Telecom Regulatory Authority of India

Recommendations

on

Rating of Buildings or Areas for Digital Connectivity

New Delhi, India

February 20, 2023

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CONTENTS

ANNEXURES

CHAPTER 1

INTRODUCTION

1.1 Background

Digital connectivity is vital to the way we live and work. In fact, the exponential growth in digitalization during last decade has revolutionised the world impacting everything, from economy, innovation, science, and education, to health, sustainability, governance, and lifestyle. Digital technologies are fundamentally changing business models, institutions, and the society as a whole.

The demand for digital connectivity has increased many folds in the recent years. The crucial role of digital connectivity was very much acknowledged in the context of COVID-19, witnessing a surge in the demand across all segments of users, irrespective of their locations.

The Internet and Mobile Association of India (IAMAI) and Kantar report[1] titled '*Internet Adoption in India: ICUBE 2020*' states that the number of active Internet users in the country is likely to grow nearly by 45% to 900 million by 2025 as compared to 622 million in the year of 2020. Nokia's 2022[2] report states that 4G data traffic has increased by 6.5 times while mobile broadband subscribers grew 2.2 times in the last five years. This report also highlighted 31% growth in mobile data across all categories of circles and also the fact that average data consumption per user per month also grew 3 times in the last five years.

With increasing reliance on digital connectivity, the importance of good digital connectivity adding to its value and utility for a meaningful connectivity has

[1] Internet Adoption in India: ICUBE 2020
[2] Nokia's MBiT Index 2022

also gained a prime stage. The service providers therefore make all out efforts to ensure sustainable connectivity to individuals and businesses by enabling large bandwidth to meet users' requirements of remote working and distance learning. As per the website of Infrastructure Asia[3], even when 5G is being introduced, 56% of all mobile subscribers around the world and 65% of all subscribers in the Asia Pacific region will continue to use 4G connections till 2025. Further 12% of users in Asia Pacific will still be relying on 2G or 3G technologies.

In the past, Telecom Regulatory Authority of India (TRAI) and the Government have taken various policy initiatives to fulfil the demands of telecom connectivity. Key recommendations already made by TRAI in this regard are given in Annexure II of the Consultation Paper (CP)[4] on '*Rating of Buildings or Areas for Digital Connectivity*' dated 25th March 2022. These policy interventions have helped in improving connectivity. However, all these efforts have fallen short in achieving the desired level of digital connectivity specifically inside the buildings or areas. Some of these gaps are mentioned below:

a) The interest of infrastructure providers (IPs) in serving a building or premise depends upon the business opportunity it offers. Many times, it creates possibilities of monopolistic situations when exclusive rights are given to a particular IP to serve a building or an area.

b) Digital connectivity meeting the expectations of end users is not a one-time exercise. It requires regular expansion and upgradation of already laid out infrastructure to cater to increasing demand and requires frequent augmentation of network capacity. These emerging issues are to

[3] Infrastructure Asia
[4] CP on Rating of Buildings or Areas for Digital Connectivity

be dealt during entire life cycle, as every issue cannot be fully envisaged in the initial phase of creation of digital connectivity.

c) Adoption of evolution of new technologies and advancements in digital tools for cohesive creation of digital connectivity infrastructure.

TRAI has conducted many studies to assess the quality of service and to identify challenges in connectivity and suggest way forward. Based on these studies, a white paper[5] on "*Measurement of Wireless Data Speeds*" and a report[6] on "*Mobile Network QoS: Delhi Airport and Dhaula Kuan*" were published in February 2018 and March 2019 respectively.

Further, TRAI published a Monograph[7] on "*Quest for a Good Quality Network inside Multi-Storey Residential Apartments: Reimagining ways to improve quality*" on 22nd September 2020. The outcome of these studies made it necessary to find a way forward to solve the emerging issues. Thus, TRAI undertook the process of consultation on a Suo-moto basis for deliberation on these issues.

1.2 Consultation with Stakeholders

The CP on "*Rating of Buildings or Areas for Digital Connectivity*" has discussed various issues relating to in-building solutions and creating an enabling environment for development of an ecosystem for Digital Connectivity Infrastructure (DCI) in buildings or areas. Any such ecosystem should cover design, implementation, operation, maintenance as well as upgradation and expansion of existing DCI. The CP has further highlighted the importance of collaborative partnerships among all relevant stakeholders including the end-users in decision making processes from an early stage of building

[5] https://trai.gov.in/sites/default/files/measurement_wireless_data_speed.pdf
[6] https://trai.gov.in/sites/default/files/QoS_PMO_Airport_Report_06032019.pdf
[7] https://www.trai.gov.in/sites/default/files/Flipbook_Monograph_22092020.pdf

construction for design and creation of the DCI.

Further, it also provided details on the existing provisions in various laws, bye-laws, and guidelines etc., relating to the DCI in the buildings and asks for suggestions to include DCI as an essential component in the design and development of buildings.

The CP also sought suggestions from stakeholders for introduction of Rating of buildings or areas for digital connectivity by using objective and subjective assessment methodologies.

The CP was issued on 25th March 2022 and the last dates for submission of the comments and counter-comments were 4th May 2022 and 18th May 2022 respectively, which were later extended to 30th June 2022 and 07th July 2022 respectively.

Stakeholders submitted their responses to the Authority (TRAI) and their comments/counter-comments are available on TRAI's website[8].

An Open House Discussion (OHD) was held on 29th August 2022 wherein the stakeholders participated and further deliberated on the issues at length.

1.3 Building or Areas

For the purpose of these recommendations, the term 'Buildings or Areas' would include, as discussed in the CP, Buildings and their surroundings controlled, owned or managed by a Property Manager[9]. These include residential or commercial complexes, educational or non-educational campuses, offices, housing societies, industrial estates/parks, cantonment areas, ports, airports, railway stations, bus stations, metro stations etc. The

[8] Comments and counter-comments
[9] The term Property Manager has been discussed in para 2.3 of Chapter 2

term 'Buildings or Areas' has been referred hereinafter as 'Buildings' for the sake of convenience.

1.4 Structure of the Document

This document consists of 5 Chapters. The issues/ questions raised at different places in the CP having common deliberations are clubbed together under different sub-headings in the chapters.

Chapter 1 is the Introduction.

Chapter 2 deliberates on the creation of a new ecosystem for design, deployment and evaluation of the DCI. This chapter also highlights various aspects related to DCI including entities in the ecosystem and their responsibilities, ownership, and access of DCI, capacity building of DCI professionals, creation of digital platforms etc.

Chapter 3 discusses a framework for Rating of Buildings from a digital connectivity perspective along with the legal aspects related to it.

Chapter 4 proposes a draft chapter on 'Digital Connectivity Infrastructure (DCI) in the Buildings' for inclusion in Model Building Bye-laws, 2016 (MBBL) as an amendment to the addendum to MBBL "*Provisions for In-Building Solutions- Digital Communication Infrastructure*" as Annexure-III. The chapter also highlights proposed modifications in the National Building Code of India, 2016 (NBC).

Chapter 5 is the Summary of Recommendations.

CHAPTER 2
ECOSYSTEM TO CREATE DIGITAL CONNECTIVITY INFRASTRUCTURE

2.1. Digital Connectivity: More Important than Ever

2.1.1. The advancement in technologies such as 4G, 5G with enabling devices and software applications has transformed personal as well as professional lives of the people and also changed the governance and business models across the world. Nowadays, persons across all age groups spend more time on smart devices for studying, working, entertainment etc. Online services such as banking, e-commerce, citizen centric services and infotainment like gaming, social networking, etc. are feasible only with good digital connectivity. It's hard to think of any area without accessibility of such services due to no or poor digital connectivity.

2.1.2. Connectivity has never been more crucial to human society than now. The outbreak of COVID-19 had also brought spotlight on mobile and broadband technology, which became the enabler for so many online services. During lockdown, the importance of good digital connectivity was acutely realised by the people while interacting with their loved ones, accessing emergency services and working remotely.

2.1.3. Further, the adoption of smart devices such as virtual assistants, smart bulbs, smart refrigerator, smart home systems and many more, have transformed the surroundings into a digitally connected environment. As per Fortune Business Insights[10], the global smart

[10] Smart home market

home market is expected to grow from USD 99.89 billion in 2021 to USD 380.52 billion in 2028 at a CAGR of 21.1%. Also, Statista[11] forecasted that household penetration of smart devices will be 14.2% in 2022 and is expected to hit 25% by 2026.

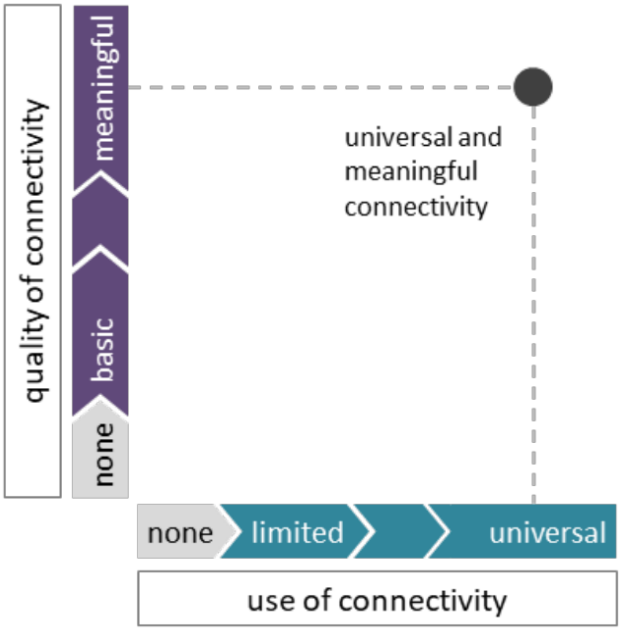
2.1.4. The confluence of the Internet of Things (IoT) with building operations and the future of the workplace is creating a significant opportunity for building owners, operators, and occupants to create smart, digitally connected spaces to support the end users. Business leaders are increasingly interested in creating a strategy for managing their Buildings that reflects the digital transformation taking place throughout their business. Those who do, may outpace their competitors in key areas such as employee attraction and retention, operating cost savings, and operational risk mitigation[12].

2.1.5. The penetration of digital services and smart devices requires meaningful connectivity rather than mere connectivity. The United Nations in its report on "*Achieving universal and meaningful digital connectivity - Setting a baseline and targets for 2030*[13]" states that digital connectivity must be universal and meaningful to maximise the impact on society and the economy. Here, "*Universal connectivity*" means connectivity for all, and "*Meaningful connectivity*" is a level of connectivity that allows users to have a safe, satisfying, enriching and productive online experience at an affordable cost. The two dimensions are complementary i.e., neither universal connectivity with poor quality nor meaningful connectivity for few, will yield significant, society-wide benefits. At the same time, the two

[11] Smart Home - Worldwide | Statista Market Forecast
[12] Deloitte - Smart buildings and digital workplaces
[13] Achieving universal and meaningful digital connectivity Setting a baseline and targets for 2030

dimensions obviously reinforce each other: more usage can lead to more meaningful connectivity, and vice versa. Figure 1 below illustrates the two dimensions, i.e., use – ranging from none to universal; and quality – ranging from no connectivity to meaningful connectivity.

Figure 1: The two dimensions of connectivity



2.1.6. Accordingly, the CP focused on measures to incorporate meaningful digital connectivity inside Buildings accessible to all.

2.2. Digital Connectivity: An Essential Service

2.2.1. Digital connectivity based on wireless, wireline and satellite technologies has become the backbone to access various services such as health, remote working, online learning, e-commerce and

entertainment. As per OECD[14], 1.3 billion citizens of OECD countries are working and studying from home. OECD also highlighted that internet exchange points (IXPs) had experienced 60% more internet traffic than before the pandemic. According to OECD, fixed and mobile operators witnessed a surge in internet traffic during this period. In Japan, NTT Communications reported an increase in data usage of 30% to 40%. In the United Kingdom, British Telecommunications reported a 35% to 60% increase in daytime weekday fixed broadband usage. Telefónica also reported nearly 40% more bandwidth in Spain, with mobile traffic growth of 50% and 25% in voice and data, respectively. Similarly, in the United States, Verizon reported a 47% increase in use of collaboration tools and a 52% increase of virtual private network traffic. AT&T had reported mobile voice and Wi-Fi call minutes up by 33% and 75% respectively, while consumer voice minutes increased by 64% on fixed lines: a reversal of previous trends. AT&T also reported 23% increment in its core network traffic.

2.2.2. The facts mentioned above indicate that the demand for digital connectivity is now more than ever. In order to fulfil such demand, development of DCI should be made an integral part of basic infrastructure for Buildings. However, there are various issues in the current framework which are bottlenecks in achieving the demands of good digital connectivity.

2.2.3. Further it is noted that, in respect of development of Buildings, there are relevant Acts, bye-laws, and regulations that prescribe minimum or essential requirements for building services like water, electricity, gas, fire safety, structural safety and other provisions. There are local

[14] OECD - keeping the internet up and running in the times of crisis

bodies and authorities who are responsible to enforce the same by granting approvals at various stages of the construction of the Buildings as well as supervision during the construction and approval for the use of such facilities. MBBL published by the Town and Country Planning Organisation (TCPO) under Ministry of Housing and Urban Affairs (MoHUA) contains the provisions for all building services. States adopt the provisions of the MBBL in their respective State bye-laws for building development related activities.

2.2.4. Issues raised in the CP

Q1. How can an ecosystem be created to design, deploy and evaluate DCI with good connectivity in a cohesive and timely manner? What would be the typical role and responsibilities of actors of the ecosystem?

In this section, the first part of Q1 is discussed.

2.2.5. Responses of the Stakeholders

Majority of stakeholders have opined that the development of DCI should be in line with the process of giving permission for development, deployment and approval of plans for water, electricity, and fire safety systems. Stakeholders also suggested making DCI a mandatory part of the basic infrastructure inside the building for ensuring availability of good digital connectivity with completion of the building development activities. Such mandatory provisions of DCI should be applied to the new developments such as Government and Commercial Buildings, Multi-Storey Residential Complexes, Public Utility Stations, etc. The completion certificates for such new buildings should be issued after confirmation of DCI implementation, as per design planned and approved. A stakeholder

was of the view that the requirements related to ducts, space, and power for installing passive and active infrastructure components for fixed line or wireless DCI, need to be included and covered under approval process for the building.

Stakeholders also agreed with the inclusion of legal provisions to support the development of DCI. Some of them suggested defining DCI related responsibilities of the building owner and incorporate the same in the NBC and MBBL to ensure uniform acceptance across all States and Union Territories. In this way the NBC and MBBL will provide the necessary backing to the development of DCI as a part of the building construction process. They have also suggested using other laws like Indian Telegraph Act, RERA Act, and other necessary legislations.

2.2.6. **Analysis**

1. As discussed above, majority of stakeholders agreed for the development of DCI inside the Buildings and inclusion of the same in MBBL and NBC. However, in order to develop and mandate DCI as a part of building construction and approval process, it is necessary to understand the scope of DCI by looking into various provisions relating to telecom infrastructure in the existing legal framework.

a) Relevant definitions in various Acts and laws related to telecommunication are stated below.

i. Definitions:

a. The *Indian Telegraph Act, 1885*[15] defines "telegraph" as

[15] THE INDIAN TELEGRAPH ACT, 1885

"any appliance, instrument, material or apparatus used or capable of use for transmission or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, visual or other electro-magnetic emissions, Radio waves or Hertzian waves, galvanic, electric or magnetic means."

b. The *Indian Wireless Telegraphy Act, 1933*[16] puts forth a definition of "wireless telegraphy apparatus" which means *"any apparatus, appliance, instrument or material used or capable of use in wireless communication, and includes any article determined by rule made under Sec. 10 to be wireless telegraphy apparatus, but does not include any such apparatus, appliance, instrument or material commonly used for other electrical purposes, unless it has been specially designed or adapted for wireless communication or forms part of some apparatus, appliance, instrument or material specially so designed or adapted, nor any article determined by rule made under Section 10 not to be wireless telegraphy apparatus."* The Section 10 of this act illustrates the power of the Central Government for "*determining that any article or class of article shall be or shall not be wireless telegraphy apparatus for the purposes of this Act*" and "*the exemption of persons or classes of persons under section 4 from the provisions of this Act*".

[16] Indian Wireless Telegraphy Act, 1933

c. Section 2(k) of the TRAI Act, 1997[17], defines telecommunication service as "*service of any description (including electronic mail, voice mail, data services, audio tex services, video tex services, radio paging and cellular mobile telephone services) which is made available to users by means of any transmission or reception of signs, signals, writing, images and sounds or intelligence of any nature, by wire, radio, visual or other electro-magnetic means but shall not include broadcasting services.*

Provided that the Central Government may notify other service to be telecommunication service including broadcasting services."

ii. Section 4 of Indian Telegraph Act 1885[18] states that "*Within [India], the Central Government shall have exclusive privilege of establishing, maintaining and working telegraphs: Provided that the Central Government may grant a licence, on such conditions and in consideration of such payments as it thinks fit, to any person to establish, maintain or work a telegraph within any part of [India]*".

iii. Also, as per the Clause 2.2 (i) of Licence Agreement for Unified Licence[19], *"The Licensee may establish, operate, and maintain Telecommunication Networks and telecommunication services using any technology as per prescribed standards in the service area as per scope of services authorised under this License*".

[17] Telecom Regulatory Authority of India Act, 1997
[18] THE INDIAN TELEGRAPH ACT, 1885
[19] Unified Licence

iv. The registration of Infrastructure Provider Category-I (IP-I) started in India in the year of 2000. As per DoT[20], the IP-I are those Infrastructure Providers who can establish and maintain assets such as Dark Fibre, Right of Way, Duct space and Tower for the purpose to grant on lease/rent/sale basis to the licensees of Telecom Services licensed under Section 4 of Indian Telegraph Act, 1885 on mutually agreed terms and conditions. In no case the company shall work and operate or provide telegraph service including end to end bandwidth as defined in Indian Telegraph Act, 1885 either to any service provider or any other customer.

v. The DoT, through its letter dated 9th March 2009 clarified that "*the scope of IP-I category providers, which is presently limited to passive infrastructure, has been enhanced to cover the active infrastructure if this active infrastructure is provided on behalf of the licensees, i.e. they can create active infrastructure limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only for/ on behalf of UASL/ CMSP licensees".* Further, DoT through its letter dated 28th November 2016 clarified that "*The IP-I providers are not permitted to own and share active infrastructure. The IP-I providers can only install the active elements (limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only)* ***on behalf*** *of Telecom licensees i.e., these elements should be owned by the companies who have been issued licence under Section 4 of Telegraph Act, 1885.*"

[20] Infrastructure Provider | Department of Telecommunications | Ministry of Communication

vi. In order to fulfil the ever-increasing demands of connectivity, TRAI in its "*Recommendations on Enhancement of Scope of Infrastructure Providers Category-I (IP-I) Registration*" dated 13th March 2020[21] recommended that the scope of IP-I Registration should be expanded. TRAI also recommended that *"The expanded scope of the IP-I registration should include to own, establish, maintain, and work all such infrastructure items, equipment, and systems which are required for establishing Wireline Access Network, Radio Access Network (RAN), and Transmission Links. However, it shall not include core network elements such as Switch, MSC, HLR, IN etc. The scope of the IP-I Registration should include, but not limited to, Right of Way, Duct Space, Optical Fiber, Tower, Feeder cable, Antenna, Base Station, In-Building Solutions (IBS), Distributed Antenna System (DAS), etc. within any part of India".*

vii. Various illustrations and provisions in different Acts clearly indicate that, the telecom infrastructure consists of active as well as passive elements. Further, there are processes defined by DoT for laying of telecom infrastructure through various guidelines and engineering instructions issued by DoT and TEC from time to time.

b) In view of the above and for the purpose of these recommendations, **Digital Connectivity Infrastructure (DCI) consists of passive and active elements which include any apparatus, appliance, instrument, equipment, and system**

[21] Recommendations on Enhancement of Scope of Infrastructure Providers Category-I (IP-I) Registration

used or capable of extending seamless digital connectivity. All infrastructure required for establishing Wireless or Wireline Access Networks such as Radio Access Networks (RAN) and Wi-Fi systems, and Transmission Links Interface, Duct Space, Optical Fiber, Poles, Towers, Feeder cable, Antenna, Base Station, In-Building Solutions (IBS), Distributed Antenna System (DAS), or any other equipment to be used for the provision of digital connectivity, may be part of DCI. However, it shall not include core network elements.

c) For making digital connectivity an essential part of a Building, the development of DCI is required to be made an integral part of the building construction and approval process, similar to water, electricity, gas, and fire protection, and safety, etc. The same has also been agreed to by most of the stakeholders.

2. **Present provisions in various laws, bye-laws and NBC for the design, deployment and approval of DCI**

a) **Provisions in building bye-laws:** Building bye-laws are used to regulate coverage, height, building bulk, architectural design and construction aspects of Buildings so as to achieve orderly development of an area. The first version of MBBL was prepared in 2003 by the Ministry of Urban Development wherein they incorporated provisions of structural safety, fire safety and barrier-free public Buildings. The bye-laws were later revised in 2015 in light of emerging issues such as sanitation facilities for visitors in public areas, conservation of heritage Buildings and barrier-free environment for disabled, elderly and children.

b) MBBL was issued on 18th March 2016 for the guidance of the State Governments, Urban Local Bodies, Urban Development Authorities, State Town Planning Departments and other Planning Agencies in various parts of the country in revising their respective building bye-laws. Typical Stakeholders involved in the Consultative Workshop to formulate MBBL were Central Government agencies/ Institutes (National Disaster Management Authority, Bureau of Indian Standards (BIS), National Building Construction Corporation (NBCC) etc.), State Government Departments (Town & Country planning, Urban Development authorities, Urban local bodies etc.) and Associations viz. the Confederation of Real Estate Developers' Associations of India (CREDAI) & National Real Estate Development Council (NAREDCO).

c) The bye-laws were circulated to all the State Governments and Union territories and out of 36 States and UTs, wherein 22 States and UTs have undertaken comprehensive revision of their respective building bye-laws since 2004. The Urban Local Bodies and Urban Development Authorities are required to ensure clearances in minimum possible time.

d) The term 'Authority' in MBBL means- The Authority which has been created by a statute and which, for the purpose of administering the Code/Part, may authorize a committee or an official or an agency to act on its behalf. Authority can be any Urban Local Body/Urban Development Authority/Industrial Development Authority or any other authority as notified by the State Government as the case may be.

e) Revised MBBL has envisaged 'Streamlining the Building Plan Approvals' including all clearances within a month of application through online building plan approval system in order to ensure ease of doing business.

f) DCI related Provisions in MBBL

i. As far as DCI related requirements are concerned, MBBL-2016 in para 2.10.6(f) seeks the information to be furnished with building plans for multi-storeyed building (above 4 storeys and 15m in height) and for special buildings in respect of "…*services duct (sanitation, electric & telecommunication)*".

ii. Further, para 5.5.2 on "Provision of Electrical services" mentions that "…*provision of dedicated telecommunication ducts for all new building proposals is mandatory for conveyance of telecommunication and other data cables.*"

iii. Also, para 6.1.9 of chapter 6 of the bye-laws on "*Provisions for structural safety*", highlights the guidelines relating to "telecommunication infrastructure" including cell-phone towers and telephone towers. The bye-laws also provide for the type of structure to be located, where it should be located and the necessary permissions it requires to operate, i.e., Standing Advisory Committee on Radio Frequency Allocation (SACFA) permission from the WPC/ DoT.

iv. TCPO, MoHUA issued an addendum to MBBL 2016 - "*Provisions for In-Building Solutions- Digital Communication Infrastructure*"

in March 2022, as Annexure-III. Vide O.M. dated 6th July 2021 MoHUA sought comments of TRAI on draft addendum prepared based on TRAI's recommendations on "*In-Building Access by Telecom Service Providers*" dated 20th January 2017. The Authority in its reply dated 08th February 2022 to MoHUA, while acknowledging various points captured in draft amendments, observed that processes and methodologies in respect of design, deployment and quality check of the DCI proposed to be created along with recognition of various entities involved in creation of DCI through a legal framework were not yet fully brought out in the draft addendum. The Authority also requested MoHUA that, "*it is proposed that processes for suitable modification in Building Bye Laws and National Building Code may please be initiated with provision that necessary arrangements are to be made to incorporate TRAI new recommendations on "In Building Solutions for Digital Connectivity Infrastructure (DCI)", as and when same are notified after due consultation processes*".

In the reply, the Authority also mentioned that '*With diminishing boundaries of content deliveries to end users of broadcasting and telecommunications services, the name of infrastructure proposed to be created needs a re-look and it is required to be made broader. Accordingly, it is proposed that instead of defining "In Building Solutions for CTI (Common Telecom Infra Structure)" let the name be re-defined as "In Building Solutions for DCI (Digital Connectivity Infrastructure)". This will enable both broadcasting and telecom services as well, without inclination towards any one service*'. Therefore, the term Common Telecom Infrastructure (CTI) as referred in the addendum is proposed to be replaced by Digital Connectivity Infrastructure (DCI), in

these recommendations. Henceforth, in place of CTI, the term DCI has been used.

v. In light of above discussion and in order to have a comprehensive framework for development of DCI in Buildings at one place in MBBL, the Authority proposes to include a new chapter in the MBBL. This chapter shall include relevant existing provisions on CTI installations in MBBL and also new/ amended provisions as discussed and recommended in this document.

g) DCI related provisions in NBC

i. NBC is the result of various studies conducted to standardise material and construction practices to be followed by all construction agencies across the country. The objective of the NBC is to unify the building regulations throughout the country for the use by Government departments, municipal bodies and other construction agencies. The BIS was entrusted by the Planning Commission with the preparation of the NBC. For fulfilling this task, National Building Code Sectional Committee, hereinafter referred to as Guiding Committee, was set up by the Civil Engineering Division Council of the Indian Standards Institution (the then BIS) in 1967. This Committee, in turn, set up 18 specialist panels to prepare the various parts of the Code. The Guiding Committee, and its specialist panels were constituted with architects, planners, materials experts, structural, construction, electrical, illumination, air conditioning, acoustics, public health engineers and town planners. These experts are drawn from the Central and State

Governments, local bodies, professional institutions, and private agencies. Panel related to telecommunication is '*Panel for Information and Communication Enabled Installations*' with its convenor in personal capacity.

ii. The NBC lays down a set of minimum provisions designed to protect the safety of the public with regards to structural sufficiency, fire hazards and health aspects of the Buildings. In the 3rd revised edition of NBC, published in 2016, the NBC Volume II, Part-8 ("Building Services") incorporates a Section-6 relating to '*Information and Communications Enabled Installations*'. The provision under this section covers the essential requirements for information and communication enabled installations, technology systems and cabling installations in a building. This section also covers the basic design and integration requirements for telecommunication spaces within buildings along with their cabling infrastructure, their pathway components and passive connectivity hardware. The provisions given in this section are basic requirements applicable to all residential and other buildings. As telecommunication requirements of users vary from building to building, the requirement of infrastructure may also vary, as one solution cannot be suitable for all types of buildings.

iii. For making DCI Standards as part of the NBC, new standards in respect of very high-speed broadband infrastructure, ubiquitous wireless coverage with adequate connectivity and futuristic upgradability of DCI in Buildings should be incorporated.

h) Real Estate (Regulations and Development) Act 2016

i. It is an act establishing the Real Estate Regulatory Authority (RERA) for regulation and promotion of the real estate sector and to ensure sale of plot, apartment or building, as the case may be, or sale of real estate project, in an efficient and transparent manner and to protect the interest of consumers in the real estate sector and to establish an adjudicating mechanism for speedy dispute redressal and also to establish the Appellate Tribunal to hear appeals from the decisions, directions or orders of the Real Estate Regulatory Authority and the adjudicating officer and for matters connected therewith or incidental thereto.

ii. The provisions of this act advocate for protection of the interests of the consumers of real estate sector and for speedy disposal of their disputes. It mainly focusses on the implementation of the builder-buyer agreement and ensure provision of services as promised at the time of sale offer. The Clause (zb) of Section 2 of this Act defines *"internal development works"* as *"roads, footpaths, water supply, sewers, drains, parks, tree planting, street lighting, provision for community buildings and for treatment and disposal of sewage and sullage water, solid waste management and disposal, water conservation, energy management, fire protection and fire safety requirements, social infrastructure such as educational health and other public amenities or any other work in a project for its benefit, as per sanctioned plans*;"

iii. MoHUA notified the Real Estate (Regulation and Development)

(General) Rules, 2016 and the Real Estate (Regulation and Development) (Agreement for Sale) Rules, 2016 on 31st October 2016. So far 34 States/UTs have notified rules under RERA.

iv. Considering above, the Authority is of the view that provisions for mandating DCI inside the Buildings, its maintenance, timely upgradation, etc. may be incorporated in the builder-buyer agreement for covering it under the jurisdiction of this Act and its enforceability by the RERA.

3. From the above discussion, it can be concluded that the MBBL and NBC need amendment to incorporate provisions on DCI and make DCI development an intrinsic part of building development activities. Further suitable provisions for DCI should be included in RERA Act to protect the interest of the consumers and to resolve disputes on the lines of other building services.

2.2.7. Recommendations

1. **The Authority recommends that Model Building Bye-Laws (MBBL) and National Building Code of India (NBC) should be amended to incorporate necessary provisions on Digital Connectivity Infrastructure (DCI) as recommended herein.**

2. **The Authority also recommends that, DCI should be made an essential component of the building development plans, on the line of water supply, electrical services, gas supply, fire protection and fire safety requirements, etc.**

3. **In case of development of Buildings in rural, semi-urban, remote and hilly areas, etc. where MBBL is not directly applicable, the Authority recommends that the Government**

may work with State Governments/ UTs for incorporation of suitable provisions for DCI development in the respective bye-laws or other relevant laws of the State Governments/ UTs.

4. **As RERA act protects the interests of the consumers of the real estate sector and provides platform for speedy disposal of their disputes, the Authority recommends that provisions for mandating DCI inside the Buildings, its maintenance, timely upgradation, etc. should be incorporated in the builder-buyer agreement for covering it under the jurisdiction of RERA act and its enforceability by the RERA.**

2.3. Entities for Development of DCI

2.3.1. The Chapter 4 of the CP focused on creation of an ecosystem to design, deploy and evaluate DCI. Proposed entities of the ecosystem mentioned in the CP are as follows:

a) Property Manager refers to the person who is responsible to oversee and manage the operation and maintenance affairs of a particular property, building, premises or an area and he has the authority on behalf of the owner of the property to carry out the functions requisite for upkeep or upgradation of the systems deployed inside the building or property or an area. The CP defined the term Property Manager from DCI perspective in detail and the same is enclosed as Annexure-I to this document.

b) DCI Designers are certified professionals, having competence and desired qualifications to design networks for in-building solutions.

c) DCI Engineers are certified professionals having competence and desired qualifications to implement the designed solutions.

d) DCI Evaluators are certified professionals to evaluate the quality of the DCI deployed.

2.3.2. Issues raised in the CP

Q1. How can an ecosystem be created to design, deploy and evaluate DCI with good connectivity in a cohesive and timely manner? What would be the typical role and responsibilities of actors of the ecosystem?

In this section, the second part of Q1 is discussed.

