Office Consolidation Cabinets

A consolidation cabinet must be provided in each home. The cabinet is specified to accommodate two telecom operator's requirements at the same time. The minimum specifications are as follows, depending on the apartment/villa size.

3.4.1 Home Consolidation Cabinet – Serving up to 24 ports of RJ-45 per Tenant

Minimum internal dimension 600mm x 600mm x 150mm (H x W x D):

a) Concealed in the wall with the front of the cabinet flush with the wall;
b) Located in an accessible area inside the home close to the entrance and not inside the kitchen, laundry room or bedroom;
c) Installed at a height of 1200mm (between finished floor level and the bottom edge of the cabinet);
d) An adequate safe working space around the location;
e) Adequate lighting;
f) Not close to the sources of water or heat;
g) Not close to any electrical distribution or bus bars;
h) Adequate ventilation must be provided; minimum of one air change per hour;
i) Fitted with 24 port Copper patch panel;
j) 24 number of CAT6 Cables or less per tenant;
k) Fibre terminal box fitted with 2 port of LC/APC adaptor & pigtails and with 2 port of SC/APC adaptor & pigtails for 4 core SM fibre drop cable termination. Refer to the Appendix-1 Figure 19.
l) Lockable front door;
m) Horizontal cable management for unshielded twisted pair (UTP) patch cables;
n) Sufficient cable entries to accommodate the incoming Fibre optic and UTP cables;
o) 13A dual socket must be provide inside consolidation cabinet with dedicated circuit breaker on the domestic supply and not loop with other power sockets;
p) Labelled with villa or floor/flat number.

Refer to the Appendix-1 Figure 20 for home consolidation elevation layout.

3.4.3
Business Consolidation Cabinets - Commercial Predefined Rooms

A consolidation cabinet must be provided in each office or business area. The cabinet is specified to accommodate two telecom operator's requirements at the same time. The minimum specifications are as follows:

a) Minimum internal dimension 12U (H) 600mm x 600mm x 350 mm (H x W x D)
b) Located in an accessible area inside the business area close to the entrance and not inside a pantry, washroom, etc.;
c) Installed at a height of 1200mm (between finished floor level and the bottom edge of the cabinet);
d) An adequate safe working space around the location;
e) Adequate lighting;
f) Not close to sources of water or heat;
g) Not close to any electrical distribution or bus bars;
h) Adequate ventilation must be provided; minimum of one air change per hour;
i) 24 number of CAT6 Cables or More per Tenant;
j) Fibre terminal box fitted with 2 port of LC/APC adaptor & pigtails and with 2 port of SC/APC adaptor & pigtails for 4 core SM Fibre drop cable termination. Refer to the Appendix-1 Figure 19
k) Lockable front door;
l) Vertical and horizontal cable management for UTP patching cables;
m) Sufficient cable entries to accommodate the incoming Fibre optic and UTP cables;
n) 13A dual socket must be provide inside consolidation cabinet with dedicated circuit breaker on the domestic supply;
o) Labelled with office/room number.

Refer to the Appendix-1 Figure 22 for office consolidation elevation layout.

3.4.4
Business Consolidation Cabinet – Commercial Shell and Core

In the case of a shell and core development, provide the following requirements:

a) One number of dedicated indoor wall mounted fully loaded mini ODF (splice cabinet) must be provide in each FTR;
b) Pull 4 core single mode drop fibre cables for every 200 square meter of leasable floor space;
c) Multicore SM fibre cable capacity, which are extended from MTR, will depend on the number of 4 core SM drop fibre cables and will be pulled from leasable floor space.

The mini ODF (Splice Cabinet) specifications are as follows:

a) Fully loaded with pre- terminated SC/APC pigtail and SC/APC adaptors - for operators
b) Pull 4 core SM drop Fibre cables from Tenant's telecom cabinet to Mini-ODF inside FTR;
c) Multicore Fibre cables must be spliced on the dedicated splice trays, which are reserved for Multicore SM Fibre cables splicing unit;
d) Drop Fibre cables must be spliced on the dedicated splice trays, which are reserved for drop fibre cables splicing unit;
e) Sufficient cable entries to accommodate the multicore SM Fibre cables and drop fibre cables;
f) Lockable panels all round lockable front door;
g) Sufficient cable entries to accommodate the incoming fibre optic cables;
h) Labelled with floor number;
i) All fibre cores must be clearly labelled per Operators specification and standards.

Refer to the Mini- ODF Cabinet detail in Appendix-1 Figure 23.
Internal cable distribution must be coordinated directly between the building owner and the tenant.

3.5 Pathways

3.5.1 Containment – General

The following requirements must be applied to all containment systems:

a) The containment system must be designed such that installed cables do not exceed the minimum specified bend radius;
b) All metal containment parts must be free from sharp edges and should be earth bonded;
c) Telecom riser openings must be sealed with a suitable fire retardant material;
d) Cable trays must be easily accessible in common areas to facilitate any future provision of additional cables;
e) Any cable trays that are in publicly accessible areas less than 4.8 m above the floor must be covered;
f) Containment systems must not run through areas exposed to excessive heat, moisture, corrosive atmospheric or environmental conditions, high voltages, radio frequency interference ("RFI") or electro-magnetic interference ("EMI");
g) For all containment systems, a minimum separation must be maintained from sources of electromagnetic interference.
h) The building developer shall provide main and redundant containment system to connect with main and redundant entry points.

3.5.2 Vertical Containment – Multi-Tenant Buildings

Risers must be provided in multi-story multi-tenant buildings to allow the installation of telecom cables from the main telecom room to the floor telecom space, mobile- service rooms and roof-top rooms.

The following Hot-Dip Galvanized (HDG) slotted steel cable trays must be provided in the risers to accommodate the fibre optic cables and IBS cables.

- The vertical cable tray size must be 450mm x 50mm (HDRF) inside the building riser to accommodate building fibre optic cables;
- The vertical cable tray size must be 300mm x 50mm (HDRF) inside the building riser to accommodate IBS cables to provision IBS-solution (GSM).

3.5.3 Vertical Containment Within the Home/Villa/Warehouse

All UTP cables between the floors inside a home must run through 2 x 50 mm diameter PVC conduits via a junction / pull box located on each floor. The junction/ pull box must be of minimum dimensions 300 mm x 300 mm x 150 mm (W x H x D). The slab opening (if required) for these conduits must be in a suitable and accessible location in every floor. It is recommended that all vertical conduit runs be aligned to ease the installation of cables.

3.5.4 Horizontal Containment From Floor Telecom Space to Consolidation Points

The horizontal containment for routing cables from the floor telecom space to consolidation points on the served floor can use several systems (cable trays, conduit etc.). The solution will depend on the characteristics of the building type. Conduits must only be used when the consolidation point locations are permanent, the cable density is low, the flexibility to modify the routing is not required and dedicated individual runs of 50 mm conduit to be installed from floor telecom space to each tenant.

- The horizontal cable tray size must be 200mm x 50mm (HDRF) inside the building corridor.

3.5.5 Horizontal Containment – Mobile Service Antenna

Horizontal containment must be provided to route mobile-service antenna cables from the floor telecom closets to all common corridors including all lift lobbies, podium levels and basement levels.

- The horizontal cable tray size must be 150mm x 50mm (HDRF) inside the building corridor to accommodate mobile-service antenna cables to provision IBS solution (GSM).

3.5.6 Horizontal Containment Within the Home/Villa/Warehouse

All UTP cables inside the home must run through PVC conduit with a minimum 25 mm diameter from the home consolidation point to each dual outlet. If more than one dual outlet is fed by a conduit, the size of the conduit may need to be uprated.
Intermediate PVC junction / pull boxes must be provided on individual runs that exceed.30 m. PVC junction /pull boxes must also be provided where an individual conduit run has a sharp change in direction.
The conduit boxes referred to above must have the following minimum internal dimensions:

- 300 mm x 300 mm x 150 mm (L x W x D)

3.5.7 Horizontal Containment – Groups of Towers

When a plot consists of a group of towers, all the requirements of a single tower still apply. Additional cable trays must be provided linking the main telecom rooms of the towers. One cable tray following minimum dimensions must be provided:

- 300 mm x 100 mm (W x H) with Heavy Duty Return Flange (HDRF)

This tray must be easily accessible in common areas to facilitate any future provision of additional cables. However, if these trays are in publicly accessible areas less than 4.8 m above the floor then the trays must be covered.
In case of no common basement level / podium level between a group of towers, then underground duct system must be installed in a ring topology (between the group of towers/buildings). Minimum of 2 way D54 (100 mm) ducts must be provided between the towers/buildings.

3.6 Fibre Termination Components and GPON splitters

The following fibre termination components are to be provided to splice multicore SM fibre cables with 4 core SM drop cables:

- 4 port fibre terminal box (with LC/APC and SC/APC pigtails & adaptors) inside;
- 12U cabinet of tenant premises (Home/Office/Retail/Villa/Warehouse);
- Fully loaded high density or low density fibre patch panels with SC/APC adaptors and pigtails inside MTR– for Operators
- Wall mount mini ODF (direct splice cabinet) inside FTR are to be used to splice the multicore SM fibre cables with respective 4 core SM drop cables**.

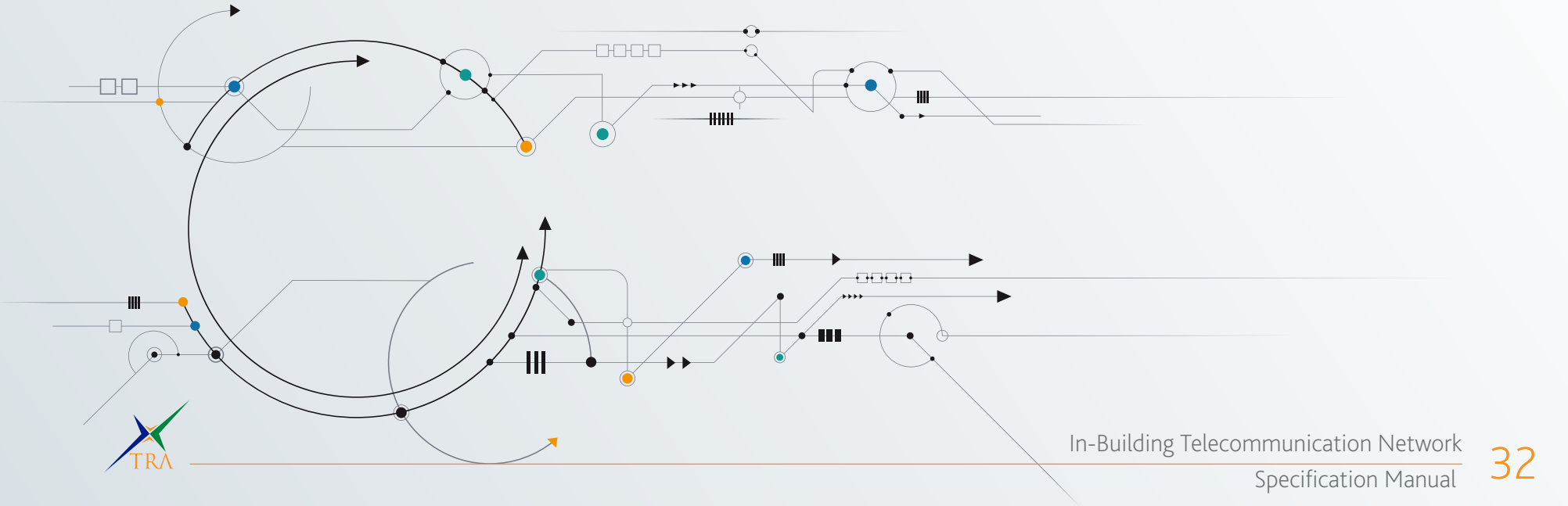
**The capacity of the mini ODF (direct splice cabinet) depends on the number of splice trays required per mini ODF to accommodate minimum of 12 core fibre per splice tray.

