Communications Regulatory Authority State of Qatar

هيئة تنظيم الاتصالات دولة قطر

Public Consultation – Framework for Infrastructure Development and Sharing

June 2024

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1. Instructions for Responding to the Consultation

1.1. Introduction

1.1.1. Context

The Government of Qatar delineated its overall development goals in the "Qatar National Vision 2030" and cascaded these goals in its National Development Strategies, highlighting the transformative role the ICT sector needs to play in the future of the country. The CRA is one of the key stakeholders driving the sector's development guided by the country's vision. It regulates the ICT sector and supports its competitiveness, with the aim of enabling access to advanced, innovative, and reliable services and balancing the rights of consumers with the objectives of service providers.

Within this context, the CRA Strategy 2020-2024 was designed to fulfil CRA's mandate and to support the vision and underlying strategies by building the foundations for a knowledge-based economy through the ICT sector. The CRA Strategy highlights the need to develop comprehensive sector performance measurements and includes, in its list of initiatives, the review of the framework for infrastructure development and sharing.

1.1.2. Framework for infrastructure development and sharing

Although there is an existing regulatory framework, there are areas of improvement to effectively facilitate the development and sharing of telecommunications infrastructure. Therefore, the CRA acknowledges the necessity for an update to address the evolving landscape of the industry.

These draft documents presented for public consultation aim to provide clearer guidance on the responsibilities and procedures related to the deployment and sharing of infrastructure, with a specific focus on Mobile Sites, In-Building Wiring, and In-Building Solutions. With this in mind, the CRAs have developed two regulatory texts:

- On the one hand, the "Regulation for the Construction, Installation and Sharing of Radio Communications Sites" updates and unifies the previous regulatory texts that governed mobile telecommunications in Qatar, namely "Regulations for the Construction and Installation of Radio Communication Stations ("Sites")", "Construction Procedures and Standards of Cellular Mobile Base Stations and Towers", and "Mobile Site Sharing Instruction".

- On the other hand, the "In-Building Telecommunications Infrastructure Standard" updates the previous "In-Building Wiring Standard", adapting it to present times and including provisions for the design and installation of all required telecommunications infrastructure inside buildings. In addition, the "In-Building Telecommunications Infrastructure Standard" also includes provisions for the design and deployment of the In-Building Solutions (IBS).

The proposed amendments to the previous texts are expected to bring several benefits to the whole industry, including:

- Streamlined infrastructure deployment processes;
- Reduced administrative burdens for stakeholders;
- Enhanced quality and reliability of telecommunications services; and ultimately
- Better access to communication technologies for consumers.

1.1.3. CRA's approach to developing the documents

During the formulation of updated regulatory texts, the CRA has proactively engaged with relevant stakeholders within the telecommunications industry, hosting multilateral workshops[1] involving Service Providers, Real Estate Developers and other Public Authorities[2]. These collaborative sessions have provided a platform for stakeholders to voice their perspectives, concerns, and recommendations, ensuring a comprehensive understanding of the various needs and challenges faced by the sector.

Additionally, the CRA has conducted a thorough review of international best practices, including the European Union, Bahrain, UAE, KSA or Singapore, among others. By leveraging these global insights and experiences, the CRA has gained valuable perspectives on effective strategies and approaches to telecommunications regulation.

Thanks to this inclusive and research-driven approach, the regulatory texts have been developed with a solid foundation and clear objectives, gaining a high level of consensus among stakeholders and ensuring a future-proof framework for telecommunications in Qatar.

This proactive engagement aims to streamline the consultation process and allow stakeholders to focus on critical aspects for successful implementation and functioning of the regulations, fostering a more efficient and collaborative regulatory environment.

[1] Specific sessions have been celebrated during the months of February and March 2024.
[2] Ministry of Municipality and Ashghal.

1.2. Consultation Questions

Stakeholders and other interested parties are invited to provide justified views and comments related to any aspect of the “In-Building Telecommunications Infrastructure Standard” and “Regulation for the Construction, Installation and Sharing of Radio Communications Sites” attached herein.

In order to gather feedback, CRA would appreciate receiving the stakeholder views as a response to the following specific questions. Stakeholders are expected to provide enough arguments and supporting evidences (e.g., international references) for their feedback. Please note that answers without proper justification may be disregarded by this Authority.

1.2.1. Questions - In-Building Telecommunications Infrastructure Standard

1. Section 5.2.2 outlines the mandatory deployment of Rooftop Telecommunications Rooms (RTRs) for all Multi-Dwelling Units (MDUs). This requirement is based on international practice, particularly in GCC countries. Do you agree with this clause? If you disagree, please provide your views along with international references and proposals.
2. As depicted on Section 5.2.2, the deployment of IBS may require the construction of Mobile Service Telecommunications Rooms (MSTRs). This is necessary when the capacity of shared Telecommunications Rooms is insufficient for the deployment of IBS equipment. Do you agree with the inclusion of MSTRs in the Standard? Should it always be necessary to deploy MSTRs or is it optional when IBS deployment is required in a specific building (refer to Section 5.4)? Could it be an option to merge the MSTR with the Main Telecommunications Room and/or Floor Aggregation Points? If so, what would be the technical specifications of such a room? Please share your thoughts with specific references and proposals.
3. Do you agree with the building aggrupation outlined in Section 5.3? Do you think the buildings should be grouped differently? Please provide your views, along with any references and proposals.
4. As agreed during the workshops, the requirements for deploying IBW and IBS are defined per building type, as outlined in Section 5.4. As indicated in the document, all MDUs and Bulk services must have an IBS deployed. However, for SDUs and compounds of SDUs a requirement study is necessary. This study should consider aspects such as outdoor-to-indoor connectivity, building size, and occupant requirements.

On the basis of the above, do you agree with the matrix proposed in section 5.4? Should any other types of buildings require further study to determine the necessity of an IBS? Please provide your views with references and a proposal.

5. It was agreed during the workshops that ownership and maintenance responsibilities of cabling in existing buildings, where the wiring was deployed by the service providers (SPs), would be transferred to the REDs via commercial agreements. Section 6.2.2 outlines this mandate and indicates a two-year timeframe after the Standard publication to complete the transfer. What are your views on this? Do you agree that the transfer should happen via commercial agreements? Is there anything else you would like to add or remove? Please provide your views, along with references and proposals.

6. As agreed during the workshops, Section 6.3 outlines the guidelines and responsibilities for deploying IBW in the different groups of buildings for both REDs and SPs. Do you agree with these responsibilities? Would you like to suggest any modifications? Please provide your opinions with references and suggestions.

7. Section 6.4 shows a summary of the responsibilities for two groups of buildings: i) SDUs and Compound of SDUs & ii) MDUs and Bulk Services. The responsibilities were agreed upon during the workshops. Please share your views on the assigned responsibilities for each scenario. If you disagree, please provide references and proposals for a new matrix definition.

8. The SPs have developed a process for reviewing the design and construction of both IBW and IBS deployments. What are your views on the processes displayed on Sections 6.7 and 6.8 (IBW) and Sections 7.6 and 7.7 (IBS)? Please provide your opinions with references and suggestions, noting that the original process submitted by the SPs has been amended.

9. Section 7.2 outlines the general requirements and responsibilities of both the REDs and the SPs for deploying IBS. These requirements and responsibilities were discussed and agreed upon during the multilateral workshops. The most important aspects in this regard included in the document are:

    - REDs responsibility for deploying passive elements defined in Section 7.3.2
    - SPs responsibility for deploying active elements defined in Section 7.3.1
    - Coordination process between SPs and REDs (design contractor)
    - Requirement for SPs to deploy the active elements to make the IBS function once the first tenant has occupied the unit.

Please provide your views and proposals, along with supporting references, for each of these points. In your answer you should also consider the definition of passive and active equipment outlined in Section 7.3. Please note that your answer will impact the responsibility matrix displayed in Section 7.4.

1.2.2. Questions - Regulation for the Construction, Installation and Sharing of Radio Communications Sites

1. Do you agree with the compliance distance defined in Section 2.1? Please provide your views, along with any relevant references and proposals.
2. As discussed in the workshops, the mobile permitting process applies to various types of buildings, including Mobile Towers, Wall Mounts, Rooftops, and IBS, among others. Do you agree with the types of sites covered by the regulation? Is there any specific type of site that you think should be included? Please provide your answer with references and proposals.
3. During the workshops, the operators expressed that, currently, they do not have any input into the planning of new sites. This lack of input and coordination between the MM and the SPs is resulting in a higher rejection rate when an SP requests a particular land for deploying a Site.

   To address this issue, and as discussed during the workshops, the CRA has developed a coordination process for planning new developments, outlined in section 5. This process requires the sharing of information from the MM to the CRA (both initial and final land allocation).

   What are your thoughts on this process? Please provide your views on the newly defined process, along with any references and proposals.
4. Do you agree with the CRA acting as the single point of contact between SPs and relevant bodies? If you disagree, please provide your reasoning along with references and proposals.
5. Do you agree with the balance and prioritization of requests proposed in section 7.1.5? If you disagree, please provide your reasoning along with references and proposals.
6. The CRA Sites Management System will enable SPs to apply for permits to install and upgrade Sites. The system will include key features for regulatory compliance and operational efficiency, as outlined in Section 7.2. Do you agree with these features? Are

there any additional features you would like to include? Please provide your response along with references and proposals.

7. During the workshops, one key aspect discussed was the establishment of an end-to-end process for deploying Sites (from Site request to On-air certification). This process is detailed in Sections 7.3 and 7.4, along with the relevant responsible party. It is important to note that not all of the steps outlined in the regulation apply to every type of Site.

   In that sense, do you agree with the steps applicable to each type of Site as defined in section 7.3 and 7.4? If not, please provide your proposal along with references.

8. To streamline the Land Allocation process, the SPs propose that a rejected application should be treated as the same request, rather than a new one. This aspect has been outlined in Section 7.4.3. Do you agree with the provisions in this section? Please provide your answer along with any references and proposals, if applicable.

9. Do you agree with including the provisions related to accelerating the Land Leasing process by seeking solutions with the MM, as set out in section 7.4.4? Please submit your response along with any references and suggestions.

10. Do you agree with the SLAs presented in section 7.5? Would you like to suggest new timeframes? Please provide your response with references and proposals.

11. Annex A has been updated to simplify submission and review. Please provide your views if you disagree with the new proposed forms.

1.3. Instruction for Responses

1.3.1. Consultation Procedures

In keeping with an open and transparent regulatory process, CRA is consulting on the attached drafts. Stakeholders and interested parties are invited to respond to the specific questions raised herein and to provide their views and comments on any aspect/clause/provision of this consultation.

When responding, interested parties are asked to make clear reference to the related clause (paragraph) of the draft documents and/or question number and to provide background, context, supporting information and amendment proposals. Respondents should provide evidence in support of their comments where necessary. Additionally, stakeholders should submit specific proposals on how to amend the text in the regulations to address their

feedback. All this will enable CRA to understand why the submitted opinions are held by the respondent and take better account of the underlying reasoning.

Responses to this consultation (and questions about this consultation) should be submitted by email to: ifa@cra.gov.qa. The subject reference in the email should be stated as **"***Consultation on the Infrastructure Development & Sharing Initiative***"**. It is not necessary to provide a hard copy of the responses.

The deadline to respond to this consultation is **June 13th, 2024**.

All submissions received in response to this consultation will be carefully considered by CRA. However, it should be noted that nothing included in the draft guidelines is final or binding, and CRA is under no obligation to adopt or implement any comments or proposals submitted.

1.3.2. Consultation Response Template

Responses to this consultation must be in the template format (table) provided below. Responses that are not in this template format may be disregarded.

Respondent: [Name of company, organization, or individual].

Clause or question references	Responses and comments	Proposed amended text in the regulation
[Please specify the number of the question of the consultation document or the number of the clause/paragraph of the proposed regulation]	[Please provide your responses and comments in relation to the question or clause/paragraph mentioned in the first column. Rationale, justification and evidence should be also provided.]	[Please provide your amendment proposal]
…	…	
…	…	

1.3.3. Publication of Comments

In the interests of transparency and accountability, CRA may publish the responses to this consultation on its website www.cra.gov.qa. All responses will be processed and treated as non-confidential unless confidential treatment has been requested by the respondents.

In order to claim confidentiality of information in submissions, respondents must provide a non-confidential version of such material in which all information considered confidential has been redacted and replaced with "[CONFIDENTIAL]" or "[CONFIDENTIAL INFORMATION]".

A comprehensive justification must be provided for each section of a response that respondents wish to be treated as confidential. Furthermore, respondents cannot request confidentiality for the entire response or whole sections of the response.

While CRA will endeavor to respect the wishes of respondents, in all instances the decision to publish responses (in full or in part) will be at the sole discretion of CRA.

By responding to this consultation, respondents will be deemed to have waived all copyright and/or intellectual property rights over the material provided. For more clarification concerning the consultation process, please contact us on ifa@cra.gov.qa or Technical department ta@cra.gov.qa.

Annex A. Regulation for the Construction, Installation and Sharing of Radio Communications Sites

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1. Introduction and background

The CRA has drafted a new text, consolidating three existing regulatory texts ("Regulations for the Construction and Installation of Radio Communication Stations ("Sites")", "Construction Procedures and Standards of Cellular Mobile Base Stations and Towers", and "Mobile Site Sharing Instruction") into a single framework. The aim of this consolidation is to streamline and clarify the existing regime, address any regulatory challenges and practical problems encountered, and ultimately contribute to the promotion of infrastructure development and sharing, innovation, investment, and competition.

Upon publication, this new Regulation will replace the three above-mentioned existing texts through a single, and more efficient, set of rules. Stakeholders are encouraged to familiarize themselves with these changes, as they will have a substantial impact on the future of the mobile telecommunications sector.

2. General provisions

2.1. Definitions

Unless stated otherwise in this Regulation, the words and expressions used herein shall have the meaning set forth in the Telecommunications Law, the Executive By-Law for the Telecommunications Law, the Regulations issued pursuant to the Telecommunications Law, and the Fixed and Mobile Network Services Licenses issued to SPs.

The terms below have the corresponding meanings:

3GPP technologies	Technologies based on existing/developing/future 3GPP standards.
Antenna	A device or mechanism made of metallic material, which absorbs or emits electromagnetic waves.
Applicable Fees	Any fees imposed by the relevant Government Entities when provisioning and approving the utilizations of Government Land, and for the issuance of a Permit for the construction and Installation of Sites.
Beautification Principles	The principles detailed in Article 10.7.
Building owner	The owner of the building/development.
Communications Regulatory Authority (or "CRA")	The ICT and Post regulator of the State of Qatar established by virtue of Emiri Decree (42) of 2014.
Compliance Distance	The general minimum distance required between Sites, excluding indoor Sites. The Compliance Distance is: ▶ Within 600 meters between two (2) Sites; ▶ Minimum 200 meters from educational institutions and health facilities; and ▶ Minimum 7 to 120 meters' distance from a High Voltage electrical power transmission line. More details about the distance between Sites and exceptional cases is described in Articles 8.5 and 10.
Decommission	The removal of a Site from service.
Electromagnetic Field (EMF)	A force field or fields generated around the Site because of the passage and movement of electric charges. EMF consists of both an electric and a magnetic field (electromagnetic radiations).

Exposure	The subjection of a person to electric, magnetic, or electromagnetic fields other than those originating from physiological processes in the body and other natural phenomena.
Exposure Limit	The limit of exposure defined by ICNIRP for the protection of human being from EMF.
Frequency	The number of electromagnetic wave oscillations per second. It determines the wave's properties and usage. Frequencies are measured in Hertz (Hz).
Government Entity	Any government institution, department and/or function, apart from the CRA, whose approval needs to be secured in relation to the use of Government Land and/or the authorization of the construction and installation of a Site on private or Government Land, either before submitting a request to the CRA for the construction and/or installation of a Site, or during the process. This also includes Civil Aviation, Security and Military Authorities, as the case may be.
Government Land	Any land owned by the State of Qatar.
Guyed Mast	Any type of Mast using wire guys connecting the above-grade portions of the Mast diagonally with the ground or the structure on which the Mast is placed.
Host	In relation to a Site or Sites, the SP who has control over that Site or Sites.
IBS	A dedicated tailored system, designed to provide mobiles services inside a building only that is intended to bring enhanced and seamless mobile communications services indoors and throughout a particular building or venue.
ICNIRP	International Commission on Non-Ionizing Radiation Protection (ICNIRP), an independent scientific body in charge of producing a recognized international set of regulations for public exposure to radio frequency waves.
Lattice Mast	A mobile tower consisting of a network of vertical and horizontal supports and crossed metal braces, forming a Mast, which is usually triangular or square in cross-section.
Service Provider (SP)	A licensed mobile telecommunications service provider in the State of Qatar.
Mast	Any wireless communication support structure, whether ground-based or deployed on any vertical or nearly vertical surface, or on rooftops.
Mobile Tower	A self-supporting or guyed structure constructed from steel lattice, monopole tubular steel, reinforced concrete or other composite material, built to support one or more antennas designed to transmit or receive digital, microwave, cellular or similar forms of wireless electronic communication.
Monopole	A Mast consisting of a single pole to support antennas and connecting appurtenances.

No Objection Certificate (NOC)	A legal document that serves as a declaration that the issuer has no reservations or legal constraints in carrying out the actions proposed by the recipient of the certificate
Non-ionizing Radiations	Any type of electromagnetic radiation that does not carry enough energy to ionize living material.
Permanent Site	A Site built on a permanent foundation, connected to a direct source of electricity supply from Qatar General Electricity and Water Corporation (Kahramaa), and which is in service and provides a permanent network and wireless coverage. A Permanent Site may be a: ▶ Mobile Tower (e.g., Guyed Mast, Lattice Mast or Monopole); ▶ Wall Mounted structure; ▶ Rooftop Mast; ▶ IBS system (e.g., indoor Small Cells or Distributed Antennas System – DAS); or ▶ Outdoor Small Cell Site
Permit	Authorization given to a Service Provider to use Government Land and/or to construct and install a Site on private or Government Land.
Power Density; Power Flux-Density (S)	Power per unit area, perpendicular to the direction of the electromagnetic wave propagation, usually expressed in units of Watts per square meter (W/m^2). In this Regulation, this term shall be mainly used as equivalent plane wave power density, which is true in the far-field region. NOTE – For plane waves, power flux-density, electric field strength (E) and magnetic field strength (H) are related by the intrinsic impedance of free space, $Z_0 = 120\pi\Omega$. In particular $$S_{eq} = \frac{E^2}{Z_0} = Z_0 H^2 = EH$$ Where E and H are expressed in units of V/m and A/m, respectively, and S in units of W/m^2. Although many survey instruments indicate power density units, the actual quantities measured are E or H.
Radio Communications Sites	One or more transmitters or receivers, including the accessory equipment, necessary at one location for carrying on a radio communications service.
Rooftop Mast	A Mast, which is a) attached or affixed to a structure that is not specifically constructed for the purpose of supporting a Mast or an antenna, and b) does not satisfy the definition of Wall Mount.
Service Provider (SP)	A Public Licensed Mobile Services Provider.
Site	The mobile tower structures, antennas, and any component installed in sending and receiving telecommunication signals from a mobile communications source (cell phones) and transmitting those signals to the central server of telecommunications networks.
Site Beautification	A camouflaging technique to improve the aesthetic appearance and reduce the visibility of Sites.

Site Plan	A detailed design for a Site including at least: ▶ The manufacturer's data sheet; ▶ A map with geo-location; ▶ Site sharing details; ▶ A detailed coverage plan; ▶ The radio-communications structure and design in the subjected area; ▶ A technical report indicating compliance requirements with ICNIRP; ▶ The weight, dimensions, wind resistance, and electrical loading parameters; ▶ a description of the planned radio apparatus; and Any other relevant technical details.
Small Cell Site	A low-powered cellular independent base station, deployed inside (included in IBS) or outside a building.
Telecommunications Equipment	Passive or active equipment used to provide cellular mobile services, including transmission devices, outside receivers for wireless devices, and transmitting antennas.
Telecommunications Law	Decree Law No. 34 of 2006 on the promulgation of the Telecommunications Law, as amended.
Temporary Site	A Site designed as a temporary part of a cellular mobile network for providing temporary coverage.
Wall Mount	A mast or antenna designed to securely attach to a vertical surface, such as a wall or a building exterior, for the purpose of supporting an antenna or similar equipment. This may include, for example, the exterior walls of a building, an existing parapet, the side of a water tank, or the side of a freestanding sign.
Working Day	Refers to any day other than a Friday, Saturday, or a public holiday in the State of Qatar.

Table 2.1: List of definitions

2.2. Objectives and purpose of the Regulation

This Regulation sets out the requirements, processes and procedures to be followed for the construction, installation and sharing of Sites.

The Regulation aims at achieving, among other, the following objectives:

a) Define a regulatory framework for the planning, design, installation and upgrading of Sites;

b) Establish a standard process for the construction and installation of Sites;

c) Set forth transparent processes to manage the selection of the locations for the installation and the preferred types of designs for Sites;

d) Facilitate the identification of the types of permits and certificates to be granted by Government Entities for the installation and upgrading of the various types of Sites;

e) Facilitate the construction and installation of Sites necessary for consumers to have access to high quality mobile services in the country;

f) Ensure compliance with the relevant Exposure Limits to protect the environment, and the health and safety of the public;

g) Limit the unnecessary replication of Sites, by encouraging their shared usage amongst SPs; and

h) Preserve the environment and landscape of Qatar, as well as address the concerns of its population, in planning Sites' locations.

2.3. Scope and application

The Regulation applies to SPs when:

a) Planning, designing, constructing, and installing Permanent or Temporary Sites.

b) Upgrading or modifying a Site in a way that affects the information provided during the Site's request (see 7.4.1), which includes:

   i. Modifications without a structural or visual impact;

   ii. Structural changes to an existing Site; and

   iii. Any modification to an existing Site that may deviate from ICNIRP Guidelines or any other related health and safety regulation in the State of Qatar.

c) Decommissioning of a Site in the following circumstances:

   i. Impact on health, safety and public welfare;

   ii. Non-compliance with EMF thresholds;

   iii. Change of the purpose of the land use;

   iv. Discontinuation of the lease agreement between the landowner and the SP;

   v. Non-compliance with this Regulation; and/or

   vi. Merging with a neighboring Site from another SP

In cases where Site deployments are intended to be located in or on buildings, building owners must provide equal access to all SPs, in accordance with Articles 3 and 4 of the Passive Civil Infrastructure Access Regulation[3].

[3] Passive Civil Infrastructure Access Regulation.

3. Legal basis

The CRA derives its powers from Decree No. 34 of 2006 issuing the Telecommunications Law (the "Telecommunications Law") and the Executive By-Law No. 1 of 2009 (the "Executive By-Law"). The Emiri Decree No. 42 of 2014 (the "Emiri Decree") also confers on the CRA powers to regulate the sector. The Fixed and Mobile Network Services Licenses issued to SPs further contain provisions that require the SPs to comply with the terms and conditions of their License.

3.1. The Telecommunications Law

Article (20) of the Telecommunications Law requires SPs to negotiate in good faith with a view to reaching agreements to provide reasonable access to telecommunication facilities.

Under Article (53) of the Telecommunications Law, CRA must develop the rules necessary to facilitate access to private and public property for the purposes of installing, operating and maintaining telecommunications facilities according to the provisions of the Telecommunications Law, in coordination with the relevant authorities. This provision thus empowers the CRA to draft such rules through the present document.

Article (54) of the Telecommunications Law further empowers the CRA to define technical standards and specifications for Telecommunication Equipment, and the procedures to be applied to them according to the provisions of the Telecommunications Law and any other relevant laws.

3.2. The Executive By-Law

Article (3) of the Executive By-Law obliges licensees and SPs to comply with all regulations, decisions, orders, rules and notices issued by CRA.

Article (4) of the Telecommunications Bylaw (the "Bylaw") vests the President of the CRA with general powers to issue regulations, decisions and other measures for the implementation of the provisions of the Telecommunications Law and the Executive By-Law.

Article (6) of the Bylaw gives the CRA the power to take measures, actions and decisions, as it deems appropriate, to ensure that Licensees and SPs comply with the provisions of the Law, the Executive By-Law and the provisions of their licenses, or to remedy their breaches.

Article (24.3) of the Executive By-Law provides that CRA shall ensure the use of radio spectrum is consistent with the national frequency assignment plan, related allocations and assignments, any applicable international, treaties, commitments, protocols and standards and Radio Spectrum License conditions, including taking related compliance and enforcement actions.

Article (46) of the Executive By-Law requires the CRA to issue regulations, orders or notices to address issues related to, among other things, the terms, conditions and processes of access to facilities.

Article (47) of the Executive By-Law requires all SPs to negotiate in good faith to reach interconnection and access agreements. If the negotiating parties are unable to reach an agreement within 60 days, the CRA may issue a binding determination.

Pursuant to the requirements stipulated in Article (111) of the Executive By-Law, SPs must comply with all applicable laws and regulations and with all applicable planning and approvals requirements and related processes.

Article (112) of the Executive By-Law requires SPs with existing telecommunications facilities (also including Sites, among other categories of facilities) to allow other SPs to share and co-locate their own telecommunications facilities on those existing facilities, where such sharing and co-location is technically and economically feasible.

3.3. The Emiri Decree

Under Article (4) of the Emiri Decree, the CRA is granted various powers to regulate the sector, by issuing necessary regulations. This includes all the powers necessary to monitor SPs' compliance with the regulatory frameworks and to take any necessary measures to ensure compliance with the regulations issued by the CRA.

The Emiri Decree's Article (17) expressly stipulates that the CRA's mandate includes developing technical standards in relation to interconnection, access, construction of telecommunications infrastructure and telecommunications infrastructure sharing, and monitoring their implementation.

4. Types of sites covered by the regulation

This article outlines the various types of mobile sites that fall under this Regulation, namely:

a) Mobile Towers, including Guyed Mast, Lattice Mast or Monopoles

b) Rooftop Masts

c) Wall Mounts

d) Temporary Sites. A Temporary Site can be deployed for a maximum period of:

   i. Three (3) months for special events, emergency mobile coverage, or Site upgrade; and

   ii. Six (6) months for temporary mobile coverage in new areas, subject to a building permit being issued for a permanent Site within the Six (6) months. The SP can apply for an extension of the Temporary Site in cases where the building permit has not been issued on time with a valid justification.

e) In-Building Solutions (IBS)

f) Outdoor Small Cell Sites

g) Upgrading existing Sites including

   i. Modifications without a structural or visual impact;

   ii. Structural changes to an existing Site; and

   iii. Any modification to an existing Site that may deviate from ICNIRP Guidelines or any other related health and safety regulation in the State of Qatar.

h) Sharing of an existing Site

   Agreements reached by both SPs to share an existing Site.

Categorizing these Sites based on their nature enables effective addressing of the unique challenges and considerations associated with each type. Refer to Article 7.3.2 for further information.

5. Coordination on the planning of new developments

This Section outlines the process for strengthening coordination between the Ministry of Municipality and the CRA in relation to the planning of new developments in the State of Qatar.

The aim of this process is to:

a) Improve coordination and interactions between the CRA, SPs and the Ministry of Municipality in the process of land allocation in new developments.

b) Implement a transparent process as regards the land allocation between SPs, the CRA and the Ministry of Municipality.

c) Optimize the land allocation process, increasing the success rate of the lands requested by the SPs.

For coordination purposes, the planning of new developments goes through the individual steps discussed in the subsections that follow.

5.1. Sharing of Initial Land Subdivision

The Ministry of Municipality shall initiate the process by sharing the preliminary land subdivision through the “Service Coordination System.”

The CRA and all relevant utilities shall be notified to provide comments on the initial subdivision.

The CRA shall share the preliminary land subdivision with the SPs, for their comments and insights.

5.2. Rationalization of Feedback

Upon receipt of feedback from SPs, the CRA shall analyze and rationalize the information received by, for example, consolidating sharable sites to prevent duplication and enhance efficiency.

The rationalized feedback shall be communicated back to the Ministry of Municipality for further action.

5.3. Interactions between stakeholders

If the feedback communicated by CRA to the Ministry of Municipality is not acceptable by the latter (e.g., due to conflicts with other utilities), the Ministry of Municipality shall organize workshops between the affected stakeholders, in order to agree on the final planning structure.

5.4. Adjustment, Finalization and Information Sharing

Upon receiving the CRA's or (as the case may be) the stakeholders' feedback, the Ministry of Municipality shall make necessary adjustments to finalize the land use subdivision.

Upon finalization of the land use subdivision by the Ministry of Municipality, the Ministry shall promptly share the allocation details with the CRA, by sending an official letter to the CRA, delineating the lands reserved for telecommunication use.

This will facilitate efficient communication between the CRA and SPs, enabling the dissemination of information for coordinates and plots of land that are more likely to receive approval from the Ministry of Municipality and other relevant entities involved in the land allocation process.

For further details, refer to Articles 7.4.2 and 7.4.3 of this Regulation.

6. Annual planning of sites construction and upgrade

The SPs shall provide to the CRA on an annual basis:

a) Accurate information regarding Sites they plan to construct or upgrade within the following twelve (12) month period, as per the format set in Appendix D; and

b) Any other information or report requested by the CRA.

The Annual Planning of Sites shall aim at:

a) Increasing coordination and interactions between the CRA, the SPs and the Relevant Bodies in the process of deploying Sites;

b) Optimizing the use of existing Sites by promoting sharing, whenever sharing is the optimal solution pursuant to the provisions set forth in Article 8; and

c) Keeping the number of new deployments of Sites to the minimum necessary to ensure efficient operation and to limit the impact on the surrounding environment.

Based on the information received, the CRA shall review the deployments proposed by each SP, in a period no longer than 4 weeks, to assess opportunities for sharing new or existing Sites.

The CRA and the SPs shall hold quarterly meetings to review the annual planning to seek consensus among the parties, in accordance with the assessment carried out by the CRA.

7. Processes for Site request

7.1. Overview of the new approach for the end-to-end process for building sites

The implementation of a new approach in the end-to-end process for building sites represents a significant milestone in the telecommunications landscape of the State of Qatar, establishing the foundations for a seamless and efficient procedure for the development of mobile Sites.

Several key aspects drive the development of this approach, to ensure its robustness, compliance, and effectiveness in addressing the evolving demands of connectivity within the country. These are described in the following subsections and include:

a) CRA's overview and support throughout the end-to-end process

b) Development of the Sites Management System

c) Transparency towards SPs throughout the whole process

d) Balance and prioritization of requests

e) Timeframe definition

7.1.1. CRA's overview and support throughout the end-to-end process

The CRA shall act as the single point of contact between SPs and Government Entities, streamlining the process of acquiring necessary Permits and certificates for Mobile Site installation and upgrades.

The CRA shall enter into separate memoranda of understanding with the Government Entities concerned for the smooth execution of its single point of contact role and to support adherence to the procedures and standards defined in this Regulation.

As a result, the CRA will facilitate and streamline interactions between SPs and Government Entities, thus supporting compliance with the timeframes set out in Article 7.5.

7.1.2. Development of the Sites Management System

The CRA is considering establishing a digital system which shall allow the SPs to make applications for obtaining Permits and/or certificates for the installation and upgrading of Sites, submit sharing applications and complete other tasks on-line as the CRA sees fit.

Until the system is developed by the CRA, the requests will be handled manually by the CRA.

7.1.3. Transparency towards SPs throughout the whole process

The CRA shall establish a transparent process towards SPs, enabling them to track their requests effectively.

The process will present the following stages, linked to the steps outlined in Article 7.4:

a) Site Requested

b) CRA Preliminary Review

   i. Resubmission or Information Correction (in the case of non-compliant request)

   ii. Rejection (if applicable, including rationale about rejection)

   iii. Request pre-approved

c) Land Allocation Application

   i. Application submitted

   ii. Alternative Solutions/Location Discussion (if applicable)

   iii. Land allocation granted

a) Land Leasing Application

   iv. Land Leasing Requested

   v. Land Leasing Granted

b) Building Permit Application

   i. Building Permit in process

   ii. DC1 (Design Control Phase 1) Completed

   iii. DC2 (Design Control Phase 2) Completed

   iv. Building Completion

   v. Construction Certification

c) On-Air Certification

   i. On-Air Certification on-going

   ii. On-Air Certified

The CRA shall ensure that SPs are notified any time a Site is requested by another SP, thus fostering opportunities for collaborative deployment. The location of the requested Site (i.e., search area) will be shared along with the notification.

7.1.4. Balance and prioritization of requests

The CRA shall establish an algorithm designed to ensure fairness and efficiency in handling requests from multiple SPs.

The algorithm shall integrate round-robin scheduling to manage Site building requests, whereby:

a) There will be one queue for each SP, based on First-In First-Out (FIFO) approach. This means that each SP's requests will be processed sequentially, starting from the earlier one in the queue.

b) CRA will alternate sites from the queue of each operator, ensuring that both operators have the same opportunities for their requests to be processed.

7.1.5. Timeframe definition

The CRA recognizes the essential role of defined timeframes within this regulatory framework. Timeframes are fundamental in ensuring the effectiveness of the Site request review process conducted by the relevant bodies.

Transparency shall be ensured throughout the process, providing SPs with clear and concise expectations on the timeframe for the completion of Site requests.

The CRA also recognizes the importance of co-deployment schemes in connection with the objectives set out in Article 2.2. The CRA is therefore committed to minimizing the Service Level Agreements (SLAs) outlined in Article 7.5 for such schemes.

This commitment is rooted in the collaborative efforts between the CRA and the relevant entities involved in the Site building process, as outlined in Article 7.4.

7.2. Site Management System overview

The CRA's proposed digital system shall be a comprehensive regulatory framework designed to facilitate the permitting process for the installation and upgrading of Mobile Sites.

It shall include several key features essential for regulatory compliance and operational efficiency:

a) Centralized database: The system shall incorporate a central database to collect and store all necessary information related to Service Provider requests, namely:
   i. Site code;
   ii. Site coordinates;
   iii. Date of application; and
   iv. Process current status (refer to Article 7.1.3), among others.

b) Request Management: Collection and organization of Service Provider requests to ensure accuracy and completeness of documentation submission, simplifying the permitting process.

c) Geospatial mapping: Integrated mapping capabilities shall accurately capture Site request locations, supporting regulatory and compliance assessments.

d) Time tracking: The system shall transparently track time spent for each Site in each step, allowing the supervision of compliance with the SLAs in accordance with Article 7.5.

e) Status updates: Real-time visibility of request progress to facilitate effective communication and decision-making.

f) Automated workflows: Automated workflow management to streamline the request process, notifying the CRA and the SPs once a step has been completed, reducing manual tasks.

The system shall also include Sites databases with all relevant information on the active Sites of each Service Provider. The implementation of these databases replaces the SPs' previous obligation of sharing a biannual list of sites. The database shall include the following information:

a) Site Name;

b) Identification Code;

c) Type of Site (Mobile Tower, Rooftop (including type of camouflage if applicable), Cell on Wheel, macro, micro, indoor, outdoor, etc.);

d) Site activation date;

e) Site address with GPS & Qatar coordinates;

f) Operational Networks and Frequencies;

g) Other Technical information (Cell Type, Antenna Height, Antenna Azimuth, Routing Area, etc.)

The database shall be updated by CRA, based on the information of the Sites' requests approved following the process of Article 7.4.

The CRA has the right to ask SPs for any additional information related to the mobile Sites at any point in time, to verify the accuracy of the information provided.

The SPs shall have access to its Site database and shall notify the CRA of any inconsistency/inaccuracy on the Sites' information as soon as it is detected.

7.3. Steps to build a Site

7.3.1. High-level end-to-end steps

The Service Providers or the CRA, as the case may be, in coordination with the relevant Government Entities, shall undertake:

a) Site Request, pursuant to Article 7.4.1 of this Regulation;

b) CRA preliminary review, pursuant to Article 7.4.2 of this Regulation;

c) Land Allocation process, pursuant to Article 7.4.3 of this Regulation;

d) Land Leasing process, pursuant to Article 7.4.4 of this Regulation;

e) Relevant entities approval, pursuant to Article 7.4.5 of this Regulation;

f) Building Permit, pursuant to Article 7.4.6 of this Regulation;

g) Building construction, pursuant to Article 7.4.7 of this Regulation;

h) Building construction certificate, pursuant to Article 7.4.8 of this Regulation; and

i) On-air certification, pursuant to Article 7.4.9 of this Regulation.