2.3.3. Responses of the Stakeholders

a) All stakeholders agreed to the approach of creating an ecosystem to design, deploy and evaluate DCI for good connectivity. Some suggested that existing buildings/areas can have DCI and be governed by long term contracts as a part of the overall ecosystem.

b) A stakeholder was of the view that TSPs/IP-Is working model had worked magnificently and was the key factor for India's successful digital infrastructure story. There was no need for any new ecosystem especially if we would like that networks are planned, designed, deployed, and upgraded to serve the DCI requirements in a timely manner. IP-Is of today are quite competent and capable of designing & deploying DCI. The stakeholder also argued that the issues deliberated in the present CP are likely to affect the business prospects of IP-Is. The CP dwells upon disjointing certain aspects which have primarily

been in the domain of IP-I and therefore a thoughtful review of the issues covered in the CP would be required to be undertaken.

c) Some stakeholders were of the opinion that existing TSPs and IP-Is would be permitted to design, implement and evaluate along with this new breed of professionals/entities in the envisaged ecosystem. Further, they argued that there might be no need for any certification for IP-Is as they had been already registered with DoT.

d) One stakeholder proposed that IP-Is can be either Property Managers or may have contractual agreements with them who would own the DCI for the building they are responsible for. The IP-Is have the requisite competency and are ideally suited to install and maintain it themselves. As a neutral host they can share their DCI with the TSPs on a non-discriminatory basis. Owning of the assets by Property Managers may give control in their hands, not only at the initial stages of DCI design and deployment but during its entire life cycle.

e) Some stakeholders supported the composition, roles and responsibilities of the entities in the ecosystem proposed in the CP while some stakeholders provided following additional details to be considered for the ecosystem:

   i) The Property Manager should either be the building owner or the person-in-charge who should be involved during planning, designing and construction of the building and will be responsible for providing requisite DCI. Some also added that the Property Manager should maintain minimum DCI requirements and can also assign a third-

party agency to maintain or augment the DCI on his behalf.

ii) The role of Property Manager can also be fulfilled by maintenance agencies, RWAs, builders, etc. who possess different capabilities, core expertise and can function for different types and sizes of buildings. Some stakeholders also augmented this by proposing that a Property Manager can be any RWA or Real Estate developer or Government/PSU/PSE or any other legal authority or manager who has a right to control or monitor the property or has right of possession over the property.

iii) Property Managers should provide earmarked space and common infrastructure which can be then offered to the TSPs. So, Property Managers will have to work closely with the TSPs/IP-Is to facilitate smooth working conditions under this ecosystem.

iv) The new ecosystem should consist of real estate developers, representatives of NBC and Building Bye Laws, TEC in addition to those players suggested in the CP i.e., Property Manager, DCI Designer, DCI Engineer, and DCI Evaluator. A stakeholder suggested that the real estate developers can take care of requirements of DCI right from the planning stage,

v) IP-Is have the required competence and capabilities to invest so it may be advisable to maintain status quo and they may continue to hold proxy for the Property Manager's responsibilities in this regard. Further, the IP-Is may work as DCI Designer, DCI Engineer.

vi) Some stakeholders suggested that Council of Architecture should provide the eligibility for DCI Designers, DCI Engineers and DCI Evaluators. TSPs and IP-Is can also act as DCI Engineers without any additional eligibility from the Council of Architecture. Further, field units of Government (like LSA Units of DoT) can also be additionally allowed to act as DCI Evaluators which should be based on guidance from telecom authorities like DoT/TRAI/TEC.

f) A stakeholder suggested that TRAI's earlier recommendations on 'In-Building access by TSPs' need to be incorporated in building laws and more importantly ensure their implementation.

2.3.4. **Analysis**

a) The CP invited suggestions on what approach should be taken to empower consumers for incorporating their requirements as a part of design and creation of DCI.

b) Further, this ecosystem requires entities such as Property Manager and certified DCI Professionals i.e., Designer, Engineer and Evaluator, to play roles in development and management of DCI. Introducing certified professionals would create a new market, which would in turn bring new job and business opportunities to existing and new players.

c) The existing players such as IP-Is will have opportunities to expand their scope as designer, developer, evaluator, maintenance & upgradation agency or complete solution providers. Additionally, IP-Is who are fully gelled with the ecosystem shall be free from current hassles of seeking permissions to access the premises for development of DCI.

Thus, the new ecosystem, instead of hampering business prospects of existing players, as apprehended by some stakeholders is actually providing new opportunities and business models operating in a systematic framework with wider acceptance.

d) In the MBBL and NBC various terms such as builder, developer, owner, promoters, etc. have been used to represent a person or body responsible for development activities related to buildings. The CP introduced the term Property Manager, which not only encompasses all the terms included in MBBL & NBC but also takes care of other entities responsible for development, management and governance of a property or an area. Property Manager also includes venue manager of an event, Government body responsible for development and maintenance of an area, etc. Thus, the term Property Manager, as explained in the CP, referring to a person or body who is responsible to oversee and manage the development, operation and maintenance of a particular property, building, premises or area and has the authority either as owner(s) of the property or on behalf of the owner(s), can be adopted for representing various similar entities and its scope can even be extended in case the need arises. Accordingly, a uniform nomenclature i.e., Property Manager, may be used for the entity responsible for the development and management of DCI in its entirety of life cycle.

e) The scope and responsibilities of the DCI Professionals as mentioned in CP are agreed by most of the stakeholders. The scope and responsibilities may therefore be included in the proposed draft chapter of MBBL.

f) It is pertinent to note that basic qualification for DCI Designer, DCI Engineer and DCI Evaluator may be similar. So, to provide more flexibility and opportunity to an individual, the Authority is of the view that, any person who possesses the requisite skills, can perform the functions as DCI Designer or DCI Engineer or DCI Evaluator.

2.3.5. **Recommendations**

5. **The Authority recommends that the actors to design, deploy and evaluate the DCI should include the Property Manager and DCI Professionals i.e., DCI Designer, DCI Engineer and DCI Evaluator, where:**

   a) **The Property Manager is the person or body who is responsible to oversee and manage the development, operation and maintenance of a Building and has the authority either as owner(s) of the Building or as an agent of the owner(s). The term "Property Manager" would include an owner or a developer or a builder of a real estate project(s) or an area(s) responsible to plan, design and build facilities like Multi-storey residential buildings, Commercial buildings or complexes, etc.**

   b) **DCI Designer is a professional who has the competence and possesses prescribed qualifications to design DCI for Buildings**.

   c) **DCI Engineer is a professional who has the competence and possesses prescribed qualifications to implement the DCI designed for Buildings.**

d) **DCI Evaluator is a professional who has the competence and possesses prescribed qualifications to measure and evaluate the quality of the DCI deployed inside Buildings**.

6. **The Authority further recommends that any person who possesses the requisite skills, as may be prescribed, can perform the functions as DCI Designer or DCI Engineer or DCI Evaluator.**

2.4. Procedures and Standards of DCI

2.4.1. The CP invited suggestions on process to be followed for co-design and co-creation of DCI. The Property Manager can hire DCI Professionals to get required infrastructure designed.

2.4.2. Further, the CP also invited suggestions on what should be the approach and ways for exchanging information of user requirements, building related information and approach on using digital tools and platforms for modelling various solutions and choosing the best, which meets the requirements of all the stakeholders. Digital tools such as BIM (Building Information Modelling), CAD (Computer-aided Design), COBIE (Construction-Operations Building Information Exchange), Digital Twin, etc. can help to factor-in the requisite information and enable gathering of user requirements.

2.4.3. The CP further discussed that design of DCI requires consideration of various technical and other parameters including aesthetics and safety. Such parameters can vary according to the type and size of the Buildings, and service requirements of the end users. Buildings can be specifically classified for DCI depending upon the factors like area, height, density, type of construction, type of use, etc. Thus, the

CP sought inputs on inclusion of processes and standards for DCI as a part of NBC. These standards may also incorporate wireless and wireline technologies for DCI development.

2.4.4. Also, the CP discussed the usage of standard products in deployment of DCI. Such products need to be certified by TEC, which is already a certification agency for telecom products. List of certified products may be made available in public domain for use by the DCI Professionals.

2.4.5. **Issues raised in the CP**

Q3. How would the ecosystem proposed in response to Question no.1 enable DCI Designers to factor in the digital connectivity requirements of the existing and/or prospective users of the network? How can such requirements be gathered at the stage of construction of a new building or at the time of upgradation or expansion in case of pre-existing DCI?

Q4. How would the ecosystem proposed in response to Question no.1 enable DCI Evaluators to get requisite information to evaluate and ensure that the designed or deployed network would meet the requirements of end users?

Q18. How can the clearances or approvals required for DCI at various stages of construction of building may be incorporated in building bye laws? In typical building bye laws, there are provisions for getting clearances from central government e.g., in case of civil aviation, defense and telecom being a central subject, what role can be played by the central government in giving such clearances or granting such approvals?

Q28. Is there a need to amend legal provisions under various laws, bye laws dealing with development of land and buildings or areas including forest areas, cantonment areas, port areas, panchayat areas, municipal areas etc. to facilitate creation of DCI and ratings of the buildings or areas?

Q15. As one solution might not be suitable for all types of buildings, whether current requirements stipulated in the National Building Code of India, 2016 would be required to be evolved and prescribed *ab initio* to make it more appropriate for DCI requirements?

Q16. Whether NBC needs to prescribe a separate classification of buildings for the purpose of DCI? If yes, which factors should be considered to make such a classification? If not, how to accommodate DCI specific requirements in the existing classification of buildings by the NBC?

Q13. Whether creation of a digital platform for procurement of certified products would help Property Managers in creation of DCI? How would the certified products for the purpose of DCI be identified and updated on the platform?

2.4.6. **Responses of the Stakeholders**

a) All stakeholders supported the process suggested in the CP for creation and deployment of DCI.

b) With regard to enabling DCI Designers to factor in and gather information, some stakeholders proposed that different buildings will have different user requirements and such requirements should be collected and collated by the Property Manager for use

during deployment and upgradation of the DCI. Property Managers can get the DCI deployed as per the requirements and based on feedback of the end users. The feedback can be collected through surveys and in interactive iterations using advanced tools.

Some stakeholders suggested that use of digital tools and platforms can play an important role in designing, monitoring and predictive evaluation of network coverage for the buildings. Some of the methodologies suggested by the stakeholders are as follows:

i) Digital tools can help in collecting end-customer requirements with due consent. Such digital tools can be installed in the mobiles and other electronic equipment of the end users. This can form the basis of doing the initial DCI design.

ii) There is a need to digitalise building plans to ensure a robust DCI.

iii) Data analysis and AI can play a significant role in ensuring an optimum outcome for the development of DCI in the buildings.

iv) A platform for this purpose will enable continuous feedback from users or prospective users to construct new DCI or re-calibrate pre-existing DCI.

v) Collaboration among stakeholders including potential users can be achieved through digital platforms which can help in gathering their telecom requirements at the time of

construction of a new building.

One stakeholder proposed that a framework for interaction between DCI Designers and TSPs/ IP-Is should be created to understand the requirements of TSPs and IP-Is.

Some stakeholders proposed that DCI Designers should mandatorily upload the final DCI design on a government portal with their registered id. Such a portal can classify the DCI design depending on the geographical location of the building (metropolitan, tier 2 city, etc.), the nature of building (residential, office space, commercial space, etc.) height of building (high rise, limited floors, villa, etc.), etc. Such a portal will create region wise categorised/labelled databases which can be used by the DCI Designers while designing solutions to achieve targeted outcomes.

One stakeholder suggested that the Start-Ups and DCI professionals should be incentivized to hasten the 3D maps creation. Local Bodies (Urban/ Rural) should undertake the same initiative under Digital India to earn incentives as per government established policies.

Some of the stakeholders also supported the use of Data Analytics, Artificial Intelligence, digital tools and platforms to collect end-consumer requirements, to digitalise building plans, to obtain feedback from users. The stakeholders also proposed that final DCI Design should be mandatorily uploaded on digital platforms or Government portal.

Some stakeholders were of the opinion that augmenting the building plans with Census Data will provide a robust database

to all TSPs/ DCI consultants for designing the standardised templates/ guidelines for ensuring a seamless wireless and wireline network to serve end customers. In addition, relevant authorities can issue standards/ guidelines, in consultation with ecosystem stakeholders, for different types of buildings which will ensure a minimum adherence for the Property Managers while ensuring DCI compliance as IBS for any project.

One stakeholder suggested that all the building infrastructure be categorised based on the end users' requirements. A model guideline should be created to upgrade the existing infrastructure and adopt the same for new constructions. This will create uniform standardisation of building infrastructure across different categories and the same can be used for various applications. Formulation of guidelines for different types of buildings is also supported by another stakeholder.

A stakeholder proposed that the builders, TSPs and IP-Is have good experience and knowledge of the typical standard requirements of the prospective users for upcoming buildings. The stakeholder further stated that these TSPs and IP-Is, together are best placed to define the starting point and subsequently keep adding the knowledge gained through interactions and experience.

Few stakeholders added that the Property Manager will also be responsible to take design inputs from DCI Designer into account while constructing the building and for providing required ducts, telecom space and other requirements as indicated by DCI Designers. It was also suggested by stakeholders that the Property Manager should provide ducts to run cables, cable

trays, power supply etc. during the implementation of DCI.

A stakeholder suggested that DCI Designer should provide inputs to the Property Manager in two parts:

i) In the first part, the inputs should relate to provisioning of required telecom space, ducts from the telecom spaces to individual offices/flats/rooms which are required during the design, planning and construction of the building.

ii) In second part, when the inputs from users are available at later stage of the project, the collated user requirements can be catered subsequently by the DCI Designers to decide the active and passive equipment details and other requirements to meet their requirements.

c) In order to enable DCI Evaluators to get requisite information for the evaluation of the designed and deployed DCI, the responses of the stakeholders are as mentioned below:

One stakeholder proposed that establishing digital platforms (also supported by other stakeholders) may enable collaborative working among stakeholders. The proposed platform would enable a continuous monitoring and evaluation process; that would ensure that continuous feedback from the users or prospective users were taken into account while construction of new building or re-calibration of pre-existing DCI. It was also suggested by the stakeholders that market dynamics would create templates in respect of DCI for different categories of buildings viz. Residential, Commercial, Office Complex, and also depending upon the size and price band.

One stakeholder proposed that data from Census reports would help in creating a grid/matrix for estimation of data consumption in the buildings. Correlating the current data usage norms available with TRAI/ DoT, an average data consumption per household in the particular locality can be estimated. Based on the estimated data usage and number of service providers, the DCI Evaluators can frame the guidelines for the minimum DCI requirements to serve end customers. The DCI designs submitted by the DCI Designers (post validation by the DCI Evaluators) should also have the connectivity values at different locations in the building structure. That would enable development of a database for the values of the DCI metrics, which would help in predictive evaluation of the DCI design to improve and optimize future plans.

One stakeholder proposed that evaluation by DCI Evaluator can be either for a designed network or for a deployed network. In the case of a designed network, the evaluator can use simulation or AI/ ML techniques to assess the network capability. While in case of a deployed network, the process can be similar to the rating process proposed by the Authority. In that case, it would depend upon subjective and objective parameters.

One stakeholder suggested that the evaluation process for the DCI should be outlined based on relevant ISO/IEC evaluation/ assessment standards. The property owner and Property Manager will apply for assessment/ certification and provide the necessary information/ documentation in accordance with the specified process.

Another stakeholder was of the opinion that sensors or devices

for data collection may be used to check the quality of wireless network within a building. The test reports of the wired connectivity in terms of signal strength should be captured in every fibre or CAT 6 (LAN) cable used within the premises at the time of construction. Evaluators should validate the reports for granting building clearance. There should be a grievance redressal mechanism for users to register complaints about the DCI quality.

One stakeholder suggested that DCI Evaluators can have the set criteria available in public domain for rating the infrastructure project. The Property Manager can be mandated to collect the user requirements of the respective project in prescribed format and fashion which should be provided to the DCI Evaluators during evaluation process. That would facilitate the verification of the same by the DCI Evaluators to ensure that the DCI designed and deployed is meeting requirement of the end users and appropriate ratings can be assigned to the property.

d) Regarding amendments in MBBL, NBC and other related laws or acts, the responses are mentioned in following paras:

Majority of stakeholders were of the view that the provisions of NBC might not be sufficient to accommodate requirements of current and future telecom ecosystem. NBC might be required to come up with more detailed guidelines on DCI to meet the desired coverage and capacity requirements. That would require referring to the specific standards for telecom and ICT and Best Current Practices (BCPs). Standards for DCI should be open and ready to accommodate futuristic standards evolving from time to time. Such standards would be required to be made applicable

to special areas and organisations like Railways, Defence estates, Cantonment areas, etc. The above guidelines may be formulated with due consultation with TRAI, RERA and TSPs.

Two stakeholders were of the view that NBC could assign some specialised agency for framing standards of DCI. NBC should be further incorporated in various buildings bye-laws and guidelines published by the Ministry of Housing and Urban Affairs and/or State/UT Governments.

A stakeholder suggested that the requirements related to ducts, space and power for installing passive and active infrastructure components for fixed line or wireless DCI need to be included and covered under approval process of the building completion or occupancy certification. For all future buildings, MBBL approval process should include approval plan for DCI prepared by DCI Designer and duly certified by DCI Evaluator.

e) With regard to **approval and clearances** required for DCI at various stages of construction, the responses of the stakeholders are mentioned below:

Some stakeholders suggested that there is a need to develop separate standards for DCI, which would be validated at various stages of construction of building through clearances/approvals. NBC and building bye-laws might be required to be amended to recognize the DCI professionals and standardisation body, so as to provide legal backing. The standardisation body should be entrusted with formulation of standards including specifications, guidelines, and processes. In addition, stakeholders also suggested that the standardisation body should be created either

under the broad ambit of NBC or through any other agency, as deemed fit. This body should frame standards to take care of innovative solutions offered by the network designers.

Some stakeholders suggested that TRAI and DoT should play an active role in getting such DCI related clearances incorporated in building bye-laws, through institutional mechanism and understanding between two sectoral regulators/bodies. TRAI should also play an active role in getting clearance from the Central Government e.g., in case of civil aviation, defence and telecom being a central subject.

A stakeholder was of the view that the Central Government in coordination with State Authority could give clearance for DCI at various stages of construction of buildings. It should be simple, transparent and time-bound with minimum government and maximum governance. Another stakeholder proposed that the Central Government could support faster SACFA clearance for towers, if required to be installed in the building premises as part of DCI readiness.

A stakeholder suggested that DCI approval be introduced at;

i) DCI design plan approval at building layout approval stage, before starting construction.
ii) DCI completion certification after completion of construction during building completion certification.
iii) Certification by TSPs for readiness of DCI, who would lease the same for provisioning of services.
iv) DCI evaluation certification during occupancy certification stage.

Another stakeholder suggested that DCI related approvals might

be required at multiple stages of building construction, for instance:

i) At the design level, which might be sought at the time of approval of a map of building projects. Prediction tools might be used to confirm whether design is good, and likely to meet the requirements of end users.

ii) At the time of issuance of completion certificate for the project, it might be a combination of the proposed design and field inspections.

iii) At the time of giving possession/handover to the Property Manager, an in-building network might be live to offer the services. In that case, field measurements might also be conducted to ensure availability of a good quality network.

f) Majority of the stakeholders suggested **creation of a platform/market** which would allow the Property Manager to select the suitable DCI professional and would also ensure that there was no monopolization in the service provider market.

g) For uniformity of collection of basic input data to be shared to DCI Designers by the Property Managers, the stakeholders suggested **adoption of standard templates** to collect, collate and share necessary information for the development of DCI. The stakeholders suggested development of standard guidelines for the procedure for development of DCI. As the development of DCI involves not only the use of digital tools and techniques to design, implement and evaluate, but also relevant expertise in the domains of telecom as well as construction, there is a need to involve DCI professionals, field experts and related competent authorities. For this, the stakeholders proposed establishment of a standardisation body or TRAI/DoT in collaboration with RERA

and related experts may be tasked to frame necessary framework for the development of DCI.

In addition, relevant authorities can issue standards/guidelines, in consultation with ecosystem stakeholders, for different types of buildings which will ensure a minimum adherence for the Property Managers while ensuring DCI compliance for any project.

Another stakeholder suggested that the building infrastructure are to be categorised based on the end users of properties and create model guidelines for upgrading the existing infrastructure and the adoption of the same in new constructions since beginning. This will establish uniform standards for development of DCI in different categories of buildings and the same can then be referred for multiple applications in similar buildings. Formulation of guidelines for different types of buildings is also supported by another stakeholder.

h) With respect to having specific DCI related requirements for **different classes of buildings**, majority of stakeholders agree that DCI requires a separate classification of buildings in the NBC. Some of them suggested that DCI classification may be on the lines of classification of buildings for "Fire and Safety". One stakeholder suggested that classification of buildings given in the NBC, as mentioned in Annexure VI of the CP covers all the possible classifications. DCI specific requirements may be accommodated in terms of availability of RoW to the building for fibre connectivity. However, one of the stakeholders opposed this.

A stakeholder suggested that buildings can be specifically classified for DCI based on various factors, few of which have been listed below for better understanding:

i. Purpose of use – Some buildings like stadiums, bus/railway/metro stations, museums, theatres etc. will mostly require wireless DCI only. Whereas residential buildings, office buildings, hospitals, factories, etc. will require both fixed broadband connectivity as well as wireless mobile connectivity. The quality of DCI requirement will also vary as per purpose of use.

ii. Area and density of occupants – This is important for the design of DCI and the revenue model for the TSPs; especially for the wireless part of DCI design.

iii. Design and height – Planning and investment for DCI will vary significantly depending on whether the building is a detached building, multi-storied building or high-rise building etc.

A stakeholder suggested that it is not compulsory that each building be tagged into one particular set of categories from telecom infrastructure design-thinking perspective; It could rather be a mix and match of different types of RF solutions. Hence broad categories as guidance are desirable.

Two stakeholders proposed that as MBBL 2016, issued by MoHUA, classifies buildings based on use of premises or activity, design or height, features, safety due to maintenance level etc. These classifications could be used for DCI. A stakeholder suggested that classification must be based on type of

construction of building, height of building, area of building, materials used in the construction of building, type of partitions in the building, usage of building, and population using the building. Few stakeholders suggested factors like area, height, density, type of construction, occupancy, and type of use to classify buildings. One stakeholder suggested that the MBBL 2016 classifies buildings on the basis of use of premises or activity, design or height, features and safety due to maintenance level. This list can be used as a reference and suitably adopted for classification of buildings for the purpose of DCI.

i) With respect to **certification of products for DCI**, majority of stakeholders suggested that the authorised certifying agency such as TEC can upload all certified products on the portal for knowledge of Property Managers.

A stakeholder was of the view that the products for the purpose of DCI could be regulated or licensed and totally unregulated or build on multiple other specifications e.g., electrical components or batteries under BIS and telecom under TEC standards. Few stakeholders suggested that certification of products will ensure the quality of the network and service support for future. A stakeholder suggested that certification should be done in a time-bound, transparent and impartial manner. It should be open to new developments and should encourage manufacturers to develop high quality, cost effective, safe, and efficient products. Some stakeholders were of the view that certification of products should be voluntary for procurement by the Property Managers. Another stakeholder argued that there is no need for separate certifying agencies for products as almost all the products used

are based on global or Indian standards and have already undergone certification.

j) Some stakeholders proposed that the in-building network, plugged with appropriate backhaul connectivity from all TSPs, behave as a **'neutral host'** IP-I. Builders should engage with IP-Is to create neutral infrastructure to cater to multi-TSP services. A single rollout should be done for a multi-operator service environment (Neutral host). This will avoid repetition, bring efficiencies, and better network utilisation.

k) Few stakeholders proposed that commercial terms for **sharing of the in-building telecom infrastructure**, may be decided by the provider or by IBS service provider and same shall be done in transparent, fair, and non-discriminatory manner. In case of public buildings, the provider should be obliged to issue a reference offer, a copy of which may be filed with an Authority (e.g., TRAI). Some stakeholders suggested that builders or Property Managers should engage with the IP-Is to create infrastructure which can cater to multi-TSP services. The IP-Is can act as a neutral host and can provide access to other TSPs.

2.4.7. **Analysis**

a) In previous discussions, the Authority recognised **digital connectivity as an essential component** of the Building development plans, similar to other building services such as water, electricity, gas, fire protection and safety etc. and therefore recommended MBBL and NBC should have necessary provisions for the development of DCI. The development of a Building goes through various stages which include design of building plan by

architect, approval and seeking of permit from development authority to develop Buildings as per the design and construction of the Building under supervision of engineers. The design and construction phases of a Building also include development of various building services i.e., provisioning water supply system, gas pipelines, fire escape, etc. Further, after development of the Buildings, the owner seeks completion/occupancy certification from development authorities to put the Building in use. Accordingly, development of DCI is also to be considered in a phased manner as per stages of building construction and approval plans in line with the other building services.

b) As regards to, **collation and sharing of digital connectivity requirements** of the users and building information with the DCI Professionals, the Property Manager being the key entity, should normally coordinate with all stakeholders be it architect, DCI solution providers, digital infrastructure or service providers or end users. This view has also been supported by the stakeholders.

c) For uniformity of collating and sharing of information it is necessary to adopt **standard templates** for the development of DCI. Further, there should be standard and separate guidelines and procedures for development of DCI for different kinds of Buildings. While defining the standards, use of digital tools for scientific analysis and conclusions thereof should be promoted.

d) The existing panel on Information and Communication Enabled Installations, constituted under NBC, may also work as a standardisation body for DCI. However, the **scope of the panel is to be enhanced** for taking into account new technologies such

as 4G, 5G, smart IoT, Metaverse, surveillance systems, etc.

e) Wireless technology has now become a dominant technology in access services and therefore requires inclusion of its standards in building construction practices. **To define such standards**, it is essential to include relevant experts having domain knowledge of wireless communication with use of advanced tools and digital information systems. Accordingly, the scope of the existing panel (specialist panel on Information and Communication Enabled Installations under NBC) requires to be widened to include Telecommunication Engineering Centre (TEC), Telecommunications Standards Development Society India (TSDSI), domain experts from telecom RF planning and experts on digital modelling of Building. This expanded panel should deliberate and define standards for the deployment of wireless technologies in DCI designing, utilizing CAD based 3D and 4D design, Building Information Module and Digital Twins, etc.

f) Further, in order to account for new standards in respect of fast changing technologies in telecommunication sector and adopting the same in the Indian telecom network including IBS, the current **Convenor arrangement** (as mentioned in para 2.2.6(2)(g)(i)) of the panel on individual capacity needs review. It is suggested that the nodal officer of the Government, responsible for development of digital connectivity in the country, i.e., DoT should convene the meeting of the panel. This will enable better coordination between DoT and BIS for quick incorporation of new standards on digital connectivity. DoT will be in a better position to formulate agendas based on sectoral understanding and technological developments.

g) Additionally, the **Guiding Committee** (as mentioned in para 2.2.6(2)(g)(i)) responsible for codifying various standards in NBC does not have **representation from telecommunications field** and therefore, in order to comprehend the recommendations of the panel in a better way, it is essential to include experts from DoT and telecom industry.

h) For occupancy/ use of completed Building including DCI, issuance of occupancy/completion certificate by the competent authority is required. There may be circumstances when all works except few minor works of DCI are completed. In such situations, to avoid the delay in usage of the Building, the panel may identify and prescribe **essential requirements of DCI**, where completion of essential component may be made mandatory before issuance of occupancy/completion certificate.

i) The requirement of DCI shall vary in **different classes of Buildings** depending upon their usage (residential/ commercial/ educational/ industrial/ business etc.), design and requirements of the end users. The DCI requirement of a residential Building would be different from that of a commercial or office Building. Similarly, Data Centres or IT Parks developed, or Industrial Estate being developed in various States will have different DCI requirements. Thus, one solution might not be suitable for all types of Buildings.

j) TRAI, while recognising the importance of DCI in Data Centres has already given its recommendations on 18th November 2022 vide "*Regulatory Framework for Promoting Data Economy Through Establishment of Data Centres, Content Delivery Networks, and Interconnect Exchanges in India*".

Accordingly, there is requirement of prescribing different set of standards for different categories of the Buildings. The Panel should look into the above aspects while finalizing the standards for different classes of Buildings.

k) Currently, TEC is assigned the responsibility to **prepare specification and standards for telecom equipment** and their interoperability. Since the deployed DCI is to be utilised by multiple service providers, it needs to be ensured that the products used in development of DCI are **shareable as well as interoperable**. This may help to retain aesthetics of the Buildings apart from optimising Capex and Opex. TEC should continue to take up this responsibility even for the products and equipment to be used for DCI. These standards can help Property Managers and DCI Professionals to develop DCI as per the requirements of the stakeholders. Stakeholders have also widely supported that TEC should continue to work as certification authority of the products and equipment. Also, TEC is required to set new standards for new products to be used in upgradation or expansion of DCI.

2.4.8. Recommendations

7. **The Authority recommends that a separate chapter should be included in MBBL on comprehensive framework for development of DCI.**

8. **The Authority recommends that the Bureau of Indian Standards (BIS) should be tasked to review existing standards and procedures of DCI for Buildings.**

9. **The Authority recommends that the "National Building Code Sectional Committee" constituted under NBC, also referred as Guiding Committee should include members from the Department of Telecommunication and Telecom Industry.**

10. **The Authority further recommends that the Panel on 'Information and Communication Enabled Installations' under NBC (Volume II, Part 8, Section 6) should be expanded to include representatives from Telecommunication Engineering Centre (TEC) and Telecommunications Standards Development Society India (TSDSI) and, experts on telecom RF planning and experts on digital modelling of Buildings. The convener of this panel should be the representative nominated by DoT.**

11. **On standards for products and procedures for DCI, the Authority recommends that,**

    a) **the BIS should prescribe and update standard templates which will be used by Property Managers for collecting building-related information and connectivity requirements of users. In case of non-availability of data from the users, the Property Manager shall use the data available for similar Buildings. Data collected through such templates shall be used by the DCI Designers.**

    b) **the standards and procedures framed, and templates prescribed for DCI by BIS should be made part of the National Building Code (NBC).**

c) **TEC should continue to work as the equipment standardisation and certification agency for standard products and equipment required for DCI.**

d) **TEC should prescribe necessary specifications in respect of new products required for upgradation of DCI.**

e) **TEC should also ensure that the certified products for DCI are shareable and interoperable.**

f) **TEC should enlist and publish such DCI products and equipment which require certification.**

12. **The Authority recommends that BIS should prescribe different standards for different classes of Buildings for DCI.**
13. **Further, the Authority recommends that BIS should also prescribe such provisions of DCI that would be mandatorily required (essential requirements) to be completed for issuance of completion/occupancy certificate for Buildings.**

2.5. Ownership and Access to DCI

2.5.1. As of now, TSP/ IP-Is are responsible for the design, deployment, maintenance, and upgradation of the telecom network. As per DoT Guidelines for Registration of IP-I, the IP-Is can provide assets such as dark fibres, Right of Way, duct space and tower. Also, DoT enhanced the scope of IP-I registration to cover the active infrastructure on behalf of the licensees. Further, DoT in 2016, clarified that "*IP-I providers are not permitted to own and share active infrastructure. The IP-I providers can only install the active elements on behalf of Telecom licensees i.e., these elements should be owned*

by the companies who have been issued licence under Section 4 of Telegraph Act, 1885." Also, as per Unified Licence, the Licensee may establish, operate and maintain Telecommunication Networks and telecommunication services using any technology as per prescribed standards in the service area as per scope of services authorised under this Licence. In case, the licensee obtains Access Spectrum, the terms and conditions of the allotment of spectrum regarding use of technology shall be applicable.