3.6.1 General GPON Optical Splitter Specification

- Optical splitter shall be made of Planar Lightwave Circuit (PLC) type;
- Manufacturer of optical splitters shall be fully compliant with Telcordia GR-1209, GR-1221 or with IEC 61300, IEC 67153-031-6;
- All metal plating's and plastic materials of optical splitter shall be RoHS compliant;
- Optical splitters shall have the operating wavelength (nm) range from 1260 nm ~ 1635 nm;
- Optical Splitters shall have the operating temperature range from -24°C to +85°C;
- 2 (in) x 32 (out) optical splitter shall have the maximum insertion loss + connector loss (@ operating wavelength from 1260 ~1635 nm) to ≤ 18 dB;
- Optical splitter shall have dust covers on the uplink and downlink connectors.

3.6.2 High density (2 in x 32 out) Connectorized Modular Splitter Specification

- High density modular splitters shall be used for a building, which has more than 100 units;
- The modular splitters will be fitted inside the splitter chassis (sub- rack);
- Splitter chassis (sub-rack) shall be 19th inch with in-built cable management facility to route the uplink and downlink fibre patch cords;
- Each splitter chassis (sub-rack) shall have 8 numbers of (2 in x 32 out) modular splitters with LC/APC connector type;
- Each splitter chassis (sub-rack) shall have 4 numbers of (2 in x 32 out) modular splitters with SC/APC connector type;
- Each splitter chassis (sub-rack) shall be 3U to 4U in height;
- Each modular splitter shall have visible label holder for unique identification;
- The modular splitters shall have an easy snap-in design which requires no tools;
- Uplink and downlink ports of (2 in x 32 out) modular splitter shall have LC/APC connector type – for du*;
- Uplink and downlink ports of (2 in x 32 out) modular splitter shall have SC/APC connector type – for Etisalat*.



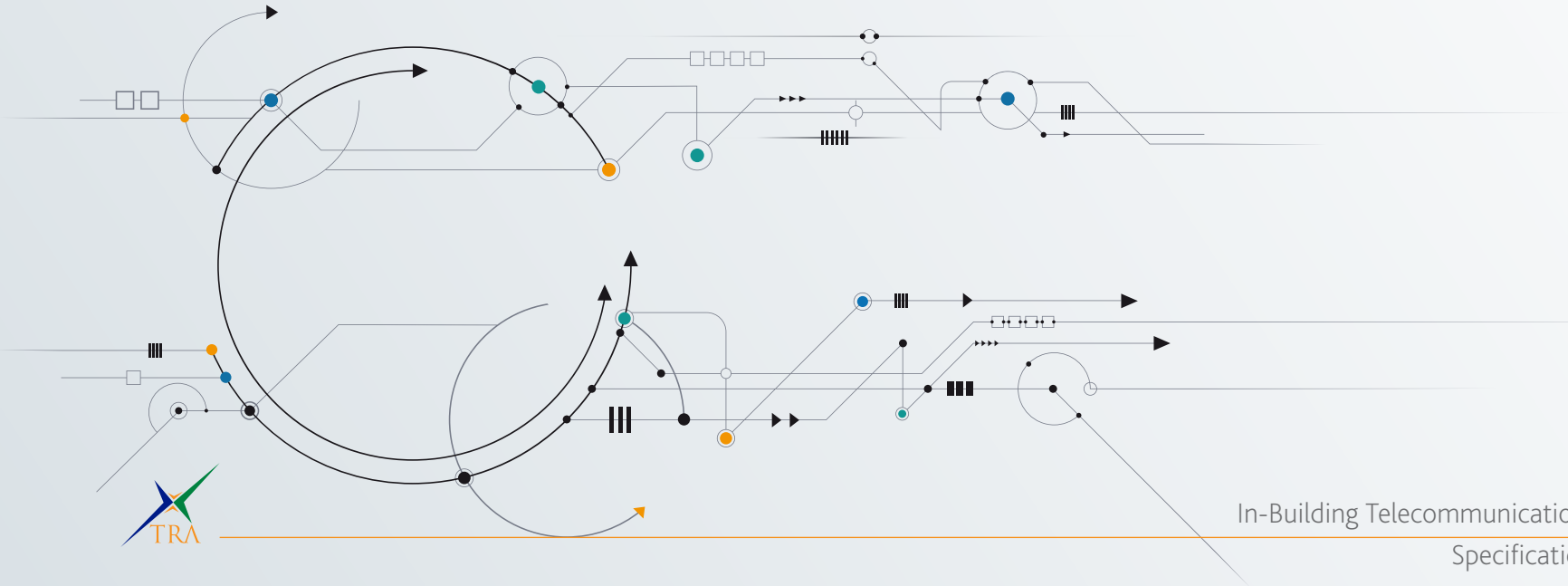
3.6.3 Low density (2 in x 32 out) Connectorized Splitter Specification

- Low density splitters shall be used for a building or villas scenario, which has less than 100 units;
- Low density splitters shall be 19th inch, 1U, rack mountable;
- Low density splitters shall have in-built cable management facility to route the uplink and downlink fibre patch cords;
- Uplink and downlink ports of (2 in x 32 out) splitter shall have LC/APC connector type – for du*;
- Uplink and downlink ports of (2 in x 32 out) splitter shall have SC/APC connector type – for Etisalat*.

* The building owner is responsible for supplying splitters, fibre patch cords and its related racks.
* The building owner is responsible to install the splitters and its related fibre patch cords to make neat pre-patching between uplink ports and outside plant fibre patch panel & between the downlink ports and inside plant fibre patch panels.
* Each splitter shall have 2 uplink ports (2 inputs), the connectivity between the 2 uplink ports of splitter with uplink patch panel has to perform in the following steps

- The 1st uplink port of splitter is to be connected to main uplink patch panel
- The 2nd uplink port of splitter is to be connected to redundant uplink patch panel

* The building owner shall supply the splitters only from the pre-approved manufacturer's list of du and Etisalat.



3.6.4 GPON Splitter Calculation per building

Number of GPON splitters required per buildings = number of tenants/units of building ÷ 30 {where 30 are the downlink ports of (2 in x 32 out) splitter and 2 downlink ports of (2 in x 32 out) splitter shall be left out as spare ports for operational maintenance}.

3.7 Fibre and Copper Cables

3.7.1 Cables - general

The proposed specifications of all the cables (and its related connecting accessories) must be from pre-approved manufacturer's list of Operators.

3.7.2 Fibre Optic Cables Specification

The following type of fibre must be provided:

a) Drop Fibre Cable:

- Single mode with 4 core;
- Flexible indoor drop fibre;
- Cable to be of flat cross-section;
- Bend insensitive;
- Comply with ITU-T G.657 A1/A2;
- Backward comply with ITU-T G.652 D;
- Jacket to be halogen free and flame retardant material (which is LSZH type).

b) Multicore Fibre Cable:

- Single mode;
- Indoor type;
- Compliant with ITU-T G.657 A1/A2;
- Backward comply with ITU-T G.652 D;
- Tight buffer structure up to 12 fibre cores;
- Flexi tube (gel free) micro module cable/micro bundle cable from 24 Fibre cores and above;
- Jacket to be halogen free and flame retardant material (which is LSZH type);
- Fibre optic color coding shall be in accordance to EIA/TIA-598.

3.7.3 Fibre Optic Cables Requirements

For single or complex of villas/warehouses scenario the fibre optic cables will be provided by the Operators.

However, 4 core fibre terminal boxes shall be supplied and installed inside the consolidation cabinet by villa/warehouse developer. For all other building scenarios, fibre optic cables should be supplied, spliced, labelled and tested inside the main telecom room, inside the floor telecom room, and inside consolidation cabinet by the building developer. This should include the supply and installation of the following fibre optic cables and its related accessories.

3.7.4 Fibre Optic Cables – from main telecom room to mini ODF (Splice Cabinet) floor telecom room

The number of fibre cores required will be dependent on the number of tenant in each serving floor. The multicore fibre cable must be provided from the main telecom room to mini ODF (splice cabinet) inside the floor telecom room.

These multicore fibre cables must be continuous lengths free from joints, branches or patching from main telecom room to each mini ODF (splice cabinet) unit.

Location of multicore mini ODF (splice Cabinet) must always start from 1st floor to cover maximum of three floors.
For example - mini ODF (splice cabinet) installed at 1st floor will cover the 1st, 2nd and 3rd floor. Next mini ODF (splice cabinet) location must be at 4th floor. This mini ODF (splice cabinet) will cover 4th, 5th and 6th floor, next mini ODF (splice cabinet) location must be at 7th floor and so forth.

Refer to Appendix-1 Figure 15, Appendix-1 Figure 24, Appendix-1 Figure 25 and Appendix-2 Table 3 for more details.

Multicore fibre cables must be directly spliced with 4 core SM fibre cables using mini ODF (Splice Cabinet) cabinet inside FTR. Minimum 25% spare fibres must be considered while calculating multicore fibre capacity for maintenance and additional service demands. All fibre optic cables shall be supplied, spliced, labelled and tested inside the main telecom room and floor telecom room.

3.7.5 Fibre Optic Cables – from mini ODF (Splice Cabinet) floor telecom room to consolidation point (CP)

The 4 core SM fibre cables must be provided from each CP unit to its respective mini ODF (splice cabinet) inside the floor telecom room.

These 4 core SM fibre cables must be continuous lengths free from joints, branches or patching from each CP unit to its respective mini ODF (splice cabinet) inside the floor telecom room.
All these 4 core SM fibre cables must be directly spliced with multi-core fibre cables using mini ODF (splice cabinet) inside FTR. Refer to the Mini ODF (Splice Cabinet) detail Appendix-1 Figure 15 and Appendix-1 Figure 24.