The following diagram illustrates the high-level end-to-end steps:

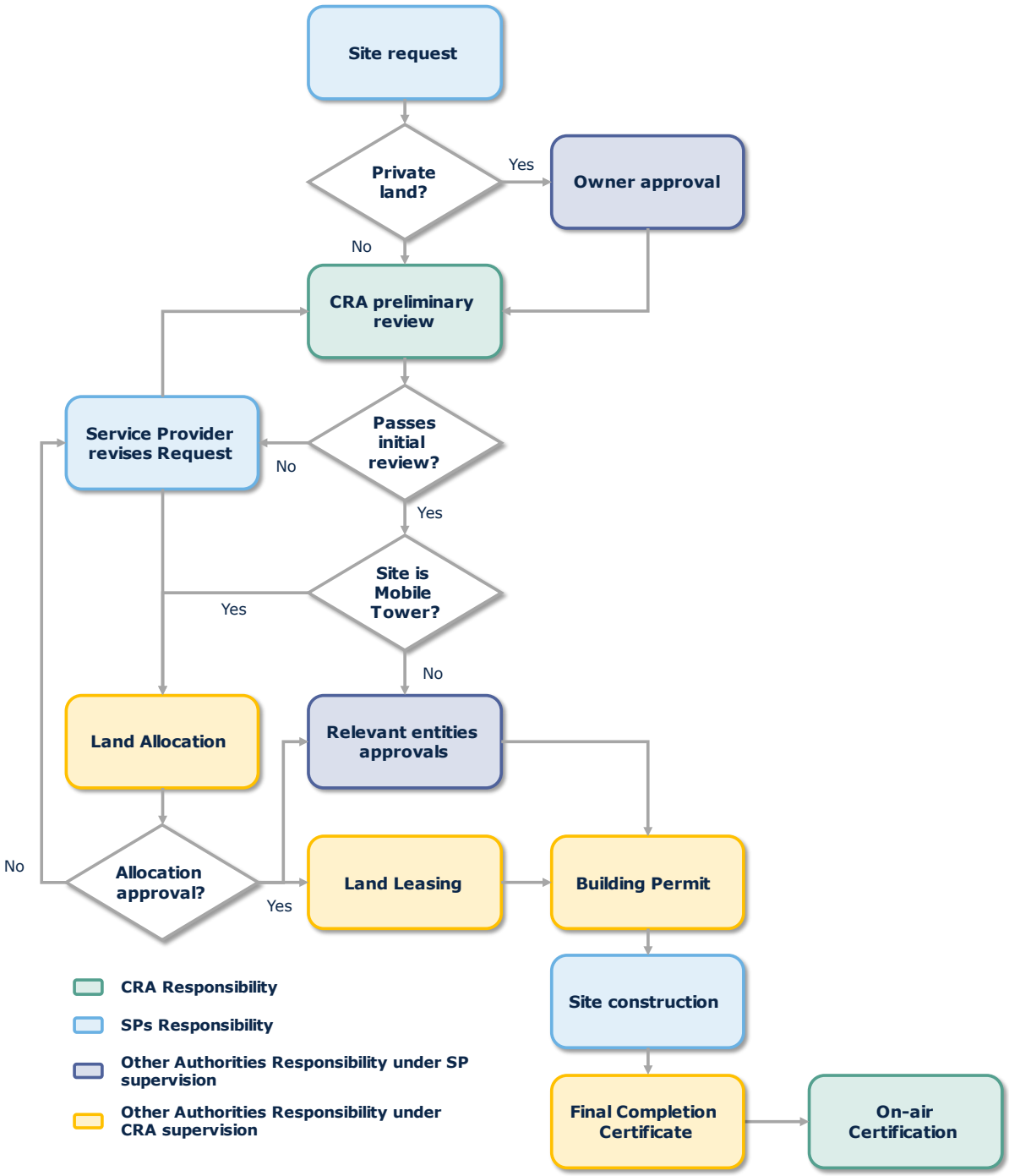

Figure 7.1: End-to-end high level steps

Each of the above steps is described in detail in Article 7.4.

As indicated in the above figure, it is important to note that not all types of Sites require all the steps indicated. Refer to Article 7.3.2 below.

7.3.2. Steps required for each type of Site

The Sites covered by this Regulation vary in nature and hence in terms of requirements (location or transience, among others). As such, each type of Site does not require the same steps to be installed and deployed, as illustrated below:

Type of mobile Site	CRA pre-review	Land Allocat.	Owner permit	Land Leasing	Building Permit	Relevant entities	Local Municip.	On air certif.
Mobile Tower (e.g., Guyed Mast, Lattice Mast, Monopole)	✓	✓	✓[4]	✓	✓	Case-by-case[5]	✗	✓
Rooftop Mast	✓	✗	✓[4]	✗	✓		✗	✓
Wall Mount	✓	✗	✓[4]	✗	✗		✗	✓
Temporary Station	✓	✗	✓[6]	✗	✗		✓	✓
Small Cell Outside Building	✓	✗	✓[7]	✗	✗		✗	✓
IBS	-[8]	✗	✓[4]	✗	✗		✗	✗
Upgrade of existing Site (with important structural and/or visual changes)	-[8]	✗	✓[4]	✗	✗		✗	✗
Existing Site sharing	-[8]	✗	✓[4]	✗	✗		✗	✓
Upgrade of existing Site (without important structural and/or visual changes)	-[8]	✗	✗	✗	✗		✗	✗

Table 7.1: Permits required for type of Site

[4] Only applicable for private land.
[5] Defined by the Guides of the Building Permit Complex, as well as any conditional approvals defined when the land is allocated (refer to 7.4.3).
[6] A NOC from the landowner will be needed to park a temporary station (Cell on Wheels) on its land.
[7] Owner of the structure where the small cell is mounted (e.g., municipality in the case of public furniture, or building owner in the case of small cells installed in a building wall).
[8] Only notification.

7.4. Site building - Application steps

7.4.1. Site request

SPs shall submit to the CRA applications for the obtention of necessary Permits and/or certificates for any type of Site (including any upgrade or modification to an existing Site) using the digital system described in Article 7.2, and provide any information requested by that system. Until the system is deployed, such requests shall be made manually by the Service Provider by filling the forms included in Appendix A and sharing them via mail using the following e-mail address: ifa@cra.gov.qa.

Each SP may submit a maximum of five (5) applications for Government Lands for approval per week (5 working days), which shall be within the same municipality zone.

For applications for private land Sites where Government Land is not available, SPs may submit a maximum of ten (10) applications for approvals per week.

Applications submitted in excess of this limit will be rolled forward as if submitted on subsequent working days.

Applications submitted after 2:00pm shall be considered submitted on the following Working Day.

The CRA may change the number of weekly applications mentioned above by issuing an Order to the SPs.

SPs' applications shall include the following information:

a) Type of Site, pursuant to Article 4;

b) Technical aspects, such as height, structure load, wind load, etc. pursuant to Article 10;

c) Drawings of the structure, plot, etc.;

d) Site address/coordinates and the type of land requested, pursuant to the land subdivision process carried out by the Ministry of Municipality;

e) Required information/documents in accordance with Appendix A; and

f) Any other information requested by the CRA if deemed necessary.

7.4.2. CRA Preliminary Review

The CRA shall review all applications for completeness within five (5) working days following the Service Provider's submission.

An application shall be considered valid only if:

a) All the mandatory fields of the Permit approval form (Appendix A) have been filled appropriately;

b) The required information, in accordance with Article 7.4.1, has been provided.

If the Site requested is an IBS or an upgrade of an existing Site (with and without structural and/or visual changes), the CRA will only review the completeness of the form of Appendix A, and update the databases accordingly.

If the CRA determines that the application submitted is incomplete, or that further clarification is required, the CRA shall request the SP to submit such information or clarifications within five (5) working days.

The CRA shall assess within five (5) working days the supplemental information submitted by the SPs to verify that any missing or incorrect information has been remedied. Should this not be the case, the CRA shall notify again the SPs. The SPs may benefit from three (3) attempts to resubmit any invalid/rejected requests. After three (3) unsuccessful attempts, or if the SP has not responded to the rejection notification within five (5) working days, the Site request shall be considered withdrawn.

If the Site request relates to Mobile Towers, the CRA shall assess the coordinates and the plot of land selected by the SP to analyze its suitability and probability of approval by the Ministry of Municipality.

If the CRA determines that approval for the land selected by the SP will be difficult to obtain from the Ministry of Municipality, the CRA will engage in discussions with the SPs to assess potential remedies, in accordance with Article 5. These potential remedies include but are not limited to:

a) Alternative land plots;

b) Alternative coordinates within the same area; or

c) Request for private lands.

Once the CRA determines that the application is complete, the CRA shall submit the appropriate requests to the Ministry of Municipality for review and follow the processes described in Articles 7.4.3 and 7.4.4 if the type of Site requested is a Mobile Tower. Otherwise, the CRA will initiate the process described in Article 7.4.6, provided that SPs have obtained approval from the relevant entities, as per Article 7.4.5.

7.4.3. Land allocation process

If the type of Site requested by the SP is a Mobile Tower, the CRA will be responsible for the submission of the land allocation request for such a Site. The CRA should submit the request digitally through the Ministry of Municipality's system (currently under development). If the system is not yet operational, requests will be made manually via email.

Incomplete application

If the Ministry of Municipality determines that the application submitted is incomplete, or that further clarification is required, the Ministry of Municipality shall request the CRA and the SP to submit such information or clarifications within five (5) working days.

Application rejection & Potential solutions assessment

Any rejection shall be duly explained by the Ministry of Municipality, indicating its reasons. If the rejection is due to land scarcity, the Ministry of Municipality shall notify the CRA and the SPs.

Following such notification, the CRA and the SP shall initiate discussions in order to find potential solutions, where:

a) If possible, the Ministry of Municipality will suggest nearby options to the SPs.

b) The SPs will evaluate these options based on the connectivity requirements for the target area.

c) If the Ministry of Municipality does not accept an initial proposal, the SPs must propose alternative coordinates and plots of land to the CRA within five (5) working days.

d) The CRA will assess the proposal from the SPs and advise on other alternatives, if necessary, within five (5) working days.

e) The CRA will submit the alternative location to the Ministry of Municipality. The Ministry will have five (5) working days to review and respond.

The Ministry of Municipality shall assess the supplemental information submitted by the CRA to verify that any missing or incorrect information has been remedied. Should this not be the case, the Ministry of Municipality shall notify again the CRA. This process shall be repeated as many times as necessary until the Ministry of Municipality is satisfied that the application is complete. Any updated submission shall be considered as part of the same, original, application request and not as a new one.

Application approval

Once the Ministry of Municipality has approved the request, a PIN number shall be allocated and an official letter shall be sent to the CRA, which shall inform the SPs and share it with them. Such letter shall indicate any required conditional approvals from other Government Entities (refer to Article 7.4.5)

After the PIN number is allocated, the CRA shall conduct the following steps:

a) Notify the other SPs that a land has been allocated in order to i) allow SPs to enter into co-deployment schemes and ii) avoid requests in a similar area/land;

b) Submit the Land Leasing request to the Ministry of Municipality, pursuant to Article 7.4.4.

In parallel, the SPs shall initiate the process of obtaining the approval of the relevant entities, in accordance with Article 7.4.5.

7.4.4. Land Leasing process

Following the PIN number allocation, the CRA shall initiate and submit the request to obtain the Land Leasing of the land allocated to the SPs.

If the Ministry of Municipality determines that the application submitted is incomplete, or that further clarification is required, the Ministry of Municipality shall request the CRA to submit such information or clarifications within five (5) working days, on behalf of SPs, where the CRA will request SPs to provide such supplemental information.

Following the submission of supplemental information by the CRA, the Ministry of Municipality shall have five (5) working days to determine whether the revised application is complete. If the Ministry of Municipality determines that the revised application is incomplete or requires further clarification, the Ministry of Municipality shall request the CRA to file additional information or clarifications within five (5) working days. This process shall be repeated as

many times as necessary until the Ministry of Municipality is satisfied that the application is complete.

After Land Leasing is granted, the CRA can initiate the request for the Building Permit, considering the SP has obtained the relevant entities approval, in accordance with Article 7.4.5.

Note that, due to the length of this process, the CRA is determined to find and agree on solutions with the Ministry of Municipalities to speed up the process. Potential solutions may consist of:

a) A definition and reduction of timeframes; and/or

b) Developing solutions that both the Building Permit Complex and State Property Department departments agree on, to run the land leasing process in parallel with the Building Permit process

The SPs shall be informed of any agreement reached by the parties.

7.4.5. Government Entities' approvals

Once the Site request has passed the initial CRA's approval and the PIN number is allocated by the Ministry of Municipality (in case of Mobile Towers), the SPs shall request approval(s) by the relevant Government Entities in order to continue with the Building Permit application.

The official letter of the Ministry of Municipality, containing the PIN number, shall indicate the Government Entities that are required to provide approval. In any case, if the type of Site is other than a Mobile Tower, the SPs can identify the relevant Government Entities and the required information to be submitted by checking the Building Permit Complex Guidelines[9].

The SPs shall upload the approvals from such entities to the CRA's system (or send them via e-mail if the system is not yet deployed). This information is necessary for the CRA to submit the Building Permit request, as per Article 7.4.6.

Note that:

a) In relation to Mobile Towers and Rooftops, this process will be required until the Building Permit Complex incorporates all relevant entities within its Building Permit system. The Building Permit Complex must notify the CRA as soon as these entities are part of the

[9] Available at https://bps.mme.gov.qa/Pages/sub.aspx?ListName=Circulars

system, so that SPs can skip this process when requesting a building permit for any relevant Site type.

b) In relation to Temporary Sites, as indicated in Article 7.3.2, SPs shall obtain the approval from the local municipality before they can apply for On-air certification.

7.4.6. Building Permit

After completing the necessary previous steps (depending on the type of Site), the CRA will start the Building Permit application by submitting the request into the Building Permit Complex system.

The process is divided into different subprocesses:

a) Design Control 1 (architectural and structural drawings)

b) Design Control 2 (services design drawings)

c) Building Construction and Building Permit completion certificate (refer to Article 7.4.8)

While the Building Permit Complex defines and describes the process in more detail,[10] this Regulation provides high-level guidelines for each of the above subprocesses.

As a first step, the CRA is responsible for:

a) Submitting the architectural drawings in Design Control 1 (DC1) stage 1 for review and approval by the relevant Government Entities defined by the Building Permit Complex; and

b) Submitting the Civil Defense life safety drawings, Kahramaa electrical & water and Ashghal road plans in Design Control 1 (DC1) stage 2 for review and approval.

After the DC1 has been approved by the Government Entities, the CRA will start the submission of the DC2 drawings, which are related to the technical aspects for the provision of services.

7.4.7. Site construction

After the DC1 phase is completed and approved, SPs can start the Building Construction while the CRA issues the DC2 drawings.

[10] Refer to https://bps.mme.gov.qa/Pages/sub.aspx?ListName=RulesAndRegulation

All new Sites shall be constructed with sufficient capacity to allow sharing by all SPs licensed at the time the Site construction is planned.

The SPs shall notify the Building Permit Complex and the CRA about the start of the construction and the expected completion timeframes.

Note that the safety and warning signage detailed in Appendix C shall be installed before initiating the building of the Site and shall remain visible to the public on all outdoor Sites at all times until the Site is decommissioned. In order to decommission the Site, the SPs shall fill the form set in Appendix B.

Site construction will be under the full responsibility of the SP.

SPs should notify via the CRA's system (or via e-mail if the system is not yet deployed) the completion of the Site construction.

7.4.8. Final Completion Certificate

After the Site is built, and DC2 drawings are approved, the Building Permit Complex will conduct the building inspection to provide the Building Completion Certificate.

Once the Building Completion Certificate is obtained, the SP should upload it to the CRA's system (or send it via e-mail if the system is not yet deployed.

7.4.9. On-air certification

Once the Site is constructed, installed and ready to be operational (On-air), the SP shall notify the CRA, by filling the form included in Appendix B.

The final approval shall be subject to the CRA's receiving proof of payment of the Applicable Fees and its reception of the Final Completion Certificate (in the case of Mobile Towers).

The CRA will review the information submitted by the SP within five (5) working days and will either grant the on-air certification or request more information in case the CRA deems it appropriate.

If the CRA determines that the application submitted is incomplete, or that further clarification is required, the CRA shall request the SP to submit such information or clarifications within five (5) working days.

The CRA shall assess within five (5) working days the supplemental information submitted by the SPs to verify that any missing or incorrect information has been remedied. Should this not be the case, the CRA shall notify again the SPs. This process shall be repeated until the CRA deems the information complete and compliant.

Note that the CRA will not provide the on-air certification for the Temporary Sites if the SPs have not obtained the local municipality approval, in accordance with Article 7.4.5.

Where the CRA determines, pursuant to the non-compliance process set forth in Article 11, that a SP has failed to comply, or is in breach of the provisions of the Site construction requirements at any point in time, the CRA may revoke the approval and direct the SP to decommission the Site, at the SP's own expense, within thirty (30) Working Days from the date of receiving the CRA notice. The 30-day notice is subject to written justification where an extended period is required. The CRA may also require the SP to implement immediate remedial actions.

7.5. SLAs

The timeframes associated with the processing of a valid Site application are as follows:

<table>
<tr><th>Type of mobile Site</th><th>CRA pre-review</th><th>Land Allocat.</th><th>Owner permit</th><th>Land Leasing</th><th>Building Permit</th><th>Relevant entities</th><th>Local Municip.</th><th>On air certif.</th></tr>
<tr><td>Mobile Tower (e.g., Guyed Mast, Lattice Mast, Monopole)</td><td rowspan="4">5 working days</td><td>Est: 45 working days</td><td rowspan="8">Out of the scope of this regulation</td><td>TBD</td><td>47.5 working days[11]</td><td rowspan="10">Other entities times</td><td rowspan="2">N/A</td><td rowspan="4">5 working days</td></tr>
<tr><td>Rooftop Mast</td><td rowspan="9">N/A</td><td rowspan="9">N/A</td><td>TBD</td></tr>
<tr><td>Wall Mount</td><td rowspan="9">N/A</td></tr>
<tr><td>Temporary Station</td><td>Other entities times</td></tr>
<tr><td>Small Cell Outside Building</td><td rowspan="8">N/A</td></tr>
<tr><td>IBS</td><td>-</td><td rowspan="2">N/A</td></tr>
<tr><td>Upgrade of existing Site (with important structural and/or visual changes)</td><td>-</td></tr>
<tr><td>Existing Site sharing</td><td>-</td><td>5 working days</td></tr>
<tr><td>Upgrade of existing Site (without important structural and/or visual changes)</td><td>-</td><td>N/A</td><td>N/A</td></tr>
</table>

Table 7.2: SLAs for the Site building steps per type of Mobile Site

[11] https://bps.mme.gov.qa/ArticleDocuments/Building%20Permit%20and%20completion%20process.pdf

8. Site sharing process

8.1. Scope and objectives

This Schedule sets forth the Site Sharing Process for new or existing Radio Communications Sites, which shall be conducted by the CRA in coordination with the SPs and the Government Entities.

As mentioned earlier, SPs are required, under Article (112) of the Executive By-Law, to allow other SPs to share and co-locate Telecommunications Facilities on their Sites, where such sharing and co-location is technically and economically feasible.

Further to the matters referred to in the Regulation, the Site Sharing Process aims to achieve the following objectives:

a) Establish an efficient single point of contact for the Site Sharing Process; and

b) Optimize the use of new and existing Sites by promoting sharing, whenever sharing is the optimal solution.

8.2. Site sharing agreements

SPs shall enter into a Site Sharing Agreement between themselves, which shall detail the commercial and technical arrangements for Site sharing. A copy of each Site Sharing Agreement shall be sent to the CRA within 5 Working Days of its execution.

8.3. Sharing at new Sites

Pursuant to Article 7.4.3, the CRA will notify SPs when a land is allocated to either SP. Such notification will include the location of the planned Site (including its GPS coordinates).

Any SP shall be able to request sharing at the proposed Site. The Site sharing request shall be sent by email or otherwise in writing to the Host SP, containing the details of the proposed equipment to be located at the Site and any other information considered relevant. CRA should be copied in any such communication ifa@cra.gov.qa.

The Host SP may request further, reasonable, information or clarification as may be appropriate.

SPs are not precluded from requesting Site sharing at any other time.

Once a Site sharing request has been submitted, the SPs shall undertake the following steps to implement the Site's sharing:

1. SPs to jointly develop a Site Plan;
2. Obtain landlord agreement to allow sharing (if applicable);
3. SPs to negotiate and sign a Site Sharing Agreement; and
4. Follow the steps set out in Article 7.4.

Ongoing management and maintenance of the Site and the shared equipment shall be in accordance with the operational procedures detailed in the Site Sharing Agreement.

8.4. Sharing at existing Sites

SPs shall provide, pursuant to a written request for another SP details, Site drawings/plans of any of their existing Sites. These Site details shall be provided within 10 Working Days of receiving such a request.

Any SP shall have the right to request Site sharing at any existing Site of any SP. The Site sharing request shall be sent via email or writing to the Host SP, indicating the details of the proposed equipment to be located at the Site and any other information considered relevant. CRA should be copied in any such communications.

The Host SP may request further, reasonable, information or clarification as may be appropriate.

The SPs shall then undertake the following steps to implement the Site's sharing:

a) Notify the CRA pursuant to Article 7.4.1;
b) Undertake a joint Site survey;
c) Obtain landlord agreement to allow sharing access (if applicable);
d) Develop a Site Plan;
e) Obtain landlord's approval of the Site Plan (if applicable);
f) Negotiate and sign a Site Sharing Agreement;
g) Develop an implementation plan;
h) Undertake the installation of the equipment;

i) Host SP review of Site sharing installation;

j) Provide final, as-built, documentation to the CRA and the Host SP.

k) Obtain on-air certification, pursuant to Article 7.4.9.

Ongoing management and maintenance of the Site and the shared equipment shall be in accordance with the operational procedures detailed in the Site Sharing Agreement.

8.5. Merging existing neighboring Sites for sharing

Where SPs have constructed Sites in nearby locations, less than 600 meters from each other, they shall work together to merge the Sites. This shall ensure that the existence of the merged Site will be consistent with the Beautification Principles of the State of Qatar.

In order to merge Sites, the following steps must be taken:

a) The CRA will notify each SP of which Sites are in breach of the compliance distance of 600m;

b) If the Sites in breach affect both SPs, the SPs will coordinate internally and undertake a Site survey to identify if the Sites can be shared or merged;

c) SPs should agree with CRA on the Sites that can be consolidated and those that can be decommissioned;

d) The SPs should develop a consolidation plan to merge the Sites;

e) The SPs should negotiate cost-based charges for decommissioning and installation of infrastructure;

f) The requesting SP shall install its telecommunications infrastructure at the shared Site;

g) The requesting SP shall decommission its relevant, now redundant, Site(s), pursuant to Article 11.2.

Ongoing management and maintenance of the merged Site and the shared equipment shall be in accordance with the operational procedures detailed in the Site Sharing Agreement.

8.6. Commercial considerations

All charges and commercial arrangements for Site sharing shall be agreed between the SPs and included within the Site Sharing Agreement.

Where the SPs cannot agree on price terms and conditions in their Site Sharing Agreement, they may refer those terms and conditions to CRA for resolution, in accordance with CRA's Dispute Resolution procedures established pursuant to Chapter 12 of the Executive By-Law.

9. Requirements for the construction of sites

Sites shall be compliant with all the requirements of this Regulation, including its Annexes and all other applicable regulations of the State of Qatar, in relation to designing, installing, upgrading, operating, and decommissioning Sites. This includes the following documents which have been issued by the relevant Government Entities or other authorities:

a) The Qatar Building Code, and the Standard Specifications for Construction Works;

b) The Qatar Civil Aviation Authority Regulations regarding wind loading requirements and standard to ensure that Mast design withstand the local environment weather conditions;

c) The Qatar environmental, health and safety legislation and guidelines, including the EMF and Public Exposure Guidelines (ICNIRP);

d) Qatar Civil Defense (QCD) fire and safety standards;

e) The In-Building Telecommunications Infrastructure Standard; and

f) Any other applicable rules, standards and regulations for designing constructions, installations and upgrades of Sites.

The Site design shall be compliant with approved standards, based on international engineering best practice and any other standard that may be issued by the CRA after coordination with relevant Government Entities. Refer to Article 10 for more information.

10. Construction Procedures and Standards

10.1. Overview

This Article sets forth the procedures and standards in relation to the general constructions principles to be applied to Sites and the associated infrastructure (which shall take into consideration the requirements of mandatory Site sharing).

This Article has the following objectives:

a) Define high level technical criteria for the construction of sharable Sites and associated infrastructure in the State of Qatar;

b) Establish health and safety criteria;

c) Establish environmental criteria, including Beautification Principles.

These procedures and standards also serve to limit human exposure to radio frequency and Electromagnetic Fields by:

a) Protecting the public of Qatar from any adverse health effects;

b) Providing best practice processes for demonstrating compliance with recognized international exposure limits and protection of the public;

c) Planning, designing and operating radio communications infrastructure to minimize RF EMF exposure;

d) Ensuring that relevant authorities are informed and consulted before radio apparatus is deployed;

e) Maintaining the well-being of Qatar's community, physical or other.

10.2. General Construction Criteria

SPs shall abide by the construction criteria set out in this Article when building new Sites in the State of Qatar. These criteria take into consideration the need for Site sharing between two or more SPs.

The design, planning, implementation and ongoing operation of the shared Site shall be detailed in the Site Sharing Agreement signed between the SPs involved.

10.3. Site Design and Construction

The SP shall:

a) Consider applying Site Beautification Principles as set out in Article 10.7 of this Regulation and as specified by Ministry of Municipality, as and when required;

b) Implement Compliance Distances. For the sake of clarity, a distance of less than 600 meters between Sites will be allowed only in exceptional cases, substantiated with a written justification.

c) Ensure compliance with the required safety and warning signage; and

d) Comply with international recognized standards, with the latest constructions code and the best practice engineering design for Sites.

The design of Sites shall be determined by the landscape where the Site is to be located. Due consideration shall be taken of the Site location when determining the appropriate height and appearance.

All Sites shall be constructed with sufficient space and loading capacity to enable all SPs to install their Telecommunications Equipment at each Site. This must include space for cabinets, shelters and back-up power equipment (if used).

SPs shall work together on producing the technical specifications and standards to be considered during Site construction to accommodate the SPs' sharing requirements including, inter alia, structure load, ground space utilization, reserved space on the structure for future utilization, structure height and material specifications.

In keeping with international recognition of common public perception concerns, the CRA encourages SPs to avoid installing Sites in the vicinity of "public-sensitive areas/buildings", where possible.

The design of Sites shall provide for specific conditions that might deviate from any values specified in this Regulation.

10.4. Site Loading

The design philosophy shall take into account both the strength limit, which considers the loading of a Site under extreme conditions, and the serviceability limit, which ensures that the

Site will provide the appropriate service considering a second SP requirement for sharing at the Site.

The load on a Site shall be analyzed under local wind, soil and seismic conditions.

In designing Sites, wind loading as well as equipment loading shall be taken into consideration.

The wind load rating shall be based on the height of the Site, its location and any relevant local conditions.

10.5. Power Criteria

Each Site shall be provided with an appropriate electrical power supply by the Host, considering a second SP at the Site.

This should be ideally through a mains electricity feed with back-up power provided from a source consisting of batteries, a generator, or both.

Each Site shall be equipped with sufficient power in order to meet its full operational capacity requirements.

Sufficient power should be provided for a second SP at the Site, if requested.

10.6. Lighting of Sites

All Sites shall be equipped with appropriate warning lights, in full compliance with the Civil Aviation Regulations of the State of Qatar.

All lights shall be inspected periodically, as required by local regulations.

A sufficient quantity of spares shall be held at each Site to enable any defective warning lights to be replaced immediately.

10.7. Beautification Criteria

The SP undertaking the construction of a Site shall take into consideration the Beautification Principles defined and agreed between the Ministry of Municipality and Urban Planning, the CRA and the SPs. These principles shall have regard to aesthetics, network performance and shareability.

In particular with regard to Site construction, the following principles should be considered:

a) To the extent possible, Sites must blend into their surrounding environment, using color and camouflaging architectural treatments, reducing the visual impact to the public and concealing the visibility of the equipment;

b) Where mandated by the relevant authorities, SPs shall co-operate to install Sites and Telecommunications Equipment that are designed, painted and otherwise hidden so as to be 'camouflaged' from public view, particularly if installed on a roadside, public parks, tourist location, heritage sites or a rooftop;

c) The Site must take into consideration the local pattern of streets and spaces, building traditions, skyline, ecology, natural environment, and landscape. To that end, the scale, massing and height of a Site shall be considered in relation to the adjoining buildings, the topography, the general pattern of heights in the area, and the views and landmarks;

d) The SP must diligently address, through the official process, any complaint or concern raised by members of the public in relation to these Sites.

SPs shall enclose any electric generators at Sites, using their best efforts to ensure that enclosures are in harmony with other radio apparatus so as not to detract unnecessarily from the landscape of the surrounding area.

10.8. International Safety Standards for the Emission of Electromagnetic Radiation

There remains a great deal of interest in monitoring the electromagnetic radiation (EMR) emitted from the different sources of these services and networks. One of the most common sources for the EMR is the 3GPP based technologies in Sites. The radiation is emitted continuously and can be powerful close to the antenna. However, the intensity of the radiation decreases significantly with distance from the Cellular Mobile Base Station or Tower, according to a power attenuation formula.

Though some countries have developed their own Non-Ionizing Radiation (NIR) Exposure Standards, most countries in the world have adopted the ICNIRP (International Commission on Non-Ionizing Radiation Protection) Exposure Standard in assessing radiation levels in their countries. The ICNIRP standard has also been recommended by the World Health Organization (WHO) as an acceptable exposure guideline.

CRA has chosen to adopt the International Standards recommended by the World Health Organization (WHO) and the International Telecommunications Union (ITU), which are in line

with ICNIRP Procedures and Standards and are designed to provide protection against all established health hazards. These standards have been widely adopted in Africa, Asia, Europe and the Middle East.

Compliance with ICNIRP public exposure Procedures and Standards is normally determined by mathematical calculation and implemented through the careful location of antennas, access restrictions and/or barriers and signage as necessary.

SPs in the State of Qatar shall adhere to the health protection standards specified in the "Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and Electromagnetic Fields" published by the ICNIRP in 1998[12] and reconfirmed in 2010[13] and in 2020[14]. By way of example only, the following table (which is extracted from the ITU-T K.52 Recommendation[15] (01/18)) illustrates the levels of exposure for the general public to non-ionizing radiations acceptable as per the ICNIRP Guidelines.

Type of Exposure	Frequency Range	Electric field Strength (V/m)	Magnetic field Strength (A/m)	Equivalent plane wave power density S_{eq} (W/m2)
General Public	Up to 1Hz	-	3.2x104	-
	1-8 Hz	10 000	3.2x104/f2	-
	8-25 Hz	10 000	4 000/f	-
	0.025-0.8kHz	250/f	4/f	-
	0.8-3kHz	250/f	5	-
	3-150kHz	87	5	-
	0.15-1MHz	87	0.73/f	-
	1-10MHz	87/f ½	0.73/f	-
	10-400MHz	28	0.073	2
	400-2000MHz	1.375 f ½	0.0037f ½	f/200
	2-300GHz	61	0.16	10

[12] Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 Ghz)
[13] Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (1 Hz to 100 kHz)
[14] Guidelines for Limiting Exposure to Electromagnetic Fields (100kHz to 300 GHz)
[15] ITU-T K.52 Recommendations: Guidance on complying with limits for human exposure to electromagnetic fields

Type of Exposure	Frequency Range	Electric field Strength (V/m)	Magnetic field Strength (A/m)	Equivalent plane wave power density S_{eq} (W/m2)
NOTE 1- f is as indicated in the frequency range column. NOTE 2- For frequencies between 100kHZ and 10GHz, the averaging time is 6 minutes. NOTE 3- For frequencies up to 100kHz, the peak values can be obtained by multiplying the rms value by √2 (≈1.414). For pulses of duration tp, the equivalent frequency to apply should be calculated as f=1/ (2tp). NOTE 4- Between 100 kHz and 10 MHz, peak values for the field strengths are obtained by interpolation from the 1.5-fold peak at 100 KHz to the 32-fold peak at 10MHz.For frequencies exceeding 10 MHz, it is suggested that the peak equivalent plane-wave power density, as averaged over the pulse width, does not exceed 1000 times the Seq limit, or that the field strength does not exceed the field strength exposure levels given in the table. NOTE 5- For frequencies exceeding 10GHz, the averaging time is 68/f 1.05 minutes (f in GHz).				

Table 10.1: General public exposure limits to non-ionizing radiations (Illustrative)

SPs shall ensure that the general public is not exposed to non-ionizing radiation in excess of the limits set by ICNIRP as a result of their construction and operation of any Site.

SPs shall ensure that the general public cannot access Sites. Each SP shall use its best endeavors to minimize the radio frequency radiation intensity in these areas in accordance with the formulas set out in the ITU-T Recommendation (ITU-T K.70[16] Annex C of ITU Radio Regulations as amended by the International Telecommunications Union from time to time). The following table is extracted from this ITU-T Recommendation and shows the expressions for the calculation of minimum distances to antennas for compliance with exposure limits for the population in general. The table is provided as a reference only:

Radio frequency range	General public exposure	
1 to 10 MHz	$r = 0.10\sqrt{eirp \times f}$	$r = 0.129\sqrt{erp \times f}$
10 to 400 MHz	$r = 0.319\sqrt{eirp}$	$r = 0.409\sqrt{erp}$
400 to 2000 MHz	$r = 6.38\sqrt{eirp/f}$	$r = 8.16\sqrt{erp/f}$
2000 to 300000 MHz	$r = 0.143\sqrt{eirp}$	$r = 0.184\sqrt{erp}$

[16] ITU-T K.70: Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations

Radio frequency range	General public exposure
r is the minimum antenna distance, in meters. f is the frequency, in MHz. erp is the effective radiated power in the direction of the largest antenna gain, in Watts. $eirp$ is the equivalent isotropically radiated power in the direction of the largest antenna gain, in Watts.	

Table 10.2: Formulae for the calculation of General public exposure

SPs shall assess all existing Sites to ensure their compliance with the ICNIRP Procedures and Standards for general public exposure and take immediate actions to rectify any non-compliant Sites.

SPs shall ensure that CRA is always in possession of up-to-date information on every Site, including a Declaration of Conformity with the ICNIRP Procedures and Standards for general public exposure. In this regard, the ICNIRP Declaration of Conformity form to be completed is attached as Appendix E. In the case that any relevant parameter is changed for a SITE, a notification should be sent to CRA, pursuant to article 7.4.

In the event of a release of a new version of the ICNIRP Procedures and Standards, SPs shall adhere to the new standards unless they contain less onerous standards than the previous version, in which case the more onerous standards shall apply, unless specified otherwise by CRA.

SPs shall declare compliance to CRA within 90 days of the publication of any new version of the ICNIRP Procedures and Standards, if technically and operationally feasible. CRA will update these Procedures and Standards accordingly.

10.9. Warning Signs

Appropriate warning signs shall be clearly displayed in order to alert both workers and members of the public about relevant dangers at all Site locations.

These shall include warnings about radiation hazards.

Such signage, as illustrated below, shall identify the entity that owns the Site and provide Site name and the identification code as well as a telephone number for any emergency calls.

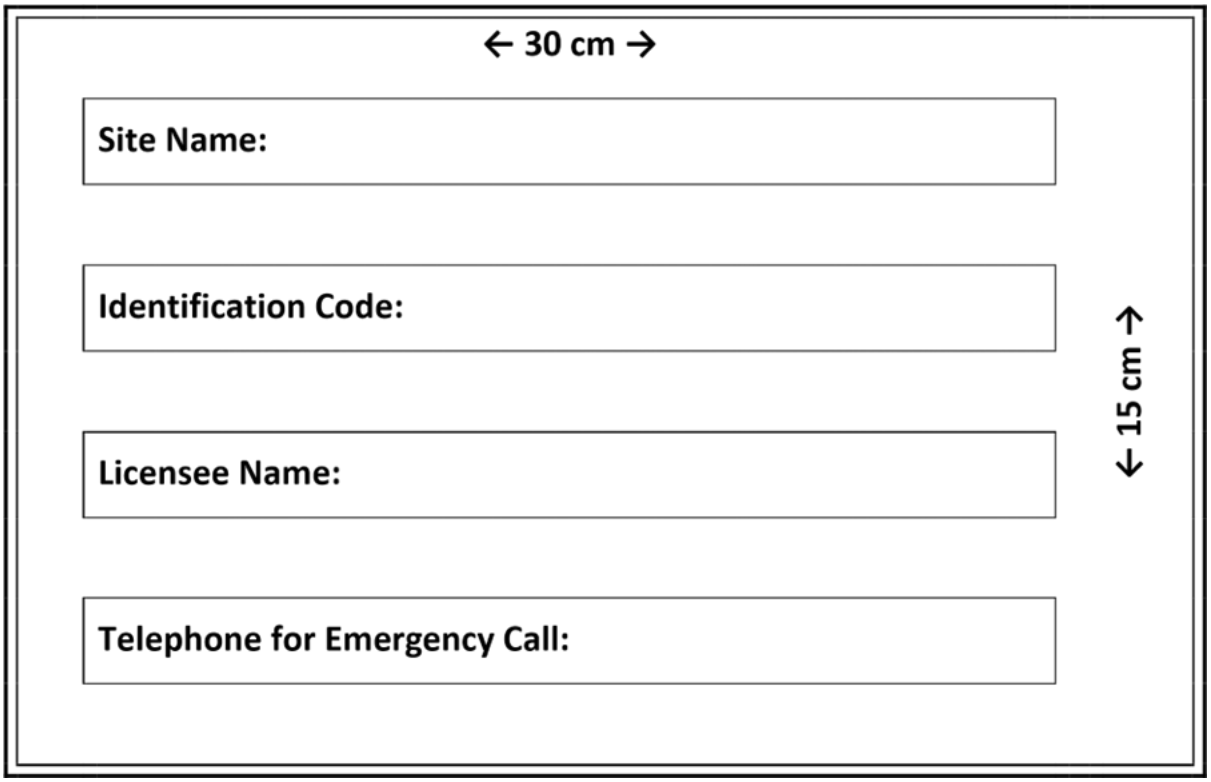

Figure 10.1: Site identification & contact details signage

10.10. Location and Planning Condition for designing Sites

10.10.1. Site Locations

All applications for new Site locations submitted by the SPs shall be based on the actual needs in terms of location and space to ensure that existing Sites have been efficiently used.