2.5.2. However, the current practice poses issues related to monopoly, principal agent problems, non-grant of access, etc. In this regard, the CP discussed that the Property Manager may be the owner of the deployed DCI. The CP also highlighted that Property Managers may be responsible for the management of all the functions needed to develop, maintain, and upgrade DCI. For effective implementation of the ecosystem, the CP also deliberated the introduction of a special class of infrastructure provider for DCI development.

2.5.3. **Issues raised in the CP**

Q2. How would the ecosystem proposed in response to Question no.1 ensure that created infrastructure does not get monopolized?

Q14. What may be the possible models of DCI ownership and its upkeep? Whether co-ownership models would help in aligning incentives in realising connectivity that would meet expectations of the end users from time to time? Should there be a need to specify terms and conditions for entities owning and responsible for upkeep of DCI to function in a fair, transparent and non-discriminatory manner?

Q19. Is there a need to introduce a special class of Infrastructure Providers to create, operate and maintain DCI for a building or cluster of buildings in ownership models suggested in response to Question No. 14? What should be the terms and conditions for such special Infrastructure Providers? Should such terms and conditions vary depending upon type, size and usage of buildings?

2.5.4. **Responses of the Stakeholders**

a) Majority of the stakeholders were of the view that **ownership of the DCI** for the buildings can lie with the Property Manager or users like Residents Organizations. Property Manager may himself register as an infrastructure provider and manage the DCI. The Property Manager may be allowed to enter into agreement with TSP/IP-I to develop and manage DCI inside his property. Current regulations should be accordingly modified so that ownership is passed on to RWAs from builders at the earliest, post completion of the building. Few stakeholders commented that the creation of DCI provisions for new buildings should be mandated under new regulations and Property Manager should be held responsible for ensuring DCI in a building.

Some stakeholders also supported to adopt co-ownership model by arguing that it would be the most optimal approach of DCI ownership and responsibility of its upkeep and upgradation from time to time. It may be adopted for the newly constructed/ upcoming buildings. For the existing buildings, there would be challenges in adopting the suggested model. However, the co-ownership model was also opposed by a few stakeholders by arguing that the concept of co-ownership model is yet to be tested

in the market. This may be left to the mutual negotiations among the stakeholders. Any mandatory addition of any new layer for co-ownership will increase the complexity for the end consumer and same should be avoided. It should be left to voluntary discretion of the Property Managers. A stakeholder also opposed the co-ownership model by arguing that there will be involvement of more than two stakeholders i.e., asset owners (local authorities and third parties listing assets on the platform), network operators and other organisations potentially looking to lease listed assets, in case of DCI.

One stakeholder was of the view that the models of ownership by the Property Managers or co-ownership with the IP-Is may co-exist, depending on what is more suitable for the Property Manager. Some stakeholders were of the view that the access to premises or buildings should be done in a fair, transparent, and non-discriminatory manner.

Two stakeholders suggested that the current system of ownership by employment of a neutral host management provider (IP-Is), who assumes all financial, regulatory, legal and technical responsibility for deploying, installing and maintaining the system, can also address the issues regarding ownership and monopolisation. The IP-Is are already aware about the requirements to build DCI so would address the risk of shifting to a new ownership model.

Few stakeholders suggested that in either model, it should be legally binding on the entity responsible for maintaining to allow fair, transparent, and non-discriminatory access to TSPs for upgradation/expansion of DCI as per the demand of the end-

users. The building access by TSPs for DCI augmentation should not be hindered owing to unfair practices adopted by Property Managers through preferential treatment and unjustified prices.

b) Some stakeholders agreed that there is a need of defining **terms and conditions for entities responsible for upkeep of DCI**, to function in a fair, transparent, and non-discriminatory manner. In case, the infrastructure provider agency/ TSP/ ISP offers some unfair or unreasonable terms to a new TSP/ ISP other than incumbent TSP/ ISP, the residents would unnecessarily suffer from poor quality of services. Any such unfair and unreasonable terms would also create a non-level playing field against the new/ other licensed TSPs/ ISPs.

c) In response to introduction of a **special class of Infrastructure Providers** to create, operate and maintain DCI for a building or cluster of buildings, a stakeholder was of the view that there should be a requirement of a very simple registration for any Property Manager to act as IP-I. The terms and conditions should ensure that the infrastructure must be shared by all interested TSPs without any discrimination and the infrastructure must be upgraded/expanded as and when required. However, majority of stakeholders opposed the introduction of a special class of infrastructure providers to create, operate and maintain DCI. They argued that IP-Is are sufficient to create, operate and maintain the DCI. The scope of IP-Is may be increased to include active infrastructure viz. DAS, FTTH, etc. besides passive infrastructure viz. towers and fibre. In addition to this, a stakeholder suggested that creation/ maintenance should be on the principles of 'open access policy' facilitating quick deployment of DCI by both infrastructure providers and TSPs. Further it is

important that both the key stakeholders can get engaged into open dialogue and work together accommodating/aligning to each other's interests. This collaborative approach is already manifesting itself in the form of neutral infrastructure providers and would be leading the way in creation of DCI in the country as envisaged by the Authority.

d) They further suggested that Property Manager should maintain transparency in **providing access to TSPs** in a fair and non-discriminatory manner. No exclusive tie-ups should be entered into by a Property Manager in giving access of DCI to TSPs/ISPs. For this, roles and responsibilities of the Property Manager should be clearly defined.

One stakeholder suggested that accessibility of infrastructure by the telecom licensee, required for providing the connectivity, must be mandatory and protected under telecom laws and RoW rules. In addition, one stakeholder proposed that TRAI and DoT should do regular sample checks and audits, to ensure that no monopolization or exclusivity exists. TRAI along with RERA should jointly address such concerns/complaints under an agreed mechanism.

Another stakeholder proposed identification and recognition of the new ecosystem under RoW rules, NBC, MBBL, MoHUA/ TCPO guidelines, etc. and legal terms and conditions under these would help to address concerns of monopoly. The guidelines for DCI Designers should include the requirement of access by multiple telecom licensees at the design stage itself. The capacity of on-boarding multiple licensees should be one of the prime criteria for evaluation of DCI.

In response to the issue of preventing monopolisation of deployed DCI, one stakeholder suggested that indulgence in such practices, through either formal or informal arrangement, should not be encouraged. A time-bound system may be developed, which may, inter-alia, include, "the seeker-TSP" i.e., who wishes to access the cables/ IBS installed by an existing IP-I (provider), should place its requirement in writing to such provider and the provider should respond in writing within 60 days' time. In case of denial of request to access the infrastructure, the provider should give reasons and justification for denial (Right of first refusal by the 'neutral host'). Another stakeholder supported open access policy where TSPs might be allowed to access the building on reasonable commercial terms based on mutual agreement. Access to Government buildings should be at no or minimal cost for TSPs and IP-Is.

Some stakeholders suggested that the issue of monopolization had been checked by certain provisions included in the addendum to the MBBL 2016 issued in March 2022. The stakeholders have submitted that, as part of the building bye-laws, the builder/ RWA are mandated to ensure the following:

i) Access to building as well as CTI facilities inside the buildings should be available on a fair, transparent, and non-discriminatory manner for all service providers/IP-Is.
ii) The service providers/IP-Is should have unrestricted access for maintenance work.
iii) Charges (rentals/power rates etc.) levied to the TSPs/IP-Is should be fair, transparent, and non-discriminatory and should be on residential rates.

Some stakeholders suggested that building owners providing good quality DCI as per bye-laws should be allowed to charge IP-Is/TSP on non-discriminatory basis. The charges should be reasonable and fair and should be suitably capped. On the other hand, in a public building with no DCI, the provider should be mandated to provide access to all IP-Is/TSPs without any charge. One of the stakeholders also suggested that the Property Managers must be encouraged to provide earmarked place/ common infrastructure like ducts to run cables, cable trays and power supply that can be easily offered to TSPs in a non-discriminatory manner.

2.5.5. **Analysis**

a) **TRAI in its earlier recommendations on "*In-building Access by Telecom Service Providers*" dated 20th January 2017**, recommended the following (please refer chapter-III - Summary of Recommendations):

Para 1

(i) Considering the requirement of ubiquitous voice and data network inside the large public places/commercial complexes/residential complexes and considering the fact that it is not practical for each TSP to put its IBS and other telecom infrastructure inside such complexes, the requirement of sharing the In-building telecom infrastructure including IBS has become inevitable. Therefore, TSPs/IP-Is should be mandated to share the in-building infrastructure (IBS, OFC and other cables, ducts etc) with other TSPs, in large public places like Airports, hotels, multiplexes, etc., commercial complexes and residential complexes.

(ii) *The TSPs/IP-Is may be categorically disallowed to enter into any kind of agreement or contract, which results in exclusive access or lessening of competition. Indulgence into such a practice, through either formal or informal arrangement, may be treated as violation of the license agreement/registration.*

(iii) *A system (time-bound) may be developed, which may, inter-alia, include:*

a. The seeker-TSP i.e., who wish to access the Cables/IBS installed by an existing TSP/IP-I (provider-TSP), should place its requirement in writing to such provider-TSP.

b. The provider-TSP shall respond in writing within 30 days time. In case of denial of request to access the infrastructure, the provider-TSP shall give reasons and justification for denial.

(iv) *Commercial terms for sharing of the in-building telecom infrastructure system, may be decided by the provider-TSP. However, the same shall be done in transparent, fair and non-discriminatory manner.*

Para 2

(i) *DoT should take up the matter with the Ministry of Urban Development to ensure that Suitable provision for the creation of Common Telecom Infrastructure (CTI) inside the newly constructed public places like Airports, commercial complexes and residential complexes, should form part of the Model Building Bye-Laws.*

(ii) *Government should ensure that the essential requirement for telecom installations and the associated cabling is formed part of National Building Code of India (NBC), being amended by Bureau of Indian Standards (BIS).*

(iii) *The telecom ducts to access the buildings from outside should invariably be part of the CTI, which could be used by TSPs/IP-Is for putting cables; which would ensure unhindered access to TSPs/IP-Is.*

(iv) *No building plan should be approved without having a plan for creation of CTI including the duct to reach to the telecom room inside the building.*

(v) *Completion certificate to a building to be granted only after ensuring that the CTI as per the prescribed standards is in place.*

(vi) *As part of Building Bye-Laws, the builder/RWA should be mandated to ensure that:*

a. Access to building as well as CTI facilities inside the building should be available on a fair, transparent and non-discriminatory manner and minimum three TSPs/IP-Is should have presence in the building.

b. Public Sector TSP (BSNL / MTNL) should be given access to Government and commercial buildings.

c. The TSPs/IP-Is should have unrestricted access for maintenance work.

d. The permission to in-building access and/or use of CTI facilities inside the building should not be seen as a source of revenue generation for builder(s)/RWA(s).

e. Charges (rentals/power rates etc.) levied to the TSPs should be fair, transparent and non-discriminatory.

b) As mentioned earlier, Addendum to MBBL issued in March 2022 by MoHUA have included provisions given in recommendations no. 1(i), 2(i), 2(iii) to 2(v) and part of 2(vi), covering mandatory sharing of infrastructure, unrestricted access for maintenance of

infrastructure, provision of telecom ducts, pathways/ runways to access Building from outside. Further the addendum mentions that charges levied for access of the infrastructure be fair, transparent and non-discriminatory and not to be considered as a source of revenue. Also, in all new constructions, mandatory provisions of creating CTI have been included in addendum for approval of building plan and issuance of occupancy/ completion certificate.

However, the recommendations no. 1(ii) to 1(iv) in respect of inclusion of disallowing exclusive tie-up by TSP/ IP-Is in license/ registration conditions, time-bound approval process for accessing the CTI deployed and terms and conditions on sharing are not yet implemented by the Government. Further, the recommendation at para 2(ii) above, regarding inclusion of CTI as an essential requirement and associated standards as part of NBC, is not addressed so far.

c) In view of above, and also addressing key issues of smooth access of infrastructure or well establish process for permission of creation of infrastructure inside the Building at no cost or reasonable prices and empowering end users to decide the kind of digital connectivity needed for them, Authority decided to review certain provisions of earlier recommendations and to introduce new provisions to make a consolidated and comprehensive recommendations to account for every aspect of DCI at one place.

d) It is well acknowledged that the issues of service/ infrastructure providers (the owner of DCI, as of now), with regard to difficulty in getting permission for access of Buildings or access being

provided at a high cost, still exist. Such issues may result into either denial of services to the end consumers or accessibility of services at a high cost. Therefore, the Authority decided to revisit the recommendations related to **ownership of telecom infrastructure.**

e) The Authority is of the view, that the end users of DCI need to be empowered to decide kind of DCI needed in their premises. The building plans are also to be aligned to meet end users' requirements. Accordingly, the Property Manager, who is responsible for the development of a property is the most suitable person to own DCI. Assigning ownership of DCI to the Property Manager is further justified due to following reasons:

   i) The working of the present arrangement has not been found very encouraging because pre-provisioned DCI in Buildings is not available to multiple service providers. In case of electricity, water, gas pipes etc., generally there is only one provider and they are not being charged for extending the services to the Building. However, in case of telecom and broadcasting, the residents/ occupants of a Building subscribe to services of multiple operators and therefore there is a requirement to provide access of DCI to all such service providers. It makes sense, that if common DCI is created by the Property Manager and access is allowed to all such service providers in fair, transparent and non-discriminatory manner, the residents will be able to access services from their respective service providers.

ii) There is a tendency to engage TSPs/ IP-Is through the highest bidding model. Such TSPs/ IP-Is, in turn work for maximisation of their revenue by charging excessive rent from other service providers.

iii) At places, Property Managers have entered into exclusive tie-up with one of the infrastructure/ service providers, who works as a monopolist and decide terms and conditions for access for his maximum benefits.

iv) Expansion or upgradation of infrastructure is normally not taken up in time to meet the users' demand resulting into delayed availability of service to the consumers and increased costs.

f) The reasons explained above are also corroborated through **examples**, wherein, users of a residential Buildings or offices or public places are forced to live with poor or compromised quality due to non-availability or non-upgradation of the infrastructure by the existing infrastructure providers and TSPs. A recent news item in Delhi for creating telecom infrastructure in a tunnel (underpass) constructed at a very high cost with no telecom infrastructure is now seeking highest bidder for provision of telecom connectivity inside the tunnel. This approach needs to be reviewed and telecom infrastructure is required to be made an essential part of the plan submitted to the local authorities for construction of the tunnel. Same is true for one of the leading airports in the country, wherein access to infrastructure for rolling out of 5G services inside airport is based on the revenue maximisation model towards monopolistic infrastructure provider. Similarly in many Government and Private Multi-storied

residential complexes in few cities, upgradation of infrastructure could not be taken up due to either high-cost demand by the existing infra providers or by RWAs and also due to pending settlement of the contractual obligations between infra providers and RWAs. In all such cases ultimate sufferer are the end users who are not getting good quality of digital connectivity at their respective places timely and at reasonable rates.

g) Above analysis indicate that the ownership of DCI should lie with a person or body who is responsible for creation, operation and upgradation of DCI as per the needs of the end users and such person or body can be Property Manager.

h) The cost towards development of DCI should also be accounted in total building plan cost along with other building services. Such cost may be realised by the Property Managers either through upfront loading on cost of constructions or distributing it in two parts one upfront and other through maintenance charges, as applicable for different classes of Buildings. Accordingly, the Property Manager should provide access of DCI to service providers without any charge. However, in case of active wireless equipment deployed by a licensee, a reasonable charge may be worked out by mutual agreement. In case of existing Buildings, the same rules should apply, for upgradation, expansion as well as for creation of DCI.

i) On provision of **Special Class of Infrastructure Providers** for Property Manager, following illustration may please be noted:

As per **Indian Telegraph Rules 1951** (Rule 472), "*Any person may without a licence establish, maintain and work a telegraph (not being a wireless telegraph) within the limits of a single*

building, compound or estate: Provided that no telegraph line pertaining to the telegraph shall pass over or under a public road". Accordingly, till the time Property Manager creates DCI within the framework of the above rule, there is no requirement to introduce a special class of infrastructure providers for them. However, if Property Manager intends to deploy active wireless equipment, licence as specified by DoT is required to be taken. Further, if Property Manager uses services of a licensee to **deploy active wireless equipment**, to that extent, the licensee shall be the owner of such active equipment. However, onus for providing access of such DCI including active wireless equipment deployed by a licensee, shall lie with the Property Manager.

j) **Access of DCI**: Para 4 (In-Building and Gated Buildings Solutions) of the MBBL addendum mentions that, *"…TSP/ IP-Is should be given legal rights and permissions to use the Common Telecom Infrastructure (CTI) within the premises of buildings/ gated society free of charge or for a standardized nominal charge just like other essential services like water, electricity and/or gas…"*.

k) In 2017, TRAI had recommended that the TSPs/IP-Is may be categorically disallowed to enter into any kind of agreement or contract, which results in exclusive access or lessening of competition. Indulgence into such a practice, through either formal or informal arrangement, may be treated as violation of the license agreement/registration. Also, recently, Authority in para 2.90 of its recommendations dated 29th November 2022 on "*Use of Street Furniture for Small Cell and Aerial Fibre Deployment*" recommended in a comprehensive manner that "*enabling provisions or suitable terms and conditions shall be introduced in*

all telecom licenses and IP-I registration agreement prohibiting the TSPs/IP-I providers from entering into any exclusive contract or right of ways with infrastructure owners/CAAs or any other authority". The Authority is of the view that, necessary amendment in the licenses of the service providers and registration of the IP-I is required to be made in addition to express prohibition of such agreements by Property Managers to give such arrangements a legal backing.

Similarly, Property Manager being owner of the DCI should also not enter into exclusive tie-ups with any of the service/ infrastructure providers for development and access of DCI in the Buildings. In all such cases, Property Manager is fully responsible for development of DCI and providing access of the same to the service providers on fair, transparent and non-discriminatory basis.

l) Also, subject to ownership being with the Property Manager, the Property Manager may have arrangements for establishment, operation, maintenance and upgradation of DCI with the service/ infrastructure provider. However, in such cases, onus for setting of the terms and conditions regarding access to electricity and safety measures remains with the Property Manager. Such arrangement shall entail Property Manager to own and not lead to monopoly and provide access of the DCI in fair, transparent and non-discriminatory manner, on a non-chargeable basis.

m) The above provisions are mainly applicable to **new Buildings** where all construction activities including DCI are covered under the building bye-laws.

n) In case of **existing Buildings**, where some telecom infrastructure already exists or there is no telecom infrastructure, there may be a need to upgrade or expand the available infrastructure or create DCI to cater to the demand arising out of new technologies. This requires a collaborative approach among all stakeholders to decide a nodal person (Property Manager) to take up upgradation or expansion of the existing infrastructure or creation of DCI and making it accessible to all the service providers in a fair, transparent, and non-discriminatory manner.

o) Further in case, DCI or any part of the DCI was created by service providers/ IP-Is, till no suitable arrangement is worked out to transfer the DCI to the Property Manager, such service providers/ IP-Is shall be governed by the mandatory provisions of the license/ registration conditions.

p) The Authority agrees with some stakeholders with regard to sharing of DCI. Such sharing helps in expanding network coverage, reducing CAPEX and OPEX and minimizing duplication of infrastructure. Such nudge is required in addition to making such sharing compulsory by amending the license conditions. As active wireless equipment can be owned only by licensees, there is a need to incentivise such sharing. The Authority is of the opinion that in a market where there are large number of players, the inherent or inbuilt incentives of cost reductions can promote infrastructure sharing. However, in a market which has only a few players, some players may look at installing exclusive active wireless equipment to gain competitive advantage. This may not be in the overall interest of the country where large investments are required to build DCI in every nook and corner of the country. The Authority thus feels that there is a need for a nudge

intervention whereby there should be incentives for those licensees who install active wireless equipment and come forward to share it with others. Licensees who lease active wireless equipment for sharing (lessor) should get some incentives. One of the ways of offering them an incentive is by exempting License Fee (LF) on such revenues. This can be done by allowing deduction of revenues earned by the lessor by way of the payments received from the lessee (the other licensee who seeks to use the infrastructure of lessors for sharing) from their Gross Revenues (GR) for arriving at Applicable Gross Revenues (ApGR).

2.5.6. **Recommendations**

14. **The Authority recommends that the Property Manager shall be the owner of the deployed DCI whether created by himself or through his agent and shall be responsible for maintenance, expansion and upgradation of such DCI. The Property Manager shall allow access of DCI to all service providers in fair, non-chargeable, transparent and non-discriminatory manner and shall not have any exclusive arrangements or agreements with any infrastructure/service provider.**

Provided that in case active wireless equipment is installed by a licensee, the licensee will be responsible for maintenance, expansion and upgradation of such DCI and to that extent, the ownership lies with that licensee. However, this installation of active wireless equipment will be carried out on behalf of the Property Manager and Property Manager shall be responsible for ensuring that the licensee compulsorily gives access of such active wireless equipment

to all service providers on fair, transparent, non-discriminatory, and non-exclusive manner.

15. **Further, the Authority recommends that, an amendment to the present Unified license conditions with a proviso for compulsory sharing of active wireless equipment in the Buildings may be carried out.**

16. **The Authority recommends that the revenues earned by sharing of active wireless equipment, as part of DCI, by lessor licensees should not attract License Fee (LF). For the same, such revenues should be reduced from the Gross Revenues (GR) of the lessor licensee to arrive at Applicable Gross Revenue (ApGR) of such lessor licensee.**

    To implement above recommendation, it is further recommended that, a new item named as "Revenue earned from other licensees from sharing of active wireless equipment, as part of DCI" should be inserted under the license provisions namely "List of other items to be excluded from GR to arrive at ApGR". It is also recommended that, appropriate modification may be carried out in UL, UL(VNO) and ISP licenses. Also, the information collected in "Format of Statement of Revenue and License Fee" that is attached with each authorization chapter in UL, UL(VNO) and with ISP licenses needs to be modified to capture information from such revenues under a separate head.

17. **For existing Buildings where DCI is partly created, the Authority recommends a collaborative approach among stakeholders to decide ownership i.e., Property Manager for development, upgradation and expansion of DCI. However, in cases where DCI is developed by a service provider/ IP-I(s), till no suitable arrangement is worked out to transfer the DCI**

to the Property Manager, such service providers/ IP-Is shall be governed by the mandatory provisions of the license/ registration conditions.

18. **The Authority reiterates its recommendation in para 2.90 of its recommendations dated 29th November 2022 on "*Use of Street Furniture for Small Cell and Aerial Fibre Deployment*" wherein it was recommended that "*enabling provisions or suitable terms and conditions shall be introduced in all telecom licenses and IP-I registration agreement prohibiting the TSPs/IP-I providers from entering into any exclusive contract or right of ways with infrastructure owners/CAAs or any other authority*".**

2.6. Provisions for Expansion and Upgradation of DCI

2.6.1. In the past few years, tremendous growth in the number of subscribers and the usage of data have been observed. As per the report published by Nokia on India Mobile Broadband Index MBiT 2021[22], the total data traffic growth had increased about 60 times in 2020 in comparison to 2015. The report also indicated that the overall data traffic increased by 36% in 2020 due to continued 4G consumption.

2.6.2. To meet the increasing demand, the telecom operators as well as the Government are continuously working towards expanding and upgrading the telecom networks. Similarly, the DCI also requires necessary expansion and upgradation to meet the increasing/ varying user demands.

[22] https://www.nokia.com/about-us/company/worldwide-presence/india/mbit-index-2021/

2.6.3. **Issues raised in the CP**

Q5. How would the ecosystem proposed in response to Question no.1 ensure that upgrades and expansion of the DCI are done from time to time and continue to meet rising demands?

Q6. How would the ecosystem proposed in response to Question no.1 ensure that the TSPs' networks are planned, designed, deployed, and upgraded to serve the DCI requirements in a timely manner?

2.6.4. **Responses of the Stakeholders**

a) With respect to the **upgradation and expansion of DCI**, some stakeholders suggested adoption of incentive-based methods to encourage Property Managers to promote regular upgrades and expansion of DCI to meet rising demands. They also suggested that the Authority should also explore possibilities of financial incentives for building in the form of tax concessions in case such buildings acquire a minimum of specified rating, for example, 5 star rated buildings can be eligible for proposed tax concession (rating scale from 1 to 5). They also proposed that ratings of buildings can help in regular updates and expansion of DCI.

Some stakeholders proposed that ratings of buildings and certification can help in regular updates and expansion of DCI. A stakeholder suggested that the adoption of the NPS (Net Promoter Score) rating system and rating agency would help in this regard. Another stakeholder proposed that mandating review of DCI rating from time to time both periodically as well as after expiry of validity period of current certification or after change in requirements arising due to traffic demand, change in

technology, change in spectrum, user needs, etc. would help in upgrades and expansion of the DCI. One stakeholder proposed that rating should also evaluate the Property Manager's plans for future upgrades (with assigned weightage during rating). Certification should be renewed only after re-evaluation, which should also outline the DCI upgradation requirements and rate the plans of Property Manager for upgradation of DCI.

Some stakeholders proposed that the Authority should also publish regular updates on standards and technology for DCI requirements for IBS. It will help the Property Managers to assess the readiness of their DCI to meet the end-consumer demand.

One stakeholder proposed that DCI Designer while making provision for upgradation of network equipment at the time of design and implementation phase of the building should also include the possibility of modification/ change of equipment/ hardware for upgradation of the technology in the future. The design and outcome of the DCI implemented for the building should be a part of the approval process of the building. Such documents should be readily available to the Property Managers preferably through online Government portal. Knowledge of built-in scope for network technology upgradation will be instrumental while planning for actual expansion or upgradation of the DCI for a building. One stakeholder suggested that post building handover, evaluation carried out on a regular time period, as decided by the regulatory guideline, shall enable upgrades and expansions, if the user requirements are not getting met.

Few stakeholders proposed that the ecosystem proposed in the Consultation Paper provides enough provisions regarding timely

upgradation of the DCI network created inside buildings. The residents would demand a quality/ upgraded network all the time and thus there would be a pressure on Property Managers who in turn would seek the upgraded active telecom infrastructure from the telecom operator.

One stakeholder proposed that the data provided by customer experience surveys and KPIs provided by the TSPs can be periodically analysed to assess the requirement of upgrades and expansion of DCI. The platform for the interaction between Property Managers, DCI Designers and TSPs will be required for such continuous interaction.

A stakeholder suggested that TRAI and RERA may devise a framework (only the norms and guiding principles) for collection of requisite information for creation and evaluation of DCI by Property Manager and DCI Evaluator respectively.

A stakeholder suggested that since the DCI would be owned by Property Managers, it will be in its own interest to consider upgrades and expansions to meet the digital connectivity requirements of its residents. Property Managers can adopt a process of collating user feedback and inputs on their digital connectivity needs throughout the period and submit the same for standardization process and at the same time evaluate the need of enhancing existing DCI to meet the user requirements. It is supported by another stakeholder by arguing that as the upgrades and expansions require capex, the decision may be left to the building's management authority.

b) With respect to **ensuring the planning, designing, deploying**

and upgrading TSPs' networks to serve the DCI requirements in a timely manner, stakeholders were of the opinion that TSPs will be aware of upcoming data requirements for a building owing to any changes in technology or services. Hence, they will be ready with the **backhaul infrastructure and availability** of required hardware/ equipment for updated technology to meet the data demand of the end-consumer in the buildings, as the same is in their commercial interest. For upgradation and expansion, access to the premises is very important.

Another stakeholder suggested that TSPs, IP-Is, licensees are best placed to understand their users' demands and plan the network expansion and upgradation accordingly. Also, a Net Promoter Score rating system and 360-degree feedback of end customers, who are using telecom services in DCI enabled buildings would help to improvise the infrastructure in terms of telecom needs fulfilment.

A stakeholder suggested that upgradation of technology and requirement of installation of updated hardware in the premises of the building by TSPs should be facilitated by the Property Managers on rent free basis. For upgradation, the ecosystem should enable the Property Managers to conveniently access professional service for DCI upgradation through digital platforms among others.

One stakeholder suggested that there was a requirement of an online portal to provide information to TSPs regarding new infrastructure projects/ big buildings from conceptualization to being ready for users. Such portal would help to consider aspects of upcoming buildings in designing, planning, developing DCI to

fulfil the future demands of the users.

A stakeholder was of the opinion that since the TSPs had their networks periodically and randomly assessed for QoS, any gaps/ deficiencies, perceived by the TSPs and/ or by Certifying Agency/ Regulator, in meeting the desired KPIs and standards would be corrected through expansion or upgradation as the case may be. This way, the IP-Is who provide the necessary passive infrastructure are obligated to provide and ensure that their networks are upgraded to meet the desired QoS levels.

One stakeholder suggested use of sensors inside the premises to monitor the quality of wireless network. The data collected from mobile handsets of voluntary users also can be analysed using AI/ML systems to evaluate the quality of TSP's Network.

One stakeholder suggested that once accessibility of buildings is made available, the competition between TSPs would ensure that due initiatives are taken to provide better connectivity.