Table A - 4 core SM fibre cables core assignment matrix

Residential or Commercial Unit/Tenant	Fibre Core	Port No	Assign to
	1 - Blue	1-SC/APC	Etisalat
	2 – Orange	2-SC/APC	Etisalat
	3 - Green	3-LC/APC	du
	4 - Brown	4-LC/APC	du

3.7.6 Fibre Optic Cables – from MTR to each Mobile Service Room and Roof-Top Room

The following specifications shall be provided by building owner to have IBS-connectivity (GSM) within premises/buildings/high rise towers:

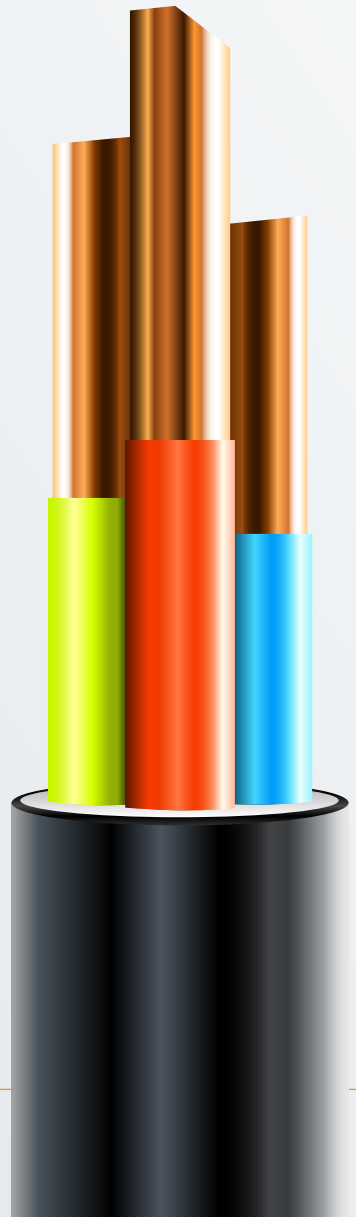
- 24 core SM indoor tight buffer fibre cables must be installed from main telecom to each mobile service room and roof-top room;
- Install pre-terminated cross connect cabinet at each mobile service room and roof-top room;
- Terminate the 24 core SM Indoor tight buffer fibre cables inside the rack at MTR side by using 19th inch, 24 port SC/APC fibre patch panel;
- Terminate the 24 core SM Indoor tight buffer fibre cables inside the pre-terminated cross connect cabinet at mobile service room side and roof-top side;
- Pre-terminated cross connect cabinet shall be minimum size of 600mm (W) X 150mm (D);
- Pre-terminated cross cabinet shall accommodate 24 SC/APC pigtail and adaptors;
- 1 to 12 core will be dedicated to connect Etisalat IBS equipment and 13 to 24 core will be dedicated to connect du IBS equipment.

Refer to the Appendix-1 Figure 16, Appendix-1 Figure 17 and Appendix-1 Figure 18 for cross connect cabinet mounting detail and cross connect cabinet elevation layout.

3.8 CAT6 Copper Cabling

To deliver services from the consolidation points to the building outlets unshielded twisted pair (UTP) copper cables must be provided. The full design is the responsibility of the building developer, however, the following minimum requirements must be followed for the efficient and effective provision of services:

a) The cables must conform to a minimum of CAT6 with 23 AWG and as per TIA/EIA-568-B specification;
b) The wiring must be in a 'star' topology fanning out from the consolidation point;
c) Dual RJ45 outlets with spring load sliding shutters must be provided where ever service is required;
d) Each socket in the dual RJ45 outlet must be wired back to the consolidation point;
e) Outlets must not be cascaded or looped and there must be no splitting of cable pairs;



f) The maximum cable length from consolidation point to outlet must not exceed 90 m;
g) At the consolidation point the cables must be terminated on an RJ45 patch panel and labelled with the socket and outlet served;
h) In each outlet each cable must be terminated to maintain the twists in each pair up to 5 mm of the termination;
i) Proper strain relief must be provided at the terminated ends of the cable;
j) The components of the CAT6 system must compatible and it is preferred that they are from a single manufacturer to insure optimum performance;
k) Design must incorporate built-in flexibility to meet the growing needs of the occupants;
l) Test result for CAT6 to be saved and recorded for reference purpose in future, the Operators to maintain the records for future reference.

4 Bulk service

This kind of service solution usually applied to projects/buildings that are having their own IT network (single tenant) and system operator such as hotels, hospitals, schools, universities, banks, airports and other similar establishments.

In this type of buildings, the client shall have an own IT server room and dedicated main telecom room with the size of 3m x 3m x 3m (L x B x H) to be allocated for the parties for telecom/network equipment installation.

Letter from the client should be provided during the design stage confirming the bulk service and explaining the service required to be provided up to the client IT room.
The exact requirements related to telecom cabling and EM requirements will be determined during the design stage based on the client's service requirements.

However,
The client shall provide the following minimum requirements for bulk services setup:

- Dedicated MTR room with minimum size of 3m x 3m x 3m (L x B x H);
- Installed 19 inch 42U free standing rack at MTR;
- Installed and test 12 core SM Indoor tight buffer fibre cable between MTR & client server room, terminate the 12 core SM fibre cables at both end by using 12 port pre-terminated fibre patch panel;
- 1 to 6 core must be dedicated to connect Etisalat equipment;
- 7 to 12 core must be dedicated to connect du equipment;
- Installed and tested 24 number of Cat6 UTP Copper cables between MTR and client server room;
- 1 to 12 port of copper patch panel must be dedicated to connect Etisalat equipment;
- 13 to 24 port of copper patch panel must be dedicated to connect du equipment;
- Install 2 number of 12 port SC/APC pre-terminated fibre patch panel to each operator's uplink fibre;
- Client shall provide SC/APC adaptors and pigtail for fibre interfaces
- Distance between MTR and client server room must be maintained within 70 meter (to avoid 90 meter distance limitation, while provisioning fixed services over Cat6 copper cables);
- Extend 300mm x 50mm HDRF cable tray from MTR to client server room;
- 4 x 13A twin sockets fed from the essential power supply with dedicated 20A circuit breaker;
- 2 number of AC & DC earth bars connected to the dedicated earth pits with resistance less than 1ohm;
- Provide 2 x 40A TP isolator fed with dedicated feeder from essential power supply (EDB);
- Dedicated A/C system (ducted split FCU) with duty & standby units with proper interlocking, to maintain the room temp. at 21°C ± 1°C;
- Heat dissipation can be considered at 300 Watts/sq. meter. + 3kW per rack;
- 2 nos. handheld CO2 cylinder extinguishers to be provided inside the room;
- Room should be provided with adequate lighting with minimum of 200 Lux at table level;
- Room shall be compliant with the fire and safety requirements like smoke detector, fire alarm, emergency light etc. as per local authority standards. Any water sprinklers to be avoided;
- Raised flooring system requirement shall be advised during design NOC stage by Operators.

Refer to Appendix-1 Figure 26 for bulk service set-up layout.

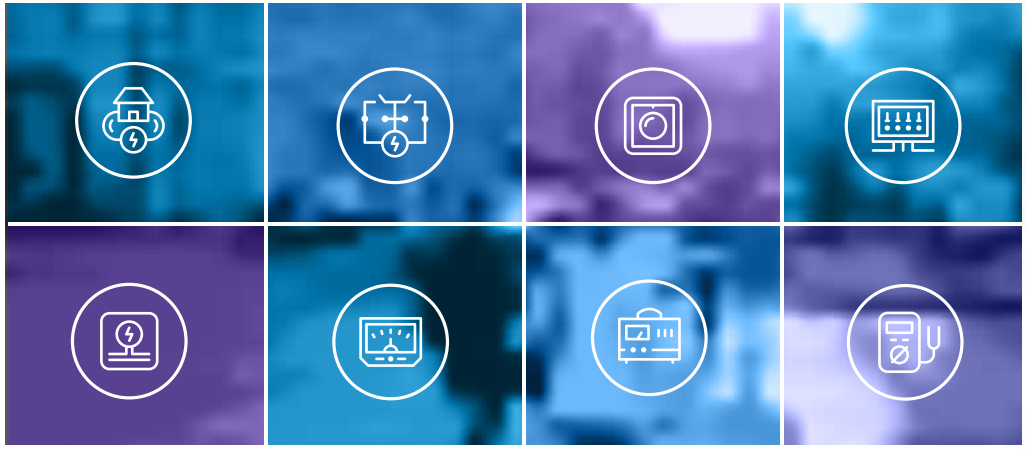
In case of any building transformation that would result in changing the type of service required, the building owner should obtain the Operator's approval by submitting amendment design.

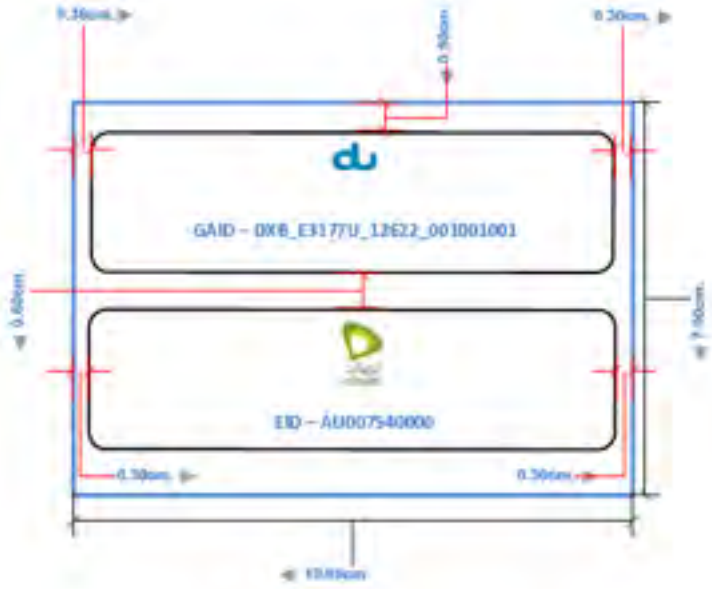
5 Labelling Scheme

1.1 GAID and EID Identification Plate for each Unit/Tenant

The identification plate must be installed at the door entrance of the residential/commercial units. The identification plate material could be made of plastic plate or light metal plate. The sample on identification plate must be submitted during NOC stage to the Operators for final approval.

The GAID and EID reference number detail will be made available by the Operators during the inspection stage.





5.2 SLD and Connectivity/Wiring detail

The Single Line Diagram (SLD) detail must be pasted inside main telecom room to trace end to end ISP connectivity.

Refer to the Appendix-4 - Wiring Plan for the detail connectivity wiring detail.