An SP who intends to construct a new Site shall conduct all reasonable investigations and Site surveys regarding the possibility of Site sharing before applying to construct a new Site within 600m of an existing Site. Survey information and investigations findings shall be explored and attached to the application form for the construction of the Site.

10.10.2. Planning Condition for designing the Sites

SPs shall not request allocation of Sites on major road intersections (as specified by the Ministry of Municipality) unless such Sites are essential for network planning, and all other options have been explored and determined to be unworkable. In this regard, SPs shall be required to demonstrate that the use of existing infrastructure and other locations is technically not feasible, by producing a report to support the application.

SPs shall consider the possibility of using existing structures such as mosque towers, beacons, street light poles, etc. instead of building new Sites. SPs shall also take into account aesthetics, such as the design and the color, in coordination with the concerned authorities in the Ministry of Municipality.

10.11. On Site Health and Safety Criteria

The following criteria shall be implemented in addition to any statutory health and safety legislation applied to such construction as part of the National Laws of the State of Qatar.

10.11.1. Safety

The SP undertaking the Site construction shall ensure that appropriate and adequate safety equipment is easily available at a Site at all times, also including fire-fighting and first aid equipment.

The SP shall provide all necessary safety equipment for all appropriate personnel in accordance with best industry practice.

10.11.2. Working at Heights

All working at heights must, at all times, be conducted in accordance with best industry practice and may only be undertaken by suitably qualified and trained personnel.

Each SP shall be responsible for ensuring that personnel required to work at heights are qualified and trained.

At least two personnel members must be present at a Site at all times when any structure is being climbed.

No work may be carried out on any structure at a Site during periods of adverse weather conditions or if the wind is gusting at over 50 kph at ground level.

10.11.3. Electrical and Mechanical Equipment

All electrical equipment (including, without limitation, power tools) and mechanical equipment (including, without limitation, cranes and other lifting equipment) used at a Site shall be in good working order and comply with all applicable legislation (including, without limitation, in relation to testing and inspection) and must, at all times, be operated in accordance with best industry practice and any applicable legislation.

All electrical tools used at a Site shall be either battery operated or be powered by an isolating transformer or a generator.

10.11.4. Fire Hazards

All welding or cutting equipment used at a Site shall be in good working order, comply with all applicable legislation and must, at all times, be operated in accordance with best industry practice (including, without limitation, ensuring that suitable emergency and fire-fighting equipment is readily available).

Where welding or cutting equipment, or any process giving off sparks or heat is used, a strict “hot work” policy must be in place in accordance with best industry practice and always adhered to.

10.11.5. Accidents and Emergencies

Before any work commences at a Site, provision must be made to ensure that personnel at the Site are able to contact the emergency services and the Site owner in the event of an accident or emergency.

A first aid box must be always available whilst any work is taking place on a Site. All personnel must be aware of the location of first aid box and the appropriate method of contacting emergency services.

10.12. Public awareness

SPs shall make available to the public, at no charge:

a) Information regarding how they address RF EMF health and safety issues in relation to their networks; and

b) Information or links to information where research reports on the health and safety impacts of radio frequency apparatus may be obtained.

SPs shall inform the CRA of the steps which they will take to make this information available to the public.

10.13. Complaint Handling

SPs shall put in place processes to respond to complaints and enquires from the public about Sites, addressing any complaints and resolving such complaints within 30 Working Days.

As part of their response, SPs must be prepared to provide the following information to members of the public:

a) A description of their radio equipment at the Site;

b) The operating frequency of the radio transmitters;

c) A declaration that radio equipment at a given Site has been designed to be in compliance with ICNIRP exposure Procedures and Standards for the general public.

11. Compliance and Enforcement Provisions

11.1. Compliance Monitoring

The CRA shall be monitoring compliance through its internal Compliance Monitoring process.

Where there is a violation or breach, the SP shall be notified prior to the issuing of a non-compliance Notice and be afforded an opportunity to remedy the breach.

Any violation of this Regulation will result in sanctions imposed in accordance with the Telecommunications Law, and any other relevant laws of Qatar. The CRA may conduct audits from time to time to ensure that the SP comply.

11.2. Enforcement Provisions

If the CRA determines that an SP has failed to comply or is in breach of the provisions of this Regulation at any point in time, the CRA shall refuse any new Site Request from the SP, and/or revoke the related On-air certification and direct the SP to decommission the Site.

In such circumstances, Site decommissioning shall be completed within thirty (30) Working Days from the date of the CRA notice, and a written notification, in accordance with Appendix B, attesting the Site decommissioning shall be provided to the CRA within five (5) Working Days from the date of decommissioning.

The CRA may also require the SP to implement any other immediate remedial actions it sees fit.

The SP shall bear the cost of the Site decommissioning and of any other action required to remedy the situation.

In the event that the SP fails to comply with any non-compliance notice within the timeframes specified by the CRA, the CRA shall consider additional enforcement procedures.

Non-compliance may be referred to court for criminal prosecution or to the Penalty Committee, depending on the nature of the non-compliance.

In the event of any violation of the Exposure Limits, the Site will be subject to immediate deactivation. The Site shall not be reactivated until the SP can supply a Permit to the CRA that it is no longer in breach of the ICNIRP standards or the Regulation.

Appendix A. Site request forms

A.1. Request form for permanent Sites

Revision History:			
REV	Remarks	Date	Name
1			
2			
3			

Contact Details:	
Operator:	
Employer Name:	
Contact Number:	
Email Address:	
Site Details:	
Type of request	□ New Site □ Site Upgrade/Modification □ Sharing of existing Site

Site Name:	English:		
	Arabic:		
Area Name:	English:		
	Arabic:		
Municipality:			
Site ID:			
Site Address/ GPS Coordinates:	1st Option	Longitude:	
		Latitude:	
	2nd Option	Longitude:	
		Latitude:	
Site Address/ Qatar National Grid Coordinates	1st Option	Longitude:	
		Latitude:	
	2nd Option	Longitude:	
		Latitude:	
Land Type:			

Description of Planned Radio Apparatus:							
SP ID:							
Type of Structure:		Monopole ☐	Self-Supporting ☐	Rooftop ☐	Wall Mount ☐	Small Cell ☐	IBS ☐
Height of Structure:							
Antenna type, make and model:							
Height of Antenna above ground level:	2G						
	3G						
	4G						
	5G						
Wind Speed:							
Azimuth direction:							
Mechanical Tilt:		Sector 1:	Sector 2:	Sector 3:			
Electrical Tilt:	GSM 900:	Sector 1:	Sector 2:	Sector 3:			
	DCS 1800:	Sector 1:	Sector 2:	Sector 3:			
	UMTS 2100:	Sector 1:	Sector 2:	Sector 3:			
	UMTS 900:	Sector 1:	Sector 2:	Sector 3:			
	C band 3.4	Sector 1:	Sector 2:	Sector 3:			
Operating Frequency Bands:	Allocated use:						
	MHz amount:						
	MHz bands:						

Description of Planned Radio Apparatus:	
Transmitter radio frequency power:	
Other Radio Equipment already installed at Site:	
Remarks:	

Mobile Site Sharing Information		
SP ID:		
Nearest distance from other SP locations:	Longitude:	
	Latitude:	
Area:		
Municipality Name:		
Possibility of sharing:	□YES	□NO Justification comment:
For non-sharable and sharable Sites, the supporting documents listed below shall be attached with this application. Coverage requirements, the coverage simulation maps for the nearest Sites after and before sharing. Capacity requirements, the capacity calculation report. Declarations of joint survey and Signed Sites agreement.	Coverage Simulations Attached □ Nearest Sites Map □ Capacity Calculations Report □ Signed Sharing Agreement □	

Required Documents Checklist:	
Site Details:	
A 3D map showing: ▶ Site name ▶ Site Location with GPS coordinates ▶ Site boundaries ▶ Site plan ▶ Location plan ▶ Radio equipment position ▶ Any other enclosure ▶ Position and type of adjoining building ▶ Landscaping the means of access ▶ Nearby Site name and coordinates	Attached □
Constructions layout concept showing: ▶ Equipment mapping ▶ General elevation ▶ Coverage area polygon	Attached □
Three (3) Site Beautification designs	Attached □
Equipment list	Attached □
Equipment data sheet	Attached □
Coverage map simulations	Attached □
Landowner or property approval (including, Owner ID + Signed and authenticated Lease Agreement+ Property Document)	Attached □
International Safety Standards:	
Safety declaration (in Site & outside) - ICNIRP safety standards	Attached □
Public awareness signage layout	Attached □
Electric generators at radio base station sites are enclosed and in harmony with other radio apparatus	Attached □ Not applicable □
Mobile Site Power Standards:	
Power source approval declaration form Document showing the premises owner commitment to facilitate power source connection.	Attached □
Power source plan and calculation report. Drawings showing: Main power source capacity (number of Phase/max volt/ max Amp). Power Consumption report for all active equipment is in the Site. Main MDB distribution drawings. The location, capacity and technical specification. Smoke Emotion Generation level. Noise generation level and working time plane for generator.	Attached □

Required Documents Checklist:	
Power dedication report for sharing, drawings should include: Sharing power space in MDB. The dedicated capacity for sharing.	Attached □

Other Requirement:	
Contractor and consultant contact details (name, contact number and email)	Attached □

CRA Review	
Applicant's Details Name: _____ Title:_____ Signature:_____ Date:_____	CRA ID#
Reviewed by: CRA Engineer, Interconnection, Access and Infrastructure Name: _____ Date: _____ Signature: _____	In compliance with the Regulation's requirements Yes □ No □ Request for missing information □ Request for further modification □ Request for MME approval □
Reviewed By: Spectrum Monitoring Section Head	Remarks

Name: _____ Date: _____ Signature:_____ Approved: Spectrum Management Department Manager Name: _____ Date: _____ Signature:_____ Approved By: Infrastructure and Access Section Head Name: _____ Date: _____ Signature:_____ Approved: Technical Affairs Department Manager Name: _____ Date: _____ Signature: _____ Reviewed: Head of Infrastructure Planning section Title:_____ Name: _____	Allocated PIN number: _____

Date: _____ Signature: _____ Approved: Ministry of Municipality and Urban Planning Head of Department Title: _____ Name:_____ Date: _____ Signature:_____ Reviewed: Urban Planning Department Manager: Title: _____ Name:_____ Date: _____ Signature:_____ Approved: State of properties Head of Department Title: _____ Name:_____ Date: _____ Signature:_____	

CRA Review	
Note: ▶ Each application shall provide for a minimum of two (2) preferred geolocations as alternatives (with a cover area polygon). ▶ Fully completed application with all required attachments with all mandatory fields should be submitted in soft and hard copy. ▶ Only the original CRA form shall be accepted; any modifications to any part of this document will result on rejections. ▶ Signed declarations of information accuracy should be attached to the applications forms. ▶ Any inaccurate or inadequate information provided with this application will result in automatic rejections of the applications, which may delay the approval process.	

A.2. Request form for Temporary Sites

Temporary Site Notification			
To:			
From:			
Deployment Date:			
Operator:			
Employer Name:			
Contact Number:			
Email Address:			
Site Details:			
Site Name:	English:		
	Arabic:		
Area Name:	English:		
	Arabic:		
Municipality:			
Site ID:			
Site Address/ GPS Coordinated:	Longitude:		
	Latitude:		
Pin Number:			

Purpose of the Site:

Special Event ☐

Emergency ☐

Mobile Site upgrade ☐

New Residential / Commercial ☐

*Note:

Three (3) months for special events, emergency mobile coverage, or Site upgrade; and Six (6) months for temporary mobile coverage in new areas. subject to a valid request for a Permanent Site.

Required Documents Checklist:	
Site Details:	
A map showing the followings: ▶ Geolocation of the planned Sites ▶ Nearby own deployed Radio Sites ▶ Nearby other SP deployed Sites	Attached □
Compliance Distance from the Antenna to the Public Access Area	Attached □
Landowner or property approval (Including, Owner ID + Signed Lease Agreement + Property Document)	Attached □
Signed declaration of Conformity with ICNIRP Standards	Attached □
Photograph of Standard Signage layout on the planned Site.	Attached □
Approval from the relevant Local Municipality	Attached □
Comments:	

Name/Title of Signatory:

……

Date:

……

Signature:

……

Appendix B. Notification for Sites On-Air, Cancelled or Decommissioned

Notification for Sites On-Air, Cancelled or Decommissioned:		
To:		
From:		
Date:		
Type of Notifications: □ Site is operational and ready for on-air □ Site Plan was cancelled □ Site went off-air and demolished or decommissioned	Date: Date: Date:	
CRA ID		
Comments:		

Name/Title of Signatory:

……

Date:

……

Signature:

……

Appendix C. On-Site Standard Signage Boards

Instructions:
The signage shall be installed at the following locations: Final access onto a roof at eye level; Prominently on any physical barrier installed to prevent access into a restricted area; Adjacent to an antenna at eye level; and For non-ionizing radiation warning signs, at the point(s) of controlled access and on the antennas themselves as an added precaution. All signage shall be clearly displayed in both the Arabic and English languages, in order to provide adequate notification. Advertising boards or other advertising means shall not be placed on or inside the Site without obtaining a prior approval from the relevant authority.

Site Identification

Site Owner Information Board	
Site Name/Site ID	
Operator Name	
Site Identification Code	
CRA Approval Reference Number	
Emergency Call Numbers	
This Mobile Site has been designed to be in full compliance, with the requirements of the radio frequency (RF) public exposure Procedures and Standards of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the applicable with radiation law in state of Qatar.	

- Description: 30cm x 15cm Size; A text sign including Site name, code Service provider and emergency contact.
- Location: Shall be installed at the entrance/gate of the Site to be visible to any visitor and to the public

General Site Safety Sign

- Description: A4 size; Includes PPE requirements, access authorization and EMF warning, it also includes the emergency contact number, which is the GNOC (Global Network Operation Centre).
- Location of Installation: The Site Safety Sign shall be installed at the entrance/gate of the site to be visible to any visitor and to the public.

Radio Frequency and radiation Hazards Cautions sign

- Description: A4 size; It is a Warning sign from the radio frequency waves that may be existing when the site is on-air, and to warn from working on the site unless contacting the GNOC.
- Location: Shall be installed at about 1.50meters from the bottom of the tower, in some cases it is not possible to reach the tower and shall not be visible (RDU) in this case the sign may be installed on the sun shade to give more visibility

The Fire system and fire exist Sign

Fire Extinguisher
طفايه حريق

- Description: A4 size, showing where possible to use the extinguisher.
- Location: Shall be installed at the closet location to the fire extinguisher

Radio Frequency Access Limitation Sign

- Description: A4 size; A Warning from the RF exposure if proceeding beyond the limit of the sign.
- Location: Mainly used in non-standard rooftop sites, where the antennas may be accessible by the public, in this case, the antenna railing is to be installed as documented in the RF shutdown process and then the Radio frequency access limitation sign shall be installed on the supports of the railing.

Electric hazard Sign

- Description: A4 size, indicating that there is an electric hazard in this location.
- Location: Shall be installed where electric hazard may occur. (on power panels)

Appendix D. Sites Forecast Report

Sites Forecast Report										
SP Name:										
Site ID	Geolocation		Municipality	Shareability	Type of land	Technology				Date of application
	Lat.	Long.				2G	3G	4G	5G	

Appendix E. Declaration of Conformity with ICNIRP Public Exposure Procedures and Standards (ICNIRP Declaration)

Declaration of Conformity with ICNIRP Public Exposure Procedures and Standards (ICNIRP Declaration)

(Operator logo)

(Operator name)

(Operator address)

Declares that the proposed equipment and installation as detailed in the attached site approval application at:

(Address)_____

_____

_____

is designed to be in full compliance, when operational, with the requirements of the radio frequency (RF) public exposure Procedures and Standards of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), as expressed in EU Council Recommendation of 12 July 1999 * “on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)". When determining compliance, the emissions from all mobile phone network operators on the Site are taken into account.

(Ref: CRA’s Procedures and Standards for Limiting Public Exposure to Radio Frequency Fields from Radio Base Stations and related Site Planning)

Date:_____

Signed: _____

Name:_____

Position: _____

Annex B. In-Building Telecommunications Infrastructure Standard

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1. Introduction and background

Telecommunications services have become an indispensable utility for people worldwide. They enable communication and access to vital information and other resources, making them integral to our daily lives. Therefore, the infrastructure supporting these services should be robust, efficient, and future-proof.

Careful planning of any building's telecommunications-related infrastructure is crucial during its design phase. It ensures a 'first-time-right' implementation, flawless connectivity and optimal service to the building's occupants and users.

Recognizing this critical need, and understanding the issues highlighted by stakeholders regarding the deployment of in-building telecommunications infrastructure, the Communications Regulatory Authority (CRA) has led the development and revision of this Standard for in-building telecommunication infrastructure (the Standard).

Consequently, the Standard now prioritizes early engagement between SPs and REDs, fostering collaboration to comprehensively address design complexities. It also aims to reduce challenges and simplifies the implementation process by promoting proactive dialogue and cooperation.

The Standard provides a comprehensive framework covering both internal wiring and in-building (mobile) solutions.

By following these guidelines, SPs and REDs can create a reliable and efficient communications infrastructure that meets the evolving needs of modern buildings and users, promotes productivity, enhances security and improves the overall quality of life for occupants.

The target audience for this document are the Service Providers (SP) and Real Estate Developers (RED) and their contractors, such as wiring designers, network design engineers, deployment engineers and construction consultants.

1.1. Review

This Standard will be reviewed on a regular basis, taking new developments and experience into account to keep it up to date and preserve an optimal technical and commercial approach in the future. In parallel, close collaboration among all stakeholders will provide a solid basis for any future improvements to this Standard.

1.2. Compliance

Compliance with this document may help the relevant stakeholders fulfil their legal and regulatory obligations. However, it does not constitute legal advice or a comprehensive outline of all legal issues relevant to the provision of premises wiring services in Qatar.

Notwithstanding the provisions of this document, industry participants shall bear responsibility for their compliance with all applicable laws, regulations and requirements of any government or statutory body, as well as with any other applicable industry and building standards or codes, whether voluntary or otherwise.

In the event of any inconsistency between this document and other relevant legislation or existing agreement, such inconsistency shall be resolved in the following (descending) order of precedence:

- Any legislation or regulatory instrument;
- This Standard;
- Any agreement between the parties concerned.

1.3. Best Practice Approach

In today's environment in Qatar, a high-quality telecommunication infrastructure installation is a must, regardless of the technology deployed (e.g., fiber, twisted pair copper cables, passive Distributed Antenna Systems). Most network problems with telecommunication systems can be traced to poor cabling techniques (during the construction, installation and/or maintenance phase) that damage cable and components. To reach reliable high-performance design targets for a telecommunication system, various factors must be attended to.

This document will address such factors to support the planning, construction, installation and maintenance of the most reliable and high-performance telecommunication network. It can be expected that if these factors are dealt with effectively, and a testing system of checks and balances is used during construction and installation, a highly reliable physical infrastructure can be delivered to support the best possible current and future communications networks for Qatar.

Engineering Plans - Detailed engineering plans, drawings, general directions and specifications must be provided for the infrastructure's installation.

Installation Practices - Physical stress and damage to cable must be minimized by decreasing any exposure of cables, components and individual conductors to kinking, abrasion, twisting, bending and compression.

Materials Selection - Cables, connectors, and terminals used shall meet adequate technical specifications defined in this document, including Appendix B, Appendix C, Appendix D and Appendix E, as well as references to applicable industry specifications and codes. All the hardware shall be manufactured under a certified Quality Management System (QMS) such as ISO 9000.

Quality Assurance (QA) - Sound QA strategies that include network testing during all phases of the work shall be followed.

Safety - Sound safety methods and procedures for both personal safety and protection of equipment shall be followed.

Worker Training – Use of equipment and trained installers with adequate knowledge, good M&P (methods and procedures) and correct tools, maintained in good working order, shall be required.

2. Definitions and abbreviations

For the purposes of this Standard, the following terms and words shall have the meanings ascribed to them below.

2.1. Definitions

Access Providers: any person who owns, builds, or directly controls access to Passive Civil Infrastructure. Access Providers include:

- Real Estate Developers;
- Service Providers;
- Government entities; and
- Private entities.

As-built Drawings: A revised set of drawings submitted by a third party upon completion of a project or a particular job. They reflect all changes made in the specifications and working drawings during the construction process, and show the exact dimensions, geometry, and location of all elements of the work completed under the contract.

Balanced Cable: A cable consisting of one or more metallic symmetrical cable elements (twisted pairs or quads), as referenced in the ISO / IEC 11801.

Building owner: The owner of the building/development.

Building Access Point: A physical point, located inside or outside the building, easily accessible by the Telecommunications Networks, hosting passive telecoms equipment (e.g., splice closures, Optical Distribution boxes, lead-in Ducts), through which a connection between the Outside Plant and the In-building Telecommunications Infrastructure is made.

Building Wiring Network: The wiring network inside a building, connecting each room and unit.

Contractor: The person or legal entity mandated by the RED to build a site, building or development.

Cross-connection: Any arrangement that enables a socket to be associated with a specific service.

Customer Premises Equipment (CPE): Any telecommunications terminal equipment connected to the customer's wiring, other than CLNE.

Daisy-Chain (or loop) wiring: A common form of wiring where a cable to one socket is connected to another cable to the next socket etc.

Distributed Antenna System (DAS): A passive, active or hybrid, system of spatially separated antennas connected to a common source to provide wireless services within a building or area.

Duct: A protected pathway enabling the installation of underground cable.

Ducting System: Any system that provides a passageway for cables, and can consist of pipes, trays, concrete trenches, or any other form of a channel to convey cables.

GIS: Geographic Information System.

High-Density Polyethylene (HDPE): A conduit material, which has been used for decades to protect the fiber optic highways and is known for its large strength to density ratio.

In-Building Telecommunication Infrastructure: A collection of telecommunications components that, together, provide physical support for the distribution of telecommunications services in a building, development or site. It connects the Building Access Point with the Network Termination Points in the building units, and includes the Network Termination Points, distribution frames, risers, telecommunications rooms and spaces, and lead-in Ducts.

In-Building Solution (IBS): A dedicated tailored system intended to bring enhanced or seamless wireless services indoors and throughout a particular building or site.

Insulation Displacement Contact (IDC): A technique used to terminate copper wires without stripping-off the insulation using a special insertion tool.

Jointing Chamber/ Joint Box: An inspection pit constructed on a Duct route to allow access to cables for cabling and maintenance purposes and to house cable splicing enclosures.

Lead-in Duct: A Duct needed to get the network cable from the point at which a telecom network terminates (the network terminal) at the boundary of a property, up to the point of a building inside that property where the internal cabling needs to connect to the telecom network (known as the Building Access Point).

Low Voltage (LV): Any voltage in the range of 50–1000Vrms AC or 120–1500V DC.

Manhole: An underground chamber used to host Optical Fiber Cables, Joint Chamber, splitters and other telecommunications infrastructure, which is installed along a Duct route and enables Optical Fiber Cables to be installed in, and be withdrawn from, Ducts and allows access to those Optical Fiber Cables for splicing, and operations and maintenance purposes.

Network Termination Point: Physical point at which the Telecommunications Network and the Building's Wiring Network interconnects.

New Development: The real estate 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.

Optical Fiber Cable: A cable comprised of a number of optical glass fibers, enclosed in a protective housing or jacket, which can be used to transmit data at high speed using optical transmission technologies.

Outside Plant (OSP): A section of a Telecommunication Network located outdoors, which encompasses the Telecommunications Networks up to the Network Termination Point.

Personal Protective Equipment: Protective clothing, hard hats, safety glasses, or other garments or equipment designed to protect the wear's body from injury.

Real Estate Developer (RED): A person or company developing real estate through the construction of buildings.

Service Provider (SP): A licensed telecommunication service provider in the State of Qatar.

Star Topology: An arrangement where each socket is separately cabled to a central point, where cross-connect facilities may be provided.

Telecom Corridor: A defined area along the side of a road (or a road subjected to significant upgrade or diversion), which is reserved for installation of underground telecom infrastructure and is installed as part of the road construction.

Telecommunications Network: Any wire, radio, optical or electromagnetic system for routing, switching and transmitting telecommunications services between network termination system or other utilities, circuit or packet switched network, and any network used for the delivery of broadcasting services.

Telecommunications Room: A space in a building used for housing the installation and termination of telecommunications equipment and cable terminations, and also used as a collocation area to house various equipment and cables used to distribute telecommunication, image and security services to each Unit. There are four (4) distinctive types of Telecommunications Rooms:

- **The Main Telecommunications Room** (MTR), always built at ground or basement level of a building, hosting the main telecoms equipment.
- **The Secondary Telecommunications Room**, an additional Telecommunications Room that needs to be deployed due to building requirements, such as size.
- **Floor Aggregation Point/Room** (FAP), used in MDU scenarios on floors other than ground floors. It can be a dedicated small room (any size) or a space within a service room.
- **The Rooftop Telecommunications Room** (RTTR), a Telecommunications Room placed on the rooftop of a building, whose construction is mandatory if the building meets the requirements specified in this Document.
- **Mobile Service Telecommunications Room** (MSTR), a Telecommunications Room placed at the rooftop of a building and at different stores, hosting mobile services telecommunications equipment and whose construction is mandatory if the building meets the requirements specified in this Document.

Third Party - Contractors and/or consultants who are involved in planning, design, construction and installation of telecommunications Ducts.

Trench – A long, narrow excavation in the ground.

Unit: A dwelling unit, town house, residential apartment, office space, shop, or any other closed entity within a building.

Unplasticized Polyvinyl Chloride (UPVC) - A rigid, chemically resistant and thermoplastic form of PVC, which is derived from common salt and fossil fuels and used for pipework, window frames, and other structures.

User Access Point – It is the point where the User Internal Network begins, which allows the delimitation of responsibilities regarding the origin, location and repair of breakdowns.

User Internal Network - Wire spans from the Home Distribution Box (HDB) and the individual pieces of customer equipment, including any other related elements (e.g., sockets).

2.2. Abbreviations

AC	Alternating Current
APC	Angled Physical Connect
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
BDB	Building Distribution Box
BoQ	Bill of quantities
CAT6	Transmission Category-6 as per TIA 568
CO	Central Office
CoF	Coefficient of Friction
CLNE	Customer Located Network Equipment
CPE	Customer Premise Equipment
CRA	Communications Regulatory Authority
DAS	Distributed Antenna System
DB	Distribution Box
DC	Direct Current
EIRP	Equivalent Isotropic Radiated Power
ELTCTL	Equal-Level Transverse Conversion Transfer Loss
EMI	Electromagnetic Interference
FAP	Floor Aggregation Point/Room
FDB	Floor Distribution Box
FR	Fire Retardant
FSB	Fiber Splicing Box
FTB	Fiber Termination Box
FTP or F/UTP	Foil Twisted Pair or Foil Unshielded Twisted Pair
FTTH	Fiber To The Home
GI	Galvanized Iron
HDB	Home Distribution Box
HDPE	High-Density Polyethylene
HDRF	Heavy Duty Return Flange
IBCDDS	In-building Coaxial Cable Distribution System
IBS	In-Building Solutions

IBW	In-Building Wiring
IDC	Insulation Displacement Contact
IDF	Individual Distribution Frame
JRC	Joint Reinforce Concrete
LAN	Local Area Network
LC APC	(Lucent Connector Angled Physical Contact
LPC/UL	Limited Production Certification/Underwriters Laboratories
LSZH	Low-Smoke Zero-Halogen
LTE	Long Term Evolution
LV	Low Voltage
M&P	Methods and Procedures
MCL	Minimum Coupling Loss
MDU	Multi Dwelling Unit
MIMO	Multi-Input Multi-Output
MSTR	Mobile Service Telecommunications Room
MTR	Main Telecommunications Room
NEXT	Near-End Cross Talk
NFPA	National Fire Protection Association
OD	Outer Diameter
ODF	Optical Fiber Distribution Frame
OEM	Original Equipment Manufacturer
OLT	Optical Line Terminal
ONT	Optical Network Termination
OSP	Outside Plant
OTDR	Optical Time Domain Reflectometer
Pair	Any set of two wires used to provide a circuit.
PDU	Power Distribution Unit
PHDB	Primary Home Distribution Box
PIM	Passive Intermodulation
PS ACRF	Power-Sum Attenuation to Crosstalk Ratio – Far End
PS NEXT	Power-Sum Near-End Crosstalk
PVC	Poly Vinyl Chloride
QMS	Quality Management System
RAN	Radio Access Network
RED	Real Estate Developer

RF	Radio Frequency
RFI	Radio Frequency Interference
RRU	Remote Radio Unit
RSRP	Reference Signal Received Power
RSSI	Received Signal Strength Indication
RSCP	Received Signal Code Power
RTTR	Rooftop Telecommunications Room
RxLev	Received Signal Level
SDU	Single Dwelling Unit
SHDB	Secondary Home Distribution Box
SISO	Single Input Single Output
SP	Service Provider
TCL	Transverse Conversion Loss
TCTL	Transverse Conversion Transfer Loss
TDR	Time Domain Reflectometer
TR	Telecommunications Room
TRX	Transceiver
TUV	Technischer Überwachungsverein
UL	Underwriters Laboratories
UMTS	Universal Mobile Telecommunication System
UPS	Uninterruptible Power Supply
UPVC	Unplasticized Polyvinyl Chloride
UTP	Unshielded Twisted Pair
VFQ	Vodafone Qatar
WS	Wall Socket

Table 2.1: List of abbreviations

3. Legal basis

3.1. Telecom Law

Article (20) of the Telecommunication Law (the "Law") obliges SPs to negotiate in good faith with a view to reaching agreements to provide reasonable access to telecommunication facilities.

Under Article (53) of the Law, CRA must develop the rules necessary to facilitate access to private and public property for the purposes of installing, operating and maintaining telecommunications facilities according to the provisions of the Law, in coordination with the relevant authorities. This provision thus empowers the CRA to draft such rules through the present document.

Article (54) further empowers the CRA to define technical standards and specifications for telecommunication equipment, and the procedures to be applied to them according to the provisions of the law and any other relevant Laws.

3.2. Bylaw

Article (4) of the Telecommunications Bylaw (the "Bylaw") vests the President of the CRA with general powers to issue regulations, decisions and other measures for the implementation of the provisions of the Telecommunications Law (the "Law") and the Bylaw.

Article (6) of the Bylaw gives the CRA the power to take measures, actions and decisions, as it deems appropriate, to ensure that Licensees and Service Providers ("SPs") comply with the provisions of the Law, the By-Law and the provisions of their licenses, or to remedy their breaches.

Article (3) of the Bylaw obliges licensees and SPs to comply with all regulations, decisions, orders, rules and notices issued by CRA.

Article (46) of the Bylaw requires CRA to issue regulations, orders, or notices to specify the terms, conditions, and procedures for interconnection and facilities access, and to facilitate such interconnection and related access. It also empowers CRA to oversee compliance with such and other measures relating to interconnection and facilities access.

Pursuant to the requirements stipulated in Article (111) of the Bylaw, SPs must comply with all applicable laws and regulations related to planning and approval procedures for the construction and maintenance of telecommunication facilities.

3.3. Emiri Decision

Emiri Decision No. (42) of 2014 establishing the CRA has granted broadly defined powers to the CRA, set out in its Article (4), to regulate the telecommunications sector, also including all necessary powers to monitor and enforce compliance of licensed public mobile telecommunications SPs with the prescribed regulatory frameworks.

The Decision's Article (17) expressly stipulates that the CRA's mandate includes developing technical standards in relation to interconnection, access, construction of telecommunications infrastructure and telecommunications infrastructure sharing, and monitoring their implementation.

3.4. Qatar Construction Specifications 2014 (QCS-2014)

QCS-2014 is a regulation issued by the Qatar Standards, Laboratories and Standardisation Affairs, Ministry of Environment, 2014, which provides technical guidance in connection with the execution of constructions in the State of Qatar. Its subsection 1.3.2.1 requires that works be executed in accordance with a list of Government specifications, regulations, notices and circulars that follows in its text.

Item (l) on that list includes, as part of such mandatory regulatory texts, any current and relevant regulations, notices or circulars issued by, among other government bodies, Qatar Telecom (Q-TEL). Further, subsection 1.3.2.3 clarifies that *"[w]here any standard publication, specification, regulation, notice, etc or any correspondence refers to a Government Ministry, department, division, section, etc it will be deemed to be the same as any successor Ministry, department, division, section, etc which has or may subsequently be officially promulgated by the Government of the State of Qatar."*

Article 4 of Decree Law No. (34) of 2006 on the promulgation of the Telecom Law has repealed the concession granted to Q-TEL, and all its powers and authorities related to regulating telecommunications were transferred to the Supreme Council of Telecommunications and Information Technology. Subsequently, Article 2 of the 2017 amendment of the Telecom Law has replaced all of the Law's references to the Supreme Council with references to the CRA.

It therefore follows that, pursuant to the above provisions, the present Standard is part of the mandatory regulatory texts to be complied with in the execution of works in the State of Qatar.

4. Scope

This document establishes standards for in-building telecommunication infrastructure, applicable to Single and Multi-Dwelling Units, including buildings such as single or multiple buildings, villas, warehouses, etc. (refer to Section 5 for the types of buildings covered). This Standards' scope covers both new and existing buildings (refer to Section 5 for the types of buildings covered), thus ensuring a comprehensive and consistent approach to evolving communication needs.

For all new constructions, it is imperative to install physical infrastructure capable of supporting high-speed networks. Access points must be readily accessible to SPs, facilitating efficient connectivity deployment. Such accessibility, pursuant to Articles 3 and 4 of the Passive Civil Infrastructure Access Regulation, must be granted by Access Providers equally to any SP.

These Standards serve as minimum requirements, providing a foundational framework for network setup in typical scenarios (refer to Sections 6 and 7 for the typical scenarios). They aim to ensure the establishment of a consistent and reliable communication infrastructure, fostering seamless connectivity.

4.1. Types of telecommunication services

The infrastructure described herein is intended to support the full range of current residential and enterprise services available as well as applications and services that can be reasonably expected to emerge in future. These would include, but not be limited to, the following:

Services from a fixed location
Fixed voice - VoBB, VoWiFi
Video Delivery Services Subscription television: IPTV (Internet Protocol Television) Video-on-Demand (VoD).
Data Services including Virtual Private Networks (VPN) and Internet Protocol Virtual Private Networks (IP VPNs) services support multiple data, voice and video applications on a shared network infrastructure. These shared networks may be within a single building/ complex or across a wide geographic area.
High Speed Internet services from a fixed location
Cellular mobile services (e.g., HD voice calls, short messages, High Speed Internet services).

Services from a fixed location
Smart services

Table 4.1: Non-exhaustive list of services supported

Most of these services require broadband Internet connectivity and download speeds that are many times faster than a traditional connection.

The network infrastructure described in this document will need to support a large variety of building services that involve not only large volumes of streaming video and other graphic applications, but also the rapidly expanding demand for the simultaneous delivery of multiple communications services involving large volumes of network traffic, both upstream and downstream.

5. In-Building telecommunications infrastructure overview

5.1. Type of buildings covered

This document covers the following building types:

Type of building	Description
Single villas	Single dwelling units with one or multiple floors (but less than 10).
Compound of villas	A residential complex comprising multiple individual villas, typically inside a fenced community.
Residential/commercial towers	Medium or high-rise buildings, consisting of multiple floors or levels with individual residential/commercial units arranged vertically within the building.
Groups of shops and retail outlets	Typically, clusters or an aggrupation of individual stores and businesses, situated in close proximity to one another, within the same commercial area.
Shopping malls	Large commercial complexes, typically consisting of multiple floors with multiple tenants/units. This type of building usually features a multi-story underground infrastructure, with storage rooms and public parking spaces.
Warehouses and sheds	Large industrial facilities designed for the storage and management of goods, materials, and inventory.
Warehouse compound	An industrial facility comprising multiple warehouses or storage units within a single complex.
Labor accommodation	In Qatar, residential facilities provided by employers or contractors to accommodate their workforce. Labor accommodations can be small or multistore buildings.
Bulk services	Service solutions usually applied to projects/buildings that have their own IT network (single tenant) and system operator such as universities, banks, airports, railway stations, stadiums, governmental buildings, industrial complex and other similar establishments.