2.6.5. **Analysis**

a) **Expansion or upgradation of the deployed DCI** is a regular exercise to take care of challenges posed by increased user demand or introduction of new technologies. Upgradation is also taken up to cater new spectrum bands if introduced by Government or service providers to enhance capacity and coverage requirements, etc. Customer experience surveys and TSPs' network analysis on periodical basis would help in deciding the requirement of upgradation and expansion of DCI, if any.

b) **Backhaul upgradation and capacity enhancement** are also to be taken up in parallel with the access expansion so as to meet increased user demand seamlessly. Accordingly, there has to be very close coordination between the service providers and the Property Manager managing DCI to implement requisite upgradations in sync.

c) Operation and Maintenance have been found to be a great challenge in sustaining the **quality of deployed DCI over the time**. The quality is affected due to change in traffic, technology, introduction of new spectrum bands, structural changes in the Building and customers' preferences towards new service offerings. Accordingly, there is a need to have continuous monitoring of the DCI for ensuring good quality of service to the end users.

d) It is therefore required that the **standards proposed need to be reviewed** on regular basis and if required, new standards should also be included as per the availability of technology and need of the end users. At the same time, BIS is also required to incorporate the aspects of upgradation and expansion of DCI while framing standards and procedures.

e) Further, since DoT is the licensor, allocating spectrum bands, and overseeing the affairs of the telecommunication industry in India, and DoT being the proposed convener of the BIS panel should take necessary initiatives to incorporate the provisions in respect of upgradation and expansion of DCI in NBC and MBBL in time.

f) Similar to the DCI development process, in order to ensure that minor pending works on DCI do not delay the issuance of building

completion certificate, the BIS should prescribe **essential and non-essential requirements** for upgradation/ expansion of DCI.

g) In case of **non-essential requirements**, the Property Manager should submit self-evaluation certificate to the approval authority after completion of the same in a definite time frame prescribed in standards or time frame allocated by approval authority (as the case may be).

h) As recommended in para 2.5.6, the upgradation and expansion of the existing infrastructure shall be taken up by the Property Manager. The Property Manager shall also be responsible to provide access of upgraded and expanded DCI to all service providers, in line of those recommendations.

i) Further, digital connectivity being essential part of everyone's life, there is need to have good quality DCI ubiquitously, be it office or commercial complexes, residential buildings, industrial estates, technology parks, educational institutions, public places or places in semiurban, rural or remote places, etc. Many of the Buildings mentioned above have very high footfalls and therefore, it is required to include some mandatory provisions in building bye-laws to upgrade the existing telecom infrastructure in Buildings not covered earlier, within a reasonable time frame. This will enable users of such Buildings to access of good digital connectivity based on new technologies, similar to those who are part of development of DCI in new Buildings.

j) To begin with, the following may be considered:

    i. In the Buildings of public importance, where users do not have ownership rights but such Buildings have very high

footfall considering its usage viz. airports, railway stations, bus stations, metro stations, Government offices, commercial Buildings, public malls, etc. DCI in such Buildings is required to be created as well as upgraded/ expanded mandatorily, to extend the highest level of digital connectivity therein.

ii. For such Buildings, the building bye-laws should define a reasonable time frame for new DCI development or expansion or upgradation of existing DCI, as the case may be. This will ensure ubiquitous accessibility of DCI to the consumers residing or visiting such Buildings for discharge of their work or business obligations or for education, travel, commerce, entertainment, etc.

iii. In Buildings other than those mentioned in above para, provision of DCI may be decided by the Property Managers based on the users' requirements and market forces. However, considering the importance of good digital connectivity to everyone, the Authority is of the view that MoHUA should take suitable measures to review the same with in a time frame, say three years, after inclusion of mandatory provisions for DCI in Buildings mentioned above and should include DCI development for such Buildings in building bye-laws after following due process of consultation with stakeholders.

2.6.6. **Recommendations**

19. **The Authority recommends that in case of introduction of new spectrum bands, change in technologies, increased users' demands etc.,**

a) **DoT should take up with BIS and MoHUA for incorporation of amendments in National Building Code and Model Building Bye-Laws, respectively.**

b) **BIS should also prescribe essential provisions that would be required to be carried out by Property Manager for upgradation and expansion of DCI.**

20. **The Authority recommends that the MBBL should have appropriate provisions for the approval of upgradation and expansion of DCI.**
21. **The Authority further recommends that the Property Manager should ensure upgradation and expansion of DCI in the timeline as will be prescribed in the MBBL.**
22. **The Authority recommends that, in all existing Buildings owned by the Government, PSUs or autonomous bodies of the Government, commercial buildings and public places such as airports, ports, railway stations, bus stations, metro stations or any other Building as may be decided by MoHUA in consultation with DoT, DCI shall be upgraded or provided to meet the requirements of state-of-the-art digital connectivity. In such cases, the Authority also recommends that the building bye-laws should prescribe a reasonable time frame so as to ensure availability and accessibility of upgraded DCI.**
23. **The Authority further recommends that for existing Buildings other than those mentioned in recommendation no. 22, the new building bye-laws should be issued by MoHUA within three years after due consultation with the various stakeholders. Till then, it is recommended that, the Property**

Managers of such existing Buildings shall implement the new bye-laws voluntarily.

2.7. Institutional Mechanism for Capacity Building of the DCI Professionals

2.7.1. For creation of an ecosystem to co-design and co-create DCI, the CP introduced DCI professionals such as DCI Designers, DCI Engineers and DCI Evaluators to design, implement and evaluate DCI. Property Managers would require services of these professionals to get DCI developed. The qualifications of such professionals may be required to be defined and recognized through an institutional mechanism. The Architect Act 1972, recognises and lays down minimum qualifications of Architects through the Council of Architecture (CoA). The Council also has the responsibility to regulate the education and practice of profession throughout India besides maintaining the register of architects. The CP invited suggestions on an approach to recognise and lay down qualifications of DCI Professionals.

2.7.2. Further, for capacity building of DCI Professionals, to cater all India requirements, the CP invited suggestions on development of courses and conduct exams for certification of qualified DCI Professionals. The CP also mentions that organisations such as BICSI, iNARTE, CTNS etc. are already offering courses related to DCI in the telecom domain. However, there may be a need to re-examine the content of such courses and their suitability for DCI in the Indian context. The CP sought inputs in respect of enrolling more and more institutions to conduct such courses for DCI.

2.7.3. Issues raised in the CP

Q7. How can an ecosystem be created to build capacity requirements of skilled professionals such as DCI Designers, DCI Engineers, DCI Evaluators? What would be the typical role and responsibilities of actors of the ecosystem?

Q8. How would the ecosystem proposed in response to Question no.7 ensure that relevant training courses are available in the country?

Q9. Whether the training courses proposed in response to Question no. 8 are already being offered by any organisation or institution that can be recognized for the purpose? If yes, please provide a list of organisations offering such courses. If not, how specialized courses can be designed to meet the requirements?

Q10. Is there a need to establish a council on the lines of "Council of Architecture" (CoA) to regulate minimum qualifications, additional specialized courses and practice of DCI profession in the country?

Q11. Whether the requirements of additional specialized courses and practices of profession would vary depending upon the size of work or kind of work involved in a particular DCI project?

Q17. Whether there is a need to include DCI Professionals as Persons on Record as typically done in building bye laws or development regulations? Or registration with the Council proposed in Question no. 10 would suffice to practice profession across the country as followed in the case of Architects?

2.7.4. **Responses of the Stakeholders**

a) The approach for **recognising DCI professionals**, as discussed in the CP, is agreed by majority of the stakeholders. Some of the stakeholders were of the view that a register of qualified DCI professionals should be maintained, and minimum standards should be laid down for DCI education for IBS in the country on the lines of Architect Act 1972.

   A stakeholder suggested that DCI Designers and Evaluators can be established on the line of concept of "Master System Integrator (MSI)" as a stream initially nurtured through a start-up ecosystem and incentivized by various Government plans of digitised maps creation as extension to providing basic infrastructure provisions for DCI.

b) The CP's approach of **development of training courses** was also supported by majority of the stakeholders. Few stakeholders were of opinion that the role to cross collaborate and design appropriate modules to train workforce in such areas, can be entrusted to the respective sectoral skill councils i.e., Telecom Sector Skill Council (TSSC) and Construction Skill Development Council of India (CSDC). In-fact, the ITIs (Industrial Training Institutes) can also be roped in to collaborate in such areas for imparting certification courses and training. Another stakeholder suggested that organisations such as TSSC, Telecom Centre of Excellence, NTIPRIT, TEC, etc. might be roped in to develop curriculum, standard training programs for DCI Designers, Engineers, and Evaluators.

c) Regarding the **organisations or institutions offering courses** related to DCI, the stakeholders supported the suggestions of CP. They also provided following list of offered courses:

i) Certified IP Telecom Network Specialist (CIPTS) offered by Telecommunications Certification Organisation (TCO).
ii) International Association for Radio, Telecommunications, and Electromagnetics (iNARTE) offers a certification program that includes the Telecommunications Technician and Telecommunications Engineer credentials.
iii) Master Technician Certification offered by National Centre for Trade Information (NCTI).
iv) The Registered Communications Distribution Designer (RCDD) certification offered by Building Industry Consulting Service International (BICSI).
v) The WIRED certification offered by WiredScore.
vi) Certified Network Infrastructure Technician (CNIT) offered by CNet Training, formerly CableNet Training Services Limited.
vii) Certified Telecommunications Network Specialist (CTNS) by TCO.
viii) Certified Telecommunications Subject Matter Expert (CTSME) by TCO.
ix) Certified Telecommunications Analyst (CTA) by TCO.
x) Certified VoIP Analyst (CVA) by TCO.
xi) Certified Wireless Analyst (CWA) by TCO.
xii) Certified IP Telecom Network Specialist (CIPTS) by TCO.

d) Regarding **establishment of a council** on the lines of CoA, varying opinions of stakeholders were received. A stakeholder

suggested that CoA can be given additional responsibilities to regulate specialised courses for DCI Designers. CoA can maintain register of the certified DCI Professionals in the country in line with the register for the Architects. CoA should also notify a separate minimum standards of DCI education on the lines of '*Minimum Standards of Architectural Education Regulations, 2020'*. It can also regulate minimum qualifications, additional specialised courses, and practice of the DCI Professionals. While another stakeholder suggested the creation of a council on the lines of CoA to regulate minimum qualifications, additional specialised courses and practice of DCI Professionals. Few stakeholders opposed establishment of council on the lines of CoA where requirements are more civil/ electrical in nature and therefore suggested to establish an independent council for DCI. They suggested that cross collaboration of TSSC, CDSC and ITIs can be more relevant to function jointly, under a common framework to develop such certification and modules. The framework may be overseen by the sectoral regulators such TRAI and RERA jointly.

A stakeholder was of the opinion that NBC can assign the responsibility to some specialised agency for creating a system for defining qualifications of professionals and their registration processes etc., which can be further incorporated in various building bye-laws and guidelines published by MoHUA and/or State/UT Governments.

Another stakeholder suggested formulation of a working group to recommend minimum qualification requirements for the DCI Professionals. Such working groups should also review the contents of the courses offered by organisations such as BICSI,

iNARTE, CTNS for their adequacy and suggest curriculum befitting roles of DCI Professionals, specific to Indian environment.

A stakeholder proposed creation of a professional body which can create a specifically designed course curriculum and be an authorised body to give certification. Further, guidelines and certifications will help in ensuring quality and minimum standards for DCI implementation. The certified professionals will be able to provide relevant and timely guidance to the Property Managers in accordance with the regulatory changes, if any.

e) For the **development of specialised courses**, many stakeholders were of the opinion that the DCI Professionals do not warrant full-fledged separate degree course structure, like that for an Architect. A specialised certification course can be adopted for building up the capacity of DCI Professionals. While a stakeholder opposed creation of specialised and mandatory courses or degree and recommended offering specific modules as certifications, which may be included in the existing curriculum of technical institutes for the purpose of DCI.

A stakeholder proposed that specialised certification courses for DCI Designer or DCI certified architects/ planners may be developed. The TSPs can also provide services required for DCI Engineers, while the DCI Evaluators can be a certified evaluator registered with the Authority.

Another stakeholder proposed that Authority should develop specialised courses for DCI Professionals in consultation with such bodies, using training infrastructure already available in the telecom sector.

Certification courses should be voluntary and not mandatory. In this regard a stakeholder also suggested that relevant topics could be included in undergraduate curriculum for Architecture and Engineering streams in consultation with CoA and AICTE.

One stakeholder proposed that CoA should outline the scope of course to be completed by DCI Designers; modules could be developed on lines of 'minor course' as offered in multiple Indian Institute of Technology ('IITs') and the certification institutes like TCO can offer certification courses to eligible professionals to work as DCI Designers.

f) On the issue of dependency of requirements of **additional specialised courses and practices of profession** upon the size or kind of work involved in a particular DCI project, some stakeholders agreed that additional specialised courses and practices of profession would definitely vary depending upon the size of work or kind of work involved in a particular DCI project as the role of all the actors of the ecosystem is different for each project and will vary across cities/ metros based on user requirements and technologies. They proposed that the course structure should cover DCI designing for various kinds of buildings of varying sizes, i.e., small or big. The course structure should be domain based allowing the certified DCI Designer to serve clients with a wide gamut of requirements. This will also simplify the selection process for the Property Managers, where they can focus solely on the past experience/ projects of any DCI Designer, and they need not verify the suitability of the certification due to availability of multiple certifications in the domain. One stakeholder suggested that specialised courses may be required to perform the function of Rating of a building for

DCI. A stakeholder suggested that any such categorisation of any specialised modules and certification courses should be left to TSSC, CSDC to develop in consultation with TSPs, industry from time to time.

One stakeholder suggested that there could be initially two levels of course and practices – Basic and Advanced. The first, basic course could cater to the requirement of creating infrastructure for ducting and cabling in a residential/commercial building. The advanced course would include the training on wireless networks- coverage planning and in building solutions.

g) On the issue of recognition of professionals as Persons on Record (PoR), or **registration of DCI Professionals**, some stakeholders agreed that inclusion of DCI professionals as PoR will be beneficial for development of the proposed ecosystem. Inclusion as PoR will ensure delineation of the responsibilities of the DCI Professionals and hold them accountable for accomplishment of DCI development. While some stakeholders suggested that the registration of DCI professionals with the Council would be sufficient.

Some stakeholders were of the opinion that there is a need to recognise certified professionals for DCI without any delay. It is necessary to create a new category of professionals to handle the increasingly complex subject of DCI.

2.7.5. **Analysis**

a) From the comments of the stakeholders, it clearly emerges that there is a need to **recognise the qualified and certified DCI Professionals** through an institutional mechanism. These

qualified and certified DCI Professionals once engaged by the Property Managers to develop DCI and declared on the plan documents required for approvals, will be Persons on Record. For this, the provisions under different clauses of MBBL on Person on Record should also recognize DCI Professionals.

b) Further, to have qualified and certified DCI Professionals, there should be courses on DCI, run by recognized institutions and who would also conduct the exams to award certificate to the qualified DCI Professionals. Such qualified professionals need to be registered with a central body, as per the defined procedures. As such, capacity building of the DCI Professionals is imperative to ensure proper functioning of the DCI ecosystem. This being a multi-faceted task requires institutional mechanism to manage and coordinate essential processes.

c) As mentioned in the CP and supported by the stakeholders, a **council on the lines of CoA** needs to be established. Considering that, development of DCI requires cross sectoral collaboration among telecommunication and real estate, the proposed council should consist of relevant stakeholders from the telecom and construction domain including representatives from industry and academia. Also, as some stakeholders proposed that TSSC and CSDC have the competence to design appropriate course modules to train DCI Professionals, such institutions/ organisations can also be included in the proposed council.

d) As regards to **roles and responsibilities of the proposed council** for capacity building of DCI Professionals, following can be considered among others:

    i) To prescribe the qualification, roles and responsibilities of

DCI Professionals and professionals for Rating of Buildings for Digital Connectivity.

ii) To study the content of existing similar courses within and outside India and their suitability for DCI Professionals in India.

iii) To suggest appropriate Graduate and Diploma courses including elective/ certification courses at various levels for DCI Professionals.

iv) To accredit institutes and organisations for offering courses related to DCI. Considering that there are large number of Buildings in each State and UT, there may be a requirement of accreditation of institutions across all States and UTs for offering such courses and development of the workforce.

v) To conduct examination and certify DCI Professionals.

vi) Organise training for trainers and skill upgradation of DCI professionals.

vii) To register qualified and certified DCI Professionals, on similar lines to the CoA.

viii) To maintain a register of DCI Professionals and publish the same on online portal for access and use by various stakeholders.

ix) To keep a track of various activities related to capacity building and dissemination of the information to all stakeholders, the council needs to develop a digital platform for the cohesive implementation of DCI and integration of the same with various agencies.

x) Any other work related to capacity building as deemed fit by the council.

e) Since, development of the courses and accreditation of the institutions for running the courses and conducting

examinations will take a certain amount of time, the council should work out an **alternative mechanism** to support the Property Managers and other stakeholders to utilize services of the existing professionals already designing and implementing such plans.

f) However, there is a requirement to set **certain time frame** in which the council would be able to establish a mechanism for certification, registration and capacity building of DCI Professionals including setting up of digital platform. Such time frame should be considered as one year of the establishment of the council or three years from the date of these recommendations, whichever is earlier.

g) In order to **provide legal backing** for the council and the responsibilities envisaged, Telecommunication being a Central Subject, appropriate enabling provisions in the Indian Telegraph Act, 1885 will be required.

2.7.6. **Recommendations**

24. **The Authority recommends that, the Indian Telegraph Act, 1885 should be amended as follows:**

a) **The Central Government may prescribe through rules for formation of Council of Digital Connectivity Infrastructure (CoDCI).**

b) **The rules may specify the manner of certification of persons to design, deploy and evaluate DCI.**

c) **Such rules may specify the qualification of and terms and conditions subject to which, such certification**

may be granted, including through conduct of examinations for granting such certifications, the fees and charges to be paid thereof, and other connected matters.

25. **The Authority recommends that a Council of DCI (CoDCI) should be established under the Department of Telecommunications (DoT), Ministry of Communication in collaboration with the Ministry of Housing and Urban Affairs (MoHUA), All India Council for Technical Education (AICTE), National Skill Development Council (NSDC), Telecom Sector Skill Council (TSSC), and Construction Skill Development Council (CSDC) or any other organisation/institution as deemed appropriate. The CoDCI shall be responsible for taking all decisions in respect of certification, registration and capacity building of DCI Professionals.**

26. **The Authority recommends that broad roles and responsibilities of CoDCI are as follows:**

    a) **To prescribe the qualification, roles and responsibilities of DCI Professionals.**
    b) **To study the content of existing similar courses within and outside India and their suitability for DCI Professionals in India.**
    c) **To suggest appropriate Graduate and Diploma courses including elective/ certification courses at various levels for DCI Professionals.**
    d) **To accredit institutes and organisations for offering courses related to DCI. Considering that there are large number of Buildings in each State and UT, there may**

be a requirement of accreditation of institutions across all States and UTs for offering such courses and development of the workforce.

e) **To conduct examination and certify DCI Professionals.**

f) **To organise training for trainers and skill upgradation of DCI professionals.**

g) **To register qualified and certified DCI Professionals, on similar lines to the CoA. Such Professionals once engaged by Property Managers for development of DCI and declared on their plan documents shall be Persons on Record.**

h) **To maintain a register of DCI Professionals and publish the same on online portal for access and use by various stakeholders.**

i) **To keep a track of various activities related to capacity building and dissemination of the information to all stakeholders, the council needs to develop a digital platform for the cohesive implementation of DCI and linking of the same with various agencies.**

j) **Any other work related to capacity building as deemed fit by the council.**

27. **The Authority recommends that the CoDCI, within one year of its establishment or three years from the date of these recommendations, whichever is earlier, should establish a mechanism for certification, registration and capacity building of DCI Professionals including setting up of digital platform for the cohesive implementation of DCI.**

28. **The Authority further recommends that till the time CoDCI is established, the provisions in new building bye-laws for DCI as recommended herein must be implemented by utilizing the services of the existing professionals already working in the field of design and development of Buildings and DCI.**

2.8. Digital Platforms and Tools for Development of DCI

2.8.1. The CP mentioned the requirement of a centralized digital platform to enable co-design and co-creation of the DCI. This platform will help in interaction between various entities of different sectors to get DCI designed, deployed and evaluated. This digital platform can contain new entities, marketplace, processes, along with certified products and certified professionals. This platform may also play an important role in de-coupling various activities related to realisation of digital connectivity inside the Buildings by offering solutions to get the DCI developed.

2.8.2. Further, advanced tools and technologies based on AI/ML enabled analytical and decision-making capabilities, building modelling tools, computer assisted design, etc. can work as enablers of collaborative working among stakeholders during all the phases of DCI development and therefore would help in faster roll out of digital connectivity. The CP invited comments on availability of digital tools and advanced software such as AutoDesk Revit, ArchiCAD, Allplan, CYPE, ACCA and other BIM tools to aid Architects, Structural Engineers, Contractors (AEC) and Mechanical, Electrical and Plumbing (MEP) Engineers and Designers. Inputs were also sought on software applications being used for planning, designing, building, and managing digital connectivity inside the Buildings. Even for the existing Buildings which might not have building

information in BIM format, there are some tools available which can carry out surveys of the Building with the use of special software and generate BIM required for the purpose of digital connectivity.

2.8.3. **Issues raised in the CP**

Q12. Whether creation of a digital platform to hire services of professionals would help Property Managers in creation of DCI? Should there be a feedback mechanism to assess quality of services delivered by professionals?

Q13. Whether creation of a digital platform for procurement of certified products would help Property Managers in creation of DCI? How would the certified products for the purpose of DCI be identified and updated on the platform?

Q38. Whether creation of a digital platform that allows stakeholders to co-design and co-create DCI would be helpful to realise better, faster and cheaper solutions? Whether technologies and tools such as AI, ML would be helpful in achieving this objective?

2.8.4. **Responses of the Stakeholders**

a) Majority of stakeholders supported that the **creation of a digital platform** for cohesive implementation of DCI is of paramount importance. In this regard, some stakeholders suggested that creation of such platforms should be left to the market forces. A stakeholder suggested that these digital platforms may be maintained by private players and can be governed by consumer protection rules as is applicable for other such marketplace platforms. Some stakeholders suggested that if the Authority

believes that digital platforms are needed, then TRAI and RERA can jointly develop the platform.

A few stakeholders also suggested that in addition to players, the digital tools and platforms might play a role in decoupling activities related to realisation of digital connectivity, enabling Property Managers to get a network designed. The tools might provide estimated cost for various alternatives available. Establishing digital platforms may enable collaborative working among stakeholders and also help in faster roll out of digital connectivity.

b) The stakeholders suggested that the creation of a digital platform would help in **hiring services of DCI Professionals**. One stakeholder suggested that the platform could contain the brief profile of the DCI Professionals, glimpse of their past projects and provisions for client review and feedback, which would be visible to prospective clients. Some stakeholders also agreed with the platform to have a mechanism to assess the quality of services. Although, it should be ensured that such reviews are genuine, and a mechanism should be put in place to validate the same.

For ensuring the authenticity of the professionals, a stakeholder proposed that a unique certification ID may be issued by TRAI/RERA/TSSC/DCSC to such DCI professionals, which may be validated/checked online. Another stakeholder was of the view that professionals and firms must be rated by Property Managers, TSPs/IP-Is and end customers, to get feedback about the quality and performance of activity. This will help in hiring best performers to award work.

c) Majority of stakeholders agreed that digital platforms may be created for **listing of certified products**. The authorized certifying agency (e.g., TEC etc.) can upload all certified products on the portal for knowledge of Property Managers. Considering non-telecom background of Property Managers, such platforms will ensure that suggested products meet minimum functional, quality and safety requirements. In addition to this, a stakeholder proposes that the DCI digital platform can be connected with the Trusted Telecom Portal and MTCTE portal for fetching information on trusted and certified products respectively.

A stakeholder was of the view that creating an e-marketplace for certified products may be left to market forces. Another stakeholder commented that TEC can provide details regarding certified products either through a digital platform or its own web portal. Some stakeholders opposed the creation of a separate digital portal for certified products by arguing that critical and core products are anyways regulated/certified under regimes like TEC, MTCTE and others. Such products would already be passing through normal scanning.

d) Majority of stakeholders also agreed with the **adoption of AI/ML** and other emerging technologies for the development of DCI.

2.8.5. **Analysis**

a) The details provided in the CP and inputs received from various stakeholders recognized the **importance of the digital platform** to facilitate interaction and collaboration between various stakeholders including development authorities, TSPs/IP-Is, product manufacturers, Property Managers and DCI Professionals. This platform would enable engagement of relevant

stakeholders at an early stage and orchestrate the processes to develop a good quality DCI.

b) As the development of DCI has to follow certain set of rules and procedures fixed by respective State/ UT Governments, there is a need to develop a common digital platform to enable stakeholders to access relevant data and relevant market for engaging various resources i.e., professionals, products and tools. This platform should be created by CoDCI as discussed in the para 2.7. However, till the time CoDCI is established, the digital platform could be created by DoT to meet immediate objectives, which can later be handed over to the CoDCI.

c) The **broad objectives of the digital platform** should include but not limited to the following:

   i) Activities related to capacity building of DCI Professionals:

      a. Publish details of the courses, accredited institutions and the process for admissions, and applicable fee structures if any.

      b. Facility for conducting examinations for certification of DCI Professionals

      c. Registration facility for certified DCI Professionals

   ii) Publish the list of registered DCI Professionals and certified products and tools.

   iii) Provide a marketplace for buying and selling of certified products. Such e-marketplace should be linked with Open Network for Digital Commerce (ONDC).

iv) Enable Property Managers to hire services of registered DCI Professionals.

v) Enable interaction and collaboration among various stakeholders through various technologies and tools.

vi) To provide a feedback mechanism for the services delivered by registered DCI Professionals and certified products used.

vii) To maintain details with regard to development projects/ Buildings approved – ongoing, completed and put to use by the local bodies and other competent authorities.

viii) To create a repository in respect of the service providers along with technologies and spectrum bands, who are offering services in the area and update the same from time to time.

ix) To create a repository of knowledge based on past learning of implementation of DCI projects to support in standardisation of the processes.

x) To make available on a regular basis the information on standards, technology and best practices within India and at global level related to DCI.

xi) To publish analytical reports/articles on DCI development and related issues.

xii) To make available acts/ laws/ bye-laws/ rules/ regulations related to DCI.

xiii) To facilitate online application, clearance and approval process for service providers seeking access to DCI created in Buildings.

d) AI/ML **tools** can help in designing and deploying DCI for different classes of Buildings by learning from the data collected from all over the country. Digital tools on RF planning and designing along with building construction related tools and models such as BIM software can help in developing 2D and 3D visualisations of the Buildings and the DCI. These applications have capabilities of simulating RF coverage based on input data gathered. It can create a database of the digital models of the Buildings and their surroundings that would help to design and implement the solutions.

e) **Digital Twin** is the latest innovation related to building information and helps in creation of Digital Twin of the Building. BIM focuses on design and construction whereas a Digital Twin models how people interact with the built environment. They create robust data models about all the aspects of the Building. It may capture more context about the built environment and behaviour pattern of the people including space design to achieve better outcomes through enhanced analytical and predictive capabilities.

f) **3D models of clutter environment**: Advanced Unmanned Aerial Vehicles (UAVs) with tilt photography and computing technologies to analyse images, can facilitate generation of 3D models of reliefs, terrain textures, clutter etc. through much faster processes and at a lower cost. These are required to predict

radio propagation in a more precise manner. Such models may be used not only to improve accuracy but also to save time.

2.8.6. **Recommendations**

29. **The Authority recommends that a digital platform should be developed and maintained by CoDCI. The broad objectives of the digital platform include but not limited to the following:**

    a) **Activities related to capacity building of DCI Professionals:**

        i. **Publish details of the courses, accredited institutions and the process for admissions, and applicable fee structures if any.**

        ii. **Facility for conducting examinations for certification of DCI Professionals.**

        iii. **Registration facility for certified DCI Professionals.**

    b) **Publish the list of registered DCI Professionals and certified products and tools.**

    c) **Provide a marketplace for buying and selling of certified products. Such e-marketplace should be linked with Open Network for Digital Commerce (ONDC).**

    d) **Enable Property Managers to hire services of registered DCI Professionals.**

    e) **Enable interaction and collaboration among various stakeholders through various technologies and tools.**

f) **To provide a feedback mechanism for the services delivered by registered DCI Professionals and certified products used.**

g) **To maintain details with regard to development projects/ Buildings approved – ongoing, completed and put to use by the local bodies and other competent authorities.**

h) **To create a repository in respect of the service providers along with technologies and spectrum bands, who are offering services in the area and update the same from time to time.**

i) **To create a repository of knowledge based on past learning of implementation of DCI projects to support in standardisation of the processes.**

j) **To make available on a regular basis the information on standards, technology and best practices within India and at global level related to DCI.**

k) **To publish analytical reports/articles on DCI development and related issues.**

l) **To make available acts/ laws/ bye-laws/ rules/ regulations related to DCI.**

m) **To facilitate online application, clearance and approval process for service providers seeking access to DCI created in Buildings**

30. **Further, the Authority recommends that, till the time CoDCI is established, the digital platform should be created by DoT**

to meet immediate objectives, which can later be handed over to the CoDCI.

CHAPTER 3

RATING FRAMEWORK FOR DIGITAL CONNECTIVITY

3.1. Introduction to Rating of Buildings

3.1.1. The ecosystem envisaged in the previous chapter will not only streamline the process of enhancing digital connectivity inside the Building but will also enable consumers to get customized premium quality DCI created. However, just having legal and regulatory frameworks defining new entities, listing out processes and creating a marketplace, may not be adequate to meet the desired objective of consumer satisfaction on true digital connectivity experience. To reach a level of delightful experience, a mechanism may be required to be introduced that would nudge the Property Managers to come forward and implement the solutions accordingly. Therefore, the CP proposed the concept of Rating of Buildings from the perspective of digital connectivity experience. This rating would create a competitive environment among Property Managers to provide the best quality of digital connectivity in the Buildings. This is quite likely to happen as positive externalities of rating will impact the commercial decision of buyers and prospective tenants.

3.1.2. The following expected benefits of introducing the concept of Rating of Buildings to various stakeholders as discussed in the CP are:

a) Good connectivity would enable enhancement in the value of the property and their rental value, as it increases productivity, improves satisfaction, and thereby boosting commercial outcome of various activities.

b) Real estate buyers and tenants looking for high quality digital connectivity would be able to make informed choices and thereby put pressure on the Property Managers to build and maintain good quality DCI.

c) Good and reliable digital connectivity would improve the quality of life, social inclusion, increased use of new services and applications, and overall, a better user experience.

d) Areas such as the subway and tunnels, railway tracks, highways which often suffer from lack of coverage and poor quality, are more likely to receive attention of the community and concerned authorities once the rating of digital connectivity is published.

e) Operators would be able to optimize their connectivity inside the Buildings more easily since the Property Managers would be willing to get good ratings for their properties. Even public authorities (including those who grant clearances/permissions to lay DCI) would be eager to improve the rating of the area/city/state and work in collaboration with TSPs.

3.1.3. With the introduction of the concept of Rating of Buildings, new entities may emerge that can play an important role in survey, assessment, and evaluation of digital connectivity inside Buildings to award Ratings. This will also create new opportunities for many start-ups, and small & medium entrepreneurs to create necessary infrastructure and support systems in provisioning of good quality of services.

3.2. Rationale for Rating of Buildings

3.2.1. As discussed above, Rating in general would nudge Property Managers to get their Buildings assessed for the quality of digital connectivity available in the Building. However, adoption of Rating

without any prescribed framework may bring various issues as mentioned below:

a) Different entities involved in Rating might adopt different mechanisms and procedures according to their own standards and business interests. This would create non-uniformity in the assessment of digital connectivity by different agencies for the same Building, e.g., measurement of data speeds through various applications developed by different agencies.
b) There are various types of Buildings having varying requirements of digital connectivity based on need and category of the end users. Assessment of quality of digital connectivity and award of ratings thereof without a proper framework in place, would not reflect true Rating meeting the users' expectations.
c) Further, this framework is necessary for its acceptance by all stakeholders including developers and end users. Such framework would promote development of DCI on a larger scale and would also facilitate improving ranking of areas such as cities, towns, villages and States from the perspective of digital readiness. It is well accepted that cities, towns, villages and States having good digital connectivity will lead to better prospects of standards of living and attraction of investors to come forward and invest in various fields.