6 Responsibility Matrix

In following the responsibility split for setting up buildings and villas is provided.
Summary of responsibility matrix for multiple home/office building scenario:

Item description	Master Plan Developer	Building owner	Operators
Lead-in ducts, including connections to JV manholes outside building/single villa boundaries	✓		
Installation of Manholes and ducts outside the building /boundaries (including cover)	✓		
Entry boxes inside the building/villa/complex of villas boundaries (including the cover)		✓	
Supply and Installation of 4 core SM fibre Terminal Box with duplex LC/APC adaptors and pigtail and 2 number of SC/APC adaptors		✓	
fibre optic cables supply, pulling, termination and testing from the Main Telecom Room to FTR and drop fibre cables supply, pulling, termination and testing from the FTR to CP Cabinet.		✓	
fibre optic cables supply, pulling, termination and testing from the Main Telecom Room to FTR and drop fibre cables supply, pulling, termination and testing from the FTR to CP Cabinet (In case of Shell and core)		✓	
Supply and Installation of Mini ODF (Splice Cabinet) Cabinet at Splice point Location		✓	
Splicing and Labelling Multicore fibre cables with 4 core drop cables using Wall Mount Mini ODF (Splice Cabinet) Cabinet		✓	
Horizontal cabling work inside the unit/apartment/office/retail		✓	
FTTx components such as the fibre cables, 42U 800 X 800mm Free standing racks, Optical distribution frame (ODF), high density fibre patch panel, low density fibre patch panel, Mini ODF (Splice Cabinet) for splice point, Mini ODF (Splice Cabinet) cabinet for shell and core, 4 Port fibre terminal box (with LC/APC and SC/APC pigtails & adaptors), GPON Splitters, Open rack for splitters and fibre patch cords.		✓	
fibre optic splitter supply and installation (from the approved lists of suppliers/vendors of both du and Etisalat)		✓	

Item description	Master Plan Developer	Building owner	Operators
Supply of fibre patch cords and Pre-patching the fiber patch cords between splitter's downlink ports to building fiber patch panels (ISP) and between splitter's uplink port to Outside plant fiber patch panels		✓	
CP cabinet supply & installation (including accessories including related elements) Vertical and horizontal cable trays/pathways supply & installation		✓	
Telecom rooms/spaces and related EM and civil requirements		✓	
Plot of 10 x 10 meter to be provided for each MMR	✓		
Construction of Meet-Me-Room	✓		
Commissioning of Meet-Me-Room			✓
fibre optic cables supply, pulling, termination and testing from the main telecom room to each mobile service room and roof-top room		✓	
fibre optic components for IBS-Connectivity (GSM): Supply and Installation of fibre optic pre-terminated patch panels, cross connect cabinets and fibre patch cords		✓	

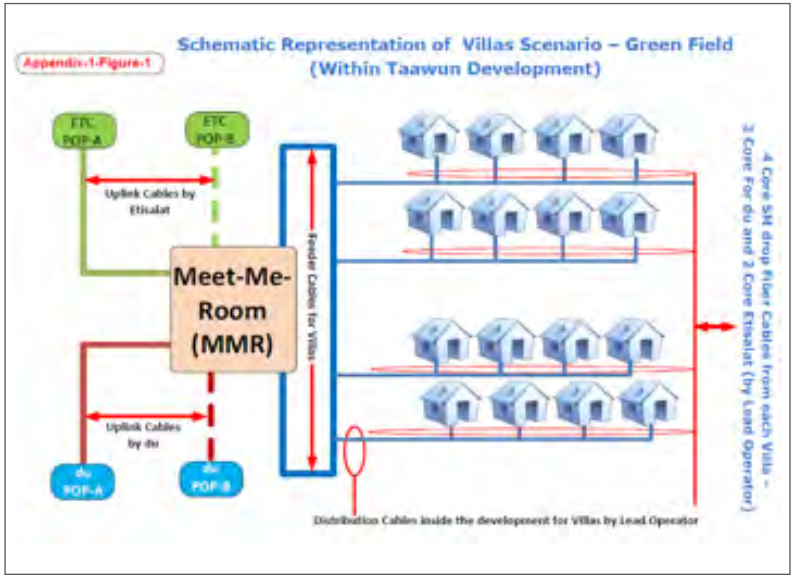
Summary of responsibility matrix for villa scenario:

Item description	Master Plan Developer	Villa's Developer	Operators
Lead-in ducts including connection to manhole outside villa boundaries	✓		
Manholes outside villa boundaries (including cover)	✓		
Pull box inside the villa boundaries (including the cover)		✓	
OSP fibre optic cables for single villa or complex villas connections (including supply, termination and testing)			✓
Supply and Installation of 4 core SM fibre Terminal Box		✓	
Patch cords supply		✓	
CP cabinet supply & installation (including accessories, power outlet and related elements)		✓	
Supply and Installation of splitters inside the stand alone Meet-me-Room's racks			✓
Plot of 10 x 10 meter to be provided for each MMR	✓		
Construction and Commissioning of Meet-Me- Room	✓		

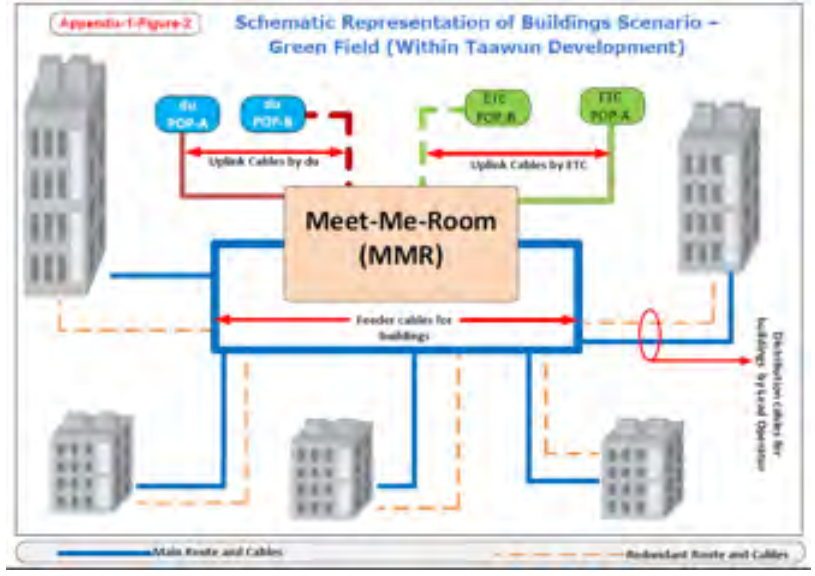
Appendix A: Detailed Drawings and Tables