Table 5.1: Description of the types of buildings covered in the Standard

Any other type of building, not falling under any of these categories, should be treated on a case-by-case basis.

Refer to Appendix F for more information on the types of buildings covered in this Standard.

5.2. General telecommunication infrastructure

5.2.1. Building Access Points

In any development, whether it involves villas, buildings, or both, the RED must provide at least one Building Access Point for connectivity with the SP's outside plant (OSP) infrastructure. The Building Access Point acts as the demarcation point between the SP's outside plant and the private physical infrastructure, and it should be easily accessible by SPs while also being protected against potential damage.

The type of Building Access Point required will depend on the development's characteristics, such as its size, type, structure, and utilization. It could range from a basic wall box on a single dwelling unit's (SDU) outer wall to a designated area (e.g., exterior manholes) for a larger development. Depending on the development's needs, multiple access points may be required. Factors such as building size, shape, total number of users, and building utilization shall be considered. This is further described in section 5.3.

5.2.2. Telecommunications Room (TR)

Telecommunications Rooms are the areas inside the building(s) where the telecommunications cabling is terminated, cross connected, and interconnected to passive or active telecommunications equipment. Different Telecommunications Rooms may be required in a development, depending on the characteristics of the buildings. The types of Telecommunications Rooms described in this Standard are:

- Main Telecommunications Room
- Rooftop Telecommunications Room
- Mobile Service Telecommunications Room
- Floor Aggregation Point/Room (FAP)

The following applies to all Telecommunications Rooms, as may be appropriate depending on their size and space:

- The room must be easily accessible by authorized personnel 24 h/day, (all days including weekends). The room must be clean, dry and free from dust and secured from unauthorized entry.

- Adequate lighting and a minimum of four 20 Amp and 240 Volt AC mains outlet from a dedicated circuit breaker should be provided.
- The room must be provided with a good earth rod of not more than 5 Ohms.
- The door opening for the room should swing outwards.
- The floor, roof and surrounding wall of the Telecommunications Room should be free of any concealed water/drainage pipes and air-conditioning Ducts passing through.
- The room must be provided with an emergency light, a smoke detector and a fire alarm.
- If the Telecommunications Room is proposed in the basement, an automatic sump draining system must be provided to handle water seepages.

Note that all Telecommunications Rooms (except the FAP) can be Type A or type B. For additional technical specifications refer to Appendix A below.

Main Telecommunications Room

All buildings except Single Villas and special cases not covered in Section 5.1 shall be equipped with at least one Main Telecommunications Room (MTR), that shall be provided on the ground floor or basement floor. The minimum TR dimensions will depend on the size, function and features of the building.

Secondary Telecommunications Room

In case more than one Telecommunications Room is required in a building, Secondary Telecommunications Rooms shall be deployed. In case Secondary Telecommunications Rooms are deployed in the building they shall be interconnected by separate cable trays.

Rooftop Telecommunications Room

Rooftop Telecommunications Rooms host active and passive equipment to provide services such as radio and TV broadcasting (analogue or digital), outdoor and indoor connectivity, etc.

Rooftop Telecommunications Rooms must be provided on the roof of all multi-dwelling buildings. The list of MDUs is provided in Section 5.3.

Mobile Service Telecommunications Room

Dedicated Mobile-service Telecommunications Rooms (MSTR), used for the provision of IBS services shall be built in the buildings that comply with the requisites of Section 5.4, provided

that the capacity in the shared Telecommunications Rooms is not sufficient for the deployment of the required IBS equipment.

Floor Aggregation Point/Room (FAP)

A FAP is used in Multi Dwelling Unit (MDU) scenarios on floors other than ground floors. It can be a dedicated small room (of any size) or a dedicated space within a service room as long as it provides:

- Ready access by the building owner and/or SP – i.e., it shall be in a common area that can be easily accessed by the SP operation and maintenance staff.
- Sufficient working space around the equipment to permit maintenance, repair and relocation of equipment as well as the safe use of tools.
- Good lighting, proper ventilation and air circulation characteristics.

Its functions are:

a) To house the Floor Distribution Box (FDB).

b) To house any other of the SPs' active and/or passive components.

c) To serve as an intermediate point to connect the Home Distribution Box (HDB) to the Building Distribution Box (BDB) in the Telecommunications Room.

d) To house any other of the SPs' Remote Radio Units (RRU), and active and passive mobile telecommunication components (e.g., IBS).

5.2.3. Distribution Boxes (DB)

In any in-building telecom infrastructure scenario there are four (4) different types of Distribution Boxes (DBs) that may be used. For any further technical specifications, refer to Appendix A below.

Building Distribution Box (BDB)

A BDB is located inside a Telecommunications Room in compounds with more than 100 connections and in all multi dwelling units (MDU). Its functions are:

a) To be the main aggregation point for all cables running inside the building.

b) To be the last point under customer responsibility, in which an SP will terminate its cable.

c) To house all of the SPs' active and/or passive components.

d) To house all customer active and/or passive components, if required.

As regards its technical specifications, the BDB:

a) Shall be a standard 19" steel rack (wall- or floor-mounted).

b) Must be of adequate size to accommodate at least the following items:

- Optical Patch Panels for the termination of optical cables from all the flats (dwelling units) in that particular building.
- Optical Patch Panels to terminate SP's optical cable(s). Each SP shall terminate its cables in a separate Optical Patch Panel.
- All of the SPs' active and/or passive components.
- 4-way Power Distribution Units (PDU) of 240V AC (BS 1363 UK standard with isolated breaker of 30A) dedicated to Telecommunications Services.
- Vertical and horizontal cable management.
- Space to coil SP optical cable(s) for maintenance purposes (max of 3m).
- Any customer equipment (switches, routers, etc...).

c) Must be accessible from all sides (front, back, right and left) with lockable doors and at least 600mm of clear space.

d) Must have cable entries from the top and bottom.

e) A dust-free ventilation mechanism must be available (grid doors, replaceable filters and/or ventilation fans).

f) Must be installed in an easy to access area with good lighting, proper ventilation and air circulation. A BDB shall not be installed in any inaccessible, high humidity or water condensing areas.

g) An earthing (grounding) facility must be provided for all metallic components with a single bonding point to connect to the building grounding system.

h) Any internal wiring and Low Voltage (LV) power cables must be separated by a distance of at least 50mm.

i) For active BDB units, a convenience outlet (240V AC) shall be provided for testing equipment of the SP maintenance and operations technical staff.

Floor Distribution Box (FDB)

A FDB is used in a FAP whenever the active and/or passive elements of the SP are used. Its functions are:

a) To be the aggregation point for all cables running on a particular floor (horizontal cables).

b) To be the link between PHDBs and BDBs.

c) To house all of the SP's passive components.

d) To house all customer passive components, if required.

As regards its technical specifications, the FDB:

a) Shall be a wall mounted 19" steel cabinet or rack (Wall mounted at a height of 120 cm above finished floor level) and located close to risers inside telecom closets.

b) Must be of adequate size (not less than 30cm(L) X 30cm(H) X 15cm(D)) to accommodate at least the following items:

- Optical Patch Panels for termination of optical cables.
- 4-way PDU of 240V AC (BS 1363 UK standard with isolated breaker of 30A) dedicated to Telecommunications Services.
- Vertical and horizontal cable management.
- Space to coil customer optical cable(s) for maintenance purposes (max of 3m).
- Any customer equipment (switches, routers, etc...).

c) Must be accessible from all sides (front, back, right and left) with lockable doors and at least 600mm of clear space. It is preferable that 750 mm of clear working space be provided in front of equipment when the access door is open.

d) Must have cable entries from the top and bottom.

e) A single conduit of at least 25 mm (1 inch) internal dia., black and UPVC material should be provided from each FDB to the indoor equipment cabinet of each office, residence, flat and other independent areas on the same floor.

f) Each FDB must only be linked to living units on the floor where it is located.

g) There can be multiple FDBs on a floor, depending on the building configuration and number of units.

h) The FDBs on different floors of a villa should be connected through a PVC conduit, of a 50 mm diameter.

i) The FDB should have one 50 mm (2 inch) conduit to the rooftop of the villa, from the cabinet or from the telephone entry Duct location, in order to provide access to cables from the antenna.

j) A dust-free ventilation mechanism must be available (grid doors, replaceable filters and / or ventilation fans).

k) Must be installed in an easy to access area with good lighting, proper ventilation and air circulation. An FDB shall not be installed in any inaccessible, high humidity or water condensing areas.

l) Earthing (grounding) facility must be provided for all metallic components with a single bonding point to connect to the building grounding system.

m) Any internal wiring and Low Voltage (LV) power cables must be separated by a distance of at least 50mm.

n) For active FDB units, a convenience outlet (240V AC) shall be provided for testing equipment of the SP maintenance and operations technical staff.

Home Distribution Box (HDB)

The HDB can be divided into two, depending on the number of floors of the flats and/or villas:

- Primary Home Distribution Box (PHDB)
- Secondary Home Distribution Box (SHDB)

Primary Home Distribution Box

A PHDB is used in flats and on ground floors of villas. Its functions are:

a) To be the aggregation point for all cables running in the flat or on the ground floor within a villa.

b) To be the aggregation point for all SHDBs.

c) To house all of the SPs' active and/or passive components.

d) To house all customer active and/or passive components, if required.

The technical specifications of the PHDB are defined below:

a) The PHDB must be protruded / mounted on the wall with 4 lockable compartments. All doors must provide a dust-free ventilation mechanism (grid doors, replaceable filters and / or ventilation fans).

b) SP compartment shall accommodate the following:

- Four (4) - way PDU of 240V AC (BS 1363 UK standard with isolated breaker of 13A) dedicated to Telecommunications Services.
- Two (2) Optical Network Termination units (ONTs) or home gateways.
- One (1) Fiber termination Box (FTB).
- Simple cable management to minimize bending stresses on cables and enable clear unambiguous identification of optical fibers.
- Space to coil fiber cable(s) for maintenance purposes (max of 1m).
- The SP compartment door must be lockable with a master lock.

c) The customer compartment shall accommodate the following:

- As a minimum, 24 Ports CAT-6 Patch Panel for villas or 8 Ports CAT-6 for flats (there is no actual limit on the total number of ports if customer demand is for more).
- 2-way PDU of 230V AC (BS 1363 UK standard with isolated breaker of 13A).
- Simple cable management to minimize bending stresses on cables and enable clear unambiguous identification of pairs.
- Any customer equipment (switches, routers, etc…).
- Must have capability for cable to enter from all sides with grommets and seals for cable entry ports and openings.

d) Must be installed in a readily accessible area with good lighting, proper ventilation and air circulation. The PHDB shall not be installed in inaccessible or hazardous areas such as inaccessible corners, areas of high humidity, prone to water condensation, adjacent to boilers, chillers or other industrial motors used to service building systems.

e) Must be dedicated to the unit that it is located in.

f) The location of the PHDB should be at a common point, where all the internal conduits meet and the Structured Cabling System (SCS) on a star topology can be installed. However, the farthest socket must not exceed 90 m from the cabinet.

g) The PHDB location should not be adjacent to any electrical distribution or bus bars.

h) The PHDB should be installed at a height of 120 cm above the finished floor level.

i) If the PHDB is made of conductive metallic materials, an earthing (grounding) connection point shall be provided and utilized (a single point for the whole PHDB).

j) Any internal wiring and LV power cables must be separated by a distance of at least 50mm.

k) All internal conduits shall be of a diameter not less than 25 mm (1 inch) to extend the structured cables from the ONT to the SCS socket locations at each room.

Secondary Home Distribution Box (SHDB)

An SHDB is used only on floors of villas other than the ground floor. Its functions are:

a) To be the aggregation point for all cables running on a particular floor within a villa.

b) To be the link between sockets and PHDBs.

c) To house all the SPs' active and/or passive components for that particular floor, if required.

d) To house all customer active and/or passive components, if required.

The technical specifications of the SHDB are defined below:

a) The SHDB must be protruded/mounted on the wall with one compartment having front door, which provides a dust- free ventilation mechanism (grid doors, replaceable filter and/or ventilation fans)

b) The box shall be of adequate size to accommodate any of the following (decided by customer demand):

- CAT-6 Patch Panel (there is no actual limit on the total number of ports).
- Two (2)-way PDU of 230V AC (BS 1363 UK standard with isolated breaker of 13A).
- Simple cable management to minimize bending stresses on cables and enable clear unambiguous identification of pairs.
- Any customer equipment (switches, routers, etc.).

c) Must have cable entry ports on all sides to permit easy connection as well as grommets and seals for these cable entry ports and openings.

d) Must be installed in an easy to access area with good lighting, proper ventilation and air circulation. The SHDB shall not be installed in inaccessible or hazardous areas such as inaccessible corners, areas of high humidity, prone to water- condensation, adjacent to boilers, chillers or other industrial motors used to service building systems.

e) Must be dedicated to the unit it is located in.

f) The location of SHDB should take into consideration Wi-Fi coverage wherever possible.

g) If the SHDB is made of conductive metallic materials, an earthing (grounding) connection point shall be provided and utilized (a single point for the whole SHDB).

h) Any internal wiring and LV power cables must be separated by a distance of at least 50mm.

5.2.4. Ducting

External Ducting

The building developer is responsible for providing Lead-in Ducts for the main and redundant routes (if required) from the Building Access Point(s) to the HDB(s) or the Telecommunications Room(s).

The number of Lead-in or external Ducts and how they are routed will depend on whether network redundancy and multiple building connections are required and will be designed and implemented as agreed between the RED and the SPs. In any case, REDs must deploy external Ducts ensuring that there is sufficient capacity for all three SPs from the Access Point to the HDB or Telecommunications Room.

For ease of location, the Ducts should be clearly marked above ground. The exact connection points at the boundary will depend on whether the SPs' network already reaches the plot. Two scenarios arise:

1. The SP's network already exists: The RED will be responsible for the connection to the SPs' Duct systems.
2. The SP's network is still to be built: The RED will be responsible for extending the Lead-in Duct to 1m outside the plot boundary.

It is important to note that SPs may have different connection points for specific developments. In all cases, the building's developer shall be responsible for maintaining and repairing Lead-in Ducts. Additionally, Lead-in Ducts shall be exclusively assigned to Telecommunications Services.

For more information regarding external ducting technical specifications, refer to Appendix D: External Ducting Specifications.

Inter-DB Ducting

This component is used in all installations. Its function is to provide a cabling channel between DBs that supplies physical support for cable elements and protects the cable from mechanical compression and abrasion stresses during the installation and operation of the communications services.

The technical specifications for Inter-DB ducting are listed below:

a) Preferably to be UPVC pipes. Other solutions, like GI (Galvanized Iron) Ducts or cable trays, are also acceptable. These are rigid or semi- rigid Ducts designed for strength and mechanical stability.

b) The percentage fill of any inter-DB ducting used to distribute cabling must not be more than 50% by volume at the design stage.

c) Sharp or acute (more than 90°) bends must be avoided, if possible. Whenever bends are required, it is necessary to use smooth gradual bends that maintain the minimum bending radius of the cable. If sharp or acute (more than 90°) turning is unavoidable, it is required to use junction boxes that can be easily accessed in the future.

d) Any inter-DB Duct shall maintain a minimum clearance of 50mm from LV lines. If crossing is unavoidable then it shall be at an angle of 90°.

e) Ducts shall not be laid under wet areas such as kitchens or bathrooms.

5.2.5. Risers

Vertical Risers

Risers are required in multiple-story buildings for the installation of telecom cables from the Main Telecommunications Room to other floors.

Galvanized slotted iron cable trays (minimum 200x50 mm Heavy Duty Return Flange (HDRF)) should be provided from the Main Telecommunications Room to each Floor Aggregation Point and extended up to the Rooftop Telecommunications Room.

- The risers to each floor must be symmetrical and vertically in line with the Main Telecommunications Room.
- Where the Main Telecommunications Room, Floor Aggregation Points and Rooftop Telecommunications Room are to be located one below the other in a vertical line, a

continuous cable tray/conduit must be provided with pull boxes/access panels at every turning point and at an interval of 15 meters each, up to the Main Telecommunications Room. Right angles or sharp bends are to be avoided.

- If a building consists of more than one tower, all the above specified requirements are required for each tower The towers must be inter-connected at the Main Telecommunications Room, by separate cable trays of a minimum of 2 nos. and a size of 200x50 mm or through floor raceways passing through a common area between the two buildings. The same requirements also apply to mezzanine and penthouse floors. The telecom cable trays should have adequate separation from electrical cable trays. Electrical cable trays should not cross the telecom cable trays.
- Flexibility in cable plant placement can be provided by first placing small diameter micro Ducts (OD < 13 mm) into the building. The small diameter micro Ducts can be more easily placed in wall cavities, riser spaces and into/through telecommunications closet spaces. The small fiber or possibly some copper building cable can be placed into the micro Duct using blowing or pulling technologies and thereby be protected from physical damage from contact with the building during placement.
- Another alternative would be to use cable raceways integrated into plastic moldings that are designed to look like wood trims and moldings used along ceiling/wall and floor/wall corners. The cabling is then readily accessible but hidden from direct sight inside the molding products.

Horizontal Risers

The design of the horizontal distribution facilities for each building depends on the nature and telecommunications services requirements. REDs should co-ordinate with the SPs in the design review phase so that suitable and appropriate horizontal distribution facilities can be determined.

Ducts/conduits for horizontal wiring are recommended to be concealed during the construction of floors. All the concealed Ducts/conduits should be kept straight. Ducts/conduits with more than one bend should be provided with adaptable boxes at each turning for wiring work.

For buildings with small floor sizes, one 25mm diameter concealed conduit from the riser to the outlet end of each unit should be provided. For large floor size buildings, horizontal trunking system should be provided for cable running.

5.3. Reference models

Based on the nature of each type of building, it is possible to group these buildings into three case scenarios, each with its own unique requirements. The aggrupation is illustrated in the table below:

Building Aggrupation	Type of building
Detached SDUs	Single Villas
	Single Warehouse
	Small labor accommodation
Compound of SDUs	Compound of villas
	Group of shops and retail outlets
	Warehouse compounds
MDUs	Residential/commercial towers
	Shopping malls
	Multistore labor accommodation
Bulk services	Airports
	Banks
	Governmental buildings
	Hotels
	Hospitals
	Industrial complexes
	Railway stations
	Schools & Universities
	Stadiums

Table 5.2: Aggrupation of the types of buildings covered in the Standard

For illustrative purposes, the following figures show the reference models used across this document for the four groups of buildings defined above. The elements shown in those figures are described in the text below them.

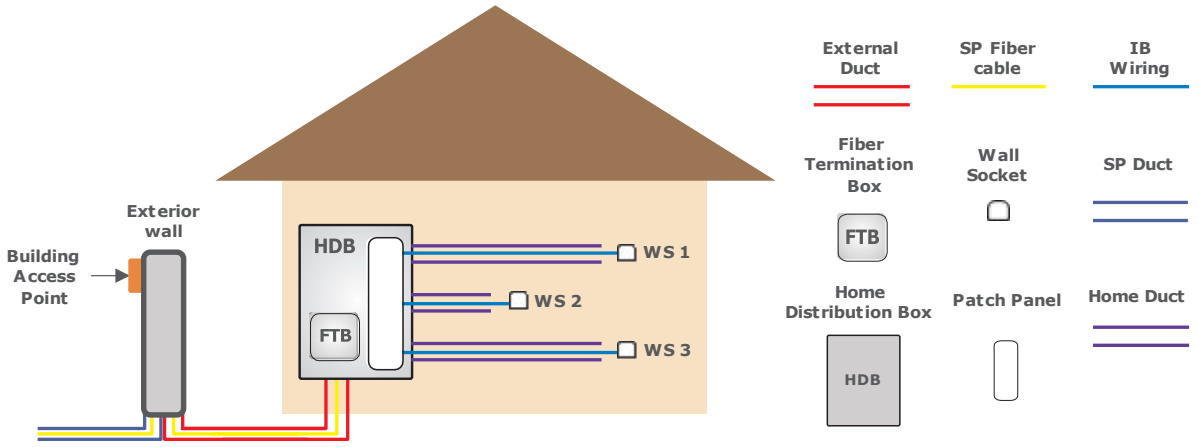

Figure 5.1: Detached SDU reference model

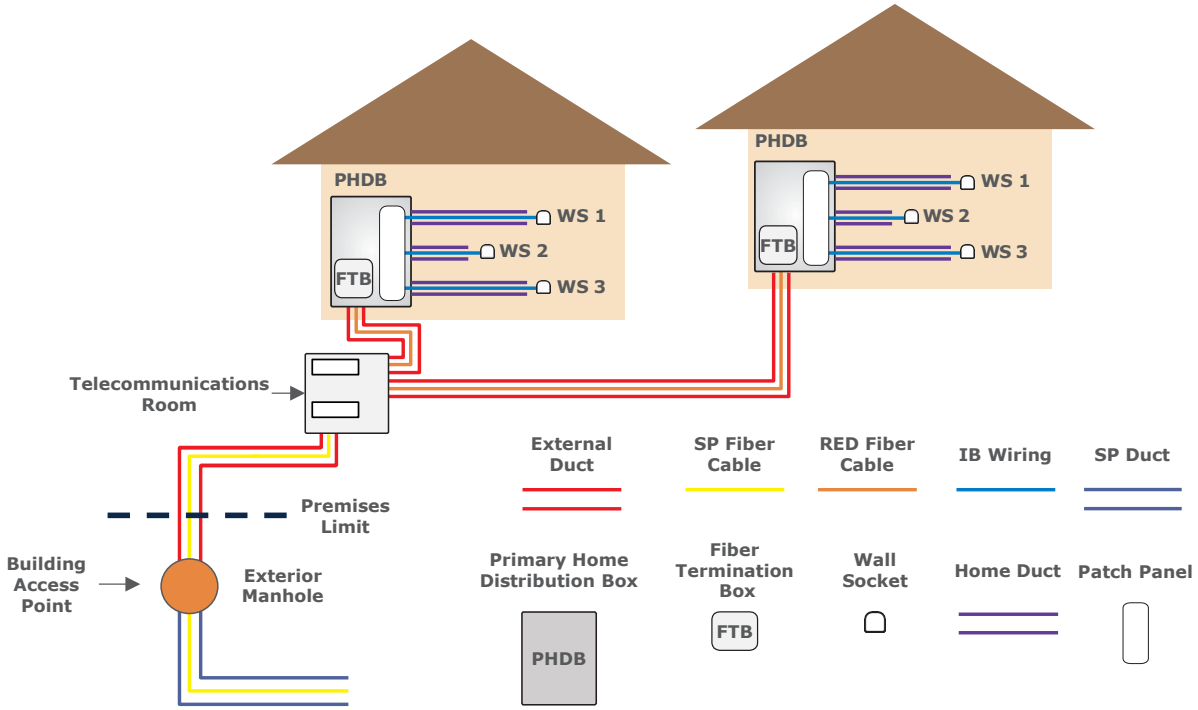

Figure 5.2: Compound of SDUs reference model

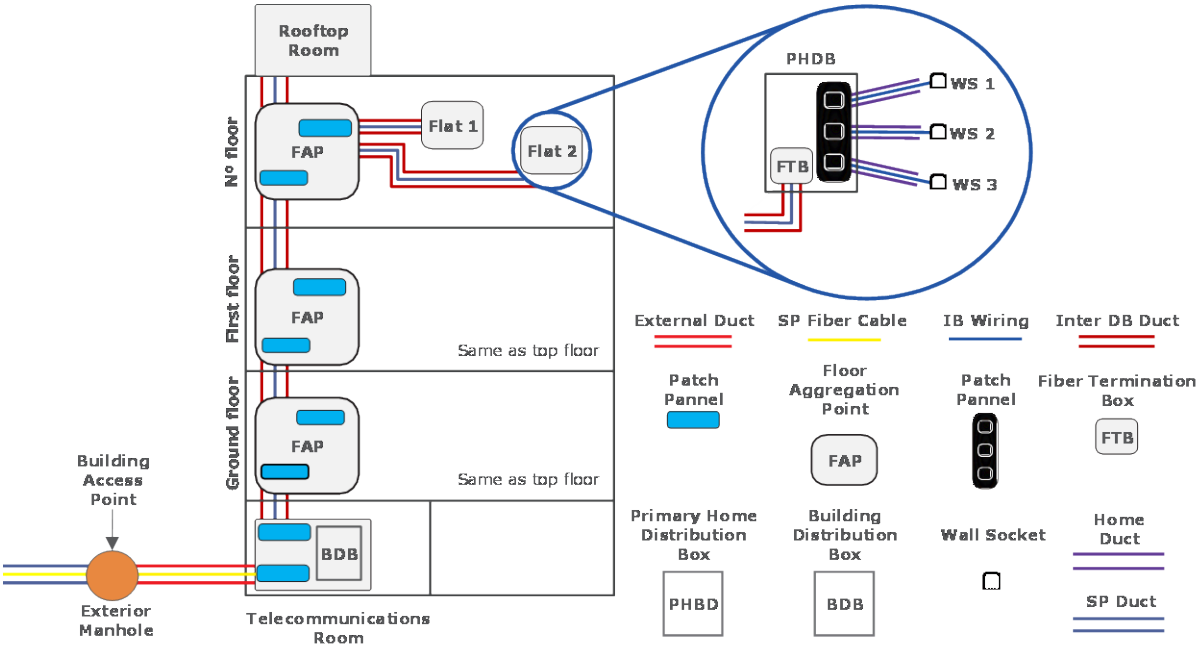

Figure 5.3: MDUs reference model

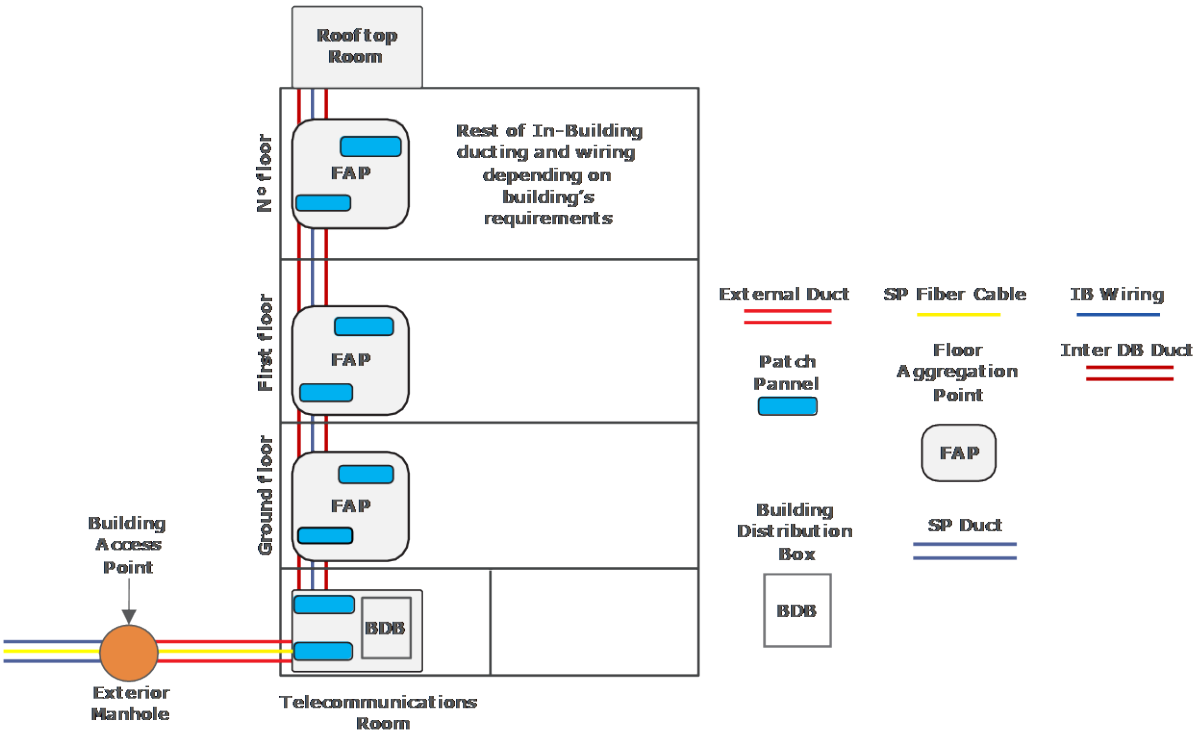

Figure 5.4: Bulk services reference model

5.4. Criteria to deploy IBW & IBS

The table below summarizes the types of buildings that require IBW and IBS. In the case of IBS, we observe that some buildings require further study to determine if an IBS is necessary. Such a study shall be performed during the building design phase, in coordination between the RED, its design contractor and the SPs.

Aspects that may be considered during the study are, inter alia: outdoor to indoor connectivity, size of the building(s), and the requirements of the occupants. If the study shows that IBS is required, the system shall comply with all relevant requirements set forth in this document and agreed by the parties.

Building Aggrupation	Type of building	IBW required	IBS required
Detached SDUs	Single Villas	✓	Subject to study
	Single Warehouse	✓	Subject to study
	Small Labor Accommodation	✓	Subject to study
Compound of SDUs	Compound of Villas	✓	Subject to study
	Group of Shops and retail outlets	✓	Subject to study
	Warehouse compounds	✓	Subject to study
MDUs	Residential/commercial towers	✓	✓
	Shopping malls	✓	✓
	Multistore labor accommodation	✓	✓
Bulk services	Airports	✓	✓
	Banks	✓	✓
	Governmental buildings	✓	✓
	Hotels	✓	✓
	Hospitals	✓	✓
	Industrial complex	✓	✓
	Railway stations	✓	✓
	Schools & Universities	✓	✓
	Stadiums	✓	✓
	Railway stations	✓	✓
Any	Building/compound Tunnels (e.g., connecting buildings, maintenance, utilities)	✓	✓

Table 5.3: Types of buildings that require IBW and IBS

Note that building/compound tunnels (e.g., connecting buildings, for maintenance, utilities) must have IBS connectivity, as stated in Section 7.2.2. As such, they qualify for mandatory IBS connectivity regardless of the group or type of building.

As indicated above, the solution deployed must be studied during the design phase.

6. In-Building Wiring (IBW)

6.1. Introduction and objectives

In-Building wiring is a vital aspect of the telecommunications infrastructure necessary to allow SPs to deliver innovative and high-quality services to their customers in property developments such as residential, business and commercial buildings.

Due to the rapid evolution of the ICT sector, especially for data services, the requirements of residential and businesses for modern telecommunication services have increased considerably.

REDs, building owners and landlords shall engage with SPs and follow this Standard's specifications at an early stage so that any process or design issues may be resolved to ensure provisioning of best and fastest services to the customer. This In-Building Telecommunications Infrastructure Standard has the following objectives:

- A common and neutral standard for in-building wiring to facilitate rollout of FTTx networks in property developments for the benefit of all stakeholder groups.
- Supporting the deployment of fiber networks as key infrastructure in the ICT sector.
- Common standards and requirements similar to best practice standards implemented globally.
- Provision of services from several SPs in parallel.
- Optimization of investments through the sharing of infrastructure elements like rooms, Ducts, cable trays and cabling.
- Efficient utilization of unused space in rooms for other functions, where applicable.
- Meeting minimum requirements regarding the provision of internal wiring to support telecommunications services in several types of building.

The guidance provided herein on internal wiring infrastructure is also designed to help "future-proof" networks as far as reasonably possible, given current technology trends. This will be done through, among other means, the use of Ducts, Category-6 cable/connector assemblies, G.657A2 indoor cable or other cables, which conform the optical characteristics of G.657A2, and by limiting cable span lengths to help maximize transmission performance.

This Section also defines the network demarcation points, and stakeholders' responsibilities for each of the group of buildings defined in Section 5.1.

6.2. General overview

6.2.1. General responsibilities

Each residential unit, regardless of whether it is part of a Multi-Dwelling Unit (MDU) or consists of a Single Dwelling Unit (SDU), must have a minimum of 1 fiber cable with 4 fiber optic strands - one for each of the 3 SPs and one spare. The residential retail subscribers should be able to avail services from all three SPs simultaneously if they so choose.

The building owner is responsible for the maintenance, repair, and future upgrade requirements of in-building cables in all publicly accessible/maintenance areas in the building. The homeowner or dwelling unit owner owns, manages and is responsible for the internal wiring inside the living space.

The building owners, builders, property developers, consultants and contractors are advised to provide the various in–building requirements, as applicable, to ensure timely provision of services.

Building owners are also responsible for the User Internal Network as well as any special requirements for other, non-telecommunications, services (building management system (BMS), CCTV, etc.).

Figure 6.1 illustrates some of the additional internal wiring possibly required within the living area. Within these spaces, individual building and dwelling owners will make very different choices on exact cable pathways and locations based on their immediate needs and desired flexibility for the future. Such additional internal wiring must not adversely impact the quality of the installation of wiring to support telecommunications.

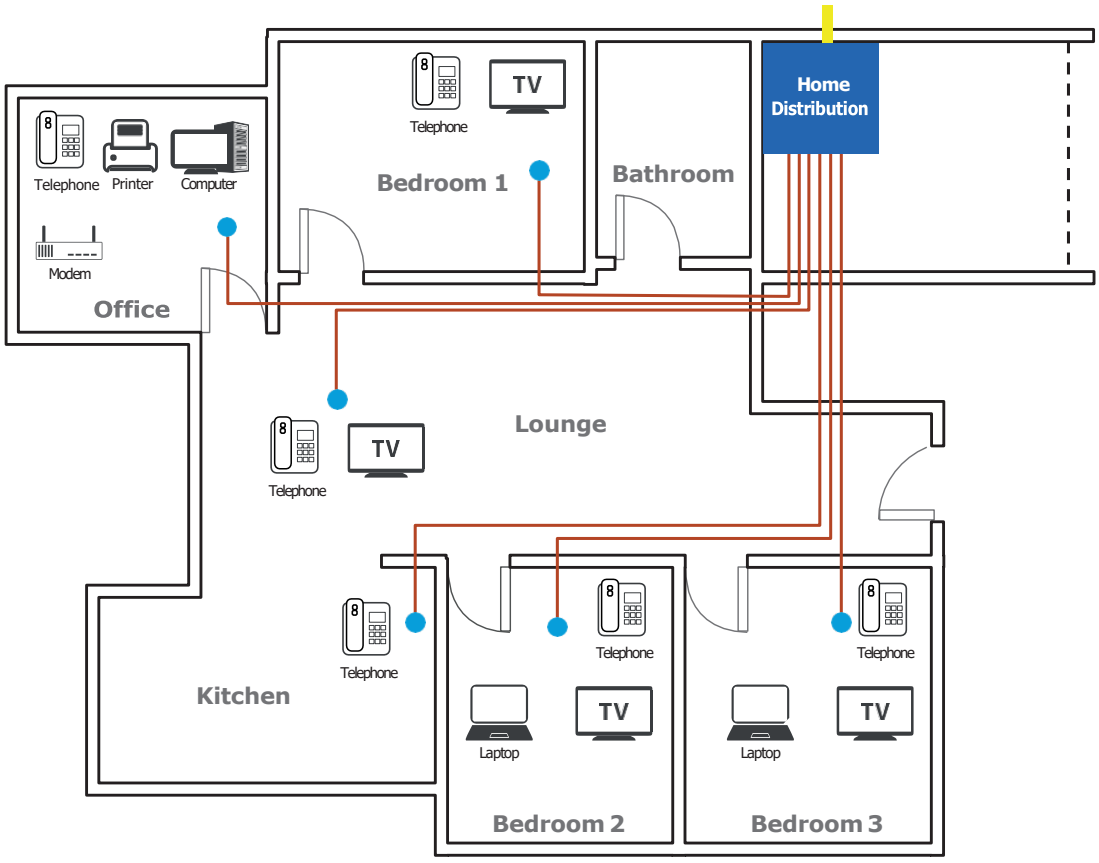

Figure 6.1: Plan view of scope

6.2.2. Existing and New Buildings Internal Wiring

Existing Building without Internal Wiring

The same requirements as for new buildings shall apply to existing buildings where no internal wiring has been deployed.

As a general note, installations prior to the issuance of this Standard document may have some inherent constraints, making it impractical or prohibitively expensive to upgrade them. It is assumed that, in such cases, no upgrades will be carried out.

Existing Building Internal Wiring

For existing buildings where the SPs have already deployed the in-building wiring, its ownership shall be transferred via commercial agreements to the RED or building owner, as will the responsibility for this wiring's maintenance and related matters. This transfer will ensure homogenization of responsibilities across the country, providing a clear definition of responsibilities, and ensuring fair competition and non-discrimination. Ownership and

maintenance responsibilities should be transferred within 2 years from the publication of this Standard.

As a general note, installations prior to the issuance of this Standard document may have some inherent constraints, making it impractical or prohibitively expensive to upgrade them. It is assumed that, in such cases, no upgrades will be carried out.

New Building Internal Wiring

Any new development is expected to comply with all the requirements set out in this document regarding internal wiring.