3.2.2. The following paras discuss various frameworks for rating operating in other jurisdictions, as highlighted in the CP. Understanding such frameworks would help in developing the same in India for Rating of Buildings:

a) WiredScore Certification Programs

WiredScore[23], a global organization rates quality and resilience of digital infrastructure in the Buildings. It is operating in multiple countries and regions including USA, Canada, Australia, UK, and Europe. Such certification acts as an independent digital connectivity benchmark and provides landlords/ managers with insights to enhance their Building's digital infrastructure. The Buildings so rated include commercial, residential properties and mixed-use neighbourhoods. It rates them on a scale of five, based on points earned through credit scores.

b) SPIRE program by UL and TIA for assessing smart buildings

In the USA, Underwriters Laboratory (UL)[24] and the Telecommunications Industry Association (TIA) announced that they would provide a joint program for assessing smart buildings. The SPIRE Smart Building Program offered both self-certification programs as well as Verified Assessment Ratings completed jointly by UL and TIA that measures the effectiveness and security of smart buildings based on six primary criteria of life and property safety, health and well-being, connectivity, power and energy, cybersecurity and sustainability. The SPIRE Self-Assessment online tool can evaluate building intelligence and

[23] https://wiredscore.com/

[24] https://ul.org/

performance based on an expertly curated, objective and holistic framework across these six criteria.

c) Other programs of certification of buildings

There are similar efforts to certify certain aspects of the built environment, by the US Green Building Council's LEED Certification but its focus is on sustainability. Arc Skoru helps power the LEED certification and has a relationship with Green Business Certification Inc. The WELL building certification standard focuses on the human health and well-being aspect of smart buildings.

3.2.3. Issues raised in the CP

Q20. What are the initiatives or practices being taken in other jurisdictions outside India with regard to rating of buildings from a DCI perspective? Please share details and suggest how similar processes can be created in India?

Q21. Is there a need to introduce Rating of buildings from the perspective of DCI that may help in nudging the Property Managers to strive for collaboration with other stakeholders to meet the digital connectivity expectations of the users of the building?

Q28. Is there a need to amend legal provisions under various laws, bye laws dealing with development of land and buildings or areas including forest areas, cantonment areas, port areas, panchayat areas, municipal areas, etc. to facilitate creation of DCI and ratings of the buildings or areas?

Q29. In case a voluntary scheme for rating is to be introduced or rating is notified as mandatory for specific classes of buildings then what should be the role of TRAI or DoT?

Q31. Is there a need to establish a Certificate Issuing Authority to award ratings to buildings from DCI perspective? If yes, what should be the structure of such an authority? If not, who can be assigned the role to perform this function?

3.2.4. Responses of the Stakeholders

a) Majority of stakeholders supported introduction of DCI rating system for buildings. It can act as a nudging factor for Property Managers to meet the digital connectivity expectations of the end-users. Some of the stakeholders also supported the benefits of introducing a rating system as listed in the CP.

b) On the issue of rating of buildings in other jurisdictions, most of the stakeholders reproduced the details already mentioned in the CP. Some stakeholders have provided additional information in this regard. The summary of the stakeholders' comments are mentioned below:

   i) WiredScore operating in USA, Canada, Australia, UK, and Europe
   ii) SPIRE Smart Building Program by Underwriters Laboratory (UL) and the Telecommunications Industry Association (TIA)
   iii) Leadership in Energy and Environmental Design (LEED) green building rating system

iv) Concept of a Smart Readiness Indicator (SRI) under European Energy Performance of Buildings Directive (EPBD)

v) DGNB System for Buildings in Germany grades buildings by using performance indices.

vi) Singapore's Green Mark Scheme was the first green building rating system to be designed specifically for the tropical climate and has been widely adopted in other ASEAN countries.

vii) In 2015 the Greater London Authority launched the Mayor's Digital Connectivity Rating Scheme. The scheme rates the quality of digital connectivity in offices, giving transparency to tenants and allowing landlords to improve their buildings.

In respect of creating a framework, comments of stakeholders are mentioned below:

i) TRAI may consider working towards formulating technical and advocacy reports taking relevant inputs from all the relevant Ministries responsible for provisioning of various services inside buildings. The report may cover the requirements of formulating the methodology of ratings, identify key stakeholders involved for ensuring hassle-free connectivity inside buildings, monitoring and security, along with including the critical elements involved in a building to ensure ubiquitous digital connectivity inside buildings. The methodology should also support the assessment of user-experience and provisions for feedback to analyse the overall quality of digital connectivity.

ii) Rating model of WiredScore can be looked at closely for adoption of the DCI rating system in India. The measurement metrics of WiredScore underscore the importance of fair, transparent and non-discriminatory access for TSPs by the Property Managers. This is critical to eliminate any possibility of monopolization owing to preferential treatment by the Property Managers.

c) In response to the role of TRAI or DoT, the stakeholders suggested following roles:

i) TRAI or DoT could be the overarching regulator to regulate the proposed new legal & regulatory framework to govern the sector.

ii) TRAI/DoT should play an active role in coordinating with RERA/MoHUA for getting the changes in the laws/ guidelines. A stakeholder also proposed that telecom ecosystem (TRAI, TSPs and IP-Is) should get a dashboard view of KPIs performance of the rating system. Based on periodic review, improvements can be communicated to counterpart institutions like RERA. This would help in creating evidence and analysis-based framework for DCI ratings.

iii) TRAI should perform a Regulatory Impact Analysis (RIA). The RIA should be a standard approach in this case and be followed by both TRAI and RERA.

iv) The role of TRAI and DoT would be multi-pronged and very crucial to institutionalise building rating systems as well as to create and strengthen new ecosystems as it would require action at multiple levels. Under the Gati Shakti program, a forum of cross-sector regulators has been

created which can be utilised to make the proposed new ecosystem operational. Following steps would be needed from the regulator:

a. A wider consultation would be needed on various aspects such as legal framework, modifications/ additions required to the current legal and administrative framework, accreditation of designers, engineers and evaluators, development of rating methodology, etc.

b. Review/ monitoring of the ecosystem including rating system from time to time depending upon evolution of wireless technology.

c. The most important aspect would be to create a mechanism to implement the new ecosystem.

v) TRAI would need to provide guidance for the regulatory framework on DCI, formulation of DCI design principles and DCI evaluation benchmarks to objectively cover different kinds of buildings and the user requirements.

d) With respect to the issue of establishment of certificate issuing authority, the stakeholders were having varying opinions. Some of them suggested that a committee/certificate issuing authority may be formed under DoT and TRAI. A stakeholder proposed for establishment of a professional body on the line of CoA to award DCI rating of the building. Some stakeholders also proposed that the certification issuing authority/committee should be a multi stakeholder body with varied representation from prominent stakeholders in the DCI ecosystem, viz. Government departments, TSPs, builder representation, DCI Designing

experts, DCI Engineering and Evaluation experts, among others. While a stakeholder suggests that Certificate Issuing Authority will need to have Certified Professionals.

Some stakeholders opposed the establishment of certificate issuing authority by arguing that the DCI Evaluator should be empowered to evaluate and issue certificates under the oversight of TRAI and RERA. While a stakeholder opposed the establishment of a Certificate Issuing Authority by arguing that the occupancy certificate certifying compliance with NBC, 2016/ Town planning authority and DCI requirements should be sufficient.

One stakeholder suggested a two-tier structure for Certificate Issuing Authority. One should be at root level i.e., offline, working at central level and secondly, multiple online subordinate certificate issuing authorities, spread across different geographical locations. This will increase the level of security. The stakeholder further commented that:

i) There should be standard methodology.
ii) There should be validation of standards.
iii) Submission of design drawings and documents by building owners should be a mandatory prerequisite.

A stakeholder proposed that there should be a central certificate issuing authority to award certificates based on the assessment/ test reports provided by the DCI Evaluators. As a large number of buildings across the country may be required to be rated or there may be voluntary options for rating, the volume of work may be huge and will require a considerable amount of time and resources. This work will need to be handled by private/

Government entities across the country which will be duly accredited as DCI Evaluators by the National Accrediting bodies such as National Accreditation Board for Testing and Calibration Laboratories (NABL) or by the proposed certificate issuing authority based on relevant international accreditation standards (ISO etc.). It is suggested that while a DCI rating can be provided by the DCI Evaluators based on the testing/assessment done, this rating shall be certified through a certificate issued by the certificate issuing authority post further evaluation/ validation of the test reports. A property would be taken to be certified/ formally rated only post issuance of certificate by the authority and Property Manager will be allowed to show/ promote/ display the DCI rating only post successful certification. The process of certification should be completely online with predefined timelines; the complete process should not exceed 30 days.

e) With respect to the issue of roles of Certificate Issuing Authority, stakeholders proposed following roles:

   i) to award DCI rating of the building based on the rules/guiding principles as laid by the TRAI/DoT.
   ii) issuance of guidelines including methodology/algorithms by TRAI and RERA.
   iii) develop an institutional mechanism for DCI rating of the buildings by publishing well defined guidelines so that the rating evaluation remains reliable, transparent and trustworthy.

f) Most of the stakeholders agreed that legal provisions under various laws would need to be amended to enforce voluntary and

mandatory requirements of ratings in any area. Some suggested that relevant laws including the Indian Telegraph Act, the Indian Wireless Act, NBC and associated bye-laws, among others need to be aligned to recognize Property Managers as legal stakeholders in providing DCI in the buildings. A few proposed that the laws and guidelines are required to be reviewed periodically so as to facilitate continuous market growth.

3.2.5. **Analysis**

a) The comments of the stakeholders supported Rating of Buildings from digital connectivity perspective. The stakeholders also acknowledged the importance and advantages of Rating system which would nudge Property Managers and developers not only to showcase their properties but also add value which would be readily acceptable to all prospective buyers or tenants.

b) From the illustrations in CP and comments offered by the stakeholders, it is found that although few agencies have started benchmarking digital connectivity experience internationally adopting objective and subjective approaches involving end users, the regulatory framework in this regard is still evolving.

c) Table 3.1 below highlights various rating initiatives or practices being followed by WiredScore and Europe's Smart Readiness Indicator (SRI). WiredScore certification acts as an independent digital connectivity benchmark and provides landlords/ managers with insights to enhance their Building's digital infrastructure. Whereas SRI allows for rating the smart readiness of Buildings, i.e., the capability of Buildings to adapt their operation to the needs of the occupant, also optimising energy efficiency and overall performance, and to adapt their operation in reaction to signals

from the grid (energy flexibility). The SRI is currently being officially tested in 6 EU countries[25]: Austria, Croatia, Czech Republic, Denmark, Finland and France. It is pertinent to note that SRI is voluntary in nature.

Table 3.1: Initiatives or practices for Ratings in other Countries

Initiatives	**WiredScore**	**Europe's Smart Readiness Indicator[26]**
Purpose	WiredScore Certification provides digital connectivity certification. It is operating in multiple countries and regions including USA, Canada, Australia, UK, and Europe. WiredScore certification measures the quality and resilience of the digital infrastructure of a building, mobile coverage, the choice of internet service providers and whether the buildings' critical digital infrastructure is safe and secure from any physical damage.	The revision of the European Energy Performance of Buildings Directive (EPBD) in 2018 introduced concept of a Smart Readiness Indicator (SRI) This indicator allows for rating the smart readiness of buildings, i.e., the capability of buildings to adapt their operation to the needs of the occupant, also optimising energy efficiency and overall performance, and to adapt their operation in reaction to signals from the grid (energy flexibility). The smart readiness indicator will raise awareness amongst building owners and occupants of the value behind building automation and electronic monitoring of technical building systems and should give confidence to occupants about the actual savings of those new enhanced functionalities.

[25] SRI test phases (europa.eu)
[26] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en

Initiatives	WiredScore	Europe's Smart Readiness Indicator[26]
Applicability	WiredScore certifies buildings including commercial, residential properties and mixed-use neighbourhoods.	EU countries may decide to implement the SRI on (part of) their territory, for all buildings or only for certain categories of buildings.
Voluntary/ Mandatory	Voluntary	The SRI is an **optional** common EU scheme; EU Member States may decide to implement the SRI on (part of) their territory, for all buildings or only for certain categories of buildings.
Validity of rating	-	10 years

d) Before considering rating of digital connectivity in India, let us see which are the other services where rating or benchmarking of product qualities are implemented. Some of the popular rating initiatives currently in practice in India are highlighted in the table 3.2 given below:

Table 3.2: Existing initiatives or practices for Ratings in India

Initiatives	Rating of Hotels	Bureau of Energy Efficiency (BEE) Rating	GRIHA Rating (Green Rating for Integrated Habitat Assessment)	Credit Rating Agencies – SEBI
Purpose	Star rating for Hotels & Restaurants based on	Rating of electrical appliances based on energy efficiency and rating of commercial	Rating of Buildings based on evaluation of the environmental performance of all	Rating of securities listed or proposed by SEBI

Initiatives	Rating of Hotels	Bureau of Energy Efficiency (BEE) Rating	GRIHA Rating (Green Rating for Integrated Habitat Assessment)	Credit Rating Agencies – SEBI
	facilities and services. Such as availability of Lift, Minimum size of rooms, Air – conditioning - % of Rooms, Minimum bed width, Safe keeping in room, etc.	and residential building from energy efficiency perspective.	habitable spaces.	
State/ Central ministries	Ministry of Tourism	Ministry of Power enacted ECA in 2001	Endorsed by **Ministry of New and Renewable Energy**	Regulated by SEBI, under **Ministry of Finance**

Initiatives	Rating of Hotels	Bureau of Energy Efficiency (BEE) Rating	GRIHA Rating (Green Rating for Integrated Habitat Assessment)	Credit Rating Agencies – SEBI
Concerned Organisation	• Hotel & Restaurant Approval & Classification Committee (HRACC) • HRACC is a Multi-stakeholder body including representation from Govt. through Ministry of Tourism, Hotel Association, Travel agents, hotel and hospitality management institutions • The committee is of two levels,	• The Bureau of Energy Efficiency • BEE is a statutory body set up under the Energy Conservation Act, 2001. • State Designated Agencies (SDA) are set up at the state level/ UT for the purpose of ensuring compliance with energy consumption Standards. SDA performs Monitoring and Market Surveillance, Enforcement, Misuse of Star Label, Search and Seizure	• GRIHA council • It is an independent society for the interaction on scientific and administrative issues related to sustainable habitats • Developed by the Centre for Research on Sustainable Building Science (CRSBS), TERI (The Energy and Resources Institute). It has been endorsed by the MNRE (Ministry of New and Renewable Energy), Government of India. • MNRE and TERI	• Credit rating agencies • They are regulated by SEBI. • The SEBI (Credit Rating Agencies) Regulations, 1999 govern the credit rating agencies and provide for eligibility criteria for registration of credit rating agencies, monitoring and review of ratings, requirements for a proper rating process, avoidance of conflict of interest and inspection of rating agencies by SEBI, amongst other things.

Initiatives	Rating of Hotels	Bureau of Energy Efficiency (BEE) Rating	GRIHA Rating (Green Rating for Integrated Habitat Assessment)	Credit Rating Agencies – SEBI
	one that assesses one-to-three-stars hotels and another that assess three-to-five-stars Hotels.		jointly founded ADaRSH to promote GRIHA and all activities related to issuance of GRIHA Ratings.	
Applicability	New and old hotels & restaurants	Electrical appliances and buildings – not mandatory for all products	The rating applies to new and existing buildings. All new construction projects with built-up area more than 2,500 square metres to 1,50,000 square metres are eligible for certification. ADaRSH has developed SVA (Simple Versatile Affordable) GRIHA for rating of smaller	Securities and instrument of an issuer company (e.g., ability and willingness of the issuer company for timely payment of interest and principal on a debt instrument)

Initiatives	Rating of Hotels	Bureau of Energy Efficiency (BEE) Rating	GRIHA Rating (Green Rating for Integrated Habitat Assessment)	Credit Rating Agencies – SEBI
			projects (100 to 2500 sq m)	
Voluntary/ Mandatory	Voluntary	For certain appliances, BEE rating is mandatory from 2010. For others it is voluntary	Voluntary	-
Validity of rating	5 Years	3 Years for electrical appliances	5 Years	Continuous monitoring and periodic reviews of rating; variable validity based on issuer company and rating agency
Time period to seek rating	The classification for newly operational hotels is required to be sought within 3 months of commencing of the operations	-	-	-

Initiatives	Rating of Hotels	Bureau of Energy Efficiency (BEE) Rating	GRIHA Rating (Green Rating for Integrated Habitat Assessment)	Credit Rating Agencies – SEBI
Appellate Authority	HRACC	Appellate Tribunal for Energy Conservation	Any request for re-evaluation is addressed by the GRIHA council.	No. But SEBI may grant exemptions in special cases.

***Note**: GRIHA is a part of NBC 2016 and Energy Conservation Building Code 2017. ADaRSH also conducts awareness workshops on Green Buildings and GRIHA rating system to all the registered project teams. It also trains trainers and evaluators. MNRE has constituted a NAC (National Advisory Council) and it is convened by the Advisor of the Ministry. GRIHA certification has been accepted by many organisations and passed on certain benefits and owners have modified standards according to it.*

e) The above illustrations clearly indicate that various initiatives or practices have already been initiated in India and other parts of the world to benchmark products or services from the users' perspectives. Such initiatives are mainly undertaken by private entities especially in the field of digital connectivity. However, for widespread adoption and acceptance by users as well as industry, such rating methodologies and processes are to be supported by regulatory frameworks issued by the respective Governments. Absence of standard methodologies or regulations may lead to biases and thereby losing confidence of investors or users due to inaccurate results.

f) Looking into the importance of digital connectivity, the introduction of rating would nudge the Property Managers to fulfil the expectations of the users. The CP also highlighted the need of mandating rating in specific classes of Buildings. However, without

any legal and regulatory framework, mandating the rating might not be feasible. This can be understood from the example of star rating of hotels and restaurants which is voluntary in nature. As per Statista[27] and Ministry of Tourism[28], the actual count of Star Category Hotels is less than 1400 across the country. This indicates that the voluntary system may be subject to market acceptance and many times the market may not respond aggressively to adopt the same quickly.

g) Further, there is a requirement of standard procedure to rate the Buildings. The standard procedure will bring uniformity and will ensure correct assessments for each Building rated.

h) Most of the stakeholders favoured establishment of a Central Authority to oversee the Rating aspects. This expectation is in reference to the current systems being followed in other organisations. GRIHA Council & BEE Committee are functioning as nodal agencies and have been assigned the tasks of rating standardisation and coordination in their respective fields.

i) Further, as regards to stakeholders' suggestions on DoT or TRAI to take responsibilities for coordinating rating and issuing of rating certificates, the organisation assigned for the task of Rating would require to create a complete ecosystem for Rating framework. This framework requires not only defining of standards but also to define methodologies of assessments for new, upcoming and existing Buildings across the country.

[27] https://www.statista.com/statistics/1230039/india-number-of-classified-star-hotels-by-category/

[28] https://nidhi.nic.in/MOT/RptDashboard.aspx

j) A digital platform needs to be developed for the purpose of Rating wherein all information with respect to Rating Policy, empanelment of Rating Agencies, Rating Methodologies, award of Ratings and conflict resolution mechanism will be included for access to different stakeholders. The platform shall also have provision for online submission of applications for Rating request and allocation of Rating agencies etc.

k) The preamble of the TRAI Act 1997 states as follows

"An Act to provide for the establishment of the Telecom Regulatory Authority of India and the Telecom Disputes Settlement and Appellate Tribunal to regulate the telecommunication services, adjudicate disputes, dispose of appeals and to protect the interests of service providers and consumers of the telecom sector, to promote and ensure orderly growth of the telecom sector and for matters connected therewith or incidental thereto."

Also, Sub-clause (v) of Clause (b) of Sub-section (1) of Section 11 of the TRAI Act 1997, entrusts TRAI the responsibility to ensure quality of service to protect the interests of consumers of telecommunication services. The same Sub-clause also mandates TRAI to lay-down standards for quality of services. Further, Clause (d) of Sub-section (1) of Section 11 mandates TRAI to *"perform such other functions including such administrative and financial functions as may be entrusted to it by the Central Government or as may be necessary to carry out the provisions of this Act"*. Accordingly, TRAI can take necessary initiatives to provide required framework for Rating of Buildings to ensure good digital connectivity experience.

l) Accordingly, TRAI has issued various regulations with regard to quality of service. Additionally, TRAI regularly carries out field measurement on quality of service. TRAI also has carried out studies on quality of service with regard to Buildings, airports, metro rail systems, railway routes, highways and national highways and areas of cities. TRAI has experienced through all these studies and surveys that, the DCI within a Building severely affects the overall quality of service offered to consumers.

m) **In the light of above facts, TRAI will come up with appropriate regulatory framework for Rating of Buildings, which will also include the issue of Rating certification. Hence, there is no need to create a separate authority for this purpose.**

n) In order to make Rating of Buildings legally enforceable, TRAI is of the view that, appropriate provisions to that extent are required to be made in the MBBL, on the lines of provisions made in the MBBL for rating of green buildings.

o) As far as mandatory Rating of Buildings being recommended in the following paras is concerned, that can be taken care of by making appropriate provisions in the MBBL. Suitable provisions in this regard have been suggested in the proposed amended MBBL.

3.2.6. Recommendations

31. **The Authority recommends that appropriate provisions for Rating of Buildings for Digital Connectivity should be included in the MBBL, on the lines of the provisions made in the MBBL for rating of green buildings.**

3.3. Proposed Rating Framework

3.3.1. Introduction of Rating and use of DCI Evaluator's Reports

The above sections highlighted the need to have a standard framework for Rating of Buildings. The CP discussed various aspects to be considered to formulate the policies for Rating of Buildings.

3.3.1.1. Issues raised in the CP

Q32. Whether the authority suggested in response to Question no. 31 may use reports from DCI evaluators to award ratings? To ensure reliability of reports from DCI Evaluators, should Certificate Issuing Authority need to conduct periodic audits of DCI evaluators?

3.3.1.2. Responses of the Stakeholders

a) On the issue of using reports of the DCI Evaluators for awarding rating, majority of stakeholders supported that DCI Evaluators would be ideally suited for providing feedback reports to the rating certificate issuing authority. However, DCI Evaluator's report alone might not be adequate and site-specific survey by the authority might be necessary especially where building developers or Property Managers might be able to influence the decisions of the DCI Evaluators. Some stakeholders also suggested that DCI Evaluators would also be required to follow certain well-defined guidelines issued by certificate issuing authority so that their evaluations remain reliable and trustworthy.

Many stakeholders agreed that periodic audits of the DCI Evaluators by the Rating Authority would be necessary to verify that reports of DCI Evaluators are in consonance with the specified guidelines/ regulation.

3.3.2. **Rating Methodology**

Apart from the provisions of the framework for Rating of Buildings, the CP discussed some methodologies and invited suggestions on possible methodologies for Rating. The CP also provided typical terminologies that can be used in the Rating assessment process such as "Area to be Rated for digital Connectivity (ARC)", "Services To be Considered", "Building Profile", "Applications To be Considered" etc. Further, the CP brought out the fact that, Rating at first instance seems to be a simple concept and easy to implement but, in reality, it might be a complex task.

Rating involves assessment of quality which can be done using objective and subjective methods. Objective methods may involve measurement of KPIs for network and service performance. Subjective methods may involve surveying about the quality perceived by the end users. For a good assessment, the outcome of both types of methods would be required to be combined. The CP also mentioned the complexities involved in the assessment made using objective and subjective methods and combining information from multiple sources. The necessity of micro-details in evaluation was also highlighted in CP.

3.3.2.1. **Issues raised in the CP**

Q39. What should be the typical process to rate a building? Whether terminologies and steps involved in the rating process need to be standardized?

Q40. Whether the process of rating would vary based on the types of buildings? If yes, then what factors or aspects of a building would matter or impact the outcome of rating?

Q41. Which objective methods should be used to evaluate the DCI? How can various aspects of performance to evaluate the quality can be combined together?

Q42. Which subjective methods should be used to evaluate perceived quality of DCI? Whether survey techniques can be improved considering penetration of smartphones? Whether improved techniques can help in providing insights and actionable items to improve DCI?

Q43. Would combining the parametric values or results of objective and subjective methods be helpful in assessing digital connectivity that is closer to the perceived quality of experience?

3.3.2.2. **Responses of the Stakeholders**

a) On the issue of typical processes to rate buildings, standardising terminologies and steps involved therein, the stakeholders have submitted divergent views.

b) Stakeholders' suggestions to develop rating framework are summarised into following points:

A stakeholder suggested that there is a need to create a connectivity index for the building by considering certain parameters for any residential or commercial complex. Mandating connectivity index would force the Property

Managers to put efforts to make their property ready for telecom infrastructure and remove any bias towards any TSP; however rating may not be made mandatory for all buildings. The market forces may push Property Managers to act in the direction of improving quality inside buildings and adding value to their properties.

Another stakeholder proposed that the rating should be done based on assessment of network coverage of all the TSPs serving that geographical area and should accordingly be prorated and reflected in the final rating. Therefore, the Rating of a building where assessment of coverage of all TSPs is done and found good, should always be higher (on a pro-rata basis) than the Rating of a building where assessment of few TSPs (less than available TSPs) is done and found good. The same will facilitate curbing TSPs' monopoly to install infrastructure through exclusive contracts with the owners/builders. Also, all the subscribers irrespective of their TSPs will be included in this criteria, ruling out any bias/disadvantage to them.

Few stakeholders suggested that Ratings shall be made available on the digital platform on the basis of scientific calculations done by the DCI Evaluator, based on the norms/guiding principles/standards laid out. The ratings shall also be communicated to the end users through the agreement/documents pertaining to the services being offered.

A stakeholder proposed that appraisal and rating for 'green' buildings under Green Rating for Integrated Habitat

Assessment ('GRIHA') involves three site visits at various stages of building construction for evaluation and final awarding of rating. Similar multi-stages evaluation, as proposed above, can be adopted for DCI related approvals. The stages at which evaluation is done at site are as follows:

i) First site visit is conducted to validate sustainable measures adopted during the construction phase. The visit is scheduled after the project has reached the plinth level and the structural work is in progress.
ii) Second site visit is conducted to validate internal finishes and electrical, plumbing and mechanical components installed in the project. The visit is scheduled after the completion of the structural work while the internal finishing work is in progress.
iii) Subsequent to it, final evaluation is done and rating is awarded.

One stakeholder proposed that special agencies should be deployed to undertake yearly inspection of the buildings for the digital connectivity rating and then award certificates. As part of the rating system, the agency should first conduct telecom speed testing and internet speed testing. A special mobile App should be made available to the users of the internet and telephone in big buildings. The details of digital connectivity readings at different points of time can be collected using this mobile App.

c) A stakeholder suggested that the typical process of Rating a building could be as follows:

i) Property Managers should submit complete application in standardised format requesting for DCI Rating for the building. Standardised procedure and guidelines should be published for collection of QoS related data from the site and end users. The rating authority should review the provided details for completeness.

ii) The details so submitted as part of application should include, among others,
   a. Details of area in which the building is located.
   b. DCI design of the building.
   c. DCI parameter values for different locations in the building, both as per DCI design as well as those confirmed by DCI Evaluators; e.g. target data speed in the parking or inside a room in any floor, etc.
   d. Type of application, i.e., fresh or renewal along with the reason.

iii) The rating authority may review the details and, if necessary, will make its own assessment of the design and parameter values in the building, before issue of the rating certificate.

Some stakeholders proposed that taking the note from "GRIHA Rating", the following Rating Process can be followed:

i) Online registration: The project team can initiate the registration process by filling the EoI form available on the website. The process of registration is completed

after the successful payment of registration fees by the project team.

ii) Orientation workshop: The registration is followed by an orientation workshop conducted by officials to provide detailed information of the rating along with an elaborate explanation to all the criteria, and post addressing project-specific queries of the teams.

iii) Due diligence visit-I: The site visit should be conducted by officials to validate sustainable measures adopted during the construction phase. It will be scheduled when the project is carrying out above plinth level work such as column and slab construction.

iv) Due diligence visit-II: The second site visit may be conducted by the officials to validate internal finishes, electrical, plumbing, and mechanical components installed during the construction phase. It is scheduled post completion of the building structure work.

v) Submission of documents: As the project is nearing completion, the project proponent will upload the documents for all criteria on the online portal using the username and password provided at the time of registration.

vi) Preliminary evaluation: Preliminary evaluation is carried out by a team of professionals from rating agencies and external evaluators, who are experts in their respective fields recognized by the agency.

vii) Final due diligence visit: The final site visit should be conducted by the rating officials to verify the submitted documents with on-site implementation. The visit is done once the project is complete and all equipment and systems are installed and commissioned.

viii) Final evaluation: The rating officials along with external evaluators shall then evaluate the final round of submitted documents and the final site visit report in response to the preliminary evaluation. The final rating may be awarded based on the final evaluation and should be valid up to 5-10 years.

ix) Additional due diligence DCI awareness drive: The officials may conduct an additional due diligence visit post the final rating, for green awareness and education amongst the occupants. This visit aims to impart basic knowledge and understanding on green buildings and their way of working.

A stakeholder suggested that the Property Manager should request for ratings through the competent authority of DCI Evaluator, by responding to the rating criteria. Application should be evaluated and inspected for the DCI, basis which rating certificate may be given. Rating of a building may be looked from different aspects like but not limited to -

i) Fibre access to the building with its redundancy.

ii) Provision to connect multiple TSPs.

iii) Provision to extend fibre to common space and individual floor, rooms, etc.

iv) Provisions of Wi-Fi Access.

v) Provisions for power, space, power backup for common space, etc.

vi) Access to the building for TSP.

vii) Provisions for mobile network tower.

viii) Quality of equipment used (certified or not certified).

ix) Coverage in elevators, corridors and common space.

d) On the issue of **dependency of the process of rating** on the types of buildings, some stakeholders were of the view that the information required for rating and evaluation would be different for different types of buildings and so would have different weightages for various parameters. At the end, it is the assessment of the KPIs defined for QoS and user experience which would be the deciding factor for award of rating. The user experience would be based on the user's expectation from the DCI, which may differ in different categories of buildings. Accordingly, the building should be awarded a rating between one to five star. Few stakeholders proposed that the process of rating should be uniform to the extent possible to avoid any ambiguities. Stakeholders were also of the view that rating should be in alignment with national standards and guidelines such as the NBC 2016 together with other relevant regulations pertaining to specific topics. A stakeholder also mentioned that Building profile, Application to be considered, Rating of Digital Connectivity Experience (REx) are factors that may impact the outcome of rating.

e) On the use of **objective methods to evaluate the DCI**, a stakeholder proposed that objective methods may include network performance monitoring apps, crowd source apps, field measurements and prediction tools. Another stakeholder suggested that objective methods can include Network KPIs, Service KPIs collected for different time and can be merged with the crowdsourced data and field measurements to provide a fair evaluation criterion for objective assessment. The stakeholder also added that all the data in these methods has different granularity e.g., Network KPIs are available at the lowest granularity of a cell, crowdsourced data would provide a data basis some grid size which would vary depending on the crowdsourcing data source. At the same time, the field measurement would be most granular. Hence, weightage can be applied appropriately based on their granularity and relevance. A stakeholder also highlighted that the outcome should be the combined value arrived from these methods to evaluate the DCI. One stakeholder proposed following processes to evaluate the DCI rating:

   i) Assessment of the communication needs of the occupants of the building.
   ii) Assessment of telecom equipment installation in the building.
   iii) Assessing the feasibility and capacity of DCI to facilitate the assessed telecom equipment.
   iv) Evaluation based on the above.

f) On the **use of subjective methods**, some stakeholders suggested that subjective methods may typically involve

online surveys, face-to-face interactions, and feedback. In fact, subjective methods may help in determining weightages applied in case of objective methods. Few stakeholders also proposed an online portal as a medium for subjective evaluation. They added that users may provide their feedback through an online portal using a GPS enabled App, which can capture the service quality of mobile network as well as common Wi-Fi access network, speed of internet from the spot of problem. A stakeholder suggested that survey techniques including drive tests conducted for determining QoS parameters in outdoor locations anyways use smartphones. Such smartphones could also be deployed in indoor locations too to assess signal levels and QoS.