A.1 Drawings

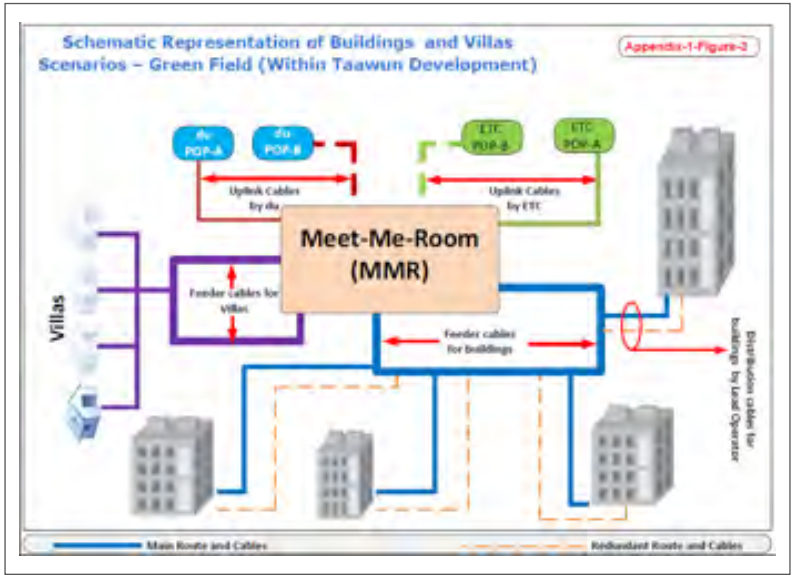
A.1.1 ppendix-1 Figure 1



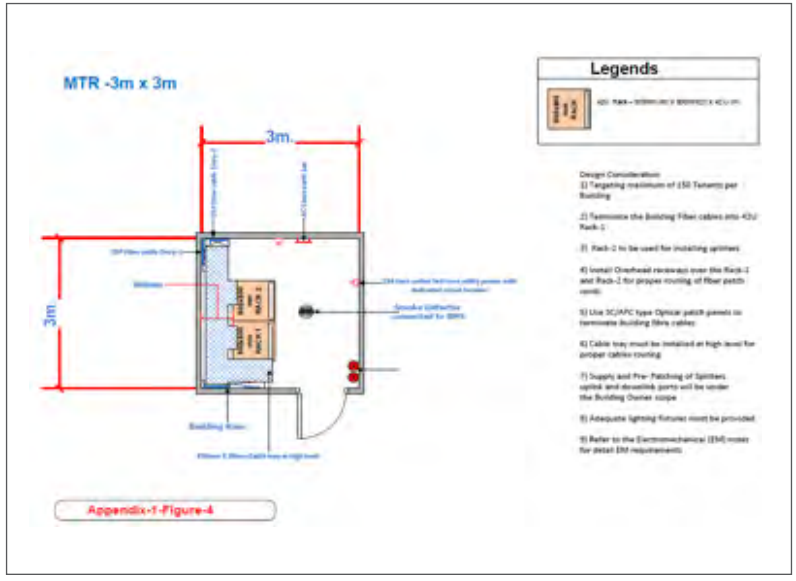
A.1.2 Appendix-1 Figure 2



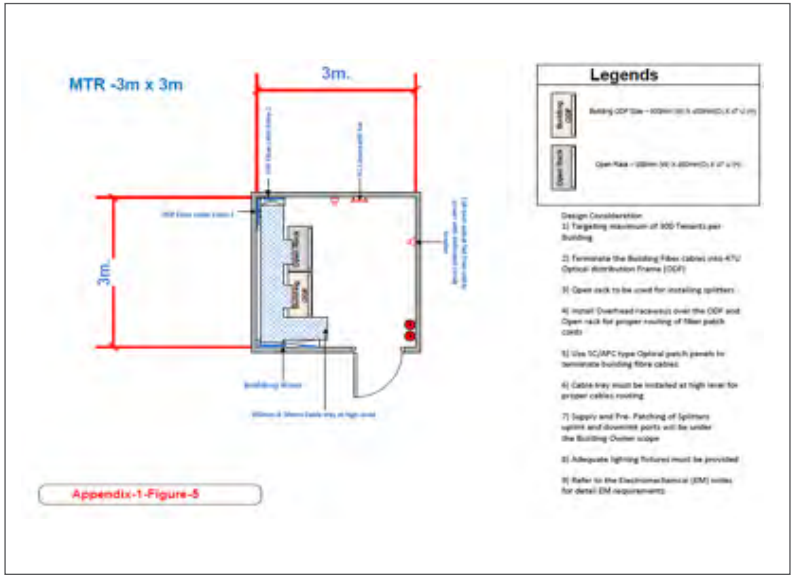
A.1.3 Appendix-1 Figure 3



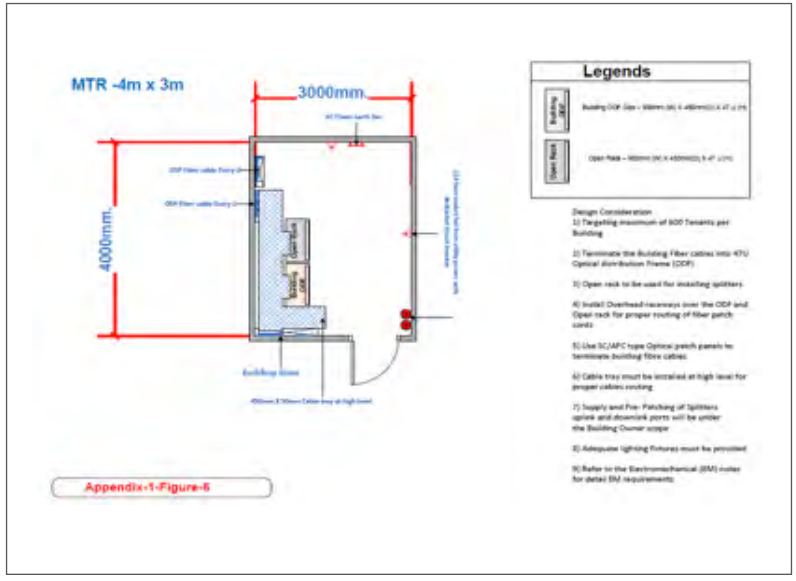
A.1.4 Appendix-1 Figure 4



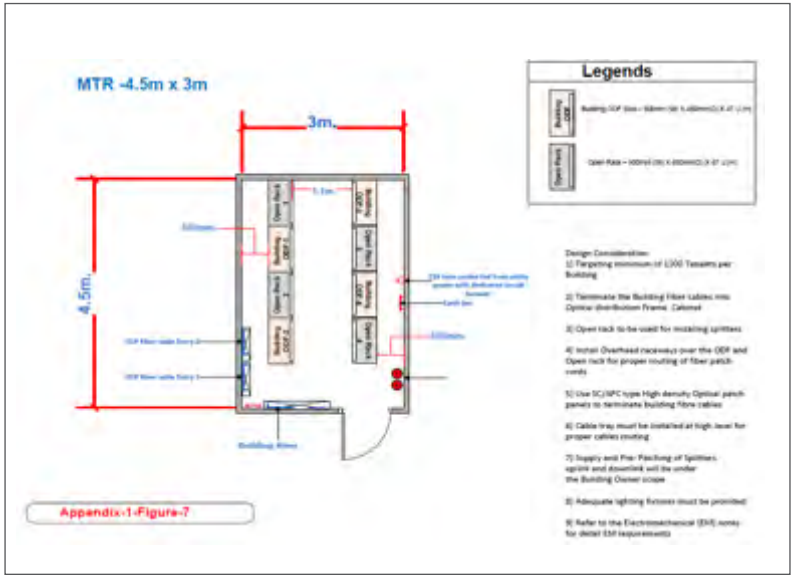
A.1.5 Appendix-1 Figure 5



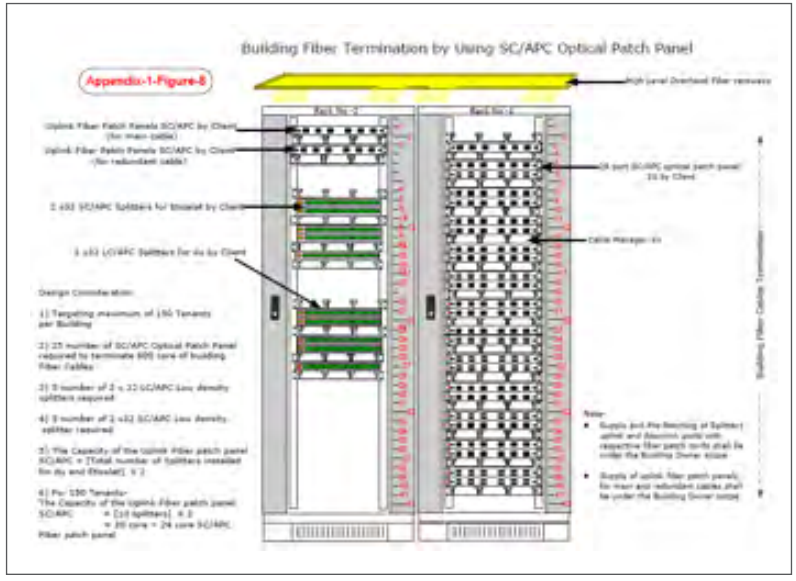
A.1.6 Appendix-1 Figure 6



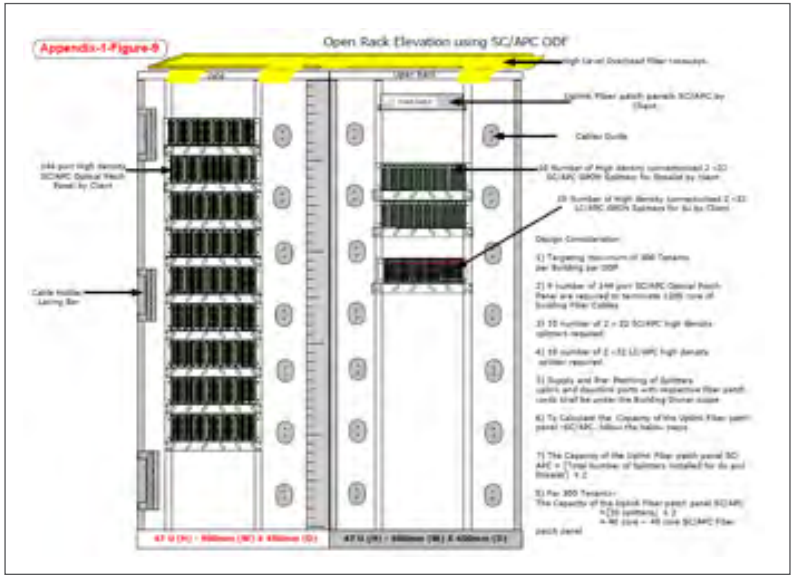
A.1.7 Appendix-1 Figure 7



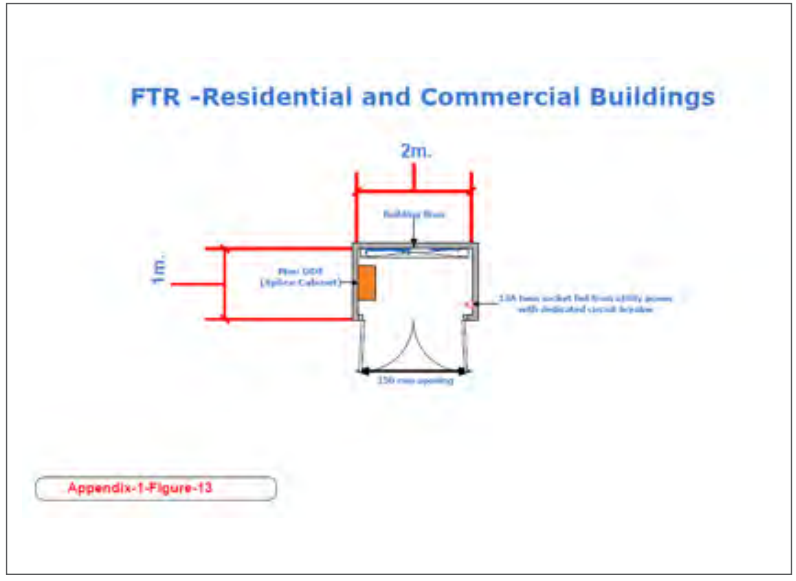
A.1.8 Appendix-1 Figure 8



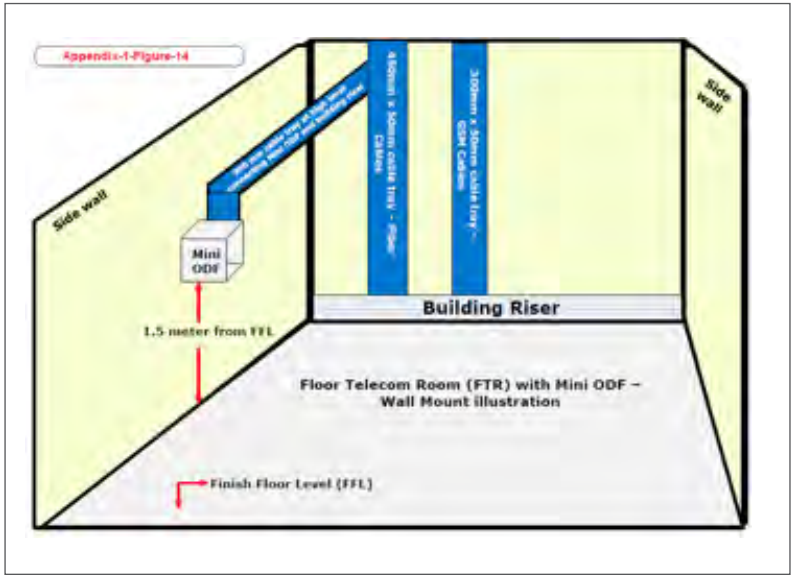
A.1.9 Appendix-1 Figure 9



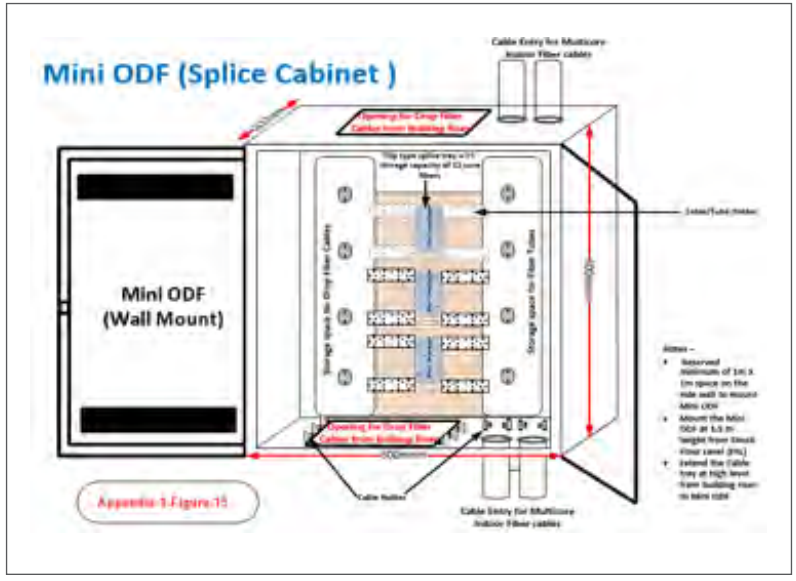
A.1.10 Appendix-1 Figure 13



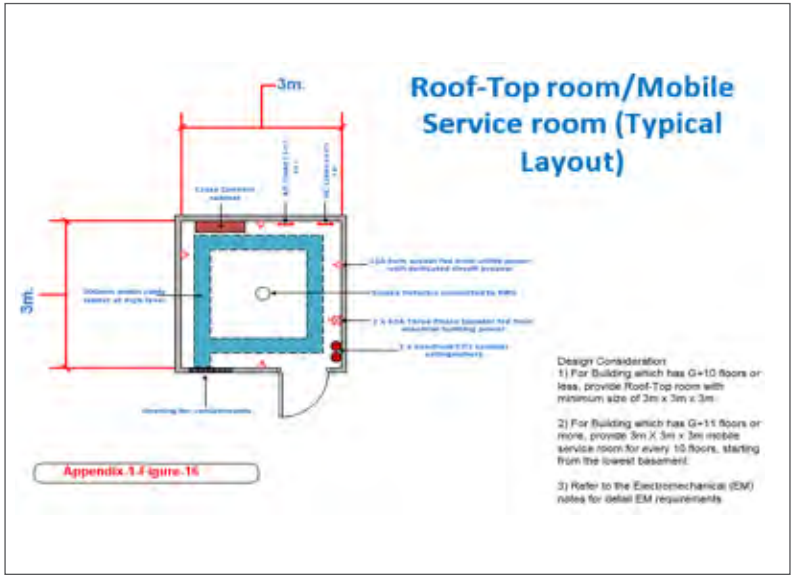
A.1.11 Appendix-1 Figure 14



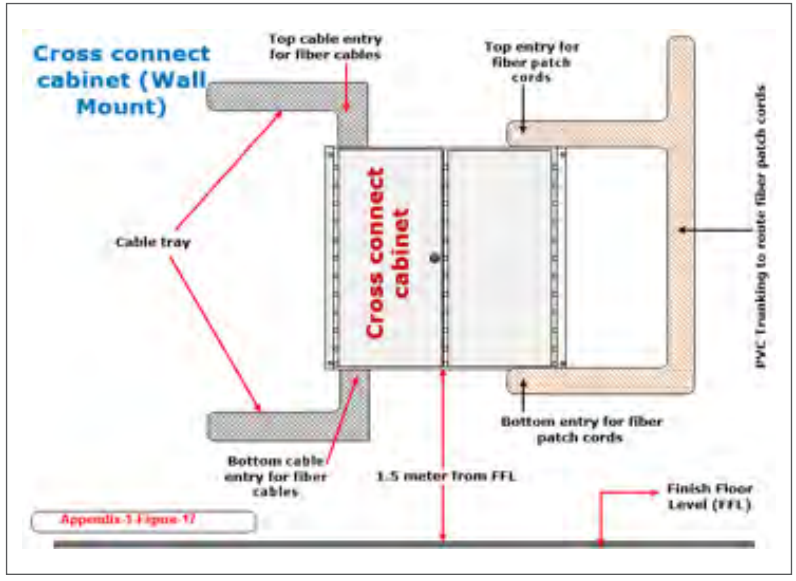
A.1.12 Appendix-1 Figure 15



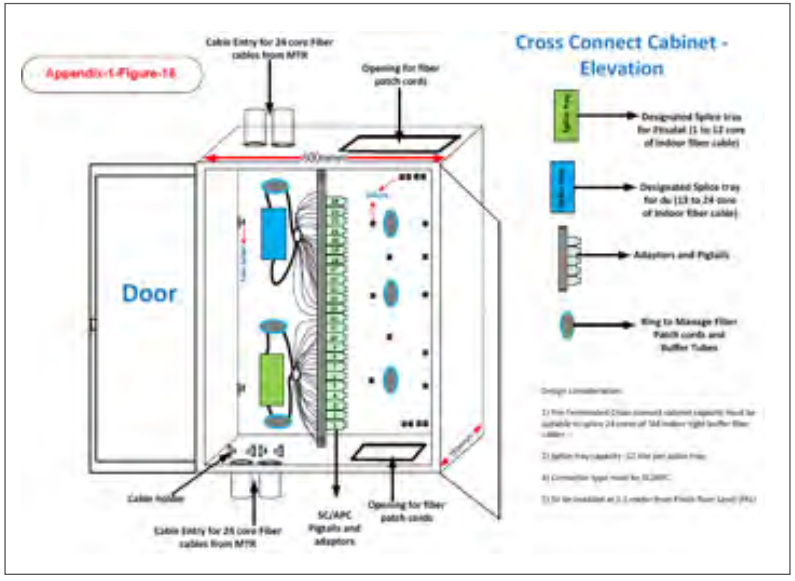
A.1.13 Appendix-1 Figure 16



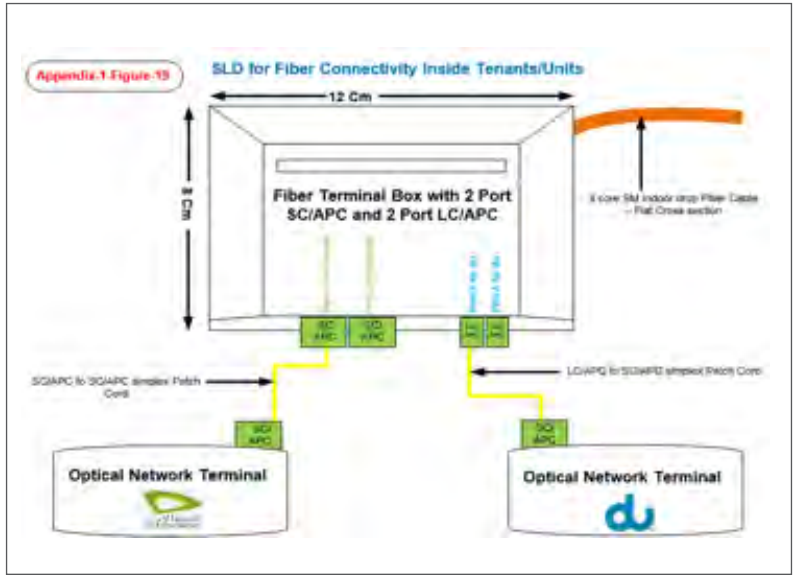
A.1.14 Appendix-1 Figure 17



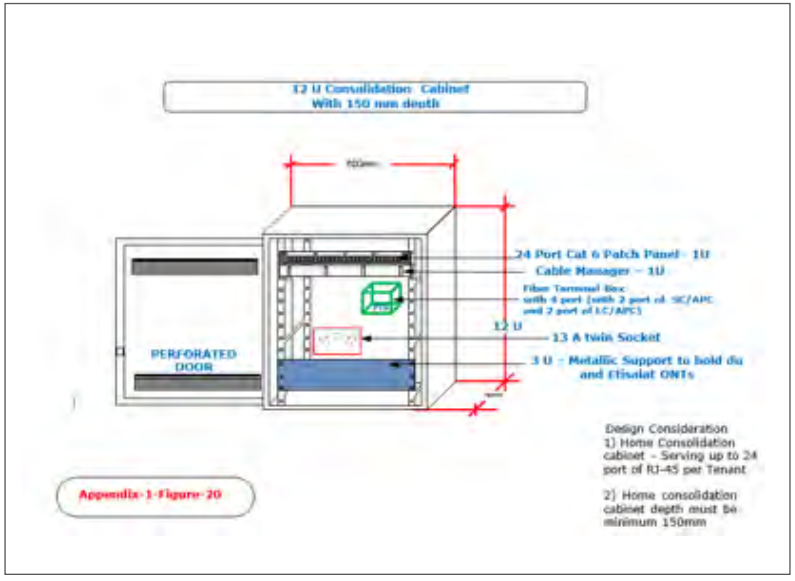
A.1.15 Appendix-1 Figure 18