6.3. Guidelines for different Scenarios

Following the aggrupation made in Section 5.3, several wiring scenarios are provided for illustration and guidance. It is understood that each individual building will have specific floor plans, wall layouts and distinct room locations that will necessitate customized cable pathways and node locations.

The sections below describe specific requirements for each group of buildings, particularly in relation to the delimitation point and REDs and SPs:

6.3.1. Detached SDUs

Even though other configurations are possible, the figure below shows a typical case of a single tenant in-building infrastructure, with the Building Access Point located at the exterior wall of the premise.

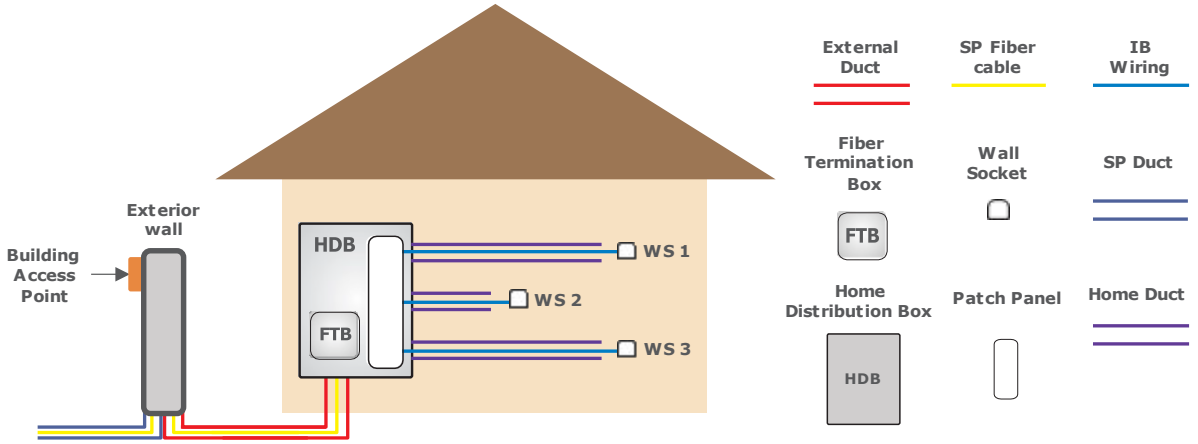

Figure 6.2: Detached SDUs illustrative diagram

The responsibilities of each party in relation to the deployment of the in-building infrastructure are summarized below:

Type of building	Building Access Point	REDs responsibilities	SPs responsibilities
Detached SDUs	Entry box placed on exterior wall	Installation and deployment ▶ Installation and deployment of the HDB, FTB and WSs. ▶ Deployment of Lead-in Ducts connecting premise and the Building Access Point. ▶ Deployment of internal wiring and ducting from the FTB (which corresponds with the Network Termination Point) to the WSs. Ownership and maintenance ▶ From the Building Access Point to each WS, excluding the fiber deployed by the SP between the OSP and the FTB.	Installation and deployment ▶ Deployment of fiber from OSP up to FTB. ▶ Installation of the CPE at the User Access Point to the extent it is included in the SP's commercial offer. The User Access Point will be the ONT or home gateways installed in the PHDBs. Ownership and maintenance ▶ The fiber deployed from the OSP to the FTB. ▶ CPE, to the extent it is included in the SP's commercial offer.

Table 6.1: Responsibilities of each party on Detached SDUs

6.3.2. Compound of SDUs

Similarly to the detached SDU's scenario, for illustrative purposes, the figure below shows a typical case for a complex of single tenant in-building infrastructure, where the Building Access Point is located at the exterior manhole outside the premise.

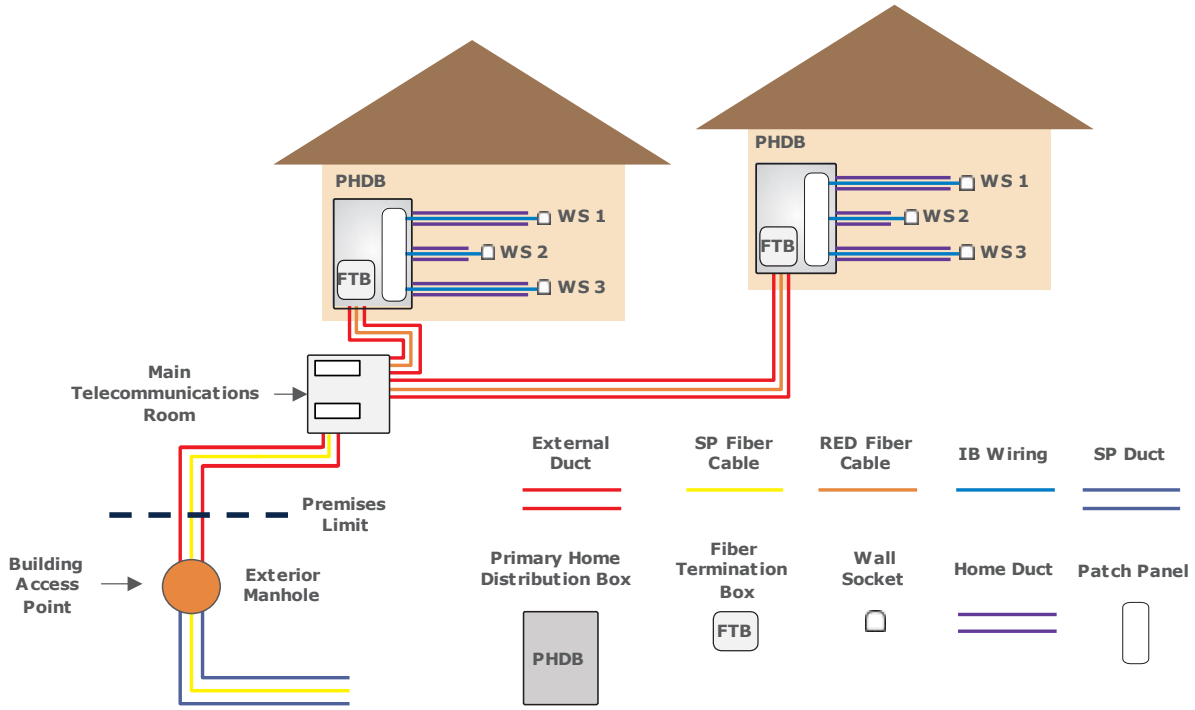

Figure 6.3: Compound of SDUs illustrative diagram

The responsibilities of each party in relation to the deployment of the in-building infrastructure are summarized below:

Type of building	Building Access Point	REDs responsibilities	SPs responsibilities
Compounds of SDUs	Outside manhole	Installation and deployment ▶ Deployment of Main Telecommunications Room. ▶ Deployment of Lead-in Ducts connecting outside Manholes. ▶ Deployment of HDBs, FTBs ad WSs. ▶ Deployment of fiber and ducting from Telecommunications Room (which corresponds with the Network Termination Point) to each FTB. ▶ Deployment of internal wiring and ducting from the FTBs to the WSs. Ownership and maintenance ▶ From the Building Access Point to each WS, excluding the fiber deployed by the SP between the OSP and the Main Telecommunications Room.	Installation and deployment ▶ Deployment of fiber up to the Compound Main Telecommunications Room. ▶ Installation of the CPE at the User Access Point to the extent it is included in the SP's commercial offer. The User Access Point will be the ONT or home gateways installed in the PHDBs. Ownership and maintenance ▶ The fiber deployed from the OSP to the Main Telecommunications Room. ▶ CPE, to the extent it is included in the SP's commercial offer.

Table 6.2: Responsibilities of each party on Compounds of SDUs

6.3.3. Multi Dwelling Units (MDUs)

For illustrative purposes, the figure below shows a typical case for a MDU building, where the Building Access Point is located at the exterior Manhole outside the premise.

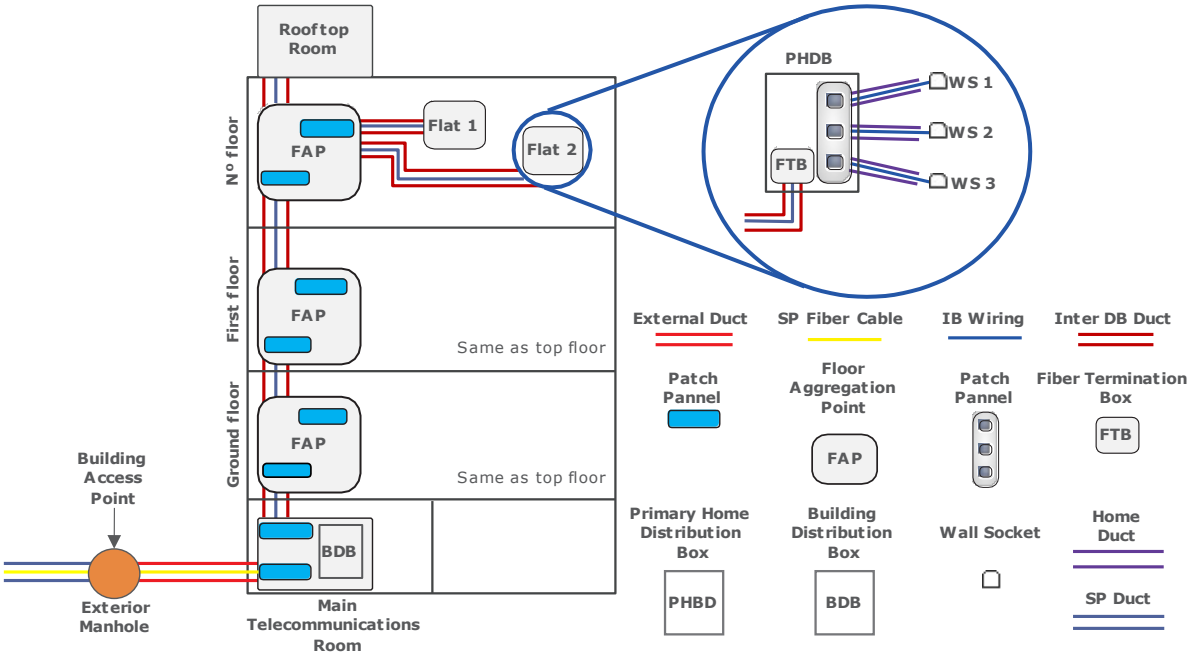

Figure 6.4: MDUs illustrative diagram

The responsibilities of each party in relation to the deployment of the in-building infrastructure are summarized below:

Type of building	Building Access Point	REDs responsibilities	SPs responsibilities
Multi Dwelling Units	Outside Manhole	Installation and deployment ▶ Building of Telecommunications Room. ▶ Deployment of Lead-in Ducts to connect outside Manholes. ▶ Deployment of FAP, PHDB, FTBs and WSs. ▶ Deployment of fiber and ducting from Telecommunications Room (which corresponds with the Network Termination Point) to each FTB. ▶ Deployment of internal wiring and ducting from the FTBs to the WSs. Ownership and maintenance ▶ From the Building Access Point to each WS, excluding the fiber deployed by the SP between the OSP and the Main Telecommunications Room.	Installation and deployment ▶ Deployment of fiber up to the Main Telecommunications Room. ▶ Installation of the CPE at the User Access Point to the extent it is included in the SP's commercial offer. The User Access Point will be the ONT or home gateways installed in the PHDBs. Ownership and maintenance ▶ The fiber deployed from the OSP to the Main Telecommunications Room. ▶ CPE, to the extent it is included in the SP's commercial offer.

Table 6.3: Responsibilities of each party on MDUs

6.3.4. Bulk services

For illustrative purposes, the figure below shows a typical case for a bulk services building, where the Building Access Point is located at the exterior Manhole outside the premise:

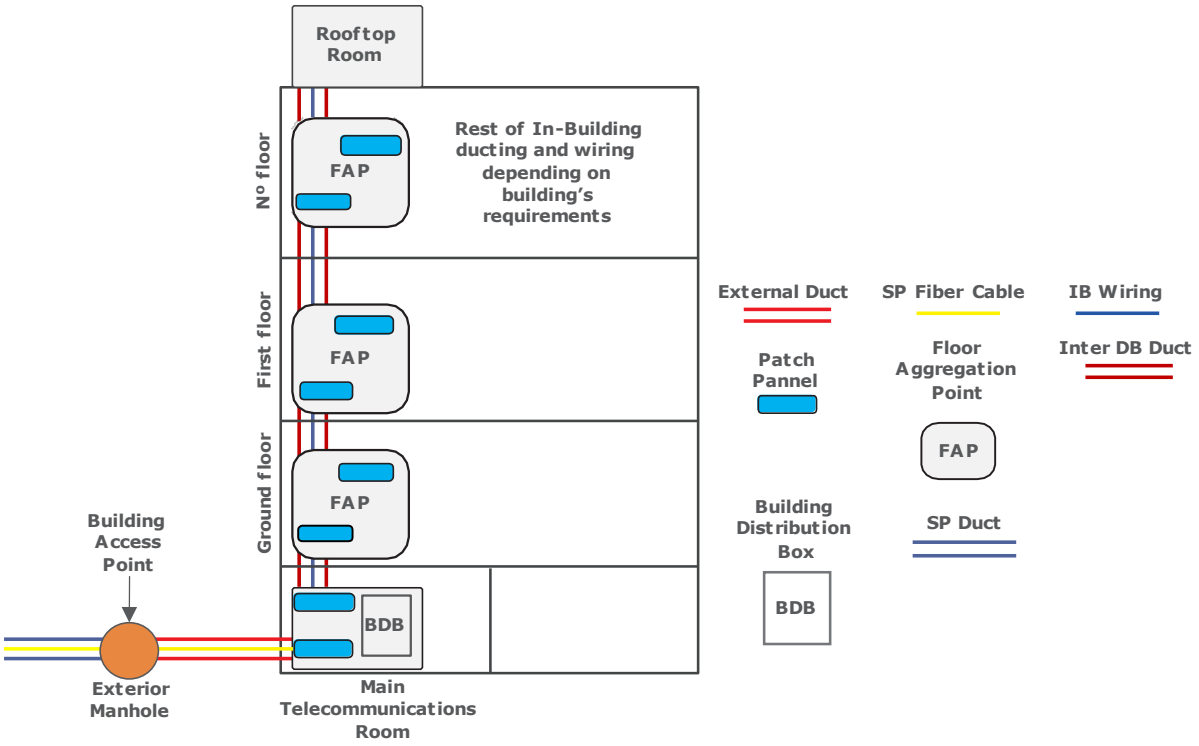

Figure 6.5: Bulk services illustrative diagram

Note that the illustration above does not define the internal wiring for such buildings. It is the building owner who will define the internal wiring requirements during the design phase, such as fiber or Ethernet connections throughout the building. However, if the building has independent units that require dedicated connectivity, such as airport shops, and the building owner does not provide it, all such units must be connected to the Telecommunications Room via fiber. This approach shall be similar to the one followed in shopping malls (refer to Section F.3).

In light of the above, the responsibilities of each party in relation to the deployment of the in-building infrastructure are summarized below:

Type of building	Building Access Point	REDs responsibilities	SPs responsibilities
Bulk services	Outside Manhole	Installation and deployment ▶ Building of Main Telecommunications Room. ▶ Deployment of Lead-in Ducts to connect outside Manholes. ▶ Deployment of FAPs and other relevant elements such as Distribution Boxes, FTBs and WSs. ▶ Deployment of internal wiring and ducting. Ownership and maintenance ▶ From the Building Access Point to each WS, excluding the fiber deployed by the SP between the OSP and the Main Telecommunications Room.	Installation and deployment ▶ Deployment of fiber up to the Main Telecommunications Room Ownership and maintenance ▶ The fiber deployed from the OSP to the Main Telecommunications Room.

Table 6.4: Responsibilities of each party on MDUs

6.4. Responsibility matrix

This section provides a summary of the detailed responsibilities of all parties for different types of buildings.

6.4.1. Detached SDUs

	Item description	Master plan developer	RED/Building Owner	SP
1	Lead-in Ducts, including connections to JRC\Manholes outside boundaries	✓		
2	Installation of Manholes and Ducts outside the building /boundaries (including cover)*	✓		

	Item description	Master plan developer	RED/Building Owner	SP
3	Entry boxes inside the building/villa boundaries (including the cover)		✓	
4	Supply and Installation of HDB		✓	
5	Splicing and Labelling Multicore fiber cables with 4 core drop cables using Wall Mount Mini ODF			✓[17]
6	Horizontal cabling work inside the unit/apartment/office/retail		✓	
7	Vertical and horizontal cable trays/pathways/Ducts/micro/patching Ducts supply and installation		✓	
8	Provision of connectivity from the SP's Access Network to the HDB			✓
9	Provisioning of Customer Premise Equipment (CPE) and patching between CPE and FTB			✓
* Subject to CRA approval				

Table 6.5: Summary of responsibility matrix for SDUs scenario

6.4.2. Compounds of SDUs, MDUs and Bulk Services

	Item description	Master plan developer	RED/Building Owner	SP
1	Lead-in Ducts, including connections to JRC\ Manholes outside boundaries	✓		
2	Installation of Manholes and Ducts outside the building /boundaries (including cover)*	✓		
3	Entry boxes inside the building/villa/complex of villas boundaries (including the cover)		✓	

[17] Single drop fiber cable laid by the SP.

	Item description	Master plan developer	RED/Building Owner	SP
4	Supply and Installation of Terminal Box		✓	
5	Splicing and Labelling of Multicore fiber cables with 4 core drop cables using Wall Mount Mini ODF		✓	
6	Horizontal cabling work inside the unit/apartment/office/retail		✓	
7	Supply and Installation of FTTx components between the Telecommunications Room and the FTB (e.g., ODF, patch panel, patching, splitters, Mini ODF, cabinet, port fiber terminal box…)		✓	
8	Supply of fiber patch cords and patching between the building's Optical Distribution Frame (ODF) and the SP's ODF (both located in the building's Telecommunications Room)			✓
9	Vertical and horizontal cable trays/pathways/Ducts/micro/patching Ducts supply and installation		✓	
10	Provisioning of Customer Premise Equipment (CPE) and patching between CPE and FTB			✓
11	Building Telecommunications Rooms/spaces (including provision of power and cooling) and related EM and civil requirements		✓	
12	Provision of connectivity from the SP's Access Network to the building's Main Telecommunications Room (MTR)			✓
13	Allocation of Rooftop Telecommunications Rooms (RTTR)/spaces	✓		
14	Building of RTTR and MSTR and related EM and civil requirements*		✓	

	Item description	Master plan developer	RED/Building Owner	SP
15	Fiber optic cables supply, pulling, termination, testing and maintenance from the MTR/HDB to: i) The FAP; ii) Each MSTR, and iii) RTTR		✓	
* Subject to CRA approval				

Table 6.6: Summary of responsibility matrix for Compounds of SDUs, MDUs and bulk services scenarios

6.5. Functional components overview

Internal wiring elements can be grouped into the functional groups listed below. Note that common components such as Telecommunications Rooms, distribution boxes or ducting, described in Section 5.2.3, are also applicable to wiring functional components.

1. Optical Fiber Components
2. Copper Components
3. Ducting System

These functional groups contain the following components:

6.5.1. Optical Fiber Components

In any internal wiring scenario, there are five (5) different types of optical components that may be used. For technical specifications of a particular type, refer to Section 6.12 and Appendix B below.

Optical Cable (Internal Optical Fiber Cable)

This component is used in any scenario other than the detached SDUs. Its function is to extend the optical signal from BDB up to PHDB, either by:

a) Direct optical cables passing through the Floor Aggregation Point (FAP),

b) Splicing inside Fiber Splicing Box (FSB), or

c) Patching inside the Floor Distribution Box (FDB).

Fiber Patch Panel

This component is used inside BDBs and, if required, inside FDBs. Its functions are:

a) To terminate optical cable(s).

b) To give an easy interface to the optical fiber network through patching to permit rapid and trouble-free re-configuration of SPs and services to individual homes' Home Distribution Box (HDB).

Fiber Splicing Box (FSB)

This component is used inside the FAP whenever SP's active or passive elements are not to be used.

Fiber Termination Box (FTB)

This component is used inside BDBs and HDBs in all installations. Its functions are:

a) To terminate optical cable(s) (the SPs' or internal cable(s)).

b) To give an easy interface to the optical fiber network through patching.

Fiber Patch Cord

This component is used in all installation scenarios. Its function is to cross-connect two optical fiber components.

6.5.2. Copper Components

In any internal wiring scenario, there are four different types of copper components that may be used. For technical specifications of a particular type, refer to Section 6.12 and Appendix C below.

UTP (Unshielded Twisted Pair) Cable

This component is used in all installations. Its function is to extend the electrical signal from an HDB (PHDB or SHDB) to copper termination points (sockets).

Copper Patch Panel or Cross-Connect Box

This component is used inside HDBs in all installations. Its functions are:

a) To terminate UTP cables in a PHDB or SHDB.

b) To give an easy interface to the copper network through patching for necessary re-configuration and testing of individual services.

Copper Termination Point (Socket or Jack)

This component is used in all installations. Its functions are:

a) To terminate a UTP cable extended from a PHDB or SHDB.

b) To give an easy interface and access to the copper network at wall sockets (jacks) points that permits disconnection/connection of different customer premises equipment as required.

Copper Patch Cord

This component is used in all installations. Its function is to cross-connect two copper components while ensuring minimum loss in signal power (low resistance) and maintaining data capacity levels at a minimum of Category 6 transmission performance.

6.5.3. Ducting System

In any internal wiring scenario, there are three (3) different types of ducting systems that may be used:

- External Ducting
- Inter-DB Ducting
- Home Ducting

Note that external ducting and inter-DB ducting are described in Section 5.2.4. For further technical specifications, refer to Section 5.2.4 and Appendix D.

Home Ducting

This component is used in all installations. Its function is to provide a cabling channel between HDB (PHDB or SHDB) and sockets that supplies physical support for cable elements and protects the cable from mechanical compression and abrasion stresses that occur during installation and operation of the communications services. Home ducting can also provide some protection to the UTP communication cable from induction effects of nearby or adjacent power supply cables.

The technical specifications for home ducting are listed below:

a) They shall be constructed in star topology. If that is not possible, a maximum of four (4) sockets can be connected in series (Daisy Chain). This shall not affect the UTP cables' star topology.

b) Home Ducts are to be preferably of UPVC pipe materials. Other solutions, such as surface floor boxes with GI Ducts or skirting multi-compartment trunking, are also acceptable.

c) The percentage fill of any home ducting solution used to distribute cabling must not be more than 50% by volume at the design stage.

d) Sharp or acute (less than 90°) bends must be avoided, if possible. Whenever bends are required, the use of smooth gradual bends that maintain the minimum bending radius of the cable is required. If sharp or acute (less than 90°) bends are unavoidable, the use of junction boxes that can be easily accessed in future is required.

e) Any Duct shall maintain a minimum clearance of 50mm from LV power lines. If crossing is unavoidable, it shall be at an angle of 90°.

f) Home Ducts shall not be laid under wet areas such as kitchens or bathrooms.

6.6. General design considerations

All designs shall support a multi-operator environment for up to three Service Providers. When this document does not specifically mention multi–Service Providers, and where diagrams within this document do not show specifics for a multi-operator environment, it is the duty of the REDs and their designers to ensure that support for up to three Service Providers is provided in their specific design(s).

1. Facilities for concealing cabling facilities and apparatus: in common with water, gas pipes, lighting conduits and electrical fixtures, cabling facilities and equipment will eventually become a permanent part of the building.
2. General requirements for cabling network systems: the REDs may refer to the latest edition of the following widely recognized standards for the design, planning and construction practices of cabling network systems:
    - TIA/EIA 568-B: Commercial Building Telecommunications Cabling Standard;
    - TIA/EIA 569-A: Commercial Building Standard for Telecommunications Pathways and spaces;
    - ISO/IEC 11801: Generic Cabling for Customer Premises;

- BS EN50173: Information Technology, Generic Cabling Systems, General Requirements and Office Areas.

3. Segregation between electricity supply and telecommunications/IBCCDS cables: the following minimum segregation between electricity supply cables and the telecommunications/IBCCDS cables should be provided:
    - For low voltage cables (not exceeding 600V between phase and earth), a minimum clearance of 50 mm should be given.
    - For high voltage cables (exceeding 600V between phase and earth), a minimum clearance of 300 mm should be given.
4. Ducts, risers and trunkings: The cable Ducts, vertical risers, and trunkings for carrying cables should be made of flame-retardant and corrosion/weather resistant materials. Sharp objects should be avoided inside or outside the trunking. It should provide removable covers throughout the entire length for installation and maintenance of cables. Trunking covers should normally be friction fit or should be secured by simple devices, but not screws. Easy bends are required at turning points to ensure that the cable bends comply with the minimum bending radius requirements.
5. A telecommunications closet will be required if it is not possible to accommodate the equipment and distribution cases/ connection boxes in the riser. The requirements of telecommunications closets will vary with the design of the in-building telecommunications systems. Developers should refer to the latest edition of the widely recognized standards for the design, planning and construction practices of cabling network systems. Developers should also discuss with the network SPs the actual requirement of the telecommunications closet, if applicable. The telecommunications closet may be an enclosure of a small floor area or a section of wall surface where the network SPs could mount their equipment onto the wall. There should be sufficient working clearance for the workers and suitable concealing arrangement to avoid unauthorized access. There should also be links between the telecommunications closet and the riser. A suitable power supply should be available in the telecommunications closet.
6. Earth connection for telecommunication: An earthing system should be provided for the telecommunications/broadcasting systems. It should have a resistance to earth of not greater than 3 Ohms and should be terminated on an earth bus bar inside the Telecommunications Room.
7. For fire safety, the developer should observe all relevant civil defiance ordinances and regulations regarding fire safety requirements in the design of building wiring networks.

8. Design of underground Duct network: the following recommendations should be considered when laying an entry Duct:
    - The Duct should be laid in the ground at an approximate depth of 600mm from the surface finishing level.
    - Entry Duct should be extended to an approximate distance of one meter into the public footpath.
    - Suitable draw rope or pulling tape should be provided in each Duct for the purpose of drawings cables at the time of installation.
    - The unconnected ends of all pipes should be capped with rubber caps to prevent entry of earth, debris or other material.
    - Location of lead-in Ducts shall be clearly marked above ground for easy locating.
9. The number of fiber cables to each unit or dwelling may vary, but the independent fibers to each unit shall be at least four (4).
10. All copper cable elements (twisted copper pairs) must be rated at Category-6 or better.
11. Wherever an UTP (Unshielded Twisted Pair) cable termination is required, all UTP cable pairs must be terminated.
12. All wall mounted DBs (Distribution Boxes) must be installed at least 1.2m above the finished surface level.
13. All UTP cables must be laid in star topology, with no exceptions.
14. The UTP cable span between Patch Panel and Socket shall not exceed 90m in length. This is to allow for 10m of patching.
15. Spans between equipment running Ethernet protocol shall not exceed 100m in length.
16. All Optical Fiber elements must be Single Mode (SM) and compliant with at least ITU-T G.657A2.
17. All fiber splices in internal wiring are to be “Fusion Spliced”. Typical splice attenuation shall not exceed 0.05dB.
18. The minimum bending radius, expressed as a multiple of the overall cable diameter shall be 20 times overall diameter for Single Mode fiber cables.
19. The bending radius is expressed as a multiple of the short access cross section of the flat drop cable (H). Under the dynamic bending, the bending radius is 20H and static 10H.

20. As a minimum requirement, the power measurement shall be taken between the ODF, located in a Telecommunications Room (TR) and the FTB (Fiber Termination Box) at 1310, 1550 and 1650nm after installation. A copy of the test results is to be provided and left with the installation documentation and certification.
    - It is advisable that the fiber characterization documentation and certified data package include OTDR (Optical Time Domain Reflectometer) scans and power loss measurements for the complete optical span from the ODF/OLT in the Telecommunications Room to the FTB.
    - Such OTDR and power measurements should be made at appropriate and convenient times during the construction and installation process to help provide interim quality checks on the splicing, placement and connection activities that can degrade the fiber performance.
21. All CAT6 spans must be continuous - middle joints are not allowed.
22. All elements of internal wiring must be labelled properly to simplify operation and maintenance work. Labels on elements must match the label in the documentation and the labels at each end of single span shall correlate in description and color. Various methods and strategies of identification can be used including printing on cable jackets along with printed or colored tags at cable/fiber termination points.
23. In any MDU complex, if the total number of connections is more than 100, a Telecommunications Room Type A must be provided.
24. In any MDU complex, if the total number of connections is less than or equal to 100, a Telecommunications Room Type B must be provided.
25. For all outlets supplying power for any telecommunications service, the use of UPS (Uninterruptible Power Supply) is the recommended back-up powering option.
26. Only components that have been independently certified to meet applicable UL or TUV safety criteria (or equivalent requirements) by a recognized independent body shall be used.
    - UL - Underwriters Laboratories
    - TUV - Technischer Überwachungsverein (Technical Inspection Association)
27. All Category-6 rated cables are to be tested and certified as meeting Category-6 transmission standards (TIA-EIA 568 criteria) through testing with a calibrated Industry Standard Category-6 test set. A certified copy of the compliance test results is to be provided and left with the installation documentation and certification.

28. Any design based on this document must clearly document that and specify which version/date of this document is being followed.

6.7. Design Review Process

Design Review and Construction Certification Process document[18] annexed to this Public Consultation.

6.8. Construction Certification Process

Design Review and Construction Certification Process document[18] annexed to this Public Consultation.

6.9. Process Installation Quality

The installation methods and procedures used to build the physical plant are a critical component of creating a quality network service. The functional performance of a good quality ITU 957 bend-resistant fiber cable (ITU G.657, “Characteristics of a Bending Loss Insensitive Single-Mode Optical Fibers and Cables for the Access Network”) can be quickly compromised by bad or improper installation methods and procedures during the construction work. A Category 6 cable connected improperly to a Category 6 terminal block can easily result in a service that is well below the acceptable and expected Category 6 performance. Typical statistics for cabling network infrastructure show that:

- Cabling costs about ~10% of the total network infrastructure;
- Typical cabling systems last 16-20 years, usually outlasted only by the shell of the building;
- 60-80% of the network problems have root causes in poor cabling techniques that damage cable and/or cable component problems.

As discussed above and elsewhere in this guide, the process checks to achieve the desired quality assurance and reliable performance of the network include various factors, namely:

a) Quality materials selection through adequate functional performance specifications for products coupled with a manufacturing process that follows good Quality Management Systems (QMS) such as ISO 9000. A 5-year warranty for the major plant elements shall be required to help ensure long-term reliable performance of plant.

[18] This document has been prepared by the Service Providers and has not been reviewed by the CRA

b) Engineering Plans. Detailed engineering plans, drawings and general directions to help specify the best cable path shall be provided.

c) Installation Practices. Physical stress and damage to cable shall be minimized by decreasing exposure of cables, components and individual conductors to kinking, abrasion, twisting, bending and compression.

d) Worker Training. Installers must be equipped and trained with adequate knowledge, good M&P (methods and procedures), and the correct tools, maintained in good working order.

e) Safety. Sound safety methods and procedures for both personal safety and protection of equipment must be followed.

To help ensure adequate quality of workmanship during construction (Items (c) and (d) in the above list), agreements covering in-process quality checks along with training requirements and certifications for construction and installation workers need to be established and followed. Having quality checks and processes in place during the installation will help avoid repair time, remedial costs and future problems. Having post- construction performance tests is a baseline requirement.

The installation/construction company is required to show that industry best practices have been followed and their installation crews have been both (a) properly and adequately trained, and (b) that the materials and tools used (e.g., cables, connectors, and crimping tools) are well-maintained and compatible with each other.

Testing of the cable, connection, termination and other network element equipment is a vital step in evaluating system performance and needs to be completed at several points during installation and construction activities. To maximize the reliable lifetime of the communications facilities, the network operator and building owner should ensure, by physical plant and transmission testing, that the system performance is met.

The final acceptance performance tests for the installed system shall be documented and certified to characterize the transmission profile for the network and for individual termination points. Separate profiles of transmission performance of the key spans shall be provided and include:

- OSP segment includes fiber link from the OLT in the SP's Central Office (CO) to the building demarcation point (BDB or PHDB). This test will be performed by the SP.
- In-building Span includes fiber or copper link from the building demarcation point (BDB or PHDB) to FDB and HDB.

- Home Span = Copper cable link from HDB to individual connection point (e.g., wall jack or socket).

These records need to be easily assessable during re-configuration of the network, adding data stations and troubleshooting any future problems to help locate and repair any problems. All test sets used to characterize these spans shall be independently calibrated and have labels detailing calibration date and status.

Qualification testing shall be completed for all new plants after they have been built or, for older plants, immediately after they have been modified. The qualification test record is used not only to certify the network as meeting contractual agreements, but also as a reference point for any future examination and troubleshooting of the network. This testing should include frequency sweeps to characterize the network fully.

See Section 6.10 and 6.12 for a further discussion and details on the appropriate guidelines and procedures for qualification testing of the in-house plant.

6.10. Installation of Equipment and Cabling Procedures

6.10.1. General Guidelines

The reliable performance of the fiber and internal copper cabling network is heavily dependent on the quality assurance procedures applied and followed during the installation and construction phases. Improper installation will easily degrade the performance of optical fiber, Category-6 cable and other hardware components. The necessary quality assurance procedures include:

1. Quality Inspections – Evidenced by documentation on materials used, expertise and training of workers, and records of the construction. This will include construction records and detailed work Methods and Procedures (M&Ps) that were followed during work.
2. Visual inspections completed during and after the installation and construction work, evidenced by documentation and certifications by the installation contractor as well as by quality inspection reports taken as part of acceptance of the as-built network by the SP, building owner and other interested stakeholders.

Quality Inspections - Checklists and Documentation

General installation guidelines and quality checklist items that can be used to help minimize plant damage and maximize performance and reliability of the inside building network include the following items:

1. Quality Check on Materials – The sources and suppliers of all cable, connector, closure box and hardware components in the network shall be documented and retained as part of the network acceptance certification. The inspection of all incoming materials and the use of correctly sized and matched tools for cable work (fiber and copper pairs) shall be part of quality assurance procedures for any construction and installation project.
2. Check of Engineering Drawings - Network schematics and engineering drawings shall be available and include the list of dwelling units, rooms, layouts and end-to-end cable route with notations of any ceiling / raised floor type construction. The testing protocols and procedures used for cable inspection and final acceptance of network shall be documented.
3. Proper Tool Selection and Use - The correct tools need to be used to obtain a good metallurgical bond for electrical connections or low loss optical connections. Punch down, splicing and crimping tools are designed to match connection housings with specific cable, conductor or fiber sizes. The type and size of tools used shall match those specified by the manufacturers of the Category-6 cables, fiber cables, connectors and termination blocks. Incorrect tools or incorrect use of tools can lead to (1) poor electrical or optical connections, (2) physically loose connections, (3) contamination of connections with small pieces of conductor (conductive metal) or dust particles, and/ or (4) damage to adjacent connections or terminal pins.
4. Training Records – The training and certification records for the installation and construction crews shall be available to show that the cable plant was placed with well trained and knowledgeable workers using industry best practices.
5. Cable Span Characterization - The final acceptance performance tests for the installed system shall be documented and certified to characterize the transmission profile for the network and for individual termination points. Separate profiles of optical loss (tested with an Optical Time Domain Reflectometer (OTDR)) or transmission performance (e.g., attenuation, impedance and crosstalk) of the key spans will be available and include:

    v. OTDR scan of the fiber span from the OLT in the CO to the building demarcation point (BDB or PHDB).

vi. Inside Building Span = From building demarcation point (BDB or PHDB) to FDB and HDB.

vii. Home Span = From HDB to individual connection point (e.g., wall jack or socket).

Visual Inspections

Visual inspections can occur during and after installation. The visual audit or walk-through of the network can be achieved with a simple toolkit of flashlight, a written checklist based on the items discussed below and a multimeter or low-cost OTDR meter.

This visual audit can and should be an on-going process throughout the installation and construction phases. Part of this audit or review can entail interviews with installers and contractors to ascertain that craftspeople understand the methods and procedures and know who and where to go for resolution of any question.