While a stakeholder was of the view that subjective methods should preferably be avoided by arguing that there are many emerging digital technologies and predictive tools that are available for doing RF mapping, assessing DCI quality, etc. This was also supported by other stakeholders who submitted that penetration of smartphones can also help in conducting surveys with maximum reach and collection of good number of samples through online processes. Feedback from user devices using dedicated software applications, could be used for capturing the objective feedback in addition to direct feedback from the user. New and emerging digital tools & techniques should be predominantly used for determining and improving DCI Ratings.

g) On the issue of **combining the results of objective and subjective methods**, some stakeholders submitted that in objective data collection methods, different customers may express varying experiences on digital connectivity, despite meeting KPI benchmarks. Hence the parameters collected in a subjective method by direct surveying and interacting with customers, can give a clear picture on the weightages that can be assigned to different KPIs captured in objective field measurements. By combining the results of objective and subjective methods, the assessment of digital connectivity will be closer to the perceived quality of experience. A stakeholder suggested that weightage of the objective feedback received through the software applications should be higher as the direct feedback from users is not only based on the experience in that building but also covering the larger geography which may impact the objective rating of the DCI. While few of the stakeholders were of the view that it is too early to give a definitive answer/ example in this regard by arguing that this concept is being discussed for the first time in India.

3.3.3. Terms and Conditions of using Rating Certifications

The CP further discussed **voluntary and mandatory** schemes for rating of different classes of Buildings, need to make necessary provisions and changes in the law to introduce a system of rating, requirement of designating a nodal officer of a Building for coordination in respect of Rating etc. Apart from all these aspects, the CP also mentioned the need for issuance of Rating certificate along with associated terms and conditions for its usage including the validity period, renewal process, provisions for review of rating awarded, etc. The CP further highlighted

the process for settlement and resolution of dispute between the Property Manager and the Rating agency in respect of Rating assessment and award thereof, through an appellate authority.

3.3.3.1. **Issues raised in the CP**

Q22. In case, rating is introduced as a voluntary scheme, is there a need to monitor the progress? If progress is not satisfactory, would there be a need to launch campaigns and awareness drive to encourage Property Managers to come forward for rating?

Q33. What should be the terms and conditions for using ratings awarded to a building(s) from a DCI perspective? What should be the validity period of awarded ratings? Do you envisage any situations under which an awardee of ratings might be required to get the ratings renewed before the validity period?

Q34. Whether in the initial stages of introduction of the rating system, validity should be for a shorter time period, and later it may be increased as evaluation system matures? Should the validity period be dependent on the type of buildings?

Q35. Whether the process of renewal of rating should be the same as the process defined to get rated first time or it may be incremental? Or renewal process may be dependent upon the grounds on which it is being renewed e.g. expiry of validity period, introduction of new technology, introduction of new spectrum band(s), introduction of new services(s) etc.?

Q36. Whether the provisions to make an appeal should be introduced to give an opportunity to the applicant to make representation against the decisions of the Certificate Issuing Authority? What should be the time frame for preferring the appeal in case of disagreement with the rating assigned and its disposal?

Q37. If somebody is found to be using ratings in an unauthorized manner, what legal actions are proposed to be taken against such entities?

3.3.3.2. **Responses of the Stakeholders**

a) On the issue of monitoring the progress of Rating, some stakeholders agreed that monitoring of progress of the rating system is necessary for its effectiveness. A few suggested that there will be a need to monitor the progress during the incubation period.

b) On the issue of the need to launch campaigns and awareness drives, the majority of stakeholders are of the view that awareness campaigns will push Property Managers to get their buildings rated. In addition to this a stakeholder suggested that if this does not work, then pilot projects may be launched in metro cities in association with reputed real estate developers to showcase the importance of good DCI. A stakeholder also suggested that a certain timeline should be defined after which the rating should become a mandatory requirement.

c) On the issue of terms and conditions of the rating certificate, some stakeholders suggested the following key terms may be associated with the Rating certificate:

i) Validity of the Rating certificate
ii) Maintaining consistent performance and QoS after award of certificate
iii) Design of DCI deployed while obtaining Rating certificate should not be altered significantly
iv) Conditions/situations where the Property Manager may use/ leverage such Rating certificate

Some stakeholders submitted that the Rating certificate given to any building can have a validity between 5 to 10 years. One of the stakeholders suggested that revalidation and renewal of Rating certificates should be mandated after every 5 to 10 years. In case there is no significant change in technology, the renewal can be done merely by confirming that there is no change in DCI design and DCI demand in the building since the issuance of last Rating certificate. While a few other stakeholders proposed that the Rating can be renewed two months prior to its expiry. One stakeholder proposed that validity of rating should be three years. It is also proposed that in case additional capabilities are introduced in DCI and renewal of rating is requested, then only incremental assessment might be required to be done. Another stakeholder proposed that the validity of the Rating should be initially for two years for a new building and once its occupancy is stable, then it can be increased to a longer period of three to five years. However the Rating of public places like airports, railway

stations, metro stations should be reviewed more frequently, say every two years.

A stakeholder was of the view that there might be following situations in which the awardee might be required to renew the Rating certificate before expiry of its validity period:

i) The DCI has been upgraded.
ii) There has been a change/upgradation in the technology leading to demand of enhanced service by the end consumer.
iii) There are user complaints regarding poor user experience/ QoS which may call for downgrading of the given rating. This could be due to poor maintenance of installed DCI or increase in the users of the DCI.

d) On the **issue of duration of the validity period**, many stakeholders agreed that validity period can be initially for a shorter period. While few stakeholders disagreed with the proposal by arguing that the minimum period should be 5 years or 10 years as having shorter validity may lead to too much work and rework on ratings. The same will also go against the principles of ease of doing business. A stakeholder proposed that the rating period can be fixed at an optimal number of years looking into various aspects of effort required to evaluate old and new buildings.

During the initial years of roll out, the standards and rating processes are likely to undergo amendments based

on the increase in understanding of the subject. Upon the rating ecosystem becoming mature and adept to deal with the diversity of type of buildings to be rated, the renewal period should be increased to 5 to 10 years. Another stakeholder suggested that the initial period of validity may be kept as three years which can be progressively increased to 5 or even 10 years, as the system matures.

A stakeholder proposed that shorter validity period should be avoided as it will require frequent revalidation leading to requirement of higher resources with no significant change on the QoS received by end users.

e) On the issue of **dependency of validity on types of buildings**, a stakeholder suggested that the validity period of the rating should be as per the building usage and type of building. The validity period can be defined depending on the class of buildings. Building with commercial and industrial or providing public services requiring digital connectivity, may have a shorter validity period. While some stakeholders opposed this concept.

f) On the **issue of the process for renewal of rating,** some stakeholders suggested that renewal of rating should be incremental in nature. This will reduce the cost and compliance burden for the Property Managers while applying for renewal of Rating and encourage them to seek the same before the end of the existing validity period. One stakeholder proposed that evaluation criteria which were prevalent at the time of testing should be followed for the renewal. One stakeholder was of the view

that if assessment is required to be done in the light of introduction of new technology, new spectrum bands, introduction of new services, etc., then perhaps the entire process, as applicable for fresh licences, may be required to be repeated. A stakeholder suggested that the evaluation criteria, guidelines and SOP must be reviewed periodically (preferably yearly) based on the introduction of technologies and the requirement of telecom service providers. The re-evaluation should be done on the basis of the extant evaluation criteria and not on the basis of the initial evaluation criteria.

A stakeholder also submitted that the renewal process should be dependent on the grounds on which it is being renewed, e.g., expiry of validity period, introduction of new technology, introduction of new spectrum band(s), introduction of new services(s) etc. In this, authority should validate that other parameters are also meeting standard norms for decided rating.

g) On the issue of **appeal in case of disagreement on the rating awarded,** many stakeholders agreed that provision for appeal against the rating awarded by the rating authority should be available with the Property Managers. A stakeholder suggested that the time period to make an appeal may be 30 days after awarding of rating, whereas another stakeholder suggested two months and some others suggested three months. Another stakeholder was of the view that the time frame for preferring the appeal in case of disagreement with the rating assigned and its disposal can be arrived based on

the time taken in the certification process and it should be less than the same, as the appeal could be only about certain parameters of rating. Another stakeholder suggested that appeals so preferred are also required to be disposed of in a timely manner (say in 4-6 weeks) for maintaining fairness and transparency in the system. A stakeholder proposed that TRAI and RERA may jointly create a wing where the Property Managers may prefer appeal for review and reconsideration of the awarded ratings. While another stakeholder proposed that there may be a need to have Appellate Authority as there may be instances of disagreement of the Property Manager with the rating assigned to his building.

Some other stakeholders opposed the provisions related to appeal by arguing that the Property Manager itself is hiring the DCI Evaluator and the certificate is issued on the basis of rating provided by DCI Evaluator. If required, the Property Manager can be provided some limited opportunities to request for re-evaluation or re-assessment through a different DCI Evaluator. Another stakeholder opposed the provision of appeal apprehending that more and more clauses may complicate the matter. Another stakeholder opposed the provision of appeal by arguing that anyone in disagreement with the rating assigned or denial of certificate may re-approach the evaluator/authority for re-assessment post a period of 30 days. A stakeholder proposed that to minimise the chances of multiple re-

evaluations, the Property Manager shall be allowed only two re-evaluation requests in six months.

h) On the issue of **unauthorised usage of rating**, a stakeholder suggested withdrawal of the rating for applicable buildings. Few stakeholders proposed that suitable fine may be imposed to recover the cost incurred in processing the rating application and also publish the default list on its website as well as in all local and major national newspapers. Some stakeholders proposed to impose penal provisions in monetary form or action like blacklisting the developer or Property Manager or DCI Evaluator may be taken. A stakeholder suggested that the legal provisions, already available in Consumer Protection Act, 2019 (Section 2(18), Section 21 and Section 89) can be used for taking action against use of false rating by any entity. Another stakeholder cited Section 415 and 465b of Indian Penal Code on forgery and fraudulent or dishonest acts. One stakeholder suggested that penal provisions under NBC, 2016 should be applicable and all the offenders should be handled as per the provisions of law there. While a stakeholder proposed that the rating assigned to buildings may be published on the RERA website and some stakeholders supported publishing ratings on digital platforms.

3.3.4. **Digital Portal for Rating**

As recommended in the previous chapter, a digital platform may be introduced for the cohesive development of DCI, which can create a synergy between various stakeholders, resources including DCI

Professionals and certified products as well as incorporate standardised procedures for a smooth functioning of the whole ecosystem. Similarly, there may be a requirement for a digital platform where Property Managers can apply and seek Ratings for their Buildings. The digital platform will ease out the process of Rating and provide a common platform for all related aspects.

Though the Rating may be a complex task, but with the advancements in digital tools and availability of advanced techniques such as AI/ ML, Rating can be conducted in a more reliable and authentic manner. With these techniques and tools, contexts may be understood in a better way and may also be considered at the stage of evaluation.

Digital tools may help in providing data points by precisely predicting through simulations. Precision may come via better algorithms and availability of detailed information related to Building. This may be crucial for making predictions about wireless signals inside Buildings. Availability of building related information in digital form makes it easier to share and factor-in while making evaluation. Further, digital tools may also help in engaging end-users to participate in the surveys and provide more precise information about the quality of experience. With the advancement in the user interfaces based on capabilities of new devices and availability of digitised building related information may make it much easier for an end-user to participate in the surveys. User interfaces may be much more interactive and intuitive and may help in capturing relevant information and avoiding unnecessary details.

Prediction tools which may predict quality of service considering network configurations, Building and other clutter related information etc. are very useful for evaluation of the quality. These digital tools with

simulation mechanisms can predict network performance in a reliable and granular manner.

3.3.4.1. **Issues raised in the CP**

Q38. Whether creation of a digital platform that allows stakeholders to co-design and co-create DCI would be helpful to realise better, faster and cheaper solutions? Whether technologies and tools such as AI, ML would be helpful in achieving this objective?

Q44. How advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML) etc. might be useful to make the evaluation process more nuanced and suitable for the purpose? How can AI/ML models evolve from the inputs of measurement and evaluation being carried out in other parts of the city, state or Country?

3.3.4.2. **Responses of the Stakeholders**

a) Majority of stakeholders agreed on the development of digital platforms and use of digital tools and advanced technologies like AI and ML for rating of buildings.

b) In response to the creation of a digital platform, some stakeholders proposed that digital platforms would help in learning from data collected from different parts or cities or states or countries. A stakeholder proposed to develop digital platform, the services of which could be used by the DCI Evaluators and rating agencies. Ownership of these platforms may be with the regulator and/or any agency authorised for the purpose. Or it may also be run by private entities with detailed terms and

conditions defined by an appropriate regulation in this regard.

A stakeholder proposed that local authorities can also develop a separate platform which allows DCI Designer on Record to register for specific buildings. Such platforms should have the data repository for past projects in the region and requisite AI/ML tools for predictive DCI designing. Platform may allow a defined number of designated login creation for a building which will allow the relevant stakeholders to view the data collected, DCI design based on data assessment and accordingly provide inputs to DCI Designer. For instance, a TSP may login, review the DCI design to suggest enhancements on equipment/hardware for better network coverage or modify the backhaul infrastructure based on data demand projection for a building.

The stakeholders also added that maintaining such a platform for a single cause like DCI may be a costly proposition. However, information created and collected through this platform might be useful for a variety of purposes, which might be used by local or state authorities and also by Property Managers to get improvement in design and evaluation of DCI. All such possible utilities can make this platform a feasible option.

c) In response to the use of digital tools and advanced technologies, stakeholders were of the view that digital tools could help in engaging end-users to participate in the surveys and provide more precise information about

the quality of experience. Also, AI/ML may help in dealing with such large number of variants, developing optimum DCI design by deriving correlation between objective and subjective parameters data and even develop predictive models for future projects. With use of digital tools and analytics through AI/ML, rating may be achieved in a more reliable and authentic manner. With these tools and technologies, contexts may be understood in a better way and may also be considered at the stage of evaluation. The advantage of having such a platform is that it would allow standards to be established based on the learnings of such evaluators, and improve the same from time to time to take care of futuristic requirements.

A stakeholder proposed that digital tools may help -

i) in prediction of network quality
ii) to conduct surveys that capture precise information.

Some stakeholders suggested that AI/ML may help in combining information from multiple sources such as network reports, field measurement reports, crowd source Apps, prediction tools, survey reports etc. Creating the picture of quality inside a building after considering multiple sources and both objective as well as subjective assessments, may be much more reliable and closer to the perceived quality. However, the process of combining data may be context specific and there may be a large number of variants, each one developed or evolved suiting to the context in which it is to be applied. Classification

of buildings from a digital connectivity perspective would help in this process.

A stakeholder suggested that,

i) AI/ML tools can help with moment-by-moment traffic management, as well as longer range capacity planning and management. After the tools identify when traffic spikes in some paths or fails to flow in others, they can send automated or manual direct management responses to correct the error.
ii) AI/ML tools can also predict traffic trends in ways that help guide future decisions. Network professionals should evaluate situations where it could be beneficial to use a ML tool to determine traffic flows.
iii) Combining ML-driven analytics with other AI tools, like natural language processing, can make interacting with the systems easier and faster. Network engineers can create virtual assistants to help network administrators diagnose and fix network issues.
iv) Additionally, AI/ML tools could also be customised for predictive models for capacity and coverage.

A stakeholder suggested that AI/ML based applications can be used to run analytics on data collected from multiple performance monitoring sensors or Apps on a user's mobile. By mapping the customer's mobile GPS position, building, Fibre access Network, TSPs etc. and

other service parameters like IP Address, rich data can be collected and analysed to initiate improvement activities.

A stakeholder suggested that use of the advanced technologies will help in predicting the perceived quality of experience in the building being evaluated considering the geographies, clutter of the region, building map, material used in the construction, height of the surrounding buildings, vegetation etc. which may not be possible to consider them in manual evaluation or without these advance technologies. They will also help in standardising the rating process and mechanism, removing the human errors from the equation while evaluating the building for connectivity and quality of experience.

A stakeholder proposed that AI/ML can also help in dealing various variants and in identification of extreme factors in both sides of evaluation which can also be removed to ensure the valuation are closer to each other so that the realistic evaluation of QoE of DCI can be calculated.

3.3.5. **Analysis**

a) As discussed in the CP and also agreed by majority of the stakeholders, the development of Rating framework and relevant policies requires collaboration among various stakeholders of the DCI ecosystem, viz. Government departments, TSPs, DCI Professionals, Property Managers etc., to cover all the necessary aspects of Rating of Buildings. Considering the submissions of the stakeholders, the Authority is of the view that, the policies related to

Rating of Buildings may be formulated after detailed consultation with the stakeholders.

b) Considering that telecom infrastructure needs to be upgraded and expanded in accordance with technological innovations, the prescribed rating methodology also needs to be modified to assess the Rating in real time. Thus, the extant policies may require to be updated from time to time.

c) Apart from formulation of the regulatory framework, its proper implementation is also critical for its success. In order to facilitate wider adoption of the policies by all stakeholders, development of a digital platform will be helpful by easing out the processes of Rating. The platform would facilitate Property Managers to get their Buildings rated, issuance of certificates for Rating of Buildings, to provide necessary information to relevant stakeholders, which includes Buildings being rated, updates in policies and methodologies adopted for rating the Building etc.

d) To conduct the Rating in an efficient and transparent manner use of advanced digital tools such as AI/ML, CAD etc. and platforms has been widely supported by all the stakeholders. Considering volume of work and multi-agency coordination, there is also requirement for establishment of a digital portal where all stakeholders can interact for submitting requests for Rating, selection and allocation of Rating Agency, submission of interim reports and issue of final certificates etc.

e) Various suggestions and useful inputs have been studied by TRAI. As has been mentioned earlier in para 3.2.5(m), TRAI will come up with appropriate regulatory framework for Rating of Buildings, which will also include the issue of Rating

certification and at the time of framing the regulations on the subject, TRAI shall consider the following aspects:

i. **Empanelment/ accreditation of various Rating Agencies, considering the large volume of Buildings and different classes of Buildings to be rated.**

ii. **Roles and responsibilities of empanelled/accredited Rating Agencies.**

iii. **Creation of a digital platform/portal to enable Property Managers to get their Buildings rated.**

iv. **Formulation of terms and conditions including validity period for using Rating certificate.**

v. **Mechanisms for monitoring of the progress of Rating of Buildings.**

vi. **Awareness campaigns in collaboration with relevant stakeholders for popularising the Rating of Buildings.**

vii. **Settlement of disputes, appeals and representations against Rating.**

viii. **Any other relevant aspects relating to Rating of Buildings.**

3.4. Timeline for Implementing Rating Framework

3.4.1. Introduction of Rating framework empowers the end users to exercise their choices judiciously, fulfilling their digital connectivity requirements. However, making Rating mandatory for the existing and new Buildings across the country may raise some concerns which need to be addressed before taking a final call in this regard. The market forces may push Property Managers to act in the direction of improving

quality inside Buildings and adding value to their properties. It is expected that once a successful model emerges, various stakeholders would start adopting it.

3.4.2. Considering the benefits of the Rating system, initially Rating may be made mandatory, especially for Buildings of public interest and which have been developed through public funding. Examples of such Buildings can be airports, ports, railway stations, public transport stations, bus stations, large shopping complexes, industrial estates, major market areas, office or workplaces, Government Buildings, Government residential colonies and any other high rise residential or office complexes of public importance.

3.4.3. **Issues raised in the CP**

Q25. Is there a need to make rating a mandatory requirement for specific classes of buildings such as public transport hubs, government buildings or any building of public importance etc.? If yes, which type of buildings should be covered under this category?

Q26. What should be the time plan to rate buildings falling under the mandatory category and is there a need to prioritize some buildings within the mandatory category to make it more effective? Whether existing buildings falling under such classes are required to be dealt differently?

Q27. Is there a need to designate a nodal official for building(s) falling under the mandatory category to comply with the rating related requirements? What actions are proposed to be taken in case of non-compliance?

3.4.4. **Responses of the Stakeholders**

a) In response to mandatory and voluntary rating of buildings, the majority of stakeholders agreed that rating may be required to be made mandatory for specific classes of buildings. These buildings may include airports, ports, railway stations, public transport stations, bus stands, highways, large shopping complexes, industrial estates, major market areas, office or workplaces, government buildings, government residential colonies and any other building of public importance. In addition to this, a stakeholder also suggested that rating may also be made mandatory for large or high-rise residential buildings. Another stakeholder mentioned that densely populated buildings, offices and buildings of high dignitaries and VIP persons, buildings where population movement is high may also be covered under the category of mandatory scheme. Another stakeholder suggested that rating should be made mandatory for all Government buildings (official and residential), new private buildings and new public place buildings in all Tier-1 and Tier-2 cities but voluntary for other buildings and rural areas.

Few stakeholders suggested that rating can be made mandatory for buildings with public offices -

i) having high footfalls of citizens,

ii) having responsibility of handling citizens' grievances,

iii) with servers for websites having heavy e-traffic.

A stakeholder proposed that for new constructions, the rating should be mandated at building completion and occupation stage. But for the existing buildings, the rating should be initially voluntary as the ecosystem of DCI professionals will need time to get mature.

A stakeholder suggested that rating should not be introduced on voluntary basis as the progress of the DCI creation and usage need to be monitored at regular interval. To start with, the provision of ratings could be introduced in a phase-wise manner. In the first phase, DCI creation and ratings should be mandatory for all building complexes of new Government buildings, stadiums, railway stations, bus terminals/depots, underground metro stations, central/state/private universities (deemed universities), shopping malls with substantial space/ footfall, indoor stadiums etc. The ratings should be introduced for buildings based on the criteria of a minimum height of 15-20 m from ground or two floors below ground. The rating should be obtained by Property Managers of the said buildings within two years of the start of this framework. In subsequent phases, the voluntary scheme of rating can be extended to cover cities, towns and villages and even States. For already existing buildings or infrastructure, the ratings can be introduced on a voluntary basis during the initial phases of implementation of this framework.

A stakeholder was of the opinion that new rating should not be implemented in private buildings. Another stakeholder was of the view that a certain threshold may be defined for including buildings under the mandatory rating scheme to get an assured level of connectivity experience of the end user.

b) In response to prescribing a time plan to rate buildings, few stakeholders proposed that a clear roadmap/ action plan/ methodology should be developed for mandatory rating of buildings. Buildings having higher flux of users may be dealt with priority for coverage under mandatory rating. However, the stakeholders have not suggested any timeline. One stakeholder suggested that it would

be too early to comment on specific timelines as on date. It should be reviewed periodically. In regard to finalising the time plan, a stakeholder suggested adopting a sandbox approach.

Another stakeholder suggested that rating of buildings under mandatory category should be completed within 24 months post the development of the legal framework and rating system. Buildings of public importance such as Airports, railway stations of metro cities, hospitals etc. which see a large footfall can be prioritised and may be covered within 18-24 months of development of the legal framework/ rating system. Another stakeholder suggested that existing buildings falling under such classes should be dealt differently. One stakeholder suggested that the ratings for the existing buildings falling under such classes shall be made on a voluntary basis during the phase-1 of implementation and creation of DCI.

c) Majority of stakeholders agreed that there is a need of designating a nodal official in case of buildings where rating is made mandatory. They supported that the nodal official may play a significant role in reaching out to the concerned stakeholders, coordinating activities, and getting digital connectivity rated. They further suggested that he should be responsible for keeping building ready with in-building telecom networks and upgrading or expanding it from time to time as per users' need. Few stakeholders suggested that nodal official may be authorised to initiate legal action in case of non-compliance by the stakeholders for completion of the rating process and subsequent required upgradation of the DCI. Nodal officials may also be authorised to recommend penalties to be levied, in case of non-compliance by the stakeholder. While a stakeholder opposed the application of penalties or advice to provide more time for

compliance. While one stakeholder suggested that non-appointment of nodal officers may be dealt as per extant Government rules related to this aspect.

One stakeholder proposed that at first attempt, if the rating is not compliant in the above category building, the nodal officials must analyse and suggest to the building authority, the steps required to be taken to improve the quality of digital connectivity inside the building. The re-rating must be scheduled within a timeframe.

3.4.5. **Analysis**

a) As discussed above, there are certain Buildings with high public footfalls such as airports, ports, railway stations, public transport stations, bus stations, large shopping complexes, industrial estates, major market areas, office or workplaces, Government Buildings, Government residential colonies and multi-storeyed complexes (residential or office complexes) etc. In such cases it is essential to have certain framework to ensure good quality digital connectivity experience to the consumers or end users of various services. In many cases end users may be a transit passenger or short time visitor, who might not be owning a permanent space in that area but during the period of his/her stay he/she needs to have good quality digital connectivity experience so as to ensure that his/ her connectivity related requirements are fulfilled without any hassle. Thus, such Buildings are required to have a mandatory rating scheme. In case of such Buildings, Rating should be made mandatory within two years of issue of the regulatory framework by TRAI or two years from obtaining occupancy certificate, whichever is later. The Property Manager should also get Buildings rated for digital connectivity within two years of obtaining the occupancy

certificate once TRAI has issued the regulatory framework. Further, it is also important to identify other classes of Buildings where rating can be introduced as mandatory in the collective interest of end-users. The Governments and their agencies should be leader in Rating of Buildings, as, maximum footfalls of the citizens are observed in the Government Buildings. Also, Government has digitalised their functions, delivery of services and even transfer of benefits. With new technologies, especially 5G based technologies is likely to revolutionise the way Government transacts, delivers services and interacts with citizens. It is therefore essential that all Government buildings should also have good quality of digital connectivity which not only meets current requirements but also is capable of extending new experiences using new technologies evolved later.

b) **TRAI will be required to identify and recommend such classes of Buildings for inclusion in the MBBL from time to time.**

3.4.6. **Recommendations**

32. **The Authority recommends that to start with, the Rating of Buildings for digital connectivity should be made mandatory for all existing as well as new Buildings of public importance within two years of issue of the regulatory framework by TRAI or two years from obtaining occupancy certificate, whichever is later. The Authority further recommends that Rating of the following Buildings of public importance should be made mandatory:**

a) **Airports,**
b) **Ports,**
c) **Railway/ metro stations,**

d) **Bus stations,**

e) **Buildings of Central/ State/ UT Governments/ Local authorities/ Government agencies/ PSUs,**

f) **Government residential colonies,**

g) **Industrial estates including industrial parks, SEZs, multi-modal logistic parks,**

h) **Large commercial office complexes,**

i) **Large commercial shopping complexes,**

j) **All institutes of higher education including research institutes,**

k) **All multi-speciality hospitals, and**

l) **Any other Buildings as Government may decide.**

33. **The Authority also recommends that, the Rating of Buildings for digital connectivity should be made mandatory for all new Buildings, excluding the class of Buildings as may be decided by MoHUA in consultation with the States/ UTs and other stakeholders.**

34. **The Authority recommends that the Property Manager should get Buildings rated for digital connectivity within two years of obtaining the occupancy certificate once TRAI has issued the regulatory framework.**

35. **The Authority also recommends that for Buildings other than those mandated, the Property Manager may get their Buildings rated for digital connectivity on voluntary basis.**

3.5. Expanding the Scope of Rating beyond Buildings: States, Cities, Towns and Villages

3.5.1. As deliberated in the CP, the concept of Rating of Buildings may be extended to rate States, cities, towns or villages (hereinafter called as a Geographies). This may push local Government authorities to mobilise local resources to create awareness about Rating. Also, the local authorities and States may take necessary steps to improve the Rating of their respective Geographies. This will attract more and more investors in other fields of manufacturing or services.

3.5.2. In addition to above, public authorities or the authorities who are currently responsible for grant of permissions for deploying DCI would be eager to improve the Rating of their Geographies by working in collaboration with TSPs to build DCI. A Geography with a better digital connectivity Rating will also attract more investors and businesses which may help in improving the economy of that particular Geography. This will also encourage real estate developers to develop Buildings used for business related activities such as enterprise workplaces, shopping malls, industrial estates, restaurants, cafeterias etc. as well as residential buildings with good digital connectivity in that Geography. In short, this will transform the social and economic activities of the Geography in a major positive way by enabling good digital connectivity.

3.5.3. **Issues raised in the CP**

Q23. Should the voluntary scheme of rating be extended to cover cities, towns and villages and even states? Would such a scheme help in encouraging local and state authorities to facilitate TSPs in creation or in improving outdoor as well as indoor DCI?

Q24. If in response to the Question No. 23 answer is yes, then what framework should be introduced to rate cities, towns, villages and states, and how weightages can be assigned to different aspects of indoor and outdoor connectivity?

3.5.4. Responses of the Stakeholders

a) Majority of stakeholders agreed that a rating scheme for buildings should be extended to cover a Geography. They were of the view that if the concept of rating of buildings is extended to rate such Geographies, then it may push local government authorities to mobilize local resources to create awareness about rating. The local authorities and States may also take necessary steps to improve rating of their respective Geographies which may include facilitating roll out of networks in collaboration with TSPs, augmentation of outdoor digital infrastructure, overhauling approval mechanism, and helping stakeholders to upgrade DCI to match new technologies.

b) In response to framework to rate a Geography, a stakeholder proposed that the framework for assigning DCI rating to such Geographies can include the following criteria, among others:

   i) Number of Central/State owned infrastructure rated in the region and ratings awarded to such buildings. This will not only help in providing data connectivity to most neglected buildings but also set an example for the private Property Managers.
   ii) Number of private buildings rated in the region and ratings awarded to such buildings.
   iii) Outdoor quality of network.
   iv) Easy approval mechanism for DCI.
   v) Total buildings plan digitization achieved.

vi) Availability of 3D maps for all structures across the town/ city/ State.

Another stakeholder suggested that criteria like number of buildings rated, ratings awarded to such buildings, outdoor quality of network, easy approval mechanism for DCI etc. may be used for DCI rating of a city.

Few stakeholders suggested that it may be done in a phased manner only. In the first phase rating of buildings should be done. Once this process of rating is tested and established then in the second phase the rating of various Geographies may be carried out.

c) In response to assigning weightages to different aspects of indoor and outdoor connectivity, a stakeholder mentioned that the highest weightage should be given to coverage of public infrastructure followed by coverage for private infrastructure, as public infrastructure is more likely to be ignored in DCI coverage. This should be followed by an ease of approval mechanism which impacts the ability of TSPs to deliver the required coverage for the region. Smallest weightage may be given for the outdoor quality of the network.

3.5.5. **Analysis**

a) As discussed above, the stakeholders widely agreed to the idea of extending the concept of Rating of digital connectivity to Geographies. They also concur that this will push the Government and authorities and Property Managers to invest in developing good digital connectivity in their respective Geographies in collaboration with the TSPs, leading to attracting more investors and businesses.