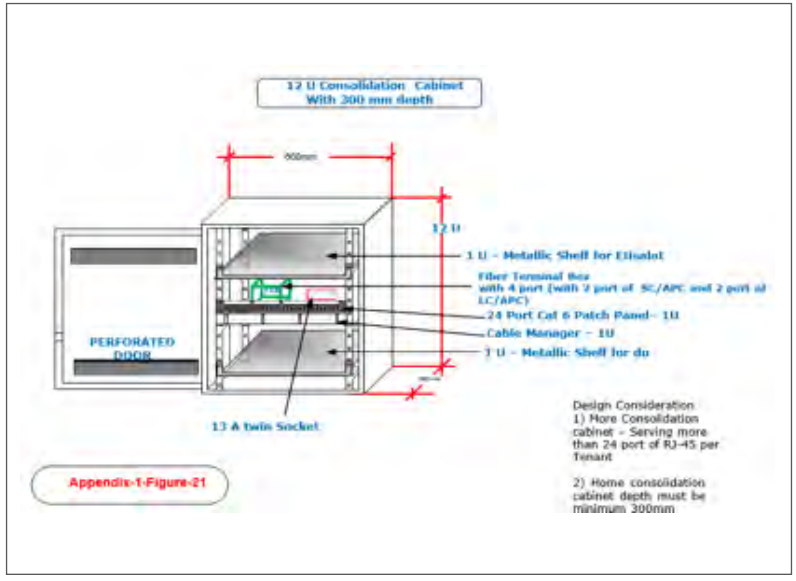
A.1.16 Appendix-1 Figure 19



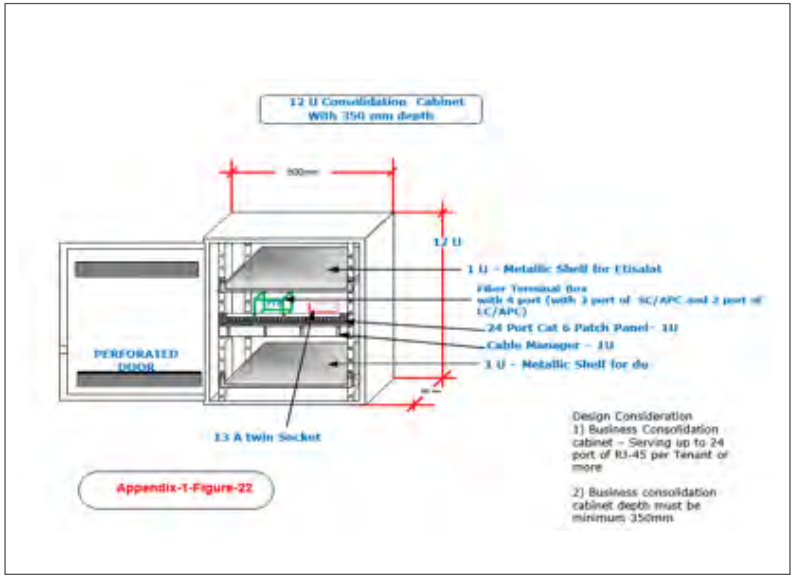
A.1.17 Appendix-1 Figure 20



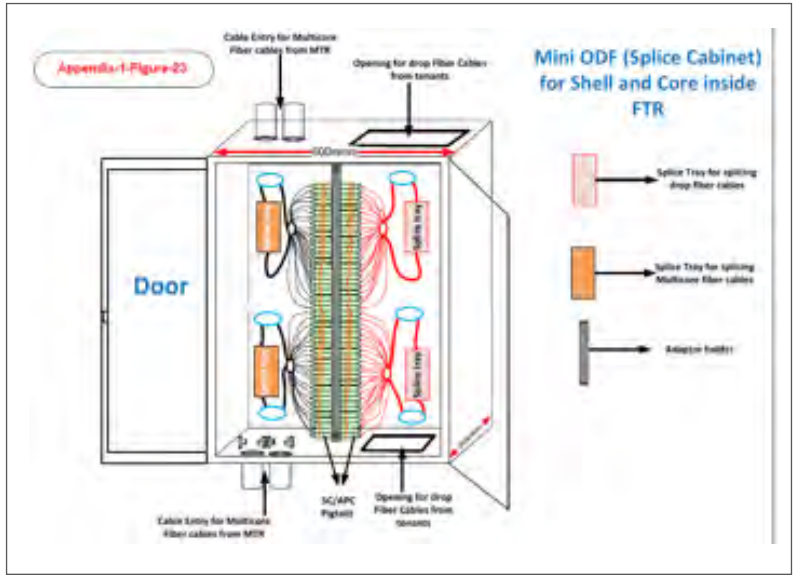
A.1.18 Appendix-1 Figure 21



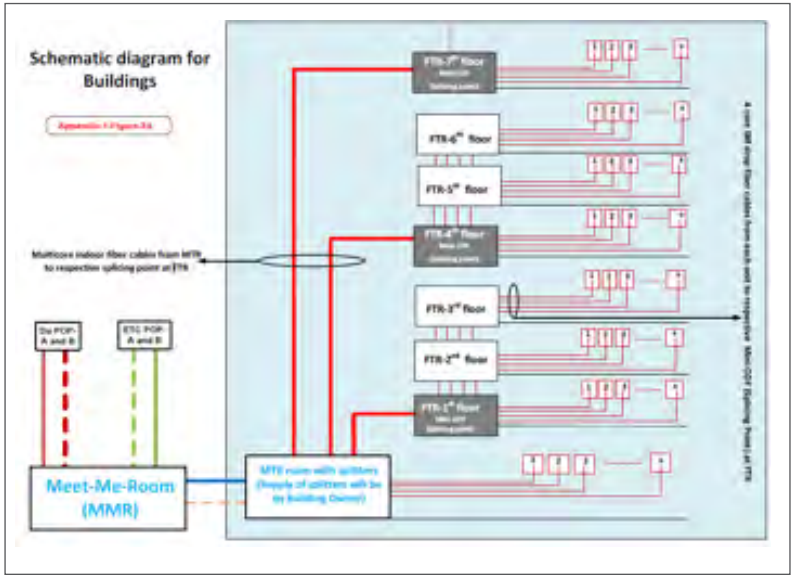
A.1.19 Appendix-1 Figure 22



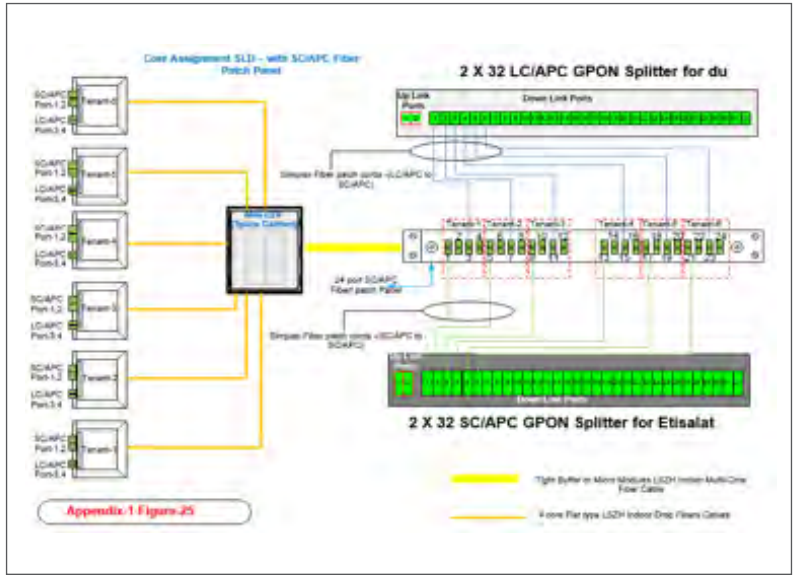
A.1.20 Appendix-1 Figure 23



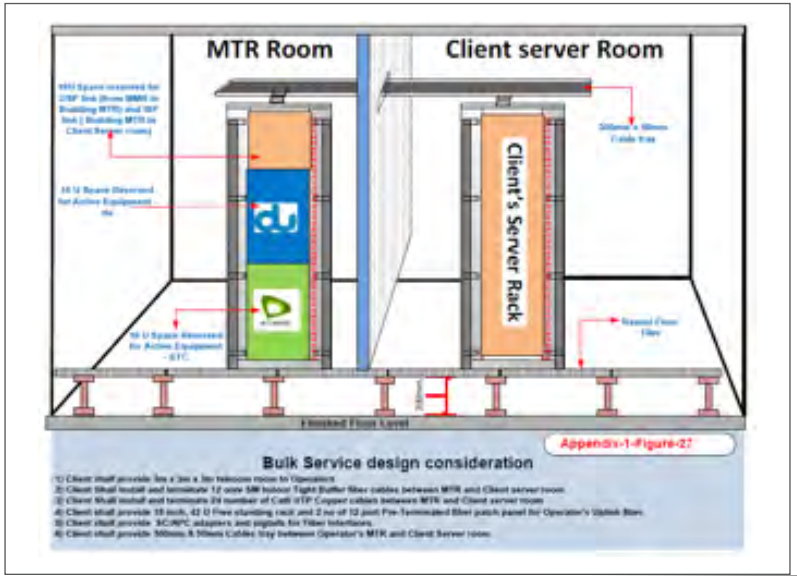
A.1.21 Appendix-1 Figure 24

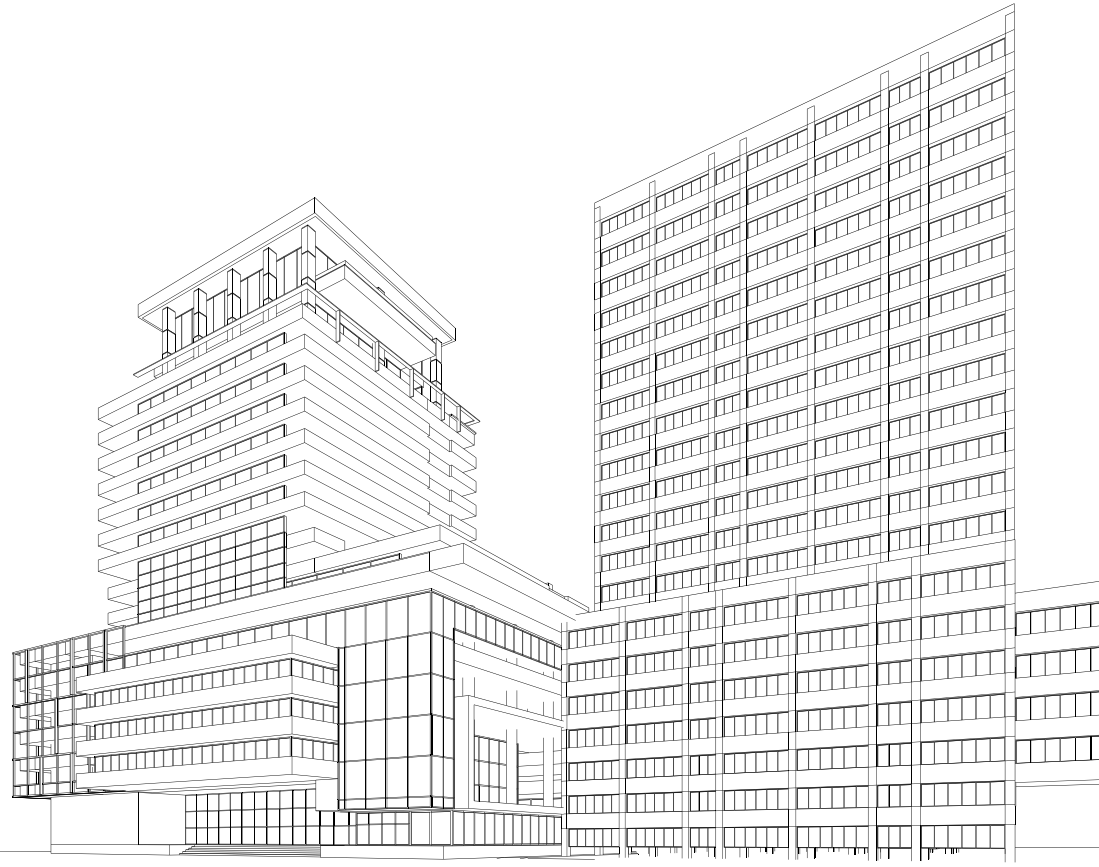


A.1.22 Appendix-1 Figure 25



A.1.23 Appendix-1 Figure 26





Appendix-2-Table-2 - Main Telecom Room Sizes-For Fixed Services

Number of Tenants per building	Number of Fiber core Per Building (Dedicate 2 core Fiber to each Operator)	Fiber Patch Panel (Port Capacity Planning)	Number of Splitter Per Buildings (Provide equal number splitters to each Operator)	Rack/ODF Size	MTR minimum Size in Meter (L X B X H)
Up to 150 Tenants	Number of Tenants X 4 core	Total Number of Fiber core Per Building /24 port SC/APC Fiber Patch Panel	[Number of Tenants / 30 Output ports of Splitter] X 2 times	Free Standing Rack 42 U 800mm (W) X 800mm (D)	3m x 3m X 3m