The visual inspection should cover not only patch panels, distribution boxes, termination racks and telecommunications closets, but may also need to follow cable pathways and Ducts. The inspector shall look in all the accessible places for certain warning signals such as:

a) Damaged cables or Ducts - Abraded, split or punctured materials caused by building corners, installation hardware and tools, or poor-quality methods and procedures.

b) Physically stressed cables or Ducts – Examples include cables/Ducts pulled tightly around bends or structural columns, or unsupported cable falls between floors, inadequate support or over-compression in cable trays, over-tight cable ties that compress underlying cable pairs together. These physical circumstances are factors that compress and distort fiber or conductor pairs and disrupt twist layers that will increase noise and attenuation particularly at higher frequencies.

c) Cable “housekeeping” – Examination of cable trays, plenum spaces, equipment connections and terminations in telecommunications closets, distribution boxes and equipment bays for the general cable layout. The cable should be neatly arranged and secured, showing good practices for stowing cable and arranging fan outs at terminations and connections.

d) Electrically Vulnerable Cables – Document location and identity of cables that are (or seemed to be) placed too close to power cables, radiating cables, signal switching cables, lighting fixtures, and other possible EMI/noise sources. Such a cable link should be scheduled for electrical testing when adjacent cables are energized and in regular use.

e) Physical and Fire Protection – Cables need adequate physical and fire protection for wall and floor penetrations. Physical support is needed to reduce damage from abrasion, physical impact and insulation degradation from cold flow (creep) of plastic insulations and jacket materials. Approved fire stop materials are needed for cables that penetrate walls or floors to help ensure cables and wall/floor holes do not become channels for spreading fires.

f) Hardware Compatibility - The individual components of the network must match with each other and with the equipment demands for the connectors, cables, terminations, patch panels, and transmission infrastructure. These hardware components need to meet the engineering design as well as local physical environment and relevant codes, with appropriate fire-rated cables used in riser and plenum spaces.

g) Termination and Patch Panels – Neatness counts with data and fiber cables, particularly at terminations and cross-connection points. Loose connections can rapidly degrade or even stop data transmission. Therefore, the review should include:

- Checks of untwisted lengths of Cat-6 data cables at terminations;
- Checks for kinks or tightly curved fiber sections;
- Looking for loose connections – Checked by applying a small pull-out stress on connection and patch panel connections by gently pulling with a force of approximately 2-4 pounds force on the cable/wire;
- Examination of the neatness and systematic arrangement of the various conductors, fibers or cables. For example, (1) terminals shall be clean with no protruding bare copper wire that may create shorts and no evidence of open pairs, split pairs, or crossed pairs, and (2) fiber connections shall be placed in orderly smooth bends into ports with minimal crossing of fibers and tight bends.

Operational Guidelines

The installation crews shall follow industry best practices work and use documented M&Ps that include (at a minimum), instructions covering the items listed below:

a) Minimize physical stress during installation – Sufficient slack cable shall be provided during and after placement to allow for connection, termination and subsequent re-arrangement of cable pairs. Cables should be blown into Ducts or pulled in Ducts will less than 100N tension. Cable reels should be positioned to allow tension free feed-off from the reel or out of the cable box into the conduit, cable tray or into plenum space. Cables placed between

floors shall be gravity fed, i.e., cables should be dropped down between floors rather than pulled up from floor to floor, to minimize the tension and stress placed on the cable. Cable shall be played out from the bottom of the reel to help it move without kinking, crushing or pinching.

b) Minimize bending stress on cables – The cable pull lines shall be straight with minimal bends or pulling around pulleys or bends. (i.e., no sheave wheels). Cables shall never be bent tighter than the larger of manufacturer's recommended bending radius. Typically, this criterion means that the data cables will not be bent at a radius less than 8 times their diameter or, for small pair count cables, a radius of less than 32 mm.

c) Limit Cable Torsion (Twisting) – To minimize possible torsional stress twisting of the cable, swivels shall be used during cable pulling operations.

d) After installation of cable, any open or non- terminated ends shall be cleared, capped and sealed. All cables, termination points, jumper cables, patch panel connections shall be labelled in a clear, readable and consistent manner.

e) Pairs of Category 6 cable shall not show excessive untwisting at the connection point – i.e., should not show more than 10-12 mm of pair being untwisted to accommodate connection or more than 60-70 mm of cable sheath being removed. These terminations shall also be such that the cable and pair are physically supported as close to the termination as possible to avoid undue physical stress on the conductor at connection point.

f) Correct Tool Use - The correct tools need to be used to obtain a good metallurgical bond that forms the required electrical connection with low loss (attenuation). Punch down tools and crimping tools are designed to match connection blocks and cable/conductor size. The type and size of tools used shall match those specified by the manufacturers of the Category-6 cables, connectors and termination blocks. Incorrect tools or incorrect use of tools can lead to (1) poor electrical connections, (2) physically loose connections, (3) contamination of connector blocks with small pieces of conductor (conductive metal), and/or (4) damage to adjacent terminal pins.

g) Maintenance of Tools – Experience has shown that the repeated use of hand tools can induce craftsperson fatigue and reduce tactile feedback, as well as abrade or blunt tool edges. For an experienced craftsperson, tactile feedback can be a very accurate indication of connection quality. However, the user fatigue and deterioration of tools can easily lead to less reliable and poor-quality connections. Electrically driven tools offer more uniform connection quality for the inexperienced worker but are also prone to use too high a force.

The high insertion force may damage the terminal block and adjacent pairs with the worker realizing the problem. The installer shall provide documentation that the correct tools are being used for terminating the cable, the installer has completed training, and the tools are well maintained.

6.11. Test Procedures

Continuity testing shall be completed by the installation company for each optical fiber or copper cable span installed.

6.11.1. Equipment Testing

All test equipment used shall be independently calibrated or verified before use. Equipment calibration checks or verifications shall be completed at least every 12 months. Typical UTP cable test equipment for these tests will typically include one or more from the following list.

Test Set	Test Function, Use and Capability
General Purpose Meter (Multimeter)	▶ Resistance, voltage and currents for the internal copper cables ▶ Checking for opens, shorts, continuity and so forth
Time Domain Reflectometer (TDR)	▶ Portable hand-held units that inject signal into optical cables and provide a graphical representation of the transmission path based on the reflected signal. ▶ Checks length and attenuation coefficient of cable. ▶ Capability to electronically save or print TDR trace/results. ▶ Excellent for locating troubles and problems in optical cable.
Wire Map Testers	▶ These portable products consist of two test units (trans-receivers) one a signal injector and one the receiver. ▶ Checks wire path looking for opens, shorts and cross pairs. ▶ Talk-set capability to facilitate testing. ▶ Capability to electronically save or print mapping results.
Automatic Cable Tester or LAN tester	▶ Measures resistance, power, voltage, data rates, noise levels. ▶ Checks continuity, loop length and compares to an internal reference standard. ▶ Shall contain software to measure and automatically cable transmission performance against variety of standards including Category-6 as per EIA/TIA 568-C or equivalent standard. ▶ It is desirable that the test settings can record crosstalk and attenuation measurements and have the capability to electronically save acceptance test results.

Table 6.7: Testing equipment and applicability

These test sets should all be “Data-Safe”, which means that on initial attachment to a cable pair or optical fiber the test set checks if the cable is an active data line before any other action. If the data line is active, then the test set asks the user if he/she is sure they wish to further test line since this will likely disrupt data service. Data-safe sets are not necessary during construction and final acceptance testing phases for qualification testing.

However, the data-safe feature is required for any test sets used for daily maintenance and repair operations. Qualification testing shall be completed for all new plants after it has been built or for older plants immediately after it has been modified. The qualification test record is used not only to certify the network as meeting contractual agreements, but also it will become the reference point for any future examination and troubleshooting of the network. This testing should include frequency sweeps to characterize the network fully.

6.11.2. Fiber Cabling Testing

Testing for optical fiber spans shall be based on visual inspection and certified OTDR (attenuation and optical loss) measurements of the “as received” cables, after span installation and acceptance testing. Optical testing shall be completed at 1310, 1550 and 1625 nm unless other testing protocols are approved.

- “As received” cables – This is a quality assurance check performed on random selection of incoming cables to verify that the documented cable specifications (fiber counts, colors, markings, length, and optical loss) supplied with cable reel match the delivered product.
- After installation – This is a quality assurance check performed on every span as installed to check for continuity and help ensure no fiber breaks or cable deformations is present that causes high losses or non-usable fibers.
- Acceptance testing - This is the formal certification that the optical network has been tested and found to meet the design specifications in terms of optical loss, and attenuation characteristics. These test results are documented and stored for future reference and testing.

6.11.3. Category-6 and Connector Cabling Testing

Testing for UTP copper cable spans shall be based on certified measurements of DC resistance, attenuation, impedance and crosstalk across the full frequency range required for the service. The transmission characteristics of the category-6 cables shall be tested at

frequencies up to 250 MHz following the transmission requirements of ANSI/TIA-568-C.2 as applicable for solid conductors.

“As received” cables – This is a quality assurance check performed on random selection of incoming cables to verify that the documented cable specifications (pair counts/ sizes, markings, twist length, and electrical characteristics) supplied with cable reel match the delivered product. For “as received” cable reel transmission tests, the test sample length shall be 100 meters, unless otherwise specified. The 100-meter length derives from the

90-meter maximum length of the permanent cable link, plus 5 meters at each end for a patch cord or flexible connection link.

After span installation – This is a quality assurance check performed on every span as installed to check for continuity and help ensure no conductor breaks, or cable bends have occurred that may cause high resistance, transmission and noise problems.

Acceptance testing - This is the formal certification that the category-6 copper network which includes cable and connections/ terminations has been tested and found to meet the design specifications in terms of:

- DC Resistance and Balance
- Capacitance
- Attenuation
- Insulation Resistance and DV Voltage withstand
- Characteristic Impedance and Structural Return Loss
- Return Loss
- Crosstalk and Attenuation to Crosstalk Ratio
- Propagation Delay (PD) and Skew
- Jacket Leakage

These test results shall be documented and stored for future reference and testing.

6.12. Technical Specifications of wiring

Section 5 contains the general requirements for the physical elements of the internal cabling, closures and connection hardware components for any type of building.

It is critical that good housekeeping practices be enforced inside the telecommunications closet with cables organized neatly, and that general work conditions are clean and well lit. Precise and consistent labels need to be used on both ends of cables and on the cross connect frames to prevent confusion and possible service outages.

6.12.1. Optical Fiber Cable

The optical fiber cables used within buildings shall require adequate fire resistance ratings Low-Smoke Zero-Halogen (LSZH) materials and mechanical robustness performance for the inside applications of placement in tall riser spaces, tight wall cavities, inside conduits/Ducts and through walls and ceilings.

These optical fiber cables also need to survive undamaged during the physical stresses involved during the handling and placement operations involved in the installation and construction phases of cabling the building. See Section Appendix B: Optical Fiber Cable Specifications for details.

Optical Fiber Termination Box (FTB)

a) Shall be wall mounted.

b) Must be “Indoor type” rated with applicable fire resistance and mechanical robustness.

c) Shall have the capacity to terminate four (4) fiber strands using fusion splicing technique and accommodate spliced fibers in splicing organizers / cassettes.

d) Shall have four (4) LC simplex adaptors, each equipped with 1.5m pigtail terminated with LC APC (Lucent Connector Angled Physical Contact) connectors. Connector insertion loss shall not be more than 0.2dB and return loss shall be better than 55dB.

e) Characteristics of the optical fiber terminated in the FTB shall be as per ITU-T G657 A2.

f) Shall have flexibility, adequate working space and ease-of-accessibility to the fiber splicing trays and cable management elements.

g) Shall have guiding rings and guiding tubes to minimize mechanical stress and facilitate fiber identification and traceability.

h) Shall have hard material body (plastic or aluminum) to resist impacts and accidental contact.

Optical Fiber Patch Panels

a) Shall be installable in a standard 19” rack with wall mounting as an option.

b) Shall have at least 24 LC/APC simplex adaptors, each equipped with 1.5m pigtail terminated with LC/APC connectors. Connector insertion loss shall not be more than 0.2dB and return loss shall be better than 55dB.

c) Characteristics of the optical fiber shall be as per ITU-T G657.A2.

d) The panel should have a locking system, cable clamps, be compact in size and use compression fittings.

e) Shall have flexibility and provide easy access to the fiber splicing and management, with a slide in/slide out mechanism for the fiber modules or opening with hinges.

f) Shall have enough splice organizing trays to splice and terminate optical cable(s) to all available connector terminated fiber.

g) There shall be guiding rings, guiding tubes and fiber patch cord management.

h) Shall have a steel body. Splice organizing trays shall comply with the following specifications:

- Must be made of plastic material that will provide resistance to water, corrosive chemicals, household cleaners, paints, extreme temperature and impacts.
- Must be able to hold minimum of 12 fusion or mechanical splices per tray with sleeve / mechanical-connector grip facility.
- Must have enough space to hold up to 1m coil of each fiber.
- Optical fiber must not suffer any attenuation inside the tray due to curvature radius.
- Each splice tray shall be protected by an individual cover.
- Cascaded trays must be easily accessible without damaging existing fiber.

Fiber Splice Box/Enclosure (FSB)

a) Shall be a wall mounted cabinet or joint closure made of plastic or steel.

b) It should have a locking system, cable clamps, be compact in size and use compression fittings.

c) Shall provide easy access to the fiber splicing and management, with an opening mechanism that uses screws or hinges.

d) Shall have sufficient splice organizing trays and optical cable(s) entries.

e) Splice organizing trays shall comply with the following specifications:

- Must be made of plastic material that will provide resistance to water, corrosive chemicals, typical cleaners, extreme temperatures and impacts.
- Must be able to hold a minimum of 12 fusion or mechanical splices per tray with sleeve / mechanical-connector grip facility.
- Must have enough space to hold up to 1m coil of each fiber.
- Optical fiber must not suffer any attenuation inside the tray due to curvature radius.
- Each splice tray shall be protected by an individual cover.
- Cascaded trays must be easily accessible without damaging existing fibers.

Optical Fiber Patch Cord

a) Shall be factory made with an LC APC simplex connector on each end.

b) Characteristics of the fiber shall be as per ITU-T G657.A2.

c) Return loss of the patch cord with connector shall be better than 55dB.

d) Insertion loss shall not be more than 0.2dB per connector.

e) Shall be of appropriate and approved lengths (1m, 2m, 3m, 5m and 10m).

f) The overall diameter of the patch cord shall not be more than 2mm.

g) The outer jacket shall be Low-Smoke Zero- halogen (LSZH) materials or Flame-Retardant PVC (FR-PVC).

6.12.2. Copper cable

Unshielded Twisted Pair (UTP) Cable

a) All UTP cables used in internal wiring must be at least Category-6 rated balanced cables.

b) Sheath materials of all UTP cables used in internal wiring must be Low-Smoke Zero-halogen (LSZH) or Fire-Retardant PVC (FR-PVC).

c) Sheath materials of all UTP cables used between individual buildings within a compound (for example) must be of external rated cable with weather-resistant jacket material – e.g., sheath shall be water (rain) resistant, sunlight resistant and able to withstand the temperature extremes and diurnal cycling between hot days and cold night conditions.

d) Depending on the customer application and likelihood of electrical induction problems in a location, twisted-pair cabling with metallic shielding - STP (Shielded Twisted Pair) cable or FTP (Foil Twisted Pairs) - can be used if required.

UTP Termination Point (UTP Outlet or Socket)

a) All UTP outlets used in internal wiring must be at least Category-6 rated.

b) Terminations shall be done using IDC (Insulation Displacement Contact) design and technique with matching and appropriate tools.

c) All UTP outlets must have a shuttered RJ45 socket and preferably a “Keystone Module” to help minimize contamination of the termination.

d) It is highly recommended that dual UTP outlets with two separate cables be installed near TV outlets and in big rooms.

e) Faceplates may be installed “horizontally” (landscape) or “vertically” (portrait), but in all cases the RJ45 socket shall be oriented in such a way that the plug latch will be on the underside. This orientation helps to ensure that the contact springs are at the top of the socket and therefore less susceptible to dust or dirt settling on them.

f) UTP outlets shall not share the same face plate with any LV power sockets.

g) UTP outlets shall not be installed outdoors unless housed in an appropriate enclosure with appropriate IP rating and environmental seals.

UTP Patch Panel

a) All Patch Panels used in internal wiring must be at least Category-6 rated.

b) All sockets shall be RJ45 and preferably “Keystone Module” to simplify maintenance.

c) Termination shall be done using IDC (Insulation Displacement Contact) technique with matching and appropriate tools.

UTP Patch Cord

a) All UTP patch cords used in internal wiring must be at least Category-6 rated.

b) Patch Cords must be factory-terminated with RJ45 connectors on both ends.

7. In-Building Solutions (IBS)

7.1. Introduction and objectives

In today's interconnected world, where communication and connectivity are paramount, it is crucial to ensure seamless connectivity within buildings. In-building solutions play a pivotal role in bridging any connectivity gap within buildings, where the traditional cellular networks often struggle to penetrate the thick walls and structures of buildings. Reliable connectivity is crucial for productivity, safety, and overall user experience in any building, whether it is an office complex, residential tower, or shopping mall.

These solutions not only benefit occupants by ensuring seamless communication and access to digital services but also serve the broader interests of businesses, property owners, and SPs.

Similarly to IBW, RED, building owners and landlords shall engage with the SPs and follow, at an early stage, the specifications set out in this Standard, ensuring a “first time right” IBS building. As such, this In-Building Telecommunications Infrastructure Standard has the following objectives regarding IBS:

- Develop and implement a standardized framework for IBS, understanding the diverse needs of all stakeholder groups for each type of building.
- Facilitate the deployment of IBS to support the seamless delivery of telecommunications services within buildings.
- Align with global best practices.
- Facilitate deployment of IBS that accommodate multiple telecommunications SPs.
- Optimize investment and design by encouraging collaboration and sharing of IBS infrastructure elements.
- Ensure compliance with regulatory standards and guidelines by meeting minimum IBS implementation requirements.

7.2. General overview

Designing a reference model for deploying IBS poses numerous challenges due to the diverse nature of building environments and technological considerations.

Several factors may have a significant impact on the efficiency of IBS deployment, such as:

- Proximity to existing cellular communication towers;
- Building characteristics (wall thickness, materials, layout, etc.);
- Interferences;
- Occupancy density and usage patterns; and
- Technological advancements and future-proofing.

Therefore, creating a one-size-fits-all model is not feasible. Instead, a customized approach tailored to the specific attributes and needs of each building is needed to ensure the optimal performance, coverage, and reliability of an IBS.

The RED must conduct a connectivity requirement assessment for building operation and occupants. This study should be performed during the building's design phase, in coordination with the REDs and SPs.

7.2.1. Types of IBS systems

Depending on the building size and coverage needs, four different solutions can be used for an IBS deployment:

- **Active DAS** involves a network of antennas connected to a common source through active electronic components, such as amplifiers and repeaters. These systems boost and distribute the cellular signal within the building. The source, typically a base station, converts the signal from the carrier into a digital format that can be transported over fiber-optic cables to remote units, which then reconvert the signal to radio waves and transmit it via the antennas.
- **Passive DAS**, by contrast, does not use active components to boost the signal. Instead, it relies on passive components such as splitters and coaxial cables. The signal from the SP’s base station is distributed using these passive elements through a series of antennas strategically placed throughout the building to cover areas with weak signal.
- **Hybrid DAS** combines elements of both active and passive systems. Such a solution may use a fiber-optic backbone to transport signals from the base station to remote units like an active system, but then distribute the signal to antennas using coaxial cabling similar to a passive system.
- **Small cells** are low-powered cellular independent base stations.

7.2.2. General Responsibilities

REDs must engage with a certified contractor from the CRA's public list, published on the CRA website (https://www.cra.gov.qa), when designing a new development. Such contractor shall follow this Standard when designing the IBS and coordinate at the same time with the SPs to ensure their requirements are met.

After the design is approved, in accordance with Section 7.5 and 7.6, the REDs shall deploy the passive elements (refer to Section 7.3.2) necessary to implement the IBS system as designed. The REDs will therefore be responsible for maintaining and upgrading the passive elements.

During the implementation phase, SPs and REDs' contractors shall collaborate to monitor and certify the construction of the passive elements of the IBS, pursuant to Section 7.7. Once the building has been constructed and a first tenant has signed a lease with the RED/building owner, the latter will notify the SPs so that they can install the active elements (see Section 7.3.1) in the building. SPs will therefore be responsible for the maintenance and upgrade of such active elements.

Note that indoor connectivity shall be provided to all floors of the buildings that require it, pursuant to Section 5.4. This includes provision in basements and any tunnels connecting buildings (e.g., for maintenance purposes) that may exist within the development.

No fees shall be imposed by either the REDs or the SPs to the other party for the installation and operation of the IBS, since both parties shall contribute, as specified in sections 7.3 and 7.4, to the deployment of the IBS elements.

7.2.3. Existing and New Buildings IBS

Existing buildings with IBS deployed

In buildings where IBS is already deployed before the publication of this Standard, the existing responsibilities for ownership, maintenance, and upgrading shall be maintained.

This means that if any SP has already deployed IBS, that same SP shall be responsible for maintaining and upgrading it. A similar approach shall be followed in cases where it is the RED who has deployed the system.

Existing buildings without IBS deployed

In existing buildings where no IBS has been deployed, compliance with the requirements set in this document is not required.

If the building owner/RED wishes to deploy an IBS system to enhance indoor connectivity within the building, the owner/RED, in collaboration with its contractor, must propose and engage with the SPs to design and deploy the relevant IBS system, keeping the same standards and responsibilities as those set out in this document.

New buildings

It is expected that any new building must comply with all the requirements laid out in this document.

7.3. Functional components overview

The functional components of an IBS can be categorized into two types of equipment:

- Active equipment
- Passive equipment

The following subsections describe each of these two categories of equipment.

7.3.1. Active equipment

Active elements in an IBS are components that require electrical power or are involved in the generation or amplification of signals to enhance wireless connectivity within a building.

Active components of an IBS include, among other examples:

- Master Unit/Base Station;
- Radio Remote Unit (RRU);
- Fiber optic repeaters;
- Small cells; and
- Backhauling from the SPs network to the telecommunications room.

7.3.2. Passive equipment

Passive components in an IBS are essential elements that do not require electrical power or generate signals, but still play a role in transmitting and distributing signals within a building.

Passive components of an IBS include, inter alia:

- Telecommunications Room (including power supply elements and cooling[19]);
- For an active system, the point of interconnect (POI) between the SP's base stations and the Master Unit;
- In-Building Wiring (IBW; refer to Section 6.5), covering splitters, couplers, attenuators, combiners, coaxial cable, fiber, risers, vertical and horizontal pathways, patch panels, patch cords, cross connect cabinets, and ODF, among other elements; and
- Antennas (note that active antennas, such as small cells, are not considered passive equipment).

7.4. Responsibility matrix

This section provides a summary of the detailed responsibilities of all parties in the deployment of IBS, without considering the design and certification aspects.

	Item description	Master plan developer	RED/Building Owner	SP
1	Supply, installation and maintenance of other passive elements required for IBS-Connectivity (refer to Section 7.3)		✓	
2	Provision, installation and maintenance of any active equipment for IBS-Connectivity (refer to Section 7.3)			✓
IBS connectivity only covers cellular public networks (e.g., GSM, UMTS, 4G, 5G). Private networks (e.g., TETRA) are excluded.				

Table 7.1: IBS Responsibility Matrix for new developments

[19] Power consumption will be subject to commercial agreements between service providers and real estate developers.

7.5. General design considerations

7.5.1. In-Building Coverage Solutions

a) While cellular systems can cover wide areas through outside base stations, complete coverage within a building may require dedicated indoor cellular systems.

b) A state of art wireless cellular DAS (Distributed Antenna System) solution or small cells will be provided for dedicated coverage and capacity inside the building.

c) The DAS solution shall consist of indoor antennas, distributed across the building to provide uniform coverage.

d) Antennas shall be connected through network of RF cables and passive components like splitters, couplers, hybrid combiners and quadplexers. Antennas shall be mounted below the ceiling.

e) The wireless signal shall be fed from the telecommunications equipment located inside the Main Telecommunications Room and the Secondary Telecommunications Rooms.

f) The proposed In-building coverage solutions will be shareable with the second Operator, under a mutual sharing agreement, with a common DAS approach.

g) If a building requires “indoor coverage” (refer to Section 0) this needs to be proposed from the RED or the respective RED’s contractor. The SP or the third party contractor will then validate the In-building requirements and design a plan by way of site surveys or layout drawings studies.

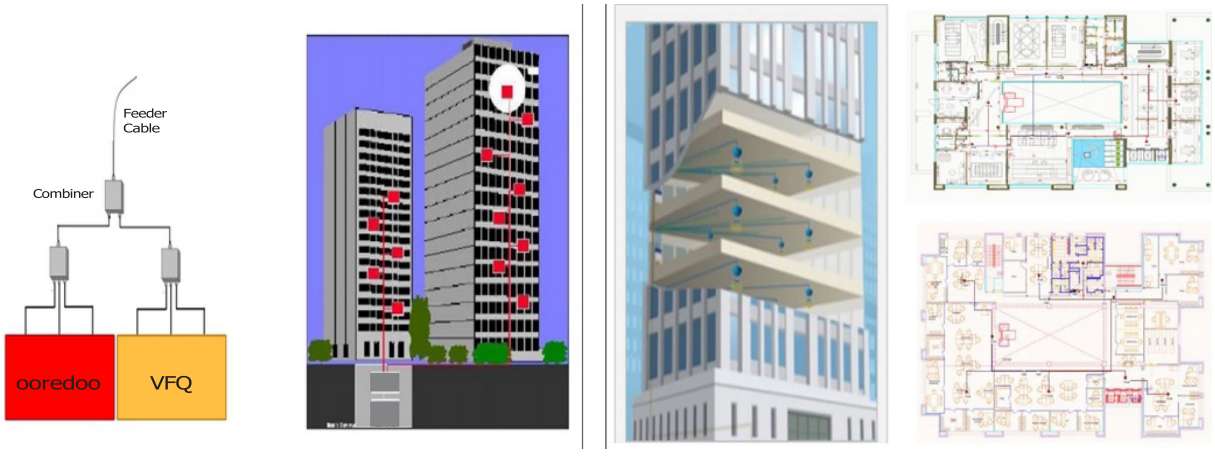

Figure 7.1: In-Building Solution (IBS)

7.6. Design Review Process

Design Review and Construction Certification Process document[20] annexed to this Public Consultation.

7.7. Construction Certification Process

Design Review and Construction Certification Process document[20] annexed to this Public Consultation.

7.8. Technical specifications

7.8.1. General Guidelines for IBS

These guidelines are expected to be used by REDs and SPs to help ensure the mobile communication needs of each development and its occupants are provided to a high standard. The design and implementation of any system will be agreed by the RED and the SPs in advance and the guidelines adopted as necessary to meet the agreed requirements.

a) IBS design should support the following frequency bands: 900, 1800, 2100, 2300, 2600 or 3500-3800 MHz, for 2G, 3G, 4G or 5G technologies. There is no requirement to support every band, only those relevant to the selected technology.

b) IBS should support both SISO and MIMO deployment scenarios based on the type of buildings proposed in Table 5.3.

c) IBS design should be multi operator based, supporting both of the country's cellular operators.

d) In IBS DAS, the total DAS loss to be within 28 dBm (+/- 2dB) and Minimum Uplink Coupling Loss (MCL) should be 70 dB (+5dB).

e) IBS VSWR test results should be better than <1.1 for DAS.

f) IBS DAS PIM test results should be better than -100dBm or 143dBc.

g) IBS DAS link budget should ensure uniform distribution EIRP per antenna with a variation of +/-2dB, with EIRP per antenna not exceeding 8dBm for UMTS including antenna gain for 3-meter height and 14dBm including antenna gain for double height ceilings, lift shaft antennas.

[20] This document has been prepared by the Service Providers and has not been reviewed by the CRA

h) Dedicated lift antenna solution to be planned in lift shafts for buildings with more than G+14 floors; and in buildings with less than G+14 floors, antenna to be planned in the lift lobby subject to signal attenuation based on the lift construction material.

i) Handover overlap region between sectors to be minimized to 5% of floor area within RxLev <-80dbm; in low traffic areas, it should be planned in horizontal sectorization. For vertical sectorization, one sector should be configured for 8 to 10 floors maximum or less, subject to floor areas.

j) Minimum 5 dB isolation should be maintained between indoor and outdoor signals within the peripheries of the building. No cell reselection to outdoor cell while in indoor coverage area inside the building.

k) Power spillage should be minimized, with receiver power from IBS at the perimeter within 5 meters away from the building to be at least 6 dB below macro cell power. No cell reselection or handover to indoor cell while walking or driving on the streets outside the buildings (Absolute RxLev values recommended: <105 for RSSI/ RSCP and < -110 RSRP for LTE).

l) Cell reselection and handover from outdoor to indoor within +/- 5m when entering the building.

m) Cell reselection and handover from indoor to outdoor within +/- 8m when exiting the building.

n) 2G IBS DAS to be designed at 37 dBm per TRX with 2TRX per sector.

o) 3G UMTS DAS to be designed at 43 dBm (CPICH at 33dBm) per carrier with 2 carrier per sector.

p) 4G LTE DAS to be designed at 15.2 dBm RSRP (46 dBm RSCP) per carrier with 2 carriers per sector barring high traffic venues like shopping malls, exhibition halls, stadiums will have 4 carriers per sector.

q) In an Active DAS system, power sharing between bands shall be equally distributed between both operators (Ooredoo and VFQ).

r) In an Active DAS system, sharing between technologies per band shall be equally commissioned for both operators (Ooredoo and VFQ).

s) In an Active DAS system, remote unit output power should be calculated based on the design capacity per technology and number of technologies per band.

t) In an Active DAS system, each remote unit configured per sector should take into account the impact of noise floor addition on cellular RAN. Limit UL noise may rise to a maximum of 3dD in cellular, in a normal low traffic usage scenario. Recommend to limit maximum 5 remote units per sector.

u) In an Active DAS system, fiber link budget loss between master unit and remote unit should be less than or equal to 8dB.

v) Traditional DAS is unlikely to support 5G bands; hence it is recommended to increase the fiber density to all the IDF Rooms dedicated to the 5G solution and add a pair of CAT6A Ethernet cables along the trunk dedicated for Wi-Fi Access point design.

7.8.2. Main components

a) All components of IBS BoQ proposed should be wide band, supporting frequency bands from 600-4000 MHz. There is no requirement to support every band, only those relevant to the selected technology in both SISO and MIMO options.

b) All DAS components except the antenna should have a PIM rating of – 160 dBc @ 2x 43 dBm.

c) Stadium arena antenna should have a PIM rating of – 153 dBc @ 2x 43 dBm; other antennas should have a PIM rating of – 150 dBc @ 2x 43 dBm.

d) Point-of-interconnect DAS components should have a composite power of 300 Watt or higher, with individual maximum Input RF power per port at 100 Watt or higher.

e) Point-of-interconnect DAS components should have a minimum power per port isolation of 25dB.

f) Components proposed should be from the approved list of OEM Vendors recommended by operator.

g) 24 Core (LC APC port should be at both ends) single mode fiber to be pulled from main hub to each remote hub.

h) Single mode fiber optical cable with the specifications below shall be required to connect the remote units to their designated master unit.

i) Minimum requirements for the Fiber Optics cable are:

- Attenuation: < 0.36 dB/km @ 1310nm < 0.26 dB/km @ 1550nm
- Max. length between the remote secondary hub and the main telecommunications hub is assumed to be within a limit of 5km.

- Fiber should be terminated and spliced in the Telecommunications Rooms.
- OTDR test results should be within 6db.

j) Horizontal RF Cables can be laid using existing cable trays (space of 100 mm) or a separate cable tray to be provided by client with 100mmx50 mm. RF cable can be laid for small distances (<10m) using support bars available. RF cables cannot be routed along with AC/Electrical Cable Trays.

k) Vertical RF cables can be laid using existing cable trays (space of 300 mm) or a separate cable tray to be provided by building management with 300mmx50 mm. (RF cables cannot be routed along with AC/Electrical Cable Trays).

l) Sharp 90° cable tray bend is not recommended for RF cable. Maximum cable tray bend to be 45° recommended.

m) RF cables can be routed using a saddling in basements/technical areas where cable trays are not available/provided.

n) The RF cables should be threaded through the pre-installed cable ties, and when the RF cable is fully installed the cable ties will be secured to the cable trays.

o) Vertical & horizontal Cat 6A / Fiber Cables can be laid using existing cable trunk (space of 100 mm). If there is such a possibility, a separate cable trunk to be provided by building management, with 100mmx50 mm.

p) On completion of the Installation, VSWR and PIM test report to be submitted. VSWR should be better than <1.3 for DAS and PIM should be 143dBc or better.

q) PIM test to be certified with testing being carried out at all DAS entry points and DAS points serving seating areas for stadium arena.

r) Permanent access panels need to be provided by building management at the location of the splitters & couplers for future maintenance whenever needed in gypsum false ceiling area.

s) If the antenna has to be installed on the gypsum ceiling, then temporary access panels are required on every antenna location in order to fix the antenna and complete the DAS work.

t) All passive components of proposed IBS BoQ should be wide band supporting 600-4000 MHz.

Appendix A. Additional technical requirements

A.1. Telecommunications Room

It is the responsibility of the building, dwelling or unit owner to provide the Telecommunications Room, where required, as defined by the requirements in this documentation.

In general, the electronic and optical equipment used in a building's Telecommunications Rooms should be designed to operate reliably, in ambient temperatures of between 5°C (41°F) and 45°C (113°F), and in humidity of up to 85% RH. The equipment should also be able to operate for short periods (e.g., up to 3-4 days) in temperatures as high as 55°C (131°F) and as low as 0°C (32°F), as well as in humidity of up to 90% RH.

Telecommunications Room Type A (TR-A)

A TR-A is used in scenarios of more than 100 connections. Type A Telecommunications Rooms are usually large and need to be fully integrated into the general building structure and associated services to have the necessary space, lighting, environmental controls, and operational support.

Its functions are:

u) To house the Building Distribution Box (BDB),

v) To house any other SP active and/or passive components (for both IBW and IBS).

w) To connect to SP over segregated routes by providing multiple external Ducts and terminating them to the BDB.

x) To house backup power systems (rectifiers and batteries). It is desirable that the power systems be contained within a separate compartment of the BDB box.

The following considerations shall be followed in the construction of Rooftop Telecommunications Rooms (RTTR) and Mobile Service Telecommunications Rooms (MSTR):

- Room dimensions are to be decided based on the size of the building and the passive and active systems' requirements.

- 12 core for each operator (LC APC port should be at both ends) spliced single mode fiber to be pulled from SP room to the main GSM room, if the MTR is not collocated with the SP Room.
- 63 amps, 3-phase isolator (one for each operator) required for connecting to rectifiers for powering up telecommunications equipment.
- DC earthing.
- Air condition provision to maintain a 5°C to 45°C temperature.
- Antistatic flooring.
- 13 amps, 2 normal 3-pin power sockets.
- Horizontal 300 mm cable ladder above the telecommunications equipment for laying cable.
- 300 mm x 50 mm cable tray connecting cable ladder and riser or DAS System.

REDs should also follow SP guidance on a site-specific basis in addition to these requirements.

Telecommunications Room Type B (TR-B)

A TR-B is used in scenarios of less than or equal to 100 connections. Its functions are:

a) To house the Building Distribution Box (BDB).

b) To house any other SP active and/or passive components (for both IBS and IBW).

c) To connect to the SP over a single route by providing external Ducts and terminating them in the BDB.

The following considerations shall be followed for the construction of RTTR and MSTR:

- 4M X 4M dimensions are proposed for space.
- 24 core per operator (LC APC port should be at both ends), spliced single mode fiber to be pulled from Secondary Telecommunications Room to Main Telecommunications Room.
- 32 amps, 3-phase Isolator.
- UPS Back-up.
- DC earthing.
- Air Condition provision to maintain 20°C to 22°C temperature.

- Antistatic flooring.
- 13 amps, 2 normal 3-pin power sockets.
- Horizontal 300 mm cable ladder above the telecommunications equipment for laying cable.
- 300 mm x 50 cable tray connecting cable ladder and riser or DAS System.

REDs should also follow SP guidance on a site-specific basis in addition to these requirements.

A.1. Air Conditioning Requirements

It is the responsibility of the building, dwelling or unit owner to provide the Telecommunications Room with adequate air conditioning to support the equipment as per the most current European Telecommunications Standards Institute (ETSI) document reference EN 300019-1-3, pertaining to Classification of Environmental Conditions; Stationary Use at Weather Protected Locations. At the time of publication of this document, the current version is ETSI EN 300 019-1-3 v2.3.2 (2009-11) and can be downloaded from the ETSI website (www.ETSI.org).

On the other hand, SPs are encouraged to deploy suitably powered base stations inside buildings to reduce power consumption/heat output.

A.2. Fire System Requirements

It is the responsibility of the building, dwelling or unit owner to provide the Telecommunications Room with a firefighting system.

The Fire System shall be designed to protect the risk area within the premises by giving warning of a fire condition when detected by an automatic detector or by the operation of a break glass call point.

NOTE:

The Contractors shall submit the material status report, including the delivery period of the extinguishing media, in their bid. During the execution of the works, the Contractors shall install and connect the extinguishing media cylinder as confirmed in their bid.

All the manufacturer's equipment and components (fire emergency plan, smoke detector, extinguishing gas, container, accessories etc.) shall be certified by LPC/UL standards for

design, construction and reliable operation. The supplier shall furnish copies of certificates issued including serial numbers of the particular product complying fully with national and international standards and code of practice.

A.2.1. Design standards

1. The fire system shall be supplied and installed in complete compliance with the recommendations of international standards.
2. The fire system shall fully comply with the National Fire Protection Association (NFPA) standard provided it is installed to comply with the limitations established by the list of Factory Mutual Research Corporation or Underwriters Laboratory Inc. The proposed system and extinguishing media shall also comply with NFPA-12 or NFPA-12A, wherever applicable.
3. The proposed extinguishing media shall also comply in all aspects with the Montreal protocol for the Ozone Depletion precautions.
4. The proposed fire extinguishing media must also be accepted and approved by the local civil defense authority.