This will also facilitate easy approval processes and ease of doing business.

b) It can be concluded that the progressive attitude of the Government and authorities to improve digital connectivity Ratings shall facilitate the service providers to create DCI.

c) As the outcome of the digital connectivity Ratings in Geographies is yet to be ascertained, the Rating for these Geographies though can be initiated simultaneously with the Rating of Buildings but its progress and acceptance need to be monitored closely. Awareness programs are also to be launched in such Geographies to communicate about the relevance and importance of Ratings of such Geographies. This would help in encouraging Property Managers and local authorities to take necessary steps to improve the digital connectivity in their respective Geographies by developing DCI for their buildings. Hence Rating of these Geographies will also act as a nudge factor to the players to improve digital connectivity in their respective Geographies.

d) Further, the concept of Rating of Geographies would also require a suitable framework as well as proper assignment of weightages to rate the same. The CP has suggested some KPIs to evaluate the quality of digital connectivity in such Geographies, which were also supported by most of the stakeholders. These KPIs include –

    i) number of Central/State owned infrastructure rated in the Geography and Ratings awarded to such Buildings,
    ii) number of private Buildings rated in the Geography and Ratings awarded to such Buildings,
    iii) outdoor quality of network,
    iv) ease of approval mechanism for DCI,

v) number of registered professionals, builders and suppliers,

vi) availability of street furniture,

vii) public Wi-Fi availability,

viii) available digitised versions of the structures and Buildings in that Geography,

ix) space available for towers and cells, etc.

More KPIs can be added to represent a comprehensive rating mechanism. ITU's United for Smart Sustainable Cities (U4SSC)[29] initiative helps to enable cities to measure their performance through the KPIs for Smart Sustainable Cities (SSC). This may provide some insights for identifying the KPIs for a Geography.

e) **TRAI will finalise such KPIs considering inputs received here in, through a separate consultation process, while framing the regulations. TRAI will formulate an appropriate Rating framework for digital connectivity with timelines, if any, for States, cities, towns, and villages.**

3.6. Regulatory Sandbox

3.6.1. Introduction of new technologies on one hand leads to an improved quality of life but on the other hand poses several challenges like complexity, uncertainty, risks and in many cases causes disruption. Introducing new and innovative solutions to co-design and co-create the DCI along with Rating of Buildings, has its own challenges viz. cross-sectoral collaborations, enabling provisions in the extant legal framework, adoption by relevant stakeholders, etc. Thus, the development of DCI and Rating, may require an experimentation platform to demonstrate various capabilities in a secured environment

[29] U4SSC

to overcome these challenges. Such demonstrations may also support in defining the standards, formulating the methodology and procedure to develop DCI and the Rating framework. Additionally, before deployment of an optimal solution in the field, there is a need to test the design in a similar environment considering all the aspects of the field. Thus, there is a need to develop platforms, which best fit the above requirements for testing and demonstration.

3.6.2. The CP discussed the approach of regulatory sandbox to demonstrate capabilities of innovative solutions before relevant stakeholders. Based on outcome of the regulatory sandbox, necessary changes can be made in extant laws and regulations which may include defining technical specifications/standards, changes required in extant approval processes, introducing new business models and entities along with their roles/ responsibilities and any other innovative solutions. Regulatory sandbox may also provide platform to various stakeholders to collaborate and demonstrate their capabilities in their respective fields. Such an approach may help in wider acceptance of the solutions proposed by all the relevant stakeholders of the ecosystem.

3.6.3. **Issues raised in the CP**

Q30. Whether creation of "Regulatory Sandbox" to carry out experiments or demonstrate capabilities of innovative solutions to improve digital connectivity would be helpful to make changes in existing policies, laws or regulations? What should be the terms and conditions to establish a regulatory sandbox?

3.6.4. **Response of the Stakeholders**

In response to the creation of a regulatory sandbox, many stakeholders opposed the creation of a regulatory sandbox by arguing that market

demand would trigger the innovations in the solutions offered to improve the digital connectivity and also encourage new entities or players in the field to provide the required solutions. Another stakeholder argued that TSPs and IP-Is are fully updated and equipped with the latest products and services. There is no need for regulatory checks and a controlled environment. The self-assessment and self-declaration by the DCI owners (IP-Is/TSPs) should be sufficient and good enough for the compliances. However, a few stakeholders agreed to the creation of a regulatory sandbox to carry out experiments and demonstrate capabilities of innovative solutions.

3.6.5. **Analysis**

TRAI agrees with the view of many stakeholders that, there is no immediate need of regulatory sandbox. In future, whenever it is required, TRAI will take appropriate action to examine the innovative solutions offered, its implementation feasibility and requirements in the sector, on a case-to-case basis using the regulatory sandbox approach.

CHAPTER 4

PROPOSED AMENDMENT IN THE MBBL AND NBC FOR DCI AND RATING OF BUILDINGS

4.1 As already discussed in para 2.5, some of the TRAI recommendations on "*In-building Access by Telecom Service Providers*" dated 20th January 2017, have been incorporated in the Addendum to MBBL 2016 on "*Provisions for In-Building Solutions - Digital Communication Infrastructure*" issued by TCPO (MoHUA) in March 2022. The recommendations which are not included in the MBBL addendum or yet to be implemented by the Government, have already been discussed in the para 2.5.

4.2 Apart from the comments already offered on Addendum to MBBL, 2016 at various stages of discussions on related sub-headings, additional views of the Authority on the Addendum are as follows:

4.2.1 As mentioned in para 2.2.6(2)(f)(iv), the Authority in response to the draft addendum had submitted its viewpoint on the subject matter indicating that draft addendum does not include all aspects of the DCI and therefore requires to incorporate a comprehensive framework for DCI development inside Buildings. The Authority, vide its reply dated 08th February 2022, also requested MoHUA that, "*it is proposed that processes for suitable modification in Building Bye Laws and National Building Code may please be initiated with provision that necessary arrangements are to be made to incorporate TRAI new recommendations on 'In Building Solutions for Digital Connectivity Infrastructure (DCI)', as and when same are notified after due consultation processes*".

4.2.2 The provisions of the Addendum in clause 7(A) titled "*Procedures of obtaining IBS-NOC during plan approval and completion*" require complete review in view of constitutional provisions as well as implementation difficulties. Clause 7(A) of the MBBL addendum on issue of No Objection Certificate (NOC) in respect to readiness of CTI (now DCI) by TERM Cells of DoT, needs to be reviewed in view of the following:

a) The 73rd amendment to the Constitution enabled States to transfer some functions, including the functions related to land and building to the Panchayati Raj Institutions (PRIs). Further, out of 29 functions listed in the 11th schedule (Article 243G), following two functions may be relevant from the perspective of DCI inside Buildings:

   i. *Land improvement, implementation of land reforms, land consolidation and soil conservation.*
   ii. *Rural housing*

b) The 74th amendment to the Constitution enabled States to transfer some functions, including the functions related to land and building to the Urban Local Bodies (ULBs). Further, out of 18 functions listed in the 12th schedule (Article 243W), following two functions may be relevant from the perspective of DCI inside Buildings:

   i. *Urban planning including town planning; and*
   ii. *Planning of land-use and construction of buildings*

c) MBBL, 2016 states that ***The Authority*** *created by a statute and which, for the purpose of administering the Code/Part, may authorize a committee or an official or an agency to act on its behalf; hereinafter called the 'Authority'*. For the purpose of uniformity this Authority can be any Urban Local Body or Urban Development Authority or Panchayati Raj Institutions or Industrial Development

Authority or any other authority as notified by the State Government as the case may be.

d) Also, the provisions of the Addendum may delay the process of granting permission of the building plan submitted as they will be required to be sent by the Authority to the respective TERM Cell (DoT) of the LSA (which might cover more than one State), before granting permission. Additionally, on post-construction, the addendum has provision of joint inspection by the TERM Cell and the officers of the Authorities and issuance of NOC by TERM cell.

e) It is understood that, in urban areas of some of the States, as high as 6000 applications for permission of construction and equal number of applications for issuance of NOC/ building use permission are received every month by different Authorities. In the same way, thousands of applications for building plan approval and NOC/ building use permission might be received by Authorities in rural areas. The present setup of TERM Cells located generally at the State capitals are not equipped to handle such enormous work. Nor it can physically inspect the sites and that too jointly in hugely dispersed geographical areas. It will also lead to coordination issues between the DoT and local bodies. This arrangement is likely to create bottlenecks and will severely impact ease of doing business.

f) The 'Authority' at local bodies at present gives permissions for construction of Buildings under the relevant State laws. The States incorporate provisions of MBBL issued by TCPO (MoHUA) in their building bye laws, which are further adopted by the local bodies. Accordingly, a single development plan incorporating various elements of building construction i.e., structure and building services such as water, electricity, fire safety etc., is submitted by the Property Manager which is approved by the local authorities. The same arrangement should be used for the purpose of approval

of the DCI plans and building use permissions instead of creating an additional process of getting clearance of such plans and designs from TERM Cells.

4.3 In view of the above, the Authority (TRAI) is of the view that approval of DCI Design and Deployment and issue of Building Use Certification (from DCI Point of view) should remain with the existing local bodies. Further, with the availability of qualified and certified DCI professional through capacity building framework, as proposed in these recommendations, the Authorities (Local bodies) may hire the services of expert/agency duly registered and certified by the Council of DCI (CoDCI) for evaluation of DCI Plan and Deployment. As it stands now, local bodies do have experts hired or recruited for approval of the plans and permission to use developed services like, water supply, electricity, fire safety etc.

4.4 Further, as recommended by Authority in recommendation no. 7 (para 2.4.8), a separate chapter, comprehensively covering all aspects of DCI development should be included in MBBL. Accordingly, a draft chapter is proposed in **Appendix-I** of this chapter to be included in MBBL.

4.5 Largely, the content of introduction and provisions in Addendum of MBBL, 2016 with regard to IBS have been retained with appropriate rewording. Wherever we have not agreed, reasons have been given in the recommendations itself. New provisions, which are not part of the Addendum, have been appropriately added in this chapter. Such new provisions have also been discussed in detail in the recommendations. For convenience's sake, the provisions have been re-arranged based on subject matter.

4.6 As already recommended in para 2.4.8, the BIS panel on '*Information and Communication Enabled Installations*' needs to review the current provisions of the standards defined in the NBC and update the same in view of these recommendations. A broad outline of the DCI standards to be made part of the NBC is given in the **Appendix-II** to this chapter, for reference.

4.7 Recommendations

36. **The Authority recommends that, approval of DCI design, deployment and use of Buildings should remain with the existing institutions as per statute of State/UT Governments for the purpose.**
37. **The Authority further recommends that, the Authorities of the States/UTs responsible for approval of DCI development plans and evaluations thereof, should hire the services of a suitable expert/agency duly registered and certified by the Council of DCI (CoDCI).**
38. **The Authority recommends that, a new draft chapter on DCI for the Buildings, as suggested in the Appendix-I to this chapter, should be included in the Model Building Bye Laws, in line with the recommendation no. 7 at para 2.4.8.**
39. **The Authority recommends that the BIS Panel on 'Information and Communication Enabled Installations' should develop standards in respect of DCI for the Buildings, to be included in the National Building Code as mentioned in Appendix-II to this chapter. The Authority further recommends that definitions, related to DCI, as mentioned in para 6.1 of Appendix-I, should be made part of the NBC.**

APPENDIX-I to CHAPTER 4

PROPOSED CHAPTER FOR INCLUSION IN THE MBBL-2016

CHAPTER XX

Digital Connectivity Infrastructure (DCI) in the Buildings

1. Introduction: Digital Connectivity and Communication Systems

1.1. The technologies used for digital communications have changed greatly over the past few years. Telecommunication network architecture is also changing to meet new requirements for a number of new technologies and services/applications viz. 5G, massive Internet of things, Artificial Intelligence, Augmented/Virtual Reality, Metaverse, etc. Information Communication Technology (ICT) systems which were earlier confined to telecommunication services are now converging wherein the thin line differentiating telecommunications and other services is blurring very rapidly. All these services are now converging into digital services which encompass telecommunications, broadcasting and various other associated services using data as carrier. Data growth is exploding globally and in India as per TRAI reports, the average monthly data usage per user in India has increased almost 17 times over the past 7 years. Covid-19 has further pushed data consumption with people staying indoors. Home consumption of data has therefore grown exponentially. According to some estimates, almost 85% data traffic and 70% voice traffic is now generated indoors.

1.2. Leading global institutes/organizations have released studies that point out direct correlation between penetration of digital connectivity networks/system and socio-economic development. The World Bank has clearly demonstrated that a 10% increase in broadband penetration yielded an additional 1.38% in GDP growth in low and middle-income countries. Even the India specific study by quasi-Government research agency, International Council for Research on International Economic Relations (ICRIER), has estimated that a 10% increase in Internet subscribers results in a 3.2% increase in rate of growth of state per capita GDP. It is very clear that applications riding on internet are contributing to GDP growth.

2. Need to place Digital Connectivity Infrastructure (DCI) at par with other utility infrastructure

2.1. As the digital economy slowly replaces physical economy, the social and economic life of an individual relies more on the digital connectivity and services. The share of digital economy in the overall economy is increasing at a faster pace and hence it is all the more important that, the buildings and associated areas should have robust Digital Connectivity Infrastructure (DCI). The dependence of occupants/users of a building on digital connectivity, to avail essential services like health, education from anywhere, work from anywhere, financial transactions, e-commerce, entertainment etc. places the requirement of DCI availability inside building at par with other essential utility infrastructures like water, electricity, fire safety etc. Unavailability of digital connectivity and services results in socio-economic divide. It is therefore essential to ensure access to digital connectivity and services in all buildings and surrounding areas. It is therefore imperative to have a comprehensive framework for the

development of Digital Connectivity Infrastructure (DCI)[30] in all types of the buildings and areas (hereinafter referred to as Buildings) for accessing digital services.

2.2. The Government has been putting in efforts towards developing smart cities. The success of the Smart City mission relies on the underlying digital communications infrastructure and therefore, it is important for all the cities identified under this programme to have DCI inside Buildings to enable seamless connectivity.

2.3. To facilitate the development of DCI, its up-gradation and maintenance, adequate arrangements are to be made in advance to ensure DCI is developed along with Building development. In case of existing Buildings, suitable frameworks are to be developed to create new DCI (if no DCI available) or upgrade existing telecom infrastructure to DCI, if already available. Realizing the same, Government has made several policy efforts in past few years in this direction.

3. Policy Efforts

3.1. The proliferation of in-building connectivity has become a key component of government policies. The National Digital Communications Policy, 2018[31] envisages *making requirement for telecom installations and the associated cabling and in-building solutions mandatory in all commercial,*

[30]Digital Connectivity Infrastructure (DCI) consists of passive and active elements which include any apparatus, appliance, instrument, equipment, and system used or capable of extending seamless digital connectivity. All infrastructure required for establishing Wireless or Wireline Access Networks such as Radio Access Networks (RAN) and Wi-Fi systems, and Transmission Links Interface, Duct Space, Optical Fiber, Poles, Towers, Feeder cable, Antenna, Base Station, In-Building Solutions (IBS), Distributed Antenna System (DAS), or any other equipment to be used for the provision of digital connectivity, may be part of DCI. However, it shall not include core network elements.

[31]National Digital Communications Policy 2018

residential and office spaces by amending National Building Code of India (NBC), through Bureau of Indian Standards (BIS).

3.2. The Government has also taken a number of steps for promoting the sharing of in-building infrastructure, in line with TRAI recommendations. Some of the steps taken by the Government are given below:

a) In October 2019, the Digital Communications Commission (DCC) approved in-building access and sharing of infrastructure among TSPs, thereby allowing them to share infrastructure and, in the process, curbing TSPs' monopoly to install infrastructure through exclusive contracts with the owners/builders.

b) In November 2019, the Department of Telecommunications (DoT) issued an advisory to encourage all TSPs to share their in-building infrastructure with other TSPs such as IBS, optical fibre, other cables, ducts, etc. in all the existing Government/public buildings/places like airports, railway stations, bus terminals, metro stations/lines and hospitals.

c) In November 2016, DoT issued the Indian Telegraph Right of Way Rules to regulate matters related to underground and overground telecommunication infrastructure. These rules have been amended further in 2017, 2021 and 2022.

3.3. Bureau of Indian Standards (BIS) has framed National Building Code of India. Volume 2, Part 8, Section 6 titled '*Information and Communication Enabled Installations*' has provisions related to Common Telecom Infrastructure (CTI), referred to as Digital Connectivity Infrastructure (DCI), inside the Buildings for provisions of telecom services. These

standards are reviewed from time to time to update the same by incorporating new standards and planning/installations guidelines required for implementation of state-of-the-art DCI. These standards work as reference for the deployment of DCI in the Buildings.

4. Current provisions in building bye-laws, issues involved and need for a new comprehensive approach

4.1. The building bye-laws currently have provisions for creating facilities [cable ducts, chutes, space for Common Telecom Infrastructure (CTI) etc.] to enable service/infrastructure providers to access the same and create infrastructure for various digital services accessible to the users of the Buildings. However, these provisions are few, inadequate and not comprehensively placed in building bye-laws and therefore, require revision.

4.2. Further, the current provisions in building bye-laws do not mandate property owner or manager to ensure existence of pre-provisioned DCI in buildings. Lack of such mandatory provisions for DCI creation in building bye-laws has resulted in several defective models/malpractices. There is a tendency to engage TSPs/ IP-Is through the highest bidding model. Such TSPs/ IP-Is, in turn work for maximisation of their revenue by charging excessive rent from other service providers. At places, Property Managers[32] have entered into exclusive tie-up with one of the infrastructure/ service providers, who works as a monopolist and decide terms and conditions for access for his maximum benefits. Expansion or upgradation of infrastructure is normally not taken up in time to meet the users' demand resulting into delayed availability of service to the

[32] Kindly refer para 6.1(k) for definition of the Property Manager

consumers and increased costs. As a result of these derelictions, users of residential buildings or offices or public places are forced to live with poor or compromised quality of telecom service due to non-availability or non-upgradation of the infrastructure by the existing infrastructure providers and TSPs. In today's world, where the socio-economic life warrants an individual to remain connected while at home or on move in public places/buildings, a new approach for DCI creation in Buildings is required. If common DCI is planned, developed, operated, upgraded (as per consumers' need) and managed by the Property Manager and access is allowed to all service providers on non-chargeable basis in fair, transparent and non-discriminatory manner, the consumers will be able to access services of their choices from their preferred service providers. The common DCI will result not only in ensuring availability of digital connectivity and services to Building users but will also avoid duplication of network resources and cost.

4.3. In case of electricity, water, gas pipes, etc., generally there is only one service provider. However, in case of telecom and broadcasting, the residents/ occupants of a building subscribe to services of multiple operators and therefore there is a requirement to provide access of DCI to all such service providers. It makes sense, that if common DCI is created by the Property Manager and access is allowed to all such service providers in fair, non-chargeable, transparent and non-discriminatory manner, the residents will be able to access quality services from their respective service providers.

4.4. These bye-laws therefore attempt to improve present arrangement and aim at ensuring that pre-provisioned DCI is available in Buildings to multiple service providers on fair, non-chargeable, transparent and non-

discriminatory basis. Some of the broad provisions that govern these bye-laws are-

a) The ownership of DCI should lie with a person or body who is responsible for creation, operation and upgradation of DCI as per the needs of the end users and such person or body can be the Property Manager.
b) Make DCI an essential component of the building development plan with design, implementation, and approval as part of overall building use, on lines of electricity, fire protection and safety.
c) Property managers will get DCI designed through DCI professionals and submit the designs to Local authorities as part of overall building plans.
d) The eligible design professionals and their duty to follow certain standards has also been brought out in the bye-laws.
e) As the entire DCI will be pre-provisioned in Building, the cost towards development of DCI should also be accounted in total building plan cost along with other building services. Such cost may be realised by the Property Managers either through upfront loading on cost of constructions or distributing it in two parts one upfront and other through maintenance charges, as applicable for different classes of buildings. The same rules should apply in case of existing buildings also for upgradation, expansion as well as for creation of DCI.
f) There are certain active wireless equipments which, as per the Indian Telegraph Act, can be owned only by Licensed entities[33]. The Property Manager should get such equipment installed through telecom licensed entities only at their costs. To that extent the ownership of all such equipment will be of the licensed entities.

[33]Those licensed under section 4 of Indian Telegraph Act, 1885

g) The Property Manager should provide access of pre-provisioned DCI owned by him to service providers without any charge. However, in case of active wireless equipment deployed and owned by a licensed entity, a reasonable charge may be worked out by mutual agreement between such licensee and amongst other licensed service providers for sharing of such wireless infrastructure.

h) Occupancy-cum-Completion certificate to a Building is to be granted only after evaluating that the DCI developed is as per the prescribed standards and duly certified by the DCI Professional on Record.

i) To ensure that Buildings under development or undergoing redevelopment are constructed with DCI of highest possible standards, the idea of Rating of Buildings for Digital Connectivity has been introduced. This will help to nudge the Property Managers to improve the conditions of digital connectivity in the Buildings under their purview. The rating may cover the aspect of resilience of DCI, future readiness of Buildings for digital connectivity, reachability of the connectivity at each corner of the Buildings, availability of the service providers and quality of user experience, etc.

j) The Rating Framework for Digital Connectivity will enable the Property Managers to get assessment of their Buildings for digital connectivity by a rating agency. The Buildings so assessed can be assigned rating labels either in terms of number of stars or any other visual representation developed for the same. The rating will be listed on a searchable property directory. Buildings with good digital connectivity Rating will enable tenants and residents to take an informed decision before moving into premises so as to ensure they will have trouble-free connectivity for any kind of activities being performed from that location.

4.5. To incorporate changes as per above discussed approach and to consolidate the provisions related to telecom infrastructure (now referred to as DCI) at one place in the Model Building Bye-Laws (MBBL), this chapter has been incorporated. The comprehensive DCI framework suggested under this chapter shall facilitate the end users to get DCI created as per their requirements and choices through the Property Managers. At the same time, the provisions in the bye-laws will nudge Property Managers to facilitate the service/ infrastructure providers to access the premises and provide best quality of the service to the end users.

5. Important aspects to keep in mind while making DCI related provisions in building bye-laws

5.1. Telecommunication and broadcasting services are similar to the other utility services in buildings such as water, power, etc. However, unlike other services, telecommunication services are constantly evolving, and hence, the DCI is required to be flexible enough to accommodate a variety of ICT systems and emerging technologies and be future proof for the next 25-30 years.

5.2. Space and power are required for installation of DCI with suitable earthing provisions to safeguard equipment. Most telecommunication utilities can share the same space since the physical topology and wiring requirements are similar and no significant power is present in the cables. However, in some cases state-of-the-art communication cabling or equipment will involve new or more specific requirements for utility spaces such as:

a) Cable routing layout and cable length restrictions between work-space and utility closet.

b) Bending radius and working clearance requirements for different cable types, e.g., Fiber optic cables, Cat-6 Cables and co-axial cables.
c) Isolated power circuits with backup for permanent communication equipment.
d) Protection, Safety, Grounding and environmental requirements of communication equipment.

5.3. While preparing the building plans, it shall be mandatory to have properly demarcated sections within Buildings and on rooftops for housing DCI. These areas shall have access to power supply for reliable and always-on services.

5.4. While developing Greenfield cities/towns, the layout plans shall clearly indicate the DCI as Utility infrastructure. BIS Standards and NBC provisions should be followed for DCI designing and evaluation, wherever applicable.

5.5. The placement and sequence of above-ground and below-ground utilities at the appropriate location in the right-of-way shall be ensured for unconstrained movement as well as easy access for maintenance. Telecommunication cables shall be placed in a duct that can be accessed at frequent service points with sufficient spare capacity to enable scaling and future expansion, and empty pipes (large size hume pipes / HDPE pipes) shall be laid before planting trees in order to accommodate additional infrastructure.

5.6. DCI should be planned in such a manner that it is:
a) not susceptible to flooding,
b) not exposed to water, moisture, fumes, gases or dust,
c) able to withstand designed equipment load (to be specified in design),

d) located away from any vibrations to avoid dislocation/dislodgement.

5.7. Wireless services are generally provided from the wireless equipment installed outside the Building. However, there are appreciable losses in signal strength when it penetrates building structures/ walls. All these result into poor in-building coverage and are more pronounced to the consumers using high-speed data services. These services require a much better signal quality than their voice counterparts. Therefore, in order to improve in-building coverage and to offer better-quality high-speed data services, there is a definite need to install in-building solutions (IBS) comprising of wireline and wireless equipment. There will also be need for installing small cells of 5G, Wi-Fi hotspots, Fibre to x (FTTX) distribution network of Fiber and Cat-6 Cables for seamless data connectivity.

5.8. Provisioning of telecom services, broadcasting services (like Cable TV, DTH), Security Services (like CCTV Cameras) and futuristic services (like AR/ VR, Metaverse) requiring very high bandwidth and low latency may need robust and always on wireline connectivity along with wireless connectivity. Wireline services through cables such as copper cables, optical fibre cables (OFC), LAN Cat-6 cables are also equally important for having uninterrupted connectivity.

5.9. While approving the building plans, it has to be ensured that plan for creation of DCI, including the common duct to access telecommunication/ equipment room inside the Building, is also prepared and separate set of drawings showing the inter / intra connectivity access to the Building with distribution network need to be furnished. The common ducts /digital access paths to access Buildings from outside should invariably be part of the DCI which could be used by the service providers for provisioning of various services to consumers.

6. Specific provisions in bye-laws for Development of DCI and Rating of Buildings:[34]

6.1. Definitions for the purpose of this chapter

a) **Backhaul:** Backhaul networks connect the access network to the core network.[35]

b) **Buildings or Areas:** For the purpose of development of DCI and Rating, 'Buildings or Areas' refer Buildings and their surroundings controlled, owned or managed by a Property Manager. These include residential or commercial complexes, educational or non-educational campuses, offices, housing societies, industrial estates/parks, cantonment areas, ports, airports, railway stations, bus stations, metro stations, etc. The term 'Buildings or Areas' has been referred hereinafter as 'Buildings' for the sake of convenience.

c) **Council of Digital Connectivity Infrastructure (CoDCI):** A Council of DCI (CoDCI) established under the Department of Telecommunications (DoT), Ministry of Communication for the purpose of developing courses, accreditation of institutions, defining qualifications and conducting examinations and registration of DCI Professionals, etc.

d) **Digital Connectivity Infrastructure (DCI):** Digital Connectivity Infrastructure (DCI) consists of passive and active elements which include any apparatus, appliance, instrument, equipment, and system used or capable of extending seamless digital connectivity. All

[34] In addition to the inclusion of aforementioned specific provisions in bye-laws for Development of DCI and Rating of Buildings, if any modification is required in any other existing provision of MBBL 2016 in this regard, then the same may be suitably incorporated by MoHUA.

[35] Recommendations_31082021.pdf (trai.gov.in)

infrastructure required for establishing Wireless or Wireline Access Networks such as Radio Access Networks (RAN) and Wi-Fi systems, and Transmission Links Interface, Duct Space, Optical Fiber, Poles, Towers, Feeder cable, Antenna, Base Station, In-Building Solutions (IBS), Distributed Antenna System (DAS), or any other equipment to be used for the provision of digital connectivity, may be part of DCI. However, it shall not include core network elements.

e) **DCI Designer:** A professional who has the competence and possesses prescribed qualifications to design DCI for Buildings.

f) **DCI Engineer:** A professional who has the competence and possesses prescribed qualifications to implement the DCI designed for Buildings.

g) **DCI Evaluator:** A professional who has the competence and possesses prescribed qualifications to measure and evaluate the quality of the DCI deployed inside Buildings.

h) **DCI Professional:** Means DCI Designer or DCI Engineer or DCI Evaluator.

i) **Digital Platform:** A central platform developed and maintained by CoDCI/ DoT for cohesive implementation of DCI.

j) **DCI Professional(s) as Person(s) on Record:** DCI Professional(s) engaged by the Property Manager(s) for development of DCI and declared on Plan document shall be Person(s) on Record for DCI.

k) **Property Manager:** The person or body who is responsible to oversee and manage the development, operation and maintenance of a Building and has the authority either as owner(s) of the Building or as an agent of the owner(s). The term “Property Manager” would include an owner or a developer or a builder of a real estate project(s) for an area (s) responsible to plan, design and build facilities like Multi-storey residential buildings, commercial buildings or complexes, etc.

l) **Rating Authority:** An authority competent to frame regulations and policies with regard to Rating of Buildings for digital connectivity. In the instant case, it is Telecom Regulatory Authority of India (TRAI).

m) **Rating Agencies:** Agencies empanelled/accredited by Rating Authority for the Rating of Buildings for digital connectivity.

6.2. Qualification and Competence of DCI Professionals

Qualifications and competence/ functions of DCI Professionals are given in the Appendix-E.[36]

6.3. Procedure for design, deployment and evaluation of the DCI

The procedure for design, deployment and evaluation of DCI shall be as follows:

a) **Pre-construction development permissions**

i. **DCI development**: No person or body shall carry out any development of DCI without obtaining prior approval from the Authority for the design plan developed by registered DCI Designer(s) excluding the following Buildings:

1. …
2. …

} To be decided by MoHUA

ii. **DCI expansion/upgradation**: No person or body shall make upgradation or expansion of any part of the previously deployed DCI, without first obtaining a separate DCI

[36] Kindly refer Annexure A to this Appendix

permission from the Authority, excluding the following Buildings:

1. ...
2. ...

} To be decided by MoHUA

b) The Property Manager shall prepare a DCI plan by engaging DCI Designer.

c) To develop DCI, the DCI Professionals (Persons on Record for DCI) shall follow standards as prescribed by the BIS from time to time.

d) Such DCI plan shall be based on the standards prescribed by BIS and shall be part of the overall building plan submitted to the Authority.

e) **Procedure for obtaining pre-construction development permissions**

i. **Notice for DCI development**: A Property Manager who intends to develop DCI shall give notice in writing to the Authority in the format prescribed by the Authority from time to time. A copy of final plan shall be retained in the office of the Authority for record after the issuance of the permission or rejection, as the case may be.

ii. **Notice for DCI expansion/upgradation**: A Property Manager who intends to make expansion/upgradation in any part of the previously deployed DCI shall give notice in writing to the concerned Authority of his intention in the format prescribed by the Authority from time to time. A copy of final plan shall be retained in the office of the Authority for

record after issuance of the permission or rejection, as the case may be.

iii. **Information accompanying notice**: The notice shall be accompanied with the design plan certified by the registered DCI Designer (Persons on Record for DCI Plan), consisting of information in respect of digital connectivity related requirements of existing/prospective users and building related information in the specified format as notified by the BIS and other documents as prescribed by the Authority.

f) The Authority shall assess the details submitted as per requirements and process defined in National Building Code for pre-construction evaluation of the DCI. The approval may be intimated within the time limit as prescribed by the Authority.

g) The Property Manager shall engage DCI Engineer to implement DCI as per the approved design.

h) **Post-construction usage permissions**

i. **Notice of completion**: Property Manager shall submit a notice of completion of the DCI in the format prescribed to the Authority regarding completion of the work described in the DCI development/expansion/upgradation permission, as the case may be.

ii. **Completion and usage permission**: The Authority on receipt of the notice of completion shall evaluate the DCI deployed as per design approved through registered DCI Evaluators and communicate the approval or refusal or objection thereto within the time limit as prescribed by the Authority. In case of approval, a completion and usage

certificate will be issued by the Authority to the Property Manager.

i) The DCI Evaluator shall not be the same professional who has been engaged either as DCI Engineer or DCI Designer for the given Building.