Up to 300 Tenants	Number of Tenants X 4 core	Total Number of Fiber core Per Building /144 port SC/APC Fiber Patch Panel	[Number of Tenants / 30 Output ports of Splitter] X 2 times	Floor Mount Optical Distribution Frame (ODF) 47U 900mm (W) X 450mm (D)	3m x 3m X 3m
Up to 600 Tenants	Number of Tenants X 4 core	Total Number of Fiber core Per Building /144 port SC/APC Fiber Patch Panel	[Number of Tenants / 30 Output ports of Splitter] X 2 times	Floor Mount Optical Distribution Frame (ODF) 47U 900mm (W) X 450mm (D)	4m x 3m X 3m
Up to 1200 Tenants	Number of Tenants X 4 core	Total Number of Fiber core Per Building /144 port SC/APC Fiber Patch Panel	[Number of Tenants / 30 Output ports of Splitter] X 2 times	Floor Mount Optical Distribution Frame (ODF) 47U 900mm (W) X 450mm (D)	4.5m x 3m X 3m
More than 1200 Tenants	Number of Tenants X 4 core	Total Number of Fiber core Per Building /288 port SC/APC Fiber Patch Panel	[Number of Tenants / 30 Output ports of Splitter] X 2 times	Will be Advised at NOC Stage	Will be Advised at NOC Stage