A.2.2. Technical specifications

1. The system shall be functioning on the basis of a double knock type in areas covered by extinguishing media and a two-stage alarm system.
2. Operation of an individual detector shall be displayed by an LED indicator fitted into the base or body of the detector. The indicator shall illuminate when the detector goes into alarm. User control switches for evacuate and reset shall be provided, and shall be operable only when enabled by a key switch.
3. The system shall operate on nominal 24 Volt DC with necessary rechargeable stand-by batteries. The rechargeable batteries shall be Nickel Cadmium of adequate capacity to operate the whole system for 6 hours, without fail. The battery set shall be able to run the sounders' bell or siren for 1 hour continuously, without fail, after maintaining the system healthy for the 6 hours duration.
4. The supplied fire system shall guarantee the following facilities as a minimum requirement:
    - Auto detection of fire accompanied by local audible and visual warning facility.
    - Audible and visual warning in case of operation of manual call point.

- A/C and Exhaust. Fan shut down facility via heavy-duty relays.
- Activation and control of automatic fire fighting and extinguishing system.

A.3. Telecommunication Closets and Distribution Boxes

The telecommunication closets and various closure boxes shall be:

- Large enough for terminal blocks and interconnections to be mounted securely and be readily accessible. The mounting support needs to be secure so that push-down tools and other connection tools can be used with solid backing to facilitate a good quality connection (IDC).
- Readily accessible in terms of physical entrance space and internal working space for workers and for entering/exiting cables. The cable that enters from a Duct or through holes in a wall needs to be arranged to provide adequate space to bend cable without undue stress and make stress-free connections to the terminal block.
- Adequate working space to arrange cables neatly and so provide sufficient space for re-arrangement and future cabling activities within the telecommunications closet. Empty conduits/Ducts should be sealed and provided with pull tapes for future work. Good housekeeping practices at the connection points in telecommunications closets and at wall jacks are critical to achieving and maintaining a high-speed data service that may be upgraded in the future.

A.4. Labelling

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 with the alphanumeric characters engraved on it.

The sample of identification plate must be submitted during the design stage to the SPs for final approval. The reference number detail must be made available by the SPs during the inspection stage.

A.5. Induction and electrical hazard

In order to avoid interference by induction (EMI) and electrical hazard through conduction or contact, telecommunications cables should always be installed with a permanent minimum radial physical separation of 50cm from electrical cables and a minimum of 1m from fluorescent

bulbs, dimmer switchers or similar light fixtures to reduce EMF/EMI field effects induced by such devices. The only allowable exception is where a certified non-conductive rigid barrier is in place.

Conduction Avoidance

Telecommunications cables should be at least 50mm from all electrical cables. It is recommended that 300mm spacing between cables be maintained to ensure minimal electrical hazard through power induction or potential conduction. Telecommunications outlets should be at least 200mm from any mains electrical outlets. Where practical, a distance of 300mm should be maintained.

All telecommunications cabling should cross electrical cables at an angle of 90 degrees (i.e., a right angle) while maintaining the spacing of at least 50mm.

Induction avoidance

To ensure no interference from electrical induction, telecommunications cables should not be run in parallel to electrical cables with a spacing of less than 100mm. Where cables are within 100mm, the parallel run should be no more than 3m. At no time shall a spacing of less than 50mm be acceptable. All telecommunications cabling should cross electrical cables at an angle of 90 degrees (a right angle) while maintaining the spacing of at least 50mm.

Rigid barriers

Rigid barriers include partition walls where the spacing between each surface is at least 200mm and solid wall linings of non-conductive material at least 50mm in depth. In severe or difficult situations, the rigid barriers can include conductive home ducting products (metallic conduit or Duct).

As an alternative, communications cables containing copper, aluminum or other metallic shields or foils can be used as shielding to help maintain electrical isolation and minimize electrical noise from causing service disruptions.

Intersystem Bonding for Earthing (Grounding)

Where power and communications facilities are in close proximity, then the grounding systems of both utilities need to be coordinated and harmonized through appropriate earthing (grounding) and intersystem bonding practices. Such grounding and bonding practices

between metallic elements of the network shall be designed to maximize the electrical safety of workers and the public.

The appropriate local building, fire and electrical codes for buildings shall be followed. Metallic closures or metallic components of shielded/armored cables shall be solidly electrically bonded to the ground electrode system of the building either at or through the FDB or BDB. Note that the design of customer powered premises equipment served by the communications cable will usually be equipped with intersystem bonding and grounding capability with the CPE, and no additional action will be needed from the communications installation crew.

Under Floor or Raised Floor Scenarios

Telecommunications cables should not be run under floors where there is any risk of wet surfaces, water runoff, excessive dampness, or where unintended water leakage may occur (under bathrooms, laundries water tanks or water pipes etc.). The only allowable exception is where the cable sheathing has been specifically rated for such purposes.

Additionally, telecommunications cables placed beneath floors or in raised floor plenums:

a) Shall be in secure Ducts or trays where practical – the Ducts, conduit or raceway shall be closed and sealed to prevent water entry.

b) Shall be easily accessible at entry and exit points and at points along the cable length.

c) Shall be secured at any point where changes in direction occur; where there is potential for movement; to avoid sagging or contact to groundwork.

d) Shall have large cable looms/coils secured to an anchor cable or cable tray.

Ceiling Void or Plenum Scenarios

Telecommunications cables should not be laid on surfaces where there is a risk of damage or movement. This includes, but is not limited to, surfaces used for storage; where there is risk of persons standing or kneeling; around chimneys/ flues, heating Ducts or plumbing. Additionally, telecommunications cables placed in these void or plenum spaces should:

a) Be placed in secure Ducts or trays where possible.

b) Be secured at any point where changes in direction occur; where there is potential for movement; to avoid sagging.

c) Have large cable looms/coils secured to an anchor cable or cable tray.

d) Not to be placed above joists and sills.

e) Be placed away from insulation or other surfaces that may retain moisture.

It is desirable that communications cabling and facilities are not located in air-handling spaces or plenums. If it is necessary or unavoidable to place communications cables in plenums or in air-handling spaces, the communications cable jackets, wire insulations and Duct materials shall have appropriate fire resistance for the application – i.e., high resistance to fire ignition and flame spread with low smoke characteristics if burned – plenum rated cables.

Appendix B. Optical Fiber Cable Specifications

B.1. Optical Fiber Characteristics

The geometrical, optical, transmission and mechanical characteristics of the fiber shall conform to ITU-T G.657.A2 for 4, 12, 24, 48, 96 and 144F cable for characteristics of a single- mode optical fiber cable.

	Attribute	Details	Value		
1	Mode field diameter	Wavelength	1310 nm		
		Range of nominal values	8.6-9.5 µm		
		Tolerance	± 0.4 µm		
2	Cladding Diameter	Nominal	125.0 µm		
		Tolerance	± 0.7 µm		
3	Core concentricity error	Max	0.5 µm		
4	Cladding non-circularity	Max	1.0%		
5	Cable cut-off wavelength	Max (λcc)	1260nm		
6	Uncabled fiber macro bending loss	Radius (mm)[21]	15	10	7.5
		No. of turns	10	1	1
		Max. at 1550nm (dB)	0.03	0.1	0.5
		Max. at 1625nm (dB)	0.1	0.2	1.0
7	Proof stress	Minimum	0.69 GPa		
8	Chromatic dispersion coefficient	λ0min	1300 nm		
		λ0[22]	1310 nm		
		λ0max	1324 nm		
		S0max	0.092 ps/nm2.km		
9	Attenuation Coefficient	Max. from 1310nm to 1625nm	0.4dB/km		
		Max. at 1310nm	0.35dB/km		
		Max. at 1550nm	0.21dB/km		
		Max. allowed point discontinuities at 1310nm and 1550nm	0.05dB		

[21] The macro bending loss can be evaluated using a mandrel winding method (method A of [IEC 60793-1-47]), substituting the bending radius and the number of turns specified in this table.
[22] The fiber shall also be suitable for use in the 1550nm region, where this fiber is not optimised for use.

	Attribute	Details	Value
		Max. allowed variation[23]	0.1dB
		Temperature rang	-5°to +70°C
		Max. aging effect (25years)	0.05dB/km
10	PMD Coefficient	M	20 Cables
		Q	0.01%
		Max. PMDQ	0.20 ps/√ km

Table B.1: Cable characteristics

B.2. Strength Elements

B.2.1. Central Strength Element

The central strength element shall be of a suitable non-metallic substance such as FRP (Fiber Reinforced Polymer) rod coated with polyethylene and shall be designed to meet all mechanical strength requirements of the cable. Requirements of typical values for the central strength member are shown in the table below.

S.N.	Item	Unit	Typical values
1	Nominal diameter	Mm	2 for 12 and 24 fiber cable, 2.5 for 48, 96 and 144 fiber cable
2	Specific gravity	-	2.1
3	Tensile Strength	MPa	1100 (minimum)
4	Tensile Modules	GPa	50 (minimum)
5	Flexural Strength	MPa	1200 (minimum)
6	Flexural Modulus	GPa	40 (minimum)
7	Elongation to Break	%	2 % (minimum)

Table B.2: Cable Central Strength Elements

B.2.2. Peripheral Strength Element

The peripheral strength element shall be of suitable aramid yarns or glass fibers wrapped with plastic tape and shall be designed to meet all mechanical strength requirements of the cable. The peripheral strength element shall be placed in between the plastic tape and the swelling

[23] Variation between the value of attenuation co-efficient for any one km length of cable is compared with that of another one km length of the cable.

tape. The required typical values for the peripheral strength element are shown in the table below.

S.N.	Item	Unit	Typical values
1	Number of Aramid Yarns	Number	21
2	Weight	kg/km	5
3	Specific Gravity	gm/cm3	1.4
4	Breaking Strength	N	300 (minimum)
5	Elongation to Break	%	2 (minimum)
6	Modulus of Elasticity	GPa (kN/m2)	85 (minimum)

Table B.3: Cable Peripheral Strength Elements

Note: Table values in Sections B.2.1 and B.2.2 are given as general values; however, any other values may be used subject to prior approval.

B.3. Cable Make-up

B.3.1. Optical Fibers Cable Choices

4 Optical Fibers: The standard cable core configuration will have a total of four (4) fibers arranged in two (2) loose tubes containing two (2) fibers each, with one strength member of aramid yarn embedded in the cable sheath. The cable will contain no metallic elements and be dielectric. Alternate designs having all four (4) fibers on a central tube or as a tight buffer cable are acceptable, with prior approval.

12 Optical Fibers: The total number of fibers in the cable shall be twelve (12) with six (6) of the fibers encapsulated within two (2) loose tubes. Tight buffer cables are also acceptable, with prior approval.

24 Optical Fibers: The total number of fibers in the cable shall be twenty four (24). Six (6) fibers shall be encapsulated within four (4) loose tubes. Tight buffer cables are also acceptable, with prior approval.

48 Optical Fibers: The total number of fibers in the cable shall be forty eight (48). Six (6) fibers shall be encapsulated within eight (8) loose tubes.

96 Optical Fibers: The total number of fibers in the cable shall be ninety six (96). Twelve (12) fibers shall be encapsulated within twelve (12) loose tubes.

144 Optical Fibers: The total number of fibers in the cable shall be one hundred and forty four (144) arranged with twelve (12) fibers encapsulated within each of twelve (12) loose tubes.

B.3.2. Loose Tubes

The loose tubes containing optical fibers together with fillers shall be suitably stranded over the central strength member in one layer. There shall be a binder to maintain core geometry, stranded around central strength element, using reverse helical wrap technique.

B.3.3. Fillers

The fillers shall be of a transparent color made of polyethylene, polypropylene or any other approved material at the discretion of the manufacturer. All fillers shall be compatible with the other constituent components of the cable and shall not adversely affect the performance of the cable throughout the operative life of the cable. The number of filler tubes shall be decided in such a way to maintain cable sheath circularity. The fillers shall completely fill the voids they are designed to and shall not phase separate under all operational conditions.

B.3.4. Tight Buffer

Individual fiber shall be coated with yellow PVC jacket of a diameter of 2.5±0.5mm each. Each fiber shall be numbered as follows:

a) from one to four for four fibers cable,

b) from one to twelve for twelve fibers cable, and

c) from one to twenty four for twenty four fibers cable.

Fiber numbers must be printed on the PVC jacket on each fiber at intervals of not more than 100mm. Numbers must be printed in numerals and in writing such as: “17 SEVENTEEN”, on the complete length of each fiber’s buffer. The printing shall be permanent, durable and not abraded during normal wear and use.

B.4. Identification

B.4.1. Inside identification

The name of the manufacturer and the year of manufacture shall be indelibly marked at intervals of not more than 100mm, either on the belting tape or on a separate polyester marking

tape of not less than 3mm wide. If a separate marking tape is used, then it shall be laid over the outer wrappings and under the sheath.

B.4.2. Cable Size Identification

The cable size shall be punch type marked (non-erasable) at every meter on the outer surface of the sheath.

B.4.3. Cable Length Identification

Cable length (meter) shall be marked at every meter on the outer sheath surface and the markings shall be clearly visible, permanent and durable. The cable length shall be punch type marked (non-erasable) at every meter on the outer surface of the sheath.

B.5. Sheath

- The sheath shall be free from pinholes, joints, mended places and other defects.
- The minimum sheath thickness shall not be less than 1mm for 4 and 12F, 1.5mm for 24, 48 and 96F, and 2mm for 144 F cables.
- The sheath shall be reasonably circular, and the curvature of the external surface shall not be concave at any point.
- The sheath material shall be of LSZH type (Low-Smoke Zero-Halogen) or Fire- Resistant PVC (FR-PVC) suitable for internal and external use and the sheath color shall be YELLOW.

B.5.1. Ultimate Tensile Strength

Tensile strength-at-break of the sheath material shall not be less than 10N/mm2.

B.5.2. Bend Test

The sheath shall show no signs of damage or ripples after a bend test have been carried out as follows:

- No Load Test:
  - The cable shall be coiled at least one complete turnaround a mandrel of diameter not more than 10 times the specified minimum cable diameter.
- Full Load Test:

- The cable shall be coiled at least one complete turnaround a mandrel of diameter not more than 20 times the specified minimum cable diameter.

B.5.3. Rip Cord

a) A rip cord having a minimum breaking load of not less than 150N shall be laid under the outer sheath of 2, 4 and 12 fiber cables respectively.

b) Two rip cords having a minimum breaking load of not less than 250N shall be laid under the sheath on diagonally opposite sides of the cable for 48, 96, 144 and 192 fiber cables.

Filing Compound

a) The filling compound shall be provided inside the loose tube only. Suitable industry proven filling compound shall be provided to completely block ingress of moisture into the loose tube.

b) The filling compound shall be safe to handle and shall not adversely affect the performance and color of the fiber, or the constituent components of the cable, throughout its operational life.

c) The filling compound shall be compatible with the need to prepare the cable and splice the fibers under field conditions.

d) The filling compound shall be suitable for installation and operation over the temperature range of -5°C to +70°C.

e) The filling compound shall be non-toxic, free from unpleasant odor and shall cause no dermatitis hazards.

f) The compound shall be non-hydrogen generating, waterproof, and neutral in color.

g) Data sheets for filling compound shall be provided along with tender documents.

B.5.4. External Diameter

The external diameter of the cable, when measured by diameter tape, shall not be more than 7mm for 4F, 14mm for 12, 48 and 96 fiber cable, 17mm for the 144 fiber cables.

B.6. Color Scheme

a) The loose tubes/fillers shall employ the following color code:

Tube No.	Color
1	Dark Blue
2	Orange
3	Green
4	Brown
5	Grey
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink
12	Light Blue
Filler	Transparent

Table B.4: Color Scheme for Loose Tubes/Fillers

b) The fibers shall employ the following color code:

Tube No.	Color
1	Dark Blue
2	Orange
3	Green
4	Brown
5	Grey
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink
12	Light Blue
Filler	Transparent

Table B.5: Color scheme for the Fibers

B.7. Mechanical Performance of Cable

a) Tensile Strength

The cable shall have sufficient strength to withstand a load of value T = 9.81×W×3 N, (where W = mass of 1km of cable in kg). The load shall not produce a total strain exceeding 0.25% in the fibers, and shall not cause permanent damage to the component parts of the cable. The load shall be sustained for 10 minutes and the strain of the fiber monitored.

b) Flexibility

The fibers and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped four (4) complete turns for ten (10) complete cycles, around a mandrel of 12×D in diameter, where “D” is the outside diameter of the cable in mm.

c) Compressive Stress

The fibers and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 1000N applied between two flat plates of dimensions 50mm by 50mm. The load shall be applied for 60 seconds.

d) Transportation and Storage

The cable shall be protectively packed in drums to withstand transportation. The cable design and packing techniques shall permit the storage of all cables, in its original packing (reel or drum).

e) Vibrations and Shock

The supplier shall state the limits of vibration and mechanical shock that the cables can withstand under conditions of transport, storage and installation.

B.7.1. References

1. BS 6234 - Specification for Polyethylene Sheath
2. ITU-T G657.A2 – Characteristics of Bending- Loss Insensitive single-mode optical fiber and cable for the access network
3. IEC 794-IF5-Water Permanent Test
4. TIA TIA-568-C.0; Generic Telecommunications Cabling for Customer Premises

Appendix C. Category-6 Cable Specifications

C.1. Insulated Conductor Characteristics

Conductor - Each conductor shall be a solid wire of commercially pure annealed copper, smoothly drawn, circular in cross section, uniform in quality, and free from defects. The nominal conductor size shall be 22 or 24 AWG. The exact conductor gauge size may vary to achieve the required Category-6 electrical requirements.

Insulation - Conductors shall be insulated with a suitable dielectric insulating material of sufficient thickness and properties to meet the electrical requirements. The insulation shall be uniform and applied concentrically, consisting of 100% virgin material. The insulation materials used will be one of the following types - polyolefin, poly (vinyl chloride), or fluoropolymer - that have proven successful at meeting the functional performance requirements of premises wires.

Imperfections - The insulated conductors should have no more than an average of one fault per 1,000 conductor meters when measured at 2500 VDC or 1750 VRMS (AC).

Adhesion - The adhesion of the insulation on the conductor shall be such that the force to remove the insulation from the conductor shall not be greater than 20 N when stripped at a rate of travel of 50mm per minute.

Tensile strength and Elongation - The average elongation-at-break shall not be less than 100% and the average tensile strength-at-break shall not be less than 13.6 MPa. It is desirable that the minimum elongation-at-break shall not be less than 150%.

Resistance to Aging - After aging at 100°C for 7 days, the insulated conductors shall show no signs of cracking, splits or tears when examined at a 5× magnification, after wrapping in 6 tight turns around a mandrel having a diameter no larger than the diameter of the insulated conductor.

Compression Resistance - Insulated conductors shall be tested for resistance to compression at a rate of approach not to exceed 0.5 mm per minute and the minimum compressive strength shall not be less than 1330N over a 50-mm length of the insulated conductor sample.

Cold Bend - Insulated conductors shall be wrapped around a test mandrel with a diameter equal to 3 times the outer diameter (OD) at -20 ± 2°C. There shall be no cracks in the tested

specimens after bending the insulated conductors 5 times around the mandrel within 20 to 30 seconds.

Shrink back - A 150mm length of insulated conductor shall be placed in a circulating air oven for 4 hours at 115 ± 1°C. After cooling to room temperature, the difference in length between the insulation and the conductor shall not exceed 8 mm.

Twist Lengths - Appropriately colored insulated conductors shall be uniformly twisted into pairs in a way that ensures that meet the Category-6 transmission electrical requirements. The average twist length of any pair in the finished wire shall not exceed 150 mm.

Insulation Color – Color coding is required so that conductors and individual pairs can be properly and easily identified. Color coding shall be accomplished by use of colored insulation in combination with either single marks of a colored ink, or an extruded colored stripe.

C.2. Other Cable Components

Foil Screens - Internal cables may include a foil screen surrounding the insulated wires or the core bundle to help protect the transmitted signal from the inductive (EMI) and interference (RFI) effects from external electromagnetic influences. These foils vary in their shielding effectiveness depending on the metal thickness of the screen, its conductivity, and the physical coverage provided by the foil for the underlying conductors. The required thickness and foil material type will depend on the electromagnetic protection level desired for the application. The foil screen is normally used in conjunction with a tinned copper drain wire, which provides electrical continuity for the foil screen. As a guideline, typical foil screens usually are 0.025 to 0.05 mm thick aluminum.

Jacket Ripcords - Jacket ripcords shall be continuous in any length of wire and shall be capable of consistently slitting the wire jacket for the continuous length of 0.75 m at 23 ±3°C without entanglement or damage to the conductor insulation when examined under 5 × magnifications.

C.3. Cable Jackets Characteristics

Jacket Material - Jacket materials that have proven successful at meeting the functional performance requirements of telecommunications premises cables include fire-retardant polyolefins, poly (vinyl chloride), and fluoropolymers. Other materials may be used provided that they meet all the applicable performance requirements in this document.

Jacket Surface - The jacket shall be smooth, free from holes, splits, blisters, and other defects, and shall not adhere to the conductor insulation or to the core wrap if used.

Jacket Thickness - Jacket thickness is dependent on the material selected, desired fire resistance, and other functional performance requirements. Jacket thickness shall be sufficient to meet the mechanical and electrical requirements.

Material Tensile Strength and Elongation - The jacket materials shall have a minimum ultimate strength (tensile strength-at-break) of 13.6 MPa and a minimum elongation-at- break of 100%. It is desirable that the minimum elongation-at-break be at least 150%.

Resistance to Aging - After aging at 100°C for 7 days, the average tensile strength-at- break of the jacket sample shall not be less than 75% of the initial value before aging, and the average elongation-at-break shall not be less than 50% of the initial value before aging.

C.4. Electrical Requirements

Caterory-6 Transmission Performance - Cables shall meet the Category-6 transmission characteristics tested at frequencies up to 250 MHz. In general, electrical test criteria and procedures noted below follow the methods and procedures of the Transmission Requirements section of ANSI/TIA-568-C.2 as applicable for solid conductors. For all transmission tests, the test sample length shall be 100 meters unless otherwise specified.

DC Conductor Resistance - For nominal 24 AWG conductors, the resistance of any individual conductor in any reel or length of wire shall not exceed 9.38 ohms per 100m measured at 20°C. For nominal 22 AWG conductors, the resistance of any individual conductor in any reel or length of wire shall not exceed 5.9 ohms per 100 m when measured at 20°C.

Conductor Resistance Unbalance - The resistance unbalance between the two conductors of any pair in completed wire shall not exceed 5.0%.

Capacitance Unbalance — Pair-to-Ground - The unbalance to ground at 1 kHz shall not exceed 330 pF per 100 m.

Insertion Loss (Attenuation) - Insertion loss (also called attenuation) is a measure of the signal loss (power) resulting from the wire as the signal passes along it between a transmitter and receiver component. The insertion loss in dB at 100 meters measured at 20°C shall not exceed $1.808\sqrt{(f)} + 0.017(f) + 0.2/\sqrt{(f)}$, where f = frequency from 1 to 250 MHz.

The insertion loss shall be measured at 40°C (104°F) and 60°C (140°F) and the maximum permitted wire insertion loss shall be computed at these elevated temperatures by using the following factors as appropriate:

- A factor of 0.4% per °C increases from 20°C to 40°C for UTP (unshielded twisted pairs) products
- A factor of 0.6% per °C increases from 40°C to 60°C for UTP (unshielded twisted pairs) products.
- A factor of 0.2% per °C increases from 20°C to 60°C for foil-screened wire products (also called FTP or F/UTP).

Insulation Resistance - Insulated conductor(s) shall have an insulation resistance of not less than 1500 megaohm-100 m.

Return Loss - Return loss of cable products shall be measured across the appropriate frequency range and shall not be less than the values calculated from the equations below where f is the frequency in MHz.

For f from 1 to 10 MHz Return Loss (dB at 100 m) < $20 + 5\log(f)$. For f from 10 to 20 MHz Return Loss (dB at 100 m) < 25

For f from 20 to 250 MHz Return Loss (dB at 100 m) < $25 - 7\log(\frac{f}{20})$

Near-End Crosstalk (NEXT) - In wire products containing 4 pairs or less, the Near-End Crosstalk (NEXT) shall be measured across the appropriate frequency range and the NEXT Loss (dB at 100 m) shall not be less than $44.3 - 15\log(\frac{f}{100})$.

Power-Sum Near-End Crosstalk (PS NEXT) - For wire products containing 25 pairs and less, the Power-Sum Near-End Crosstalk (PS NEXT) measured as dB at 100 meters between each pair and all other pairs and shall not be less than $42.3 - 15\log(\frac{f}{100})$.

Power-Sum Attenuation-to-Crosstalk Ratio, Far-End (PS ACRF) - The Power-Sum Attenuation-to-Crosstalk Ratio, Far-End shall be calculated across the frequency range and the PS ACRF values in dB at 100meters shall not be less than $24.8 - 15\log(\frac{f}{100})$.

Propagation Delay (PD) - The Propagation Delay (PD) shall be measured across the frequency range and the PD values in nanoseconds at 100meter shall not exceed the values determined from the following equation where f is the frequency in MHz - $534 + 36/\sqrt{(f)}$.

Transverse Conversion Loss (TCL) and Transverse Conversion Transfer Loss (TCTL) - Transverse Conversion Loss (TCL) is the measured loss from a balanced signal to an unbalanced signal measured at the near end of the wire product. For wire components, the TCL value is the same as Longitudinal Conversion Loss (LCL) where the measured loss is from an unbalanced signal to a balanced signal measured at the near end of the wire. Transverse Conversion Transfer Loss (TCTL) or Equal-Level Transverse Conversion Transfer Loss (ELTCTL) are the measured losses from a balanced signal at the near end to an unbalanced signal measured at the far end of the pairs in the wire product.

Transverse Conversion Loss (TCL) - The Transverse Conversion Loss (TCL) shall be measured as per ANSI/TIA-568-C.2 across the 1 to 250 MHz frequency range and the TCL values shall not be less than the values determined from the following equation, where f is the frequency in MHz.

$$\frac{TCL\ (dB\ AT\ 100m)}{30 - 10\log(f/100)}$$

Equal-Level Transverse Conversion Transfer Loss (ELTCTL) - the Equal-Level Transverse Conversion Transfer Loss (ELTCTL) shall be measured as per ANSI/TIA-568-C.2 across the 1 to 30 MHz frequency range and the ELTCTL values shall not be less than the values determined from the following equation, where f is the frequency in MHz.

$$\frac{ELTCTL\ (dB\ AT\ 100m)}{35 - 20\log(f)}$$

C.5. Complete Cable Requirements

Cold Wrap Test - The completed wire shall be capable of being bent without visual evidence of cracks or splits in the jacket after the wire has been bent around a mandrel 3 times in three close turns within 30 seconds. The test will be performed at -20 ± 2°C. For wires with an OD up to or equal to 20 mm, the diameter of the test mandrel shall equal 8× OD of the wire product. For wires with an OD greater than 20 mm, the diameter of the test mandrel shall equal 10× OD of the wire.

Impact Test - The completed wire product shall be capable of surviving a 3 inch-lb impact test at -10 ± 2°C without visual evidence of cracks or splits in the jacket after the wire has been impacted. The impact cylinder shall have a flat striking surface and be 1 inch in diameter. The wire shall be placed on an anvil with a ridge 1.6-mm wide and 2.4-mm high.

Fire Resistance – Riser Cables - Internal cables shall meet the applicable fire codes. For cables used in building riser locations, these riser-rated wire products shall meet the requirements of UL-444 where the flame height during the test shall be less than 3.7 m and the temperature at any of the monitoring thermocouples shall exceed 454°C.

Fire Resistance – Plenum Cables - Internal cables shall meet the applicable fire codes. For cables used in building plenum locations, these plenum-rated wire products shall meet the requirements of UL-444 Flame and Smoke Requirements Section and when tested as per NFPA 262 the plenum-rated wire products shall show:

- A flame spread of 5 feet (1.5 m) or less.
- A peak optical smoke density of 0.5 or less.
- An average optical smoke density of 0.15 or less.

Jacket Marking - The outer surface of the jacket shall be durably marked in black or color contrasting ink with the following information:

- Manufacturer's Name or Code
- Year of Manufacture
- Number of Pairs
- Conductor Gauge — AWG
- Fire resistance rating
- Electrical transmission classification (i.e., Category-6)

These markings shall be spaced at equal intervals to and alternating with the sequential length marking not exceeding 0.6 meters.

Packaging - Premises wires are furnished in a variety of packages to facilitate deployment in a variety of applications. Packaging can include coils, cartons, small- and medium sized reels, or other suitable configurations. The wire shall be packed in conveniently sized packages that

permit tangle-free distribution of wire from an unattended dispenser. The wire shall be evenly and compactly packed into one continuous length.

C.5.1. References

1. Telecommunications Cabling Standards with the ANSI/TIA568-C.2, Copper Cabling Components,
2. ANSI/NFPA 70, National Electrical Code, (NEC) 2008.
3. ANSI/UL 444, UL Standard for Safety Communications Cables (CSA C22.2).
4. ISO 9000, Quality Management Systems
5. ASTM D 4565, Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable.
6. ASTM D 4566, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable.
7. UL 1581, Reference Standard for Electrical Wires, Cables and Flexible Cords.
8. UL 1685, Standard for Vertical-Tray Fire- Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
9. UL 1666, Standard for Test for Flame Propagation Height of Electrical and Optical- Fiber Cable Installed Vertically in Shafts.
10. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

Appendix D. External Ducting Specifications

Multiple spans of external Ducts with Joint Boxes in between may be needed to extend the cabling channel. In MDU scenarios, a dedicated Telecommunications Room is part of external ducting.

D.1. Ducts

D.1.1. Specification

Material	Inner Diameter	Available Length	Color	Duct Standard Type
HDPE	110mm	5.8 m	Black	D54
HDPE	50mm	3 m	Black	D56

Table D.1: Duct specifications

D.1.2. Formation and Requirements

Description	No. of Ducts	Remarks
Villa	1×D56	
MDUs	2×D54	Additional 2×D54 from different direction need to be considered for cable route diversity
Joint Box to Joint Box or Joint Box to Telecommunications Room	From 2×D54 to 9×D54	The number of D54 depends on the final cabling design as it is required to maintain at least 50% Duct space for maintenance and any future expansion.

Table D.2: Duct requirements

D.1.3. External Ducting Entry Box for SDU

a) The entry box is a reinforced concrete structure, with a heavy-duty ductile iron frame and cover of rating grade ‘A’ and size is 60x60x80 cm. The cover shall have a marking as “Telecommunications”.

b) The location of the entry box depends on the location of existing/proposed external line plant.

c) The entry box should be constructed at a maximum distance of 1 meter from inside the plot line. Due to the variables involved, it is essential to consult at the design stage, to decide the location of the entry box and entry pipe. The consultants/ contractors must not deviate from the stipulated location.

d) An earth rod must be provided at the entry box. The required earth resistance should not exceed more than 5 ohms.

e) Each entry box is equipped with entry pipes. Entry pipes for the entry box are UPVC Ducts. These Ducts are to be extended from the entry box towards line plant location.

- Entry pipes should be laid at a depth of 60 cm from the proposed finished paving level. The entry pipe must be protected with concrete to prevent damage.
- Entry pipe should be extended 1 meter from plot limit towards outside the plot.
- The entry pipe should be of UPVC material and of black color.
- The open ends of the entry pipe must be properly sealed, to prevent entry of sub- soil materials and ingress of water.
- The location of entry pipes must be clearly marked, above ground for easy location.
- The building Contractors shall be responsible for locating the installed entry pipes on site.
- No right-angled sharp bends should be installed throughout the Duct length, except one wide-angle, long radius bend (factory made) at the terminating end of the Duct, inside the Main Telecommunications Room. Alternatively, at the location of the wide-angle bend, a cable pull box of minimum size 600(L) x 700(W) x 800(D) mm must be provided.
- Entry pipes must be provided with a drawing rope made of nylon of minimum of 6mm diameter.

D.1.4. Joint Boxes or Handholes

Joint Boxes need to be located in the footway or verge, in a safe location and be easy to access in the future. The orientation of the Joint Boxes window (access holes) needs to be designed to facilitate the cable entry.

Different sized Joint Boxes are based on the number of Ducts entering the Joint Box, the location and number of Joint Chambers.

D.1.5. Joint Boxes and Handholes Dimensions

Code	Internal Dimensions (mm)			Location of Chamber	Maximum Number of Duct Ways				
					Normal Depth		Extra Depth		
	L Length	W Width	D Depth		Depth	Depth	Depth (mm)	D54	D56
JRC4	915	460	780	Footway Sidewalk	-	5	75	-	6
					1	4	100	1	5
					2	2	125	2	6
JRC12	1170	680	740	Footway/ Carriageway (Roadway)	1	5	100	2	4
					2	3	125	4	2
					3	2	150	4	3
					-	-	200	4	4
JRC14	2285	680	965	Footway/ Carriageway (Roadway)	1	8	125	4	2
					2	6	150	4	4
					3	4	175	6	2
					4	3	200	6	4
					-	-	250	6	6
					-	-	300	6	8

Table D.3: Joint Boxes and Handholes Dimensions

Note: Manholes can be used if number of D54 Ducts is more than 6.

D.2. General Civil Considerations

- All external Ducts must be laid underground.
- Ducts to be laid at 600 mm depth from final ground level with pulling rope installed.
- Only one slow bend is acceptable for villa connection through D56 Ducts.
- Only one slow bend is acceptable for MDUs connection through D54 Ducts.
- All Telecommunications Rooms of Type A shall be connected from two different directions for diversity requirements.
- The maximum distance between the Joint Boxes shall not exceed 250 meters.
- A minimum of JRC12 shall be used to accommodate FO (Fiber Optic) joint closure.
- Sharp or acute (less than 90°) bends are unacceptable and not permitted.

- The type of Joint Box depends on the usage (i.e. JRC12 and JRC 14 shall be used in areas used by heavy vehicles regardless of the number of used Ducts).
- Manholes with sufficient space for closures which can accommodate minimum three splitter layers and spare cable length.

Appendix E. Internal Ducting Specifications

For cabling inside buildings, micro Ducts (Ducts with OD less than 25 mm) can provide placement flexibility. In MDU scenarios, individual micro Ducts can be used to place cable between distribution boxes and the telecommunications jack (socket). A number of colored micro Ducts can also be bundled under one outer sheath to form an internal multi-Duct conduit for easier placement and identification of cable runs.

Figure E.1: Internal ducting illustration

The micro Duct products are designed to accommodate a single fiber optical cable primarily for deployment in a residential or intrabuilding location through either cable pulling or cable blowing procedures.

The micro Duct product shall be flexible, lightweight, durable, and easy to install. Micro Duct products consist of smooth or micro-ribbed Ducts and shall be:

- Compatible with existing construction designs and building configurations for both riser- and plenum-rated applications, including cable blowing apparatus.

- Able to accommodate single or multiple microfiber cables of 2.5 to 8 mm diameter, although the most common sizes anticipated shall be fiber cables of 2.9 or 3.0 mm outer diameter.
- Allow cables to be safely deployed through pull lines or strings using less than 90-120 Newtons of force, or more often using cable blowing techniques at typical deployment speeds of 30-60 meters (100- 200 feet) per minute.

Micro Ducts are typically small-diameter, flexible, or semi-flexible Ducts with inside diameters usually ranging from 3 mm to 10 mm (larger sizes available). These Ducts are designed to provide clean, continuous, low- friction paths for placing optical cables that have relatively low pulling tension limits.

E.1. Micro Duct – Size and Material

Size - The standard sizes include the following from which a micro Duct can be chosen to match cable size and application. Various material formulations including PVC, LSZH and fluoropolymers varieties are available with differing fire resistance ratings to match building application (general purpose, risers and plenums) and customer needs.

Designation	Nominal Size (mm)	
	OD	ID
5 mm (*)	5.0	3.0
7 mm	7.0	5.5
8.5 mm	8.5	6.0
10 mm	10.0	8.0
12 mm	12.0	10.0
(*) Used for small 2-2.5 mm OD cables that are blown into microduct.		

Table E.1: Duct sizes

The micro Duct products shall meet the nominal ODs and IDs noted above within a tolerance of +/- 0.1 mm in their measured OD values.

Regrind – Micro Duct products shall have a maximum of 5% plastic regrind used in their manufacture.

Aging - No significant changes (less than 5%) in characteristic dimensions of the micro Ducts are allowed after aging at 75°C for 30 days. The micro Duct shall have a maximum longitudinal

shrinkage of 2% after conditioning at 75°C for 30 days. The micro Duct product shall show no significant change in color, surface appearance, and mechanical robustness after conditioning at 75°C for 30 days.

E.2. General Design Features

The micro Duct product shall consist of a smooth or micro-ribbed Duct designed to accommodate a single fiber optical cable primarily for deployment in a residential or intrabuilding location through either cable pulling or cable blowing procedures.