A.2.2 Appendix-2 Table 3

Fiber Core Assignment for Building Fiber Cable Termination By Using 19" 1U - 24 Port SC/APC Optical Patch Panel							
Apartment/Office/Retail		Horizontal Distribution	Vertical Distribution		Building MTR		
Tenant Number	4 Port Fiber Terminal Box with 2 LC/APC and 2 SC/APC	4 core Indoor SM Drop Fiber Cables	Wall Mount Splice Cabinet with 24 Fiber Splice Tray Capacity	24 Core Indoor SM Multicore Fiber Cable - Micro Module/ Flexi Tube	24 Port SC/APC Optical Patch Panel	Etisalat - 2 x 32 SC/APC GPON Splitter	du - 2 x 32 LC/APC GPON Splitter
Tenant - 1	Port-1 - SC/APC - Etisalat	Blue - Core - 1	Splice Tray - 1	Blue - Core - 1	SC/APC-Port-1	ETC -Splitter Downlink Port-1	
	Port-2 - SC/APC - Etisalat	Orange - Core - 2	Splice Tray - 1	Orange - Core - 2	SC/APC-Port-2		
	Port-3 - LC/APC - du	Green - Core - 3	Splice Tray - 1	Green - Core - 3	SC/APC-Port-3		du -Splitter Downlink Port-1
	Port-4 - LC/APC - du	Brown - Core - 4	Splice Tray - 1	Brown - Core - 4	SC/APC-Port-4		
Tenant - 2	Port-1 - SC/APC - Etisalat	Blue - Core - 1	Splice Tray - 1	Slate - Core - 5	SC/APC-Port-5	ETC -Splitter Downlink Port-2	
	Port-2 - SC/APC - Etisalat	Orange - Core - 2	Splice Tray - 1	White - Core - 6	SC/APC-Port-6		
	Port-3 - LC/APC - du	Green - Core - 3	Splice Tray - 1	Red - Core - 7	SC/APC-Port-7		du -Splitter Downlink Port-2
	Port-4 - LC/APC - du	Brown - Core - 4	Splice Tray - 1	Black - Core - 8	SC/APC-Port-8		
Tenant - 3	Port-1 - SC/APC - Etisalat	Blue - Core - 1	Splice Tray - 1	Yellow - Core - 9	SC/APC-Port-9	ETC -Splitter Downlink Port-3	
	Port-2 - SC/APC - Etisalat	Orange - Core - 2	Splice Tray - 1	Purple - Core - 10	SC/APC-Port-10		
	Port-3 - LC/APC - du	Green - Core - 3	Splice Tray - 1	Pink - Core - 11	SC/APC-Port-11		du -Splitter Downlink Port-3
	Port-4 - LC/APC - du	Brown - Core - 4	Splice Tray - 1	Aqua - Core - 12	SC/APC-Port-12		
Tenant - 4	Port-1 - SC/APC - Etisalat	Blue - Core - 1	Splice Tray - 1	Blue/Black Stripe - Core - 13	SC/APC-Port-13	ETC -Splitter Downlink Port-4	
	Port-2 - SC/APC - Etisalat	Orange - Core - 2	Splice Tray - 1	Orange/Black Stripe - Core - 14	SC/APC-Port-14		
	Port-3 - LC/APC - du	Green - Core - 3	Splice Tray - 1	Green/Black Stripe - Core - 15	SC/APC-Port-15		du -Splitter Downlink Port-4
	Port-4 - LC/APC - du	Brown - Core - 4	Splice Tray - 1	Brown/Black Stripe - Core - 16	SC/APC-Port-16		
Tenant - 5	Port-1 - SC/APC - Etisalat	Blue - Core - 1	Splice Tray - 1	Slate/Black Stripe - Core - 17	SC/APC-Port-17	ETC -Splitter Downlink Port-5	
	Port-2 - SC/APC - Etisalat	Orange - Core - 2	Splice Tray - 1	White/Black Stripe - Core - 18	SC/APC-Port-18		
	Port-3 - LC/APC - du	Green - Core - 3	Splice Tray - 1	Red/Black Stripe - Core - 19	SC/APC-Port-19		du -Splitter Downlink Port-5
	Port-4 - LC/APC - du	Brown - Core - 4	Splice Tray - 1	Black/Yellow Stripe - Core - 20	SC/APC-Port-20		
Tenant - 6	Port-1 - SC/APC - Etisalat	Blue - Core - 1	Splice Tray - 1	Yellow/Black Stripe - Core - 21	SC/APC-Port-21	ETC -Splitter Downlink Port-6	
	Port-2 - SC/APC - Etisalat	Orange - Core - 2	Splice Tray - 1	Purple/Black Stripe - Core - 22	SC/APC-Port-22		
	Port-3 - LC/APC - du	Green - Core - 3	Splice Tray - 1	Pink/Black Stripe - Core - 23	SC/APC-Port-23		du -Splitter Downlink Port-6
	Port-4 - LC/APC - du	Brown - Core - 4	Splice Tray - 1	Aqua/Black Stripe - Core - 24	SC/APC-Port-24		

A.2.3 Appendix-2 Table 4

Appendix-2-Table-4- Telecom Room Sizes-For Mobile Services (IBS)

Number of Floors	Mobile service room Sizes in Meter (L X B X H)	Roof-Top room Sizes in Meter (L X B X H)
Up to G+10	Not Applicable	3m x 3m x 3m
G+11 to G+100	3m x 3m x 3m (Every 10 floors starting from the basement level /Ground floor)	3m x 3m x 3m
Shopping malls and Bulk services buildings	Will be Advised at NOC Stage	Will be Advised at NOC Stage
Cluster of buildings with each having more than G+5 floors	Will be Advised at NOC Stage	Will be Advised at NOC Stage

A.3 Appendix-3 - du and ETC Telecom room label

Telecom Room

A.4 Appendix-4 - Wiring Plan

Appendix-4- Connectivity Wiring detail																			
Project Name:																			
Meet-Me- Room				Main Telecom Room (MTR)									Floor Telecom Room			Tenant/Unit				Notes
Fiber Termination				Splitter Uplink			Splitter			Splitter downlink			Splicing Point			Fiber Terminal Box (FTB)				
Room No	ODF No	Fiber patch panel no	Fiber patch panel Port no	Uplink Fiber patch panel Rack no	Uplink Fiber patch panel no	Uplink Fiber patch panel Por no	Splitter Rack No	Splitter No.	Splitt er Port No	Fiber Patch Panel Rack No	Fiber Patch Panel No	Fiber Patch Panel Port No	Floor Number of Mini ODF	Mini ODF No	Splice Tray Number of Mini ODF	Floor No	Flat no	FTB Port No	0perator Assignment Name	

A.6 Appendix-6 - Summary Table ISP Specification

S. No	Infrastructure Components Name	Single Villa	Complex of Villa	Building with up to 150Tenant	Building with up to 300Tenant	Building with up to 600 Tenant	Building with up to 1200Tenant	ShoppingMall	Bulk ServiceBuildings – Hotels, Palaces and Hospitals	Group of Warehouses andFactories
1	Entry Box	600mmX600mmX800mm	JRC 12 for every 12 Villas + JRC 12 for plot Entry600mmX600mmX800mm per Villa	JRC12 for main route + JRC12 for redundant route	JRC12 for main route + JRC12 for redundant route	JRC12 for main route + JRC12 for redundant route	JRC12 for main route + JRC12 for redundant route	JRC12 for main route + JRC12 for redundant route	JRC12 for main route + JRC12 for redundant route	JRC 12 for every 12 warehouses + JRC 12 for plot Entry600mm x600mm X800mm(L X Bx D)per Warehouse
2	Entry duct	2X50mm	2 xD56 (50mm) per Villa2xD54(100mm) for plot Entry	2x100mm primary route2x100mm secondary route	2x100mm primary route2x100mm secondary route	2 XD54(100mm) Primary Route and2 XD54(100mm) Secondary Route	2 XD54(100mm) Primary Route and2 XD54(100mm) Secondary Route	2XD54(100m m) Primary Route and2XD54(100m m) Secondary Route	2 XD54(100mm) Primary Route and2 XD54(100mm) Secondary Route	2x50mm per warehouse2x100mm primary plot entry2x100mm secondary plot entry
3	Main Telecom Room	Not applicable	Not applicable	3m X 3m X 3m	3m X 3m X 3m	4m X 3m X 3m	4.5m X 3m X 3m	4.5m X 3m X3m (final room size to be discussed during design NOC stage)	3m X 3m X 3m	Not applicable
4	Rooftop Mobile Service Room	Not applicable	Not applicable	3mx3mx3m (Considering G+10 floors or Less)	3mx3mx3m (Considering G+10 floors or More)	3mx3mx3m (Considering G+10 floors or More)	To be determined during design NOC stage	To be determined during design NOC stage	To be determined during design NOC stage	Not applicable
5	Mobile Service Room	Not applicable	Not applicable	Not applicable	3mx3mx3m every10 floors starting from the lowest Basement/Ground floor (Considering G+10 floors or More)	3mx3mx3m every10 floors starting from the lowest Basement/Ground floor (Considering G+10 floors or More)	To be determined during design NOC stage	To be determined during design NOC stage	To be determined during design NOC stage	Not applicable
6	Floor Telecom Space	Not applicable	Not applicable	2m X 2m X 3m	2m X 2m X 3m	2m X 2m X 3m	2m X 2m X 3m	To be determined during design NOC stage	To be determined during design NOC stage	Not applicable
7	Riser Cable Containment Main Risers	2 no of 50mm conduit	2 no of 50mm conduit	1 no of 450mm X50mm Cable tray for Fixed Services and 1 no of300mm X 50mm	1 no of 450mm X50mm Cable tray for Fixed Services and 1 no of300mm X 50mm	1 no of 450mm X50mm Cable tray for Fixed Services and1 no of 300mm X 50mm Cable tray forIBS (GSM)	1 no of 450mm X50mm Cable tray for Fixed Services and 1 no of300mm X 50mm	1 no of450mm X50mm Cable tray for Fixed Services and1 no of	To be determined during design NOC stage	2 no of 50mm conduit

				Cable tray for IBS(GSM)	Cable tray for IBS(GSM)		Cable tray for IBS(GSM)	300mm X50mm Cable tray for IBS (GSM)		
8	Horizontal Cable tray (Floor corridor)	Not applicable	Not applicable	200mm X 50mm Cable Tray for Fixed Services and 150 mm X50mm for IBS (GSM)	200mm X 50mm Cable Tray for Fixed Services and 150 mm X50mm for IBS (GSM)	200mm X 50mm Cable Tray for Fixed Servicesand 150 mm X50mm for IBS (GSM)	200mm X 50mm Cable Tray for Fixed Services and 150 mm X50mm for IBS (GSM)	200mm X50mm Cable Tray for Fixed Servicesand 150 mm X 50mm for IBS (GSM)	To be determined during design NOC stage	Not applicable
9	Consolidation Point (Cabinet)	12U (H) X600mm (W) X150mm(D)	12U (H) X600mm (W) X 150mm(D)	For residential12U (H) X600mm (W) X150mm(D) for up to 24 Cat6 Cables For residential12U (H) X600mm (W) X300mm(D) for above 24 Cat6CablesFor Commercial12U (H) X600mm (W) X350mm(D)	For residential12U (H) X600mm (W) X150mm(D) for up to 24 Cat6 Cables For residential12U (H) X600mm (W) X300mm(D) for above 24 Cat6CablesFor Commercial12U (H) X600mm (W) X350mm(D)	For residential 12U (H) X600mm (W) X150mm(D) for up to24 Cat6 Cables For residential 12U (H) X600mm (W) X300mm(D) for above24 Cat6 Cables For Commercial12U (H) X600mm (W) X350mm(D)	For residential12U (H) X600mm (W) X150mm(D) for up to 24 Cat6 Cables For residential12U (H) X600mm (W) X300mm(D) for above 24 Cat6CablesFor Commercial12U (H) X600mm (W) X350mm(D)	For Retail12U (H) X600mm (W) X 300mm(D)	Not applicable	12U (H) X600mm (W) X 150mm(D)
10	Optical Distribution Frame (ODF)	Not applicable	Not applicable	Free-standing 42U Rack	Optical Distribution Frame (ODF)	Optical Distribution Frame (ODF)	Optical Distribution Frame (ODF)	Optical Distribution Frame (ODF)	Free-standing 42U Rack	Not applicable
11	Fiber Network Architecture	Not applicable	Not applicable	Multicore fiber cable+Splice point on every three floor +Indoor drop cables	Multicore fiber cable+Splice point on every three floor +Indoor drop cables	Multicore fiber cable+Splice point on every three floor + Indoor drop cables	Multicore fiber cable +Splice point on every three floor +Indoor drop cables	Multicore fiber cable+Splice point on every three floor + Indoor drop cables	Direct Multicore fiber cable between MTR and Client server room	Not applicable
12	Fiber drop cable	4 core SM Outdoor drop Cable from drop enclosure	4 core SM Outdoor drop Cable from drop enclosure	4 core SM Indoor drop Cable – 2 core for du and 2 core for Etisalat	4 core SM Indoor drop Cable – 2 core for du and 2 core for Etisalat	4 core SM Indoor drop Cable – 2 core for du and 2 core for Etisalat	4 core SM Indoor drop Cable – 2 core for du and 2 core for Etisalat	4 core SM Indoor drop Cable – 2 core for du and 2 core for Etisalat	Not applicable	4 core SM Outdoor drop Cable from drop enclosure

A.7 Appendix-7 - MMR Specifications

The specifications are provided within a separate document.