The micro Duct product shall be flexible, lightweight, durable, and easy to install. The micro Duct shall have the ability to be cut cleanly using standard tools.

Indoor micro Duct products shall be able to be deployed and operational at conditions between -5°C (23°F) and 50°C (122°F) and between 10 and 85% relative humidity (RH).

The micro Duct product and accessories such as endcaps, couplers, and mounting hardware shall have no sharp edges or burrs that might be hazardous to a technician or installer, or otherwise damage any cabling placed in it following the manufacturer's instructions.

Micro Ducts shall be homogeneous and free of any visible surface flaking, chips, voids, holes, or cracks.

Micro Ducts extruded over optical cable shall not adhere to the cable sheath.

Micro Duct products shall be compatible with common tools, equipment, and procedures - specifically, Ducts shall be:

- Provided reels compatible with existing reel handling equipment.
- Capable of being placed in underground conduit using existing swivels, slings, links, grips, winches, and winch lines.
- Compatible with existing rodding devices (such as compressors or vacuum equipment) used to place a standard pull line inside the Duct.
- Compatible with generally used telephone cable lubricants.

E.3. Marking

Product information shall be permanently applied on the outside surface of the Duct in readable characters at least 1.6 mm high, although characters of 3 mm in height are preferred if there

is sufficient space on the micro Duct product. The information shall include the product name and/or number and the manufacturer's identification code, and date of manufacture.

The information shall be printed or imprinted with a contrasting color ink at minimum intervals of 0.6 m throughout the length of Duct.

Length markings shall be permanently applied on the outside surface of the Duct in readable characters, at least 1.6 mm high. The markings shall be printed or imprinted with a contrasting color ink at intervals of 0.6 m throughout the length of Duct.

E.4. Functional Performance

Installation - The product shall be able to be installed following the supplier's instructions. The supplier shall provide capabilities and capacities with 50 lbs. peak pull force. A standard fiber cable shall be able to be pulled through a test configuration that includes a minimum of 100m of Duct with at least 8 x 90° bends with radii of between 200 and 250 mm using pull forces less than 40 lbs.

Ovality -The maximum ovality of the micro Duct shall be 5% when tested at 50°C for 15 days at 2 kg of weight per linear foot.

Coefficient of Friction - The maximum coefficient of friction (CoF) for a cable moving through these micro Ducts shall be 0.35 without lubricant, and 0.30 with lubricant or in pre-lubricated Duct. It is desirable that the maximum sliding coefficient when using lubricants or pre-lubricated Duct shall not exceed 0.15.

Tensile and Pull Strength for indoor micro Ducts

- The minimum pull or tensile strength for a 7 mm OD micro Duct product shall be 55 lbs. when pulled at 1 inch/min.
- The minimum pull or tensile strength for an 8.5 mm OD micro Duct product shall be 70 lbs. when pulled at 1 inch/min.
- The minimum pull or tensile strength for a 12 mm OD micro Duct product shall be 175 lbs. when pulled at 1 inch/min.

Elongation for Indoor micro Ducts - The minimum elongation of the micro Duct shall be 2.5% when pulled to the following stress levels at a tensile strain rate of 1 inch/min:

- 40 lbs for the 7 mm micro Duct

- 50 lbs for the 8.5-mm OD micro Duct
- 100 lbs force for 12-mm OD micro Duct.

Impact - After an impact of 4 ft-lbs at -5oC, the micro Duct specimens shall show:

- No damage, cracks, or splits,
- No deformation greater than 15%, or
- No more than a 15% change in ovality.

Bending Resistance – The micro Duct shall be capable of being bent 180° over a mandrel with a radius of 15 OD of the micro Duct at -5°C. After this test, the micro Duct shall be able to be straightened without damage. After the bending test is completed, the ovality shall be less than 5%.

Pressure Burst Strength - The minimum burst strength for Duct shall be 900 kPa) at 23°C ± 5°C.

Chemical Resistance – Micro Ducts shall not stress crack or mechanically degrade on exposure to typical cleaners and lubricant chemicals that are routinely used in telecommunications industry. Micro Ducts shall retain 75% of their original pull strength after 30-day exposure to the chemicals specified below.

- Water displacement lubricant - WD-40
- Wasp and Insect Spray
- Generic cable lubricant - 10% Igepal in water
- Oil- and latex-Based House Paints
- Alkaline solutions - 0.2N NaOH.
- Fuel-based liquids - Low Odor Kerosene
- Acidic solutions - 3% H2SO4
- Cleaners - Ammonia-based cleaner
- 90% Alcohol (isopropyl alcohol in water).

Fire Resistance – Micro Ducts intended for intrabuilding use shall be rated and identified as flame resistant. The products shall exceed the following ratings when measured as per Underwriters Laboratories UL 94 or an equivalent fire resistance test.

- UL94V-2 for Riser-Rated Micro Ducts
- UL94V-0 for Plenum-Rated Micro Ducts.

Connection Hardware - The connector, coupler, and end-cap hardware for the Duct shall withstand six (6) operations of assembly and disconnection.

Appendix F. Additional buildings descriptions

F.1. Residential Towers

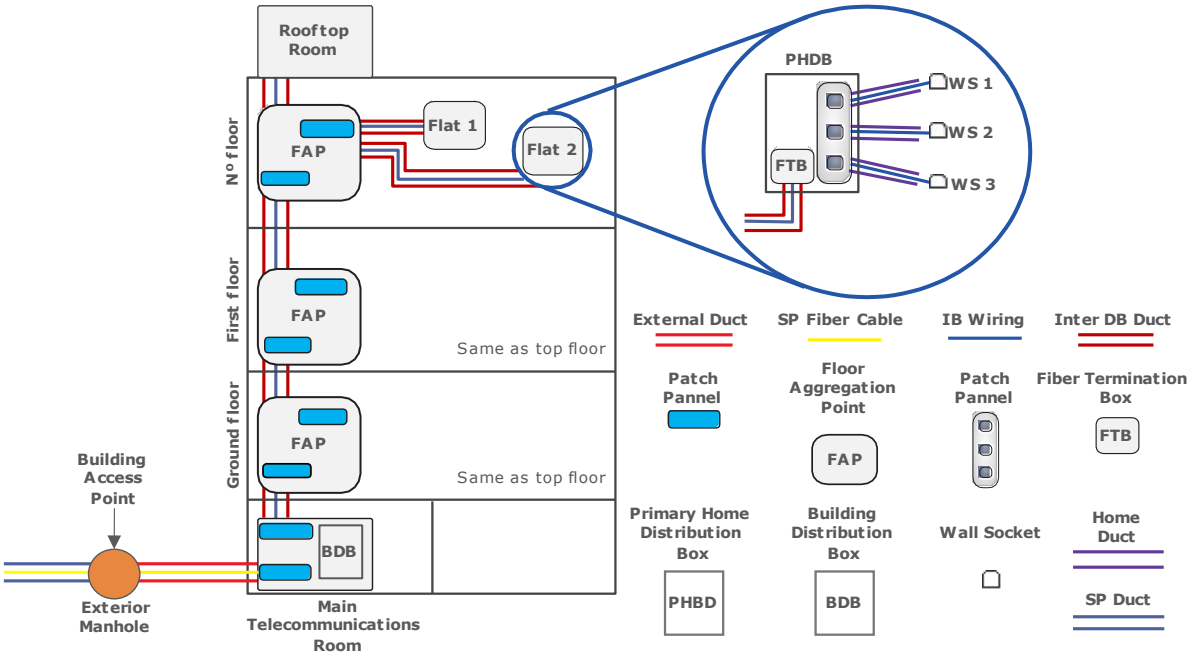

Figure F.1: Multi Dwelling Units

F.1.1. Multi Dwelling Units (≤ 100 connections)

If the number of connections is less than 16, the RED has the option not to use Telecommunications Room Type B but replace it with Fiber Aggregation Point (FAP) to serve that small number of customers.

F.1.2. Multi Dwelling Units (> 100 connections)

Note 1

For optical cable placing, there are three (3) different scenarios:

f) One - Fiber optical cable laid vertically from the Telecommunications Room (TR) through FAPs and then horizontally to each Flat directly without patching/splicing.

g) One multi-core optical cable laid vertically from TR to each FAP then patched/spliced within the FAP to connect with a 4-Fiber optical cable laid horizontally to each Flat.

h) One multi-core optical cable laid vertically from TR to service all FAPs then patched/ spliced with the 4F optical cable laid horizontally up to each Flat.

Note 2

In the scenario where patch panels are to be used, the number of patch panels in FDB inside the FAP depends on the size of riser cable and the number of horizontal cables.

F.2. Villa Complexes

Typically, a Villa is a building with a lower number of potential connections. The following designs in Figure F.2, Figure F.3, Figure F.4 and Figure F.5 are solutions considered to deliver the FTTx services.

i) Each Service Point shall be connected to the Primary Home Distribution Box (PHDB) with 1 (one) containment sufficient to carry 1 (one) Fiber Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m. If the distance between Service Point and PHDB is more than 80m, then Service Point shall be connected to the nearest Secondary Home Distribution Box (SHDB).

j) Each Service Point shall be connected to the Primary Home Distribution Box (PHDB) with either fiber optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint. If the distance between Service Point and PHDB is more than 90m, then Service Point shall be connected to the nearest Secondary Home Distribution Box (SHDB).

k) This requirement applicable for Single Villa with one floor, Single Villa with Multiple floor, Single Villa with Multiple Tenants as below connection scenarios.

F.2.1. Single Villa with One Floor

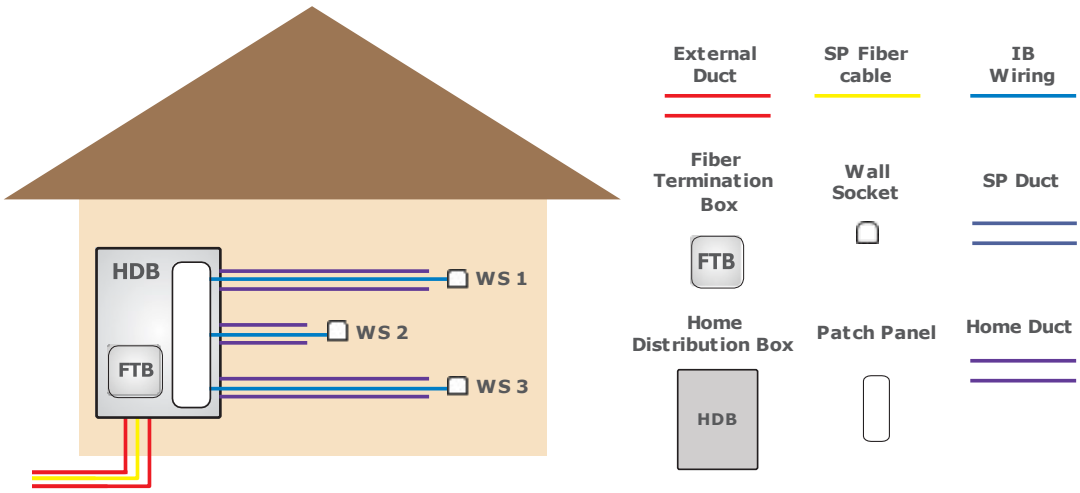

Figure F.2: Single Villa with One Floor

F.2.2. Single Villa with Multiple Floors

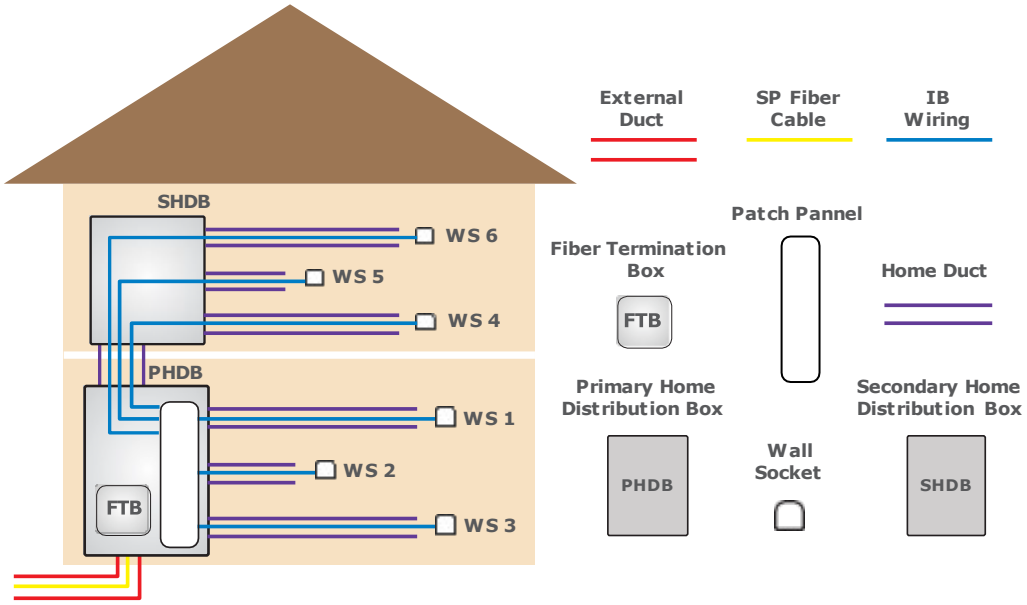

Figure F.3: Single Villa with Multiple Floors

Note 1

If the total number of sockets on floors other than the ground floor is more than 4, the RED has to install CAT 6 cable according to the number of sockets and terminate it in main Copper Patch Panel.

Note 2

If the Category-6 cable length between sockets and copper patch panel is more than 90m, designer has to revise the plan to adhere with the requirement.

F.2.3. Single Villa with Multiple Tenants

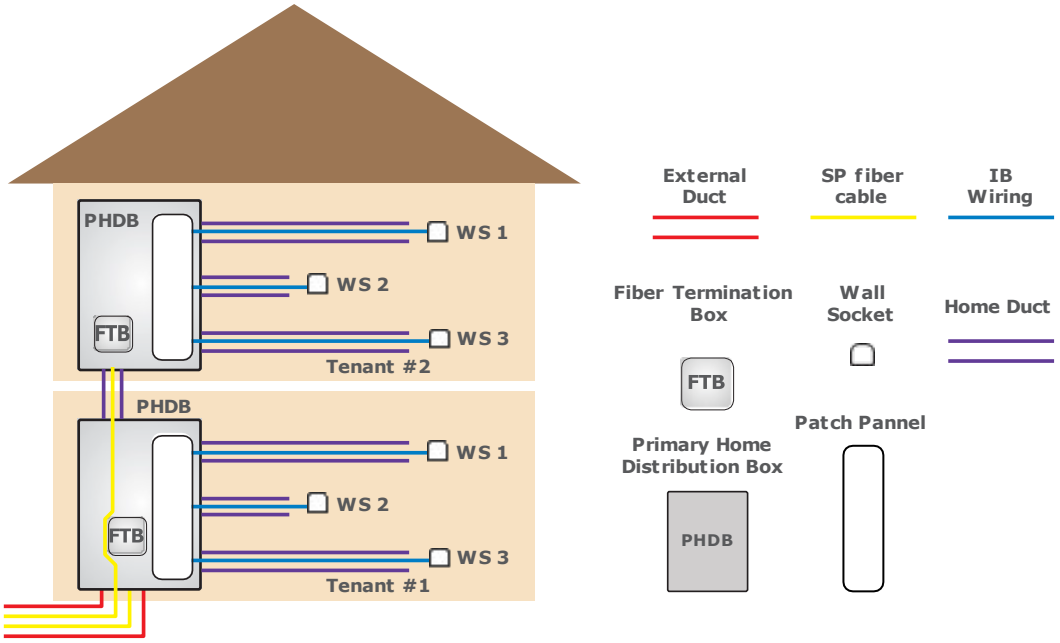

Figure F.4: Single Villa with multiple tenants

F.2.4. Compound of Villas

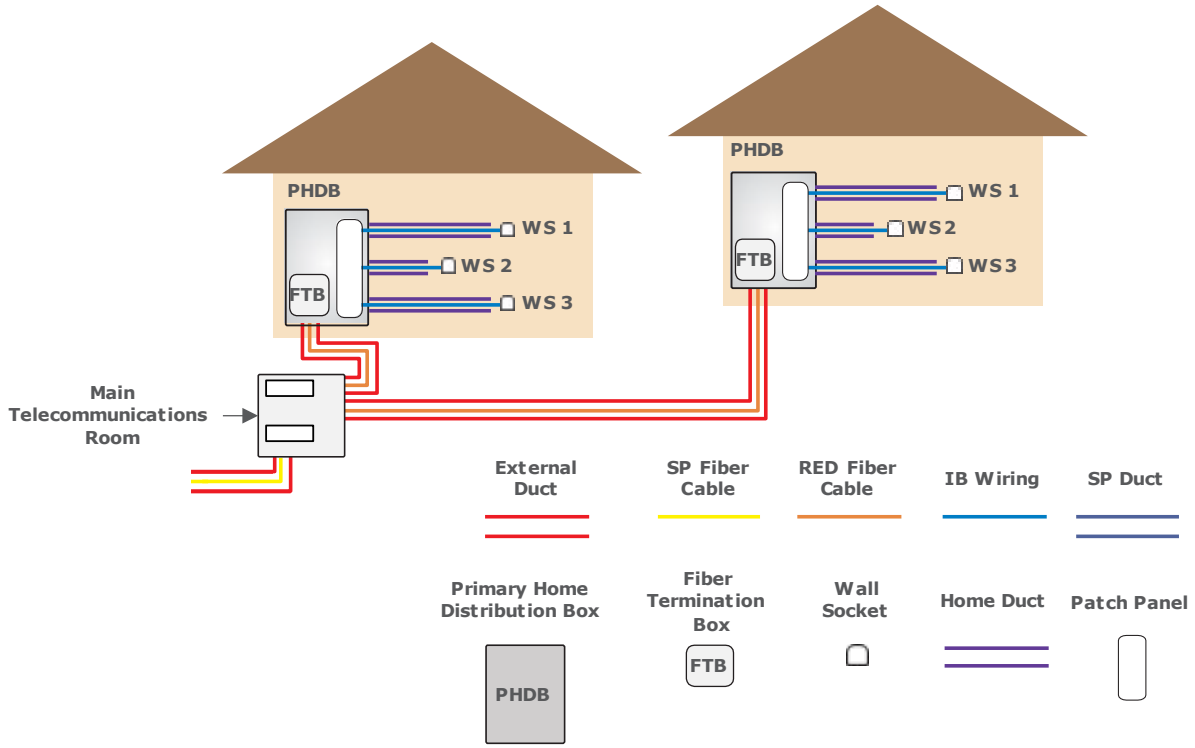

Figure F.5: Compound of Villas

Compound of villas (≤ 100 connections)

In large development projects comprising tens of villa type houses, a local underground Duct network with at least 100 mm diameter Ducts should be installed. The underground Duct network should be connected to the lead-in Duct. Two 50 mm diameter Ducts should be provided for connecting the local underground Duct network to each of the house and the route should be as straight as possible. Alternatively, separate lead-in Ducts with not less than 100mm diameter may be installed along the boundary of the development and two 50mm Ducts should be provided for connecting each house. The design of the local underground Duct network and the number of lead-in Ducts required depend on the scale and overall design of a development. Therefore, REDs are highly recommended to co-ordinate with the Network Operators for the actual need.

Compound of Villas (> 100 connections)

In any villas or compounds having more than 100 connections and in all multi dwelling units (MDU) complexes, a Telecommunications Room must be provided to serve this type of

residential complexes so that they are of type A or B at least, and the service delivery to the residential units.

F.3. Shopping Malls

Shopping malls are multi dwelling units with different floor plans, wall layouts and distinct room locations that will require customized cable pathways and node locations. The scenarios provided in section F.1.1 and F.1.2 are applicable to shopping malls.

F.4. Group of Shops and retail outlets

If the number of required connections is less than 16, the RED has the option not to use the Telecommunications Room Type B but replace it with Fiber Aggregation Point (FAP) to serve the small number of connections in the designated area. The scenario provided in section F.2.4 is applicable to a group of shops and retail outlets.

F.5. Warehouses and Sheds

F.5.1. Single Warehouse

Typically, a single warehouse is a building for storage of goods in which the potential number of connections is usually low. The design in Figure F.6, below, can be implemented for a typical warehousing compound.

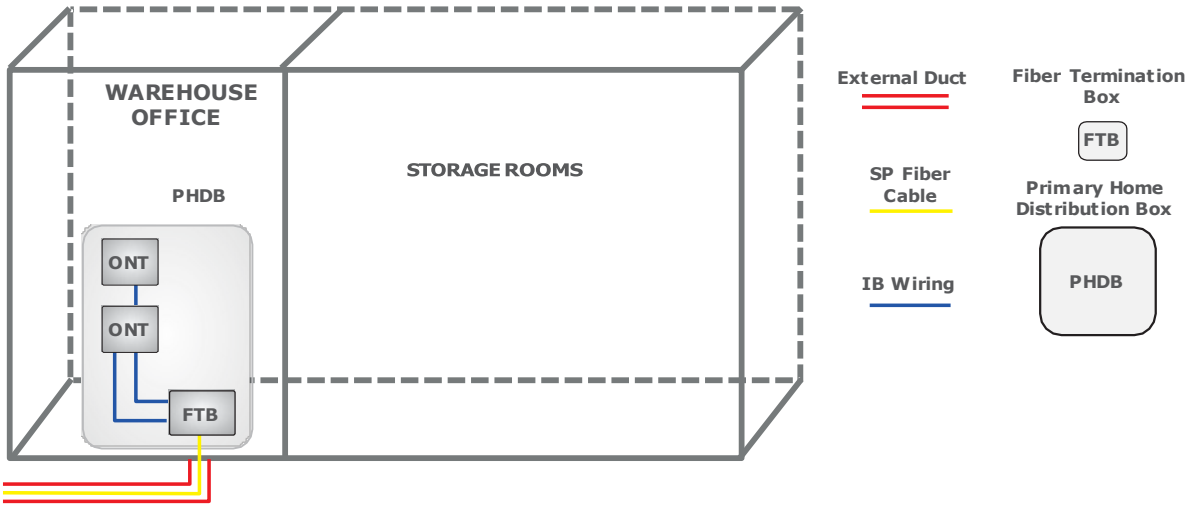

Figure F.6: Single Warehouse

F.5.2. Warehouse compound

A typical warehouse compound will have multiple buildings under different ownerships and the possibility of connections in individual buildings is limited in number. The design in Figure F.7, below can be implemented for a typical warehousing compound.

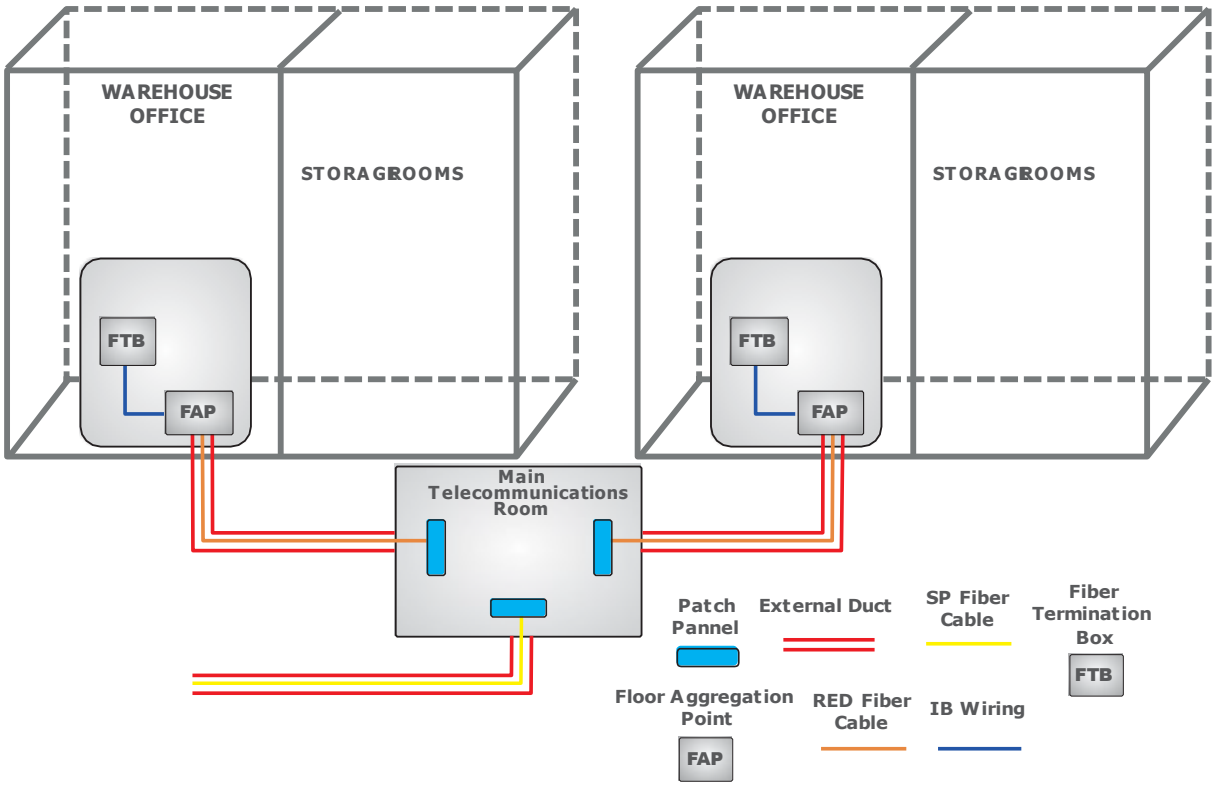

Figure F.7: Warehouse Compound

F.6. Labor Accommodation

In most likely cases, there are two scenarios for labor accommodation. The following FTTH System arrangement inside a labor accommodation is recommended in this Standard.

F.6.1. Multistore Labor Accommodation

In case of permanent and large multistore labor accommodations, it is required to lay separate drop fiber cable to each room & install ONT box. An illustration is provided in Figure F.8 for more details.

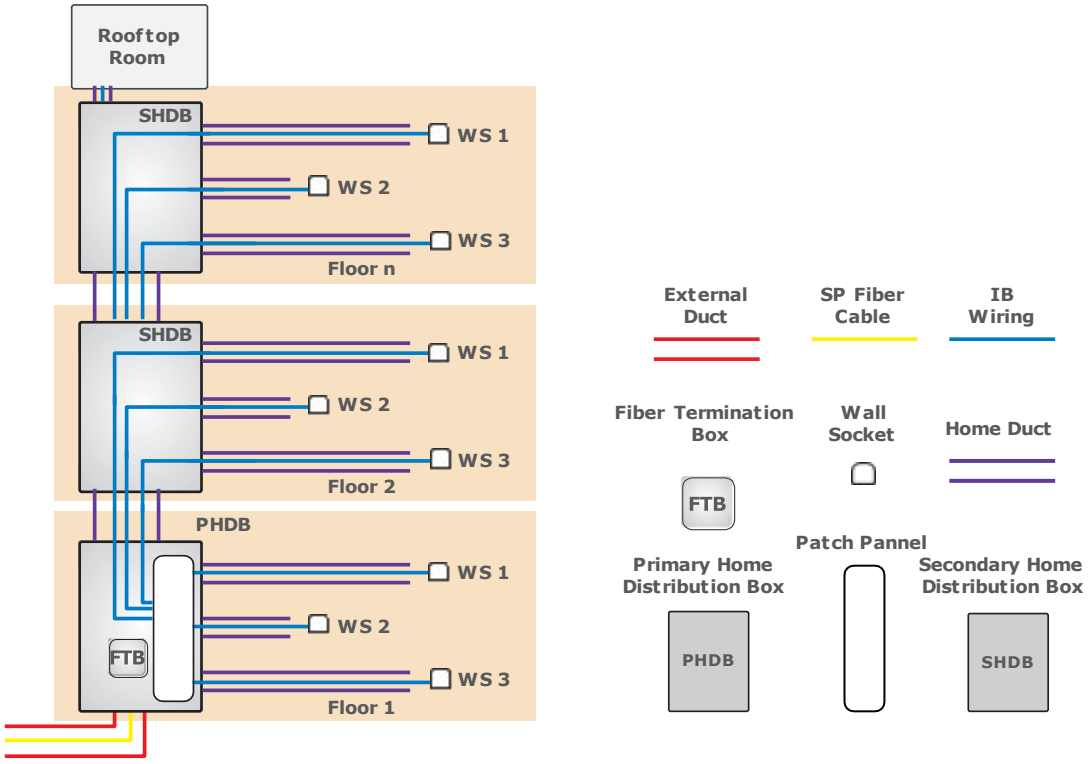

Figure F.8: Multistore Labor Accommodation

F.6.2. Small Labor Accommodation

In the case of small labor accommodations with a smaller number of rooms, a CAT 6- cable shall be laid from each room socket (maximum cable length allowed is 70mtrs) to the Telecommunications Room and terminate on the patch panels installed in the cabinet. An illustration is provided in Figure F.9 for more details.

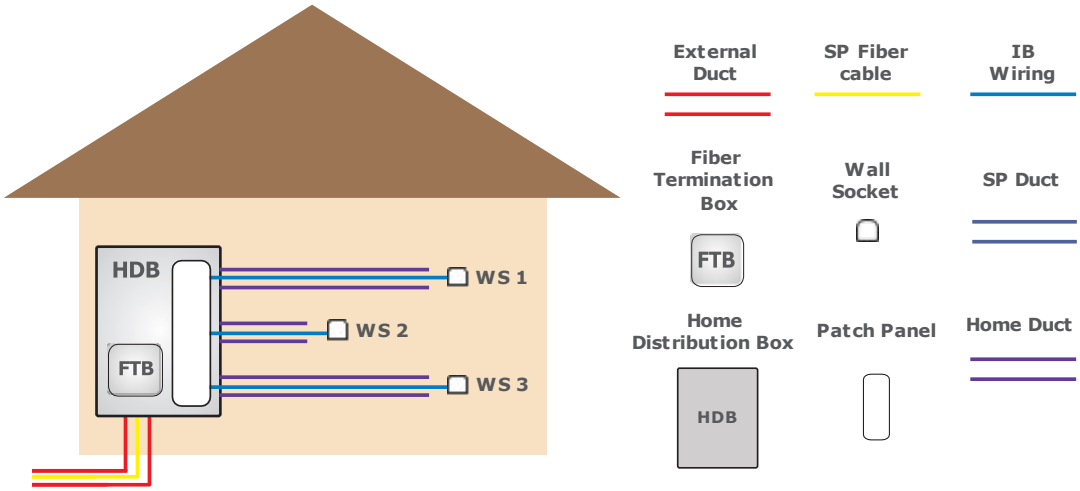

Figure F.9: Small Labor Accommodation

F.7. Bulk services

In this type of building, the building owner shall have its own IT server room and dedicated Main Telecommunications Room to be allocated for the parties' telecom/network equipment installation.

A letter from the building owner should be provided during the design stage confirming the bulk service and explaining the service required to be provided to the IT room.

The exact Lead-in Ducts and the technical requirements related to telecom cabling and EM shall be determined during the design stage based on the building owner's service requirements.

During the design phase, the building owner shall define the internal wiring requirements (e.g., fiber or ethernet connections throughout the building). However, if the building has independent units, such as airport shops, that require dedicated connectivity and where the building owner does not provide it, all such units must be connected to the Telecommunications Room via fiber. This approach shall be similar to the one followed in Shopping Malls.

An illustration is provided below:

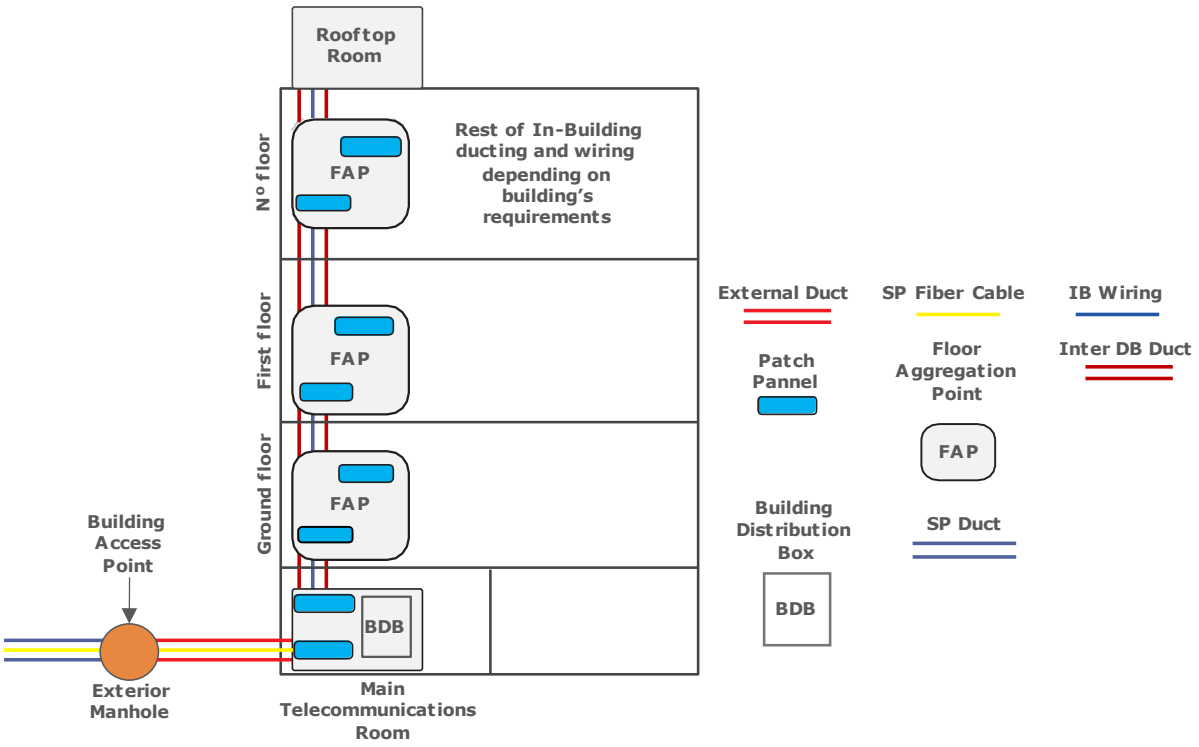

Figure F.10 Bulk Services

Appendix G. Guidelines for Network Component Usage

Component	Detached SDUs	Compound of SDUs	MDU	Shopping malls	Bulk services
Building Access Point/Entry Box	Size: 60x60x80 cm. Location: Within the compound and at Max 1 m from compound wall line	Size: JRC-4 Joint Box (Telecom standard) Location: Depends upon the layout	Size: JRC 12 Joint Box (Telecom standard) Location: Within the property, near plot line. Additional boxes at all turning points of lead-in		
Entry Pipes/ Duct	A single (2”) inch pipes/ Duct towards the villa & single x (2”) inch pipes/ Ducts to be extended outside the plotline towards SP Network	A single (4”) inch pipes/ Ducts to be extended one meter outside the plot line towards SP Network. Internal Distribution within plot to be in accordance with SP advise	2 x (4”) inch pipes/Ducts towards the building and 4 x (4”) inch pipes/ Ducts towards the SP Network. A diversity entry route may also be provisioned		
Main Telecom. Room	No requirements	Size: 2x3x3 (LxWxH) meters	Size: 3x3x3 (LxWxH) meters Location: In the ground Floor common area		
Rooftop Room	No requirements	No requirements	Size: 3x3x3 (LxWxH) meters Location: Roof of the building		
Mobile Service Telecom. Room	No requirements	No requirements	Size: 3x3x3 (LxWxH) meters Location: To be defined during design phase		
Apartment Indoor Distribution Cabinet std 19” Rack	No requirements	12U (H) x 600 mm (W) X 515 mm (D) flush mounted on wall	42U (H) x 800 mm (W) X 800 mm (D) Stand-alone type 19” equipment Cabinet		

Component	Detached SDUs	Compound of SDUs	MDU	Shopping malls	Bulk services
Floor Distribution Box	No requirements	Size: One 30x30x15 cm box recessed inside the wall for each floor. Location: Convenient location with 1 meter free wall space around and at a height between 40-120 cm above finished floor level.	Size: One 30x30x15 cm boxes flush to wall Location: To be provided in each floor Telecom Closet		
Floor Telecom Closet	No requirements		Size: Closet (LxWxD) 100x60x60 cm Location: In common area		
Riser Cable Trays	No requirements	20x5 cm cable trays	20x5 cm cable trays	To be determined during design phase	To be determined during design phase
Horizontal Cable Trays	No Requirements		20x5 cm cable trays		To be determined during design phase

Table G.1: Network Component Usage

Appendix H. References

1. ISO 9000, Quality Management Systems
2. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
3. UL 2024 Optical Fiber and Communication Cable Raceway
4. ANSI/NFPA 70, National Electrical Code, (NEC) 2008.
5. ANSI/UL 444, UL Standard for Safety Communications Cables (CSA C22.2).
6. UL 1685, Standard for Vertical-Tray Fire- Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
7. UL 1666, Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cable Installed Vertically in Shafts.
8. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.