6.4. **DCI Development in the Existing Buildings**

a) In all existing Buildings owned by Government, PSUs or autonomous bodies of the Government, commercial buildings and public places such as airports, ports, railway stations, bus stations, metro stations or any other Building as notified by the Government, DCI shall be upgraded or provided to meet the requirements of state-of-the-art digital connectivity, within three years after issuance of these building bye-laws.

b) For existing Buildings other than mentioned in para (a) above, the Property Managers of such existing Buildings shall upgrade or provide DCI to meet the requirements of state-of-the-art digital connectivity, within three years after issuance of necessary amendment in the building bye-laws for this purpose.

6.5. **Ownership and access to the DCI in the Buildings**

a) The Property Manager shall be the owner of the deployed DCI whether created by himself or through his agent and shall be responsible for maintenance, expansion and upgradation of such DCI.

Provided that, as active wireless equipment can be installed by a telecom licensee only, the Property Manager shall ensure access

to such active wireless equipment is made available to other telecom licensees in a fair, transparent, non-discriminatory and non-exclusive manner.

b) The Property Manager shall ensure access to DCI, developed inside the Buildings, to all infrastructure/service providers on non-chargeable basis in fair, transparent and non-discriminatory manner.

c) The Property Manager shall not have any exclusive arrangements or agreements with any telecom service/ infrastructure provider.

d) The telecom service providers shall have unrestricted access for maintenance work.

6.6. Standards for Development, Operations and Upgradation of DCI: National Building Code of India, 2016 (NBC 2016)[37]

a) For development, operations and upgradation of DCI, the DCI professionals, Property Managers and other entities involved shall follow standards prescribed in National Building Code of India, 2016 as amended from time to time.

b) The DCI infrastructure shall have following applicable components unless otherwise prescribed for a specific class of buildings, as detailed in the NBC 2016-

[37]The standards published by BIS with regard to DCI need to be comprehensively reviewed and revised as recommended by TRAI in its recommendations on '*Rating of Buildings or Areas for Digital Connectivity*' dated 20th February 2023. The table has been prepared on the basis of the Addendum issued in March 2022 by TCPO, MoHUA.

S. No.	DCI Components	Applicable NBC 2016 clauses	Specifics
1	Entrance Facilities (EF) /Lead-in conduits	clause 3.1.4, of Part 8: Sec 6	min. 1.2m x 1.83m space to be allocated for each TSP adjacent to the EF
2	Underground conduits/ pipes to MDF room		min 100mm dia encased conduits
3	Main Distribution Frame (MDF)/ Equipment Room (ER)	clause 3.1.2, Part 8: Sec 6	• prescribed size with L:W ratio between 1:1 to 2:1 • appropriate ventilation of MDF room • proper Lighting for vision of equipment, • located at a level above from the Natural Ground level to avoid incidence of flooding • Electric distribution panels, isolators, sockets and earthing as per specific requirements w.r.t the area proposed for coverage (DUs/ service subscribers)
4	Telecommunications Room (TR) at each building block unless provided with MDF room	all provisions of space to be as per clause 3.1.3.2, Part 8: Sec 6	Also refer Note 1 Below
5	Appropriate nos. Of Service/Telecom risers (vertical shafts) for all multi-storeyed buildings w.r.t the area proposed for coverage (DUs/ service subscribers		of appropriate numbers and size (width & depth) to accommodate cable trays with of access door at each floor
6	Telecommunications Enclosures (TE) at each floor of a block or TR	clause 3.1.5, Part 8: Sec 6	
7	Telecom Media and Connecting Hardware (TE)	clause 3.2, Part 8: Sec 6	
8	Various cabling system and trays	clause 3.2.4, Part 8: Sec 6	

9	Wireless systems	clause 3.2.5, Part 8: Sec 6	
10	Backbone Cabling Media Distribution and Bldg. pathways	clause 3.3, Part 8: Sec 6	
11	Horizontal Cabling Media Distribution and Bldg. pathways	clause 3.4, Part 8: Sec6	
12	IBS installation spaces: area for rooms or systems (e.g., antennas, base stations, remote units, power distribution boxes, etc.)	clause 3.1.3.2, Part 8: Sec6	to be provided as per requirements w.r.t the area proposed for coverage/ no. of proposed users.

Note 1:

A) Telecom room space norm for buildings with Built-up area >465 sqmt

S No	Area to be covered by IBS	Size of Telecom Room (all dimension in m)
1	Upto 465 sqmt	3.0 x 2.4
2	465.0 sqmt to 930.0 sqmt	3.0 x 3.4
3	More than 930.0 sqmt	Additional TR required with same space norms

B) Space requirements for smaller buildings with Built-up area <465 sqmt

S No	Area to be covered by IBS	Size of Telecom Room (all dimension in m)
1	Upto 93.0 sqmt	Wall cabinets, self-contained enclosed cabinets.
2	93.0 sqmt to 465.0 sqmt	Shallow Room (0.6 x 2.6)
		Walk-in Room (1.3 x 1.3)

c) For other standards and installation practices to be followed in development of DCI for different classes of Buildings, Volume 2, Section 6 of Part 8, of the National Building Code, 2016 on *'Information and Communication Enabled Installations'*, as

updated from time to time, shall be referred and followed by all entities involved including DCI professionals, Property Managers, and the Authorities.

6.7. **Framework for Rating of Buildings for digital connectivity:**

a) Framework for Rating of Buildings for digital connectivity shall be as per the regulations of TRAI issued in this regard.

b) The Rating of Buildings for digital connectivity shall be made mandatory for all existing as well as new Buildings of public importance within two years of issue of the regulatory framework by TRAI or two years from obtaining occupancy certificate, whichever is later. Rating of the following Buildings of public importance should be made mandatory:

i. Airports,
ii. Ports,
iii. Railway/ metro stations,
iv. Bus stations,
v. Buildings of Central/ State/ UT Governments/ Local authorities/ Government agencies/ PSUs,
vi. Government residential colonies,
vii. Industrial estates including industrial parks, SEZs, multi-modal logistic parks,
viii. Large commercial office complexes,
ix. Large commercial shopping complexes,
x. All institutes of higher education including research institutes,
xi. All multi-speciality hospitals, and
xii. Any other Buildings as Government may decide.

c) The Rating of Buildings for digital connectivity shall be mandatory for all new Buildings, excluding the class of Buildings as notified by the Government from time to time.

d) The Property Manager shall get Buildings rated for digital connectivity within two years of obtaining the occupancy certificate once TRAI has issued the regulatory framework. However, for buildings other than those mandated, the Property Manager may get their buildings rated for digital connectivity on voluntary basis.

Annexure A to Appendix I

Addendum to Appendix E of MBBL 2016
Qualification and Competence of Technical Personnel for Preparations of Schemes for Building Permit and Supervision

Sl. No	Professional	Qualifications	Competence/ Functions
11	DCI Professional		
11(a)	DCI Designer	As prescribed by CoDCI (Council of Digital Connectivity Infrastructure)	
11(b)	DCI Engineer		
11(c)	DCI Evaluator		

APPENDIX-II to CHAPTER 4

PROPOSED MODIFICATIONS IN THE NBC, 2016

1. Background

The National Building Code of India (NBC), a comprehensive building code, is a national instrument providing guidelines for regulating the building construction activities across the country. It serves as a Model Code for adoption by all agencies involved in building construction works be they Public Works Departments, other government construction departments, local bodies or private construction agencies.

Volume 2 Part 8 Section 6 of the NBC provides requirements related to Information and Communication Enabled Installations which mainly focus on the essential requirements for ICT-enabled installations, technology systems and related cabling installations in a Building. This section also covers basic design and integration requirements for telecommunication with earmarking of spaces within the Buildings and their cabling infrastructure including their components and passive connectivity hardware. It also mentions that Buildings meant for data centers and those for housing telecom exchange or facilities for offering public services in such Buildings may have to look into various other considerations suited to their requirements. The provisions given in this section are basic requirements applicable to all residential and other Buildings.

The provisions in the NBC are broadly related to the cable laying practices for wireline network infrastructure through common pathways, ducts and cable trays. The solutions regarding DCI development proposed through these recommendations comprise of a comprehensive design of infrastructure right from the beginning of construction of the Building and after accounting requirements of end users. It is a collaborative approach among all

stakeholders, which provides digital connectivity solutions as per user specific needs.

The present-day telecom networks majorly consist of wireless networks and more than 98% of the telecom consumers are of the wireless services. Total volume of wireless data usage increased by around 30 times from 2016[38] to 2021[39]. The recent pandemic has shifted usage pattern from office locations to anywhere i.e., working from home or from any other places as per the consumer's choice. It is therefore essential to review the standards and incorporate new standards to ensure ubiquitous and meaningful connectivity at every location in the Building. Further, standards in respect of 4G and 5G wireless services, high speed bandwidth for fixed line broadband are also to be incorporated so as to provide an immersive experience of digital connectivity to the end users.

2. Recommendations of the Authority in respect of BIS

TRAI has brought out a comprehensive framework for development of Digital Connectivity Infrastructure inside the Building. This framework includes recommendations to the Government for incorporation of DCI related provisions in MBBL, role of various stakeholders including Property Managers, recognition and capacity building of DCI Professionals and the Rating of Buildings for digital connectivity. The TRAI recommendations related to review of provisions in NBC are reproduced below for necessary consideration of BIS through National Building Code Sectional Committee and Panel on '*Information and Communication Enabled Installations*':

8. *The Authority recommends that the Bureau of Indian Standards (BIS) should be tasked to review existing standards and procedures of DCI for Buildings.*

[38] https://trai.gov.in/sites/default/files/YPIRReport04052018.pdf
[39] https://trai.gov.in/sites/default/files/YIR_08072022_0.pdf

The Authority further recommends that new terms, related to DCI, figured in the recommendations should be defined in the NBC. **(Para 2.4.8)**

9. *The Authority recommends that the "National Building Code Sectional Committee" constituted under NBC, also referred as Guiding Committee should include members from the Department of Telecommunication and Telecom Industry.* **(Para 2.4.8)**

10. *The Authority further recommends that the Panel on 'Information and Communication Enabled Installations' under NBC (Volume 2, Part 8, Section 6) should be expanded to include representatives from Telecommunication Engineering Centre (TEC) and Telecommunications Standards Development Society India (TSDSI) and, experts on telecom RF planning and experts on digital modelling of Buildings. The convener of this panel should be the representative nominated by DoT.* **(Para 2.4.8)**

11. *On standards for products and procedures for DCI, the Authority recommends that,*

    a) *the BIS should prescribe and update standard templates which will be used by Property Managers for collecting building-related information and connectivity requirements of users. In case of non-availability of data from the users, the Property Manager shall use the data available for similar Buildings. Data collected through such templates shall be used by the DCI Designers.*
    b) *the standards and procedures framed, and templates prescribed for DCI by BIS should be made part of the National Building Code (NBC).*
    c) *TEC should continue to work as the equipment standardisation and certification agency for standard products and equipment required for DCI.*
    d) *TEC should prescribe necessary specifications in respect of new products required for upgradation of DCI.*

e) *TEC should also ensure that the certified products for DCI are shareable and interoperable.*

f) *TEC should enlist and publish such DCI products and equipment which require certification.* **(Para 2.4.8)**

12. *The Authority recommends that BIS should prescribe different standards for different classes of Buildings for DCI.* **(Para 2.4.8)**

13. *Further, the Authority recommends that BIS should also prescribe such provisions of DCI that would be mandatorily required (essential requirements) to be completed for issuance of completion/occupancy certificate for Buildings.* **(Para 2.4.8)**

19. *The Authority recommends that in case of introduction of new spectrum bands, change in technologies, increased users' demands etc.,*

a) *DoT should take up with BIS and MoHUA for incorporation of amendments in National Building Code and Model Building Bye-Laws respectively.*

b) *BIS should also prescribe essential provisions that would be required to be carried out by Property Manager for upgradation and expansion of DCI.* **(Para 2.6.6)**

39. *The Authority recommends that the BIS Panel on 'Information and Communication Enabled Installations' should develop standards in respect of DCI for the Buildings, to be included in the National Building Code as mentioned in Appendix-II to this chapter. The Authority further recommends that definitions, related to DCI, as mentioned in para 6.1 of Appendix-I, should be made part of the NBC.* **(Para 4.7)**

CHAPTER 5

SUMMARY OF RECOMMENDATIONS

1. **The Authority recommends that Model Building Bye-Laws (MBBL) and National Building Code of India (NBC) should be amended to incorporate necessary provisions on Digital Connectivity Infrastructure (DCI) as recommended herein. (Para 2.2.7)**

2. **The Authority also recommends that, DCI should be made an essential component of the building development plans, on the line of water supply, electrical services, gas supply, fire protection and fire safety requirements, etc. (Para 2.2.7)**

3. **In case of development of Buildings in rural, semi-urban, remote and hilly areas, etc. where MBBL is not directly applicable, the Authority recommends that the Government may work with State Governments/ UTs for incorporation of suitable provisions for DCI development in the respective bye-laws or other relevant laws of the State Governments/ UTs. (Para 2.2.7)**

4. **As RERA act protects the interests of the consumers of the real estate sector and provides platform for speedy disposal of their disputes, the Authority recommends that provisions for mandating DCI inside the Buildings, its maintenance, timely upgradation, etc. should be incorporated in the builder-buyer agreement for covering it under the jurisdiction of RERA act and its enforceability by the RERA. (Para 2.2.7)**

5. **The Authority recommends that the actors to design, deploy and evaluate the DCI should include the Property Manager and DCI**

Professionals i.e., DCI Designer, DCI Engineer and DCI Evaluator, where:

a) **The Property Manager is the person or body who is responsible to oversee and manage the development, operation and maintenance of a Building and has the authority either as owner(s) of the Building or as an agent of the owner(s). The term "Property Manager" would include an owner or a developer or a builder of a real estate project(s) or an area(s) responsible to plan, design and build facilities like Multi-storey residential buildings, Commercial buildings or complexes, etc.**

b) **DCI Designer is a professional who has the competence and possesses prescribed qualifications to design DCI for Buildings.**

c) **DCI Engineer is a professional who has the competence and possesses prescribed qualifications to implement the DCI designed for Buildings.**

d) **DCI Evaluator is a professional who has the competence and possesses prescribed qualifications to measure and evaluate the quality of the DCI deployed inside Buildings. (Para 2.3.5)**

6. **The Authority further recommends that any person who possesses the requisite skills, as may be prescribed, can perform the functions as DCI Designer or DCI Engineer or DCI Evaluator. (Para 2.3.5)**

7. **The Authority recommends that a separate chapter should be included in MBBL on comprehensive framework for development of DCI. (Para 2.4.8)**

8. **The Authority recommends that the Bureau of Indian Standards (BIS) should be tasked to review existing standards and procedures of DCI for Buildings. (Para 2.4.8)**

9. **The Authority recommends that the "National Building Code Sectional Committee" constituted under NBC, also referred as Guiding Committee should include members from the Department of Telecommunication and Telecom Industry. (Para 2.4.8)**

10. **The Authority further recommends that the Panel on 'Information and Communication Enabled Installations' under NBC (Volume II, Part 8, Section 6) should be expanded to include representatives from Telecommunication Engineering Centre (TEC) and Telecommunications Standards Development Society India (TSDSI) and, experts on telecom RF planning and experts on digital modelling of Buildings. The convener of this panel should be the representative nominated by DoT. (Para 2.4.8)**

11. **On standards for products and procedures for DCI, the Authority recommends that,**

    a) **the BIS should prescribe and update standard templates which will be used by Property Managers for collecting building-related information and connectivity requirements of users. In case of non-availability of data from the users, the Property Manager shall use the data available for similar Buildings. Data collected through such templates shall be used by the DCI Designers.**

    b) **the standards and procedures framed, and templates prescribed for DCI by BIS should be made part of the National Building Code (NBC).**

c) **TEC should continue to work as the equipment standardisation and certification agency for standard products and equipment required for DCI.**

d) **TEC should prescribe necessary specifications in respect of new products required for upgradation of DCI.**

e) **TEC should also ensure that the certified products for DCI are shareable and interoperable.**

f) **TEC should enlist and publish such DCI products and equipment which require certification. (Para 2.4.8)**

12. **The Authority recommends that BIS should prescribe different standards for different classes of Buildings for DCI. (Para 2.4.8)**

13. **Further, the Authority recommends that BIS should also prescribe such provisions of DCI that would be mandatorily required (essential requirements) to be completed for issuance of completion/occupancy certificate for Buildings. (Para 2.4.8)**

14. **The Authority recommends that the Property Manager shall be the owner of the deployed DCI whether created by himself or through his agent and shall be responsible for maintenance, expansion and upgradation of such DCI. The Property Manager shall allow access of DCI to all service providers in fair, non-chargeable, transparent and non-discriminatory manner and shall not have any exclusive arrangements or agreements with any infrastructure/service provider.**

Provided that in case active wireless equipment is installed by a licensee, the licensee will be responsible for maintenance, expansion and upgradation of such DCI and to that extent, the ownership lies with that licensee. However, this installation of active wireless equipment

will be carried out on behalf of the Property Manager and Property Manager shall be responsible for ensuring that the licensee compulsorily gives access of such active wireless equipment to all service providers on fair, transparent, non-discriminatory, and non-exclusive manner. (Para 2.5.6)

15. **Further, the Authority recommends that, an amendment to the present Unified license conditions with a proviso for compulsory sharing of active wireless equipment in the Buildings may be carried out. (Para 2.5.6)**

16. **The Authority recommends that the revenues earned by sharing of active wireless equipment, as part of DCI, by lessor licensees should not attract License Fee (LF). For the same, such revenues should be reduced from the Gross Revenues (GR) of the lessor licensee to arrive at Applicable Gross Revenue (ApGR) of such lessor licensee.**

    To implement above recommendation, it is further recommended that, a new item named as "Revenue earned from other licensees from sharing of active wireless equipment, as part of DCI" should be inserted under the license provisions namely "List of other items to be excluded from GR to arrive at ApGR". It is also recommended that, appropriate modification may be carried out in UL, UL(VNO) and ISP licenses. Also, the information collected in "Format of Statement of Revenue and License Fee" that is attached with each authorization chapter in UL, UL(VNO) and with ISP licenses needs to be modified to capture information from such revenues under a separate head. (Para 2.5.6)

17. **For existing Buildings where DCI is partly created, the Authority recommends a collaborative approach among stakeholders to decide ownership i.e., Property Manager for development, upgradation and**

expansion of DCI. However, in cases where DCI is developed by a service provider/ IP-I(s), till no suitable arrangement is worked out to transfer the DCI to the Property Manager, such service providers/ IP-Is shall be governed by the mandatory provisions of the license/ registration conditions. (Para 2.5.6)

18. **The Authority reiterates its recommendation in para 2.90 of its recommendations dated 29th November 2022 on "*Use of Street Furniture for Small Cell and Aerial Fibre Deployment*" wherein it was recommended that "*enabling provisions or suitable terms and conditions shall be introduced in all telecom licenses and IP-I registration agreement prohibiting the TSPs/IP-I providers from entering into any exclusive contract or right of ways with infrastructure owners/CAAs or any other authority*". (Para 2.5.6)**

19. **The Authority recommends that in case of introduction of new spectrum bands, change in technologies, increased users' demands etc.,**

    a) **DoT should take up with BIS and MoHUA for incorporation of amendments in National Building Code and Model Building Bye-Laws, respectively.**

    b) **BIS should also prescribe essential provisions that would be required to be carried out by Property Manager for upgradation and expansion of DCI. (Para 2.6.6)**

20. **The Authority recommends that the MBBL should have appropriate provisions for the approval of upgradation and expansion of DCI. (Para 2.6.6)**

21. **The Authority further recommends that the Property Manager should ensure upgradation and expansion of DCI in the timeline as will be prescribed in the MBBL. (Para 2.6.6)**

22. **The Authority recommends that, in all existing Buildings owned by the Government, PSUs or autonomous bodies of the Government, commercial buildings and public places such as airports, ports, railway stations, bus stations, metro stations or any other Building as may be decided by MoHUA in consultation with DoT, DCI shall be upgraded or provided to meet the requirements of state-of-the-art digital connectivity. In such cases, the Authority also recommends that the building bye-laws should prescribe a reasonable time frame so as to ensure availability and accessibility of upgraded DCI. (Para 2.6.6)**

23. **The Authority further recommends that for existing Buildings other than those mentioned in recommendation no. 22, the new building bye-laws should be issued by MoHUA within three years after due consultation with the various stakeholders. Till then, it is recommended that, the Property Managers of such existing Buildings shall implement the new bye-laws voluntarily. (Para 2.6.6)**

24. **The Authority recommends that, the Indian Telegraph Act, 1885 should be amended as follows:**

    a) **The Central Government may prescribe through rules for formation of Council of Digital Connectivity Infrastructure (CoDCI).**

    b) **The rules may specify the manner of certification of persons to design, deploy and evaluate DCI.**

    c) **Such rules may specify the qualification of and terms and**

conditions subject to which, such certification may be granted, including through conduct of examinations for granting such certifications, the fees and charges to be paid thereof, and other connected matters. (Para 2.7.6)

25. **The Authority recommends that a Council of DCI (CoDCI) should be established under the Department of Telecommunications (DoT), Ministry of Communication in collaboration with the Ministry of Housing and Urban Affairs (MoHUA), All India Council for Technical Education (AICTE), National Skill Development Council (NSDC), Telecom Sector Skill Council (TSSC), and Construction Skill Development Council (CSDC) or any other organisation/institution as deemed appropriate. The CoDCI shall be responsible for taking all decisions in respect of certification, registration and capacity building of DCI Professionals. (Para 2.7.6)**

26. **The Authority recommends that broad roles and responsibilities of CoDCI are as follows:**

    a) **To prescribe the qualification, roles and responsibilities of DCI Professionals.**

    b) **To study the content of existing similar courses within and outside India and their suitability for DCI Professionals in India.**

    c) **To suggest appropriate Graduate and Diploma courses including elective/ certification courses at various levels for DCI Professionals.**

    d) **To accredit institutes and organisations for offering courses related to DCI. Considering that there are large number of Buildings in each State and UT, there may be a requirement of accreditation of institutions across all States and UTs for offering**

such courses and development of the workforce.

e) **To conduct examination and certify DCI Professionals.**

f) **To organise training for trainers and skill upgradation of DCI professionals.**

g) **To register qualified and certified DCI Professionals, on similar lines to the CoA. Such Professionals once engaged by Property Managers for development of DCI and declared on their plan documents shall be Persons on Record.**

h) **To maintain a register of DCI Professionals and publish the same on online portal for access and use by various stakeholders.**

i) **To keep a track of various activities related to capacity building and dissemination of the information to all stakeholders, the council needs to develop a digital platform for the cohesive implementation of DCI and linking of the same with various agencies.**

j) **Any other work related to capacity building as deemed fit by the council. (Para 2.7.6)**

27. **The Authority recommends that the CoDCI, within one year of its establishment or three years from the date of these recommendations, whichever is earlier, should establish a mechanism for certification, registration and capacity building of DCI Professionals including setting up of digital platform for the cohesive implementation of DCI. (Para 2.7.6)**

28. **The Authority further recommends that till the time CoDCI is established, the provisions in new building bye-laws for DCI as recommended herein must be implemented by utilizing the services of**

the existing professionals already working in the field of design and development of Buildings and DCI. (Para 2.7.6)

29. **The Authority recommends that a digital platform should be developed and maintained by CoDCI. The broad objectives of the digital platform include but not limited to the following:**

a) **Activities related to capacity building of DCI Professionals:**

i. **Publish details of the courses, accredited institutions and the process for admissions, and applicable fee structures if any.**

ii. **Facility for conducting examinations for certification of DCI Professionals.**

iii. **Registration facility for certified DCI Professionals.**

b) **Publish the list of registered DCI Professionals and certified products and tools.**

c) **Provide a marketplace for buying and selling of certified products. Such e-marketplace should be linked with Open Network for Digital Commerce (ONDC).**

d) **Enable Property Managers to hire services of registered DCI Professionals.**

e) **Enable interaction and collaboration among various stakeholders through various technologies and tools.**

f) **To provide a feedback mechanism for the services delivered by registered DCI Professionals and certified products used.**

g) **To maintain details with regard to development projects/ Buildings approved – ongoing, completed and put to use by the**

local bodies and other competent authorities.

h) **To create a repository in respect of the service providers along with technologies and spectrum bands, who are offering services in the area and update the same from time to time.**

i) **To create a repository of knowledge based on past learning of implementation of DCI projects to support in standardisation of the processes.**

j) **To make available on a regular basis the information on standards, technology and best practices within India and at global level related to DCI.**

k) **To publish analytical reports/articles on DCI development and related issues.**

l) **To make available acts/ laws/ bye-laws/ rules/ regulations related to DCI.**

m) **To facilitate online application, clearance and approval process for service providers seeking access to DCI created in Buildings (Para 2.8.6)**

30. **The Authority further recommends that, till the time CoDCI is established, the digital platform should be created by DoT to meet immediate objectives, which can later be handed over to the CoDCI. (Para 2.8.6)**

31. **The Authority recommends that, approval of DCI design, deployment and use of Buildings should remain with the existing institutions as per statute of State/UT Governments for the purpose. (Para 4.7)**

32. **The Authority further recommends that, the Authorities of the States/UTs responsible for approval of DCI development plans and evaluations thereof, should hire the services of a suitable expert/agency duly registered and certified by the Council of DCI (CoDCI). (Para 4.7)**

33. **The Authority recommends that the BIS Panel on 'Information and Communication Enabled Installations' should develop standards in respect of DCI for the Buildings, to be included in the National Building Code as mentioned in Appendix-II to this chapter. The Authority further recommends that definitions, related to DCI, as mentioned in para 6.1 of Appendix-I, should be made part of the NBC. (Para 4.7)**

34. **The Authority recommends that appropriate provisions for Rating of Buildings for Digital Connectivity should be included in the MBBL, on the lines of the provisions made in the MBBL for rating of green buildings. (Para 3.2.6)**

35. **The Authority recommends that to start with, the Rating of Buildings for digital connectivity should be made mandatory for all existing as well as new Buildings of public importance within two years of issue of the regulatory framework by TRAI or two years from obtaining occupancy certificate, whichever is later. The Authority further recommends that Rating of the following Buildings of public importance should be made mandatory:**

a) **Airports,**

b) **Ports,**

c) **Railway/ metro stations,**

d) **Bus stations,**

e) **Buildings of Central/ State/ UT Governments/ Local authorities/ Government agencies/ PSUs,**

f) **Government residential colonies,**

g) **Industrial estates including industrial parks, SEZs, multi-modal logistic parks,**

h) **Large commercial office complexes,**

i) **Large commercial shopping complexes,**

j) **All institutes of higher education including research institutes,**

k) **All multi-speciality hospitals, and**

l) **Any other Buildings as Government may decide. (Para 3.4.6)**

36. **The Authority also recommends that, the Rating of Buildings for digital connectivity should be made mandatory for all new Buildings, excluding the class of Buildings as may be decided by MoHUA in consultation with the States/ UTs and other stakeholders. (Para 3.4.6)**

37. **The Authority recommends that the Property Manager should get Buildings rated for digital connectivity within two years of obtaining the occupancy certificate once TRAI has issued the regulatory framework. (Para 3.4.6)**

38. **The Authority also recommends that for Buildings other than those mandated, the Property Manager may get their Buildings rated for digital connectivity on voluntary basis. (Para 3.4.6)**

39. **The Authority recommends that, a new draft chapter on DCI for the Buildings, as suggested in the Appendix-I to this chapter, should be**

included in the Model Building Bye Laws, in line with the recommendation no. 7 at para 2.4.8. (Para 4.7)

ANNEXURE-I

Definition of Property Manager

(As per the Consultation Paper)

For the sake of brevity, in this consultation paper, the term "Property Manager" is used to refer to the person who is responsible to oversee and manage the operation and maintenance affairs of a particular property, building, premises or an area and he has the authority on behalf of the owner of the property to carry out the functions requisite for upkeep or upgradation of the systems deployed inside the building or property or an area. The term "Property Manager" would also include and refer to any of the following entities depending upon the context:

- A person, who is heading Resident Welfare Association (RWA) in case of residential societies.
- A person, who is heading the maintenance agency that has entered into an agreement with the property owner or with the RWA to carry out operation and maintenance of the facilities.
- A person, who is heading the concerned unit of an organisation that has entered into concession agreements for use and operation of land or commercial premise such as in case of Airport terminals.
- A person, who is venue manager i.e., person-in-charge of a venue or an event and his main duty is to oversee activities and use of the facilities like Sport Stadiums, Cinema Halls, Theatres, Conferences, Hotels.
- A person who has been designated by the Government for operating and maintaining facilities for a particular government building or premises, area or residential colony such as in case of Cantonment

Area, Government Office Buildings, Government Residential Colonies etc.

- A person, who is a builder or a developer of a real estate project and is responsible to plan, design and build facilities like Multi-storey residential buildings, Commercial buildings or complexes.
- A person, who is designated by the Government to build or develop a real estate project for its own purposes and is responsible to plan, design and build facilities as in cases of buildings constructed by CPWD, Indian Railways, Housing Boards.
- Any other person or entity as notified by the Government.

LIST OF ACRONYMS

S. No.	Acronyms	Full Text
1	3D	Three Dimensional
2	AEC	Architecture, Engineering and Construction
3	AI	Artificial Intelligence
4	AICTE	All India Council for Technical Education
5	ApGR	Applicable Gross Revenue
6	BCP	Best Current Practice
7	BICSI	Building Industry Consulting Service International
8	BIM	Building Information Modelling
9	BIS	Bureau of Indian Standards
10	CAA	Controlling Administrative Authority
11	CAD	Computer Aided Design
12	CAGR	Compound Annual Growth Rate
13	CAPEX	Capital Expenditure
14	CMSP	Cellular Mobile Service Provider
15	CoA	Council of Architecture
16	COBIE	Construction Operations Building Information Exchange
17	CoDCI	Council of Digital Connectivity Infrastructure
18	CP	Consultation Paper
19	CPWD	Central Public Works Department

20	CREDAI	Confederation of Real Estate Developers' Associations of India
21	CTI	Common Telecom Infrastructure
22	CTNS	Certified Telecommunication Network Specialist
23	DAS	Distributed Antenna System
24	DCI	Digital Connectivity Infrastructure
25	DoT	Department of Telecommunications
26	FTTH	Fiber to the Home
27	GR	Gross Revenue
28	HLR	Home Location Register
29	IAMAI	Internet and Mobile Association of India
30	IBS	In-Building Solution
31	ICT	Information and Communication Technology
32	IEC	International Electrotechnical Commission
33	IN	Intelligent Network
34	iNARTE	International Association for Radio, Telecommunication & Electromagnetics
35	IoT	Internet of Things
36	IP	Infrastructure Provider
37	ISO	International Organization for Standardization
38	ISP	Internet Service Provider
39	IT	Information Technology

40	KPI	Key Performance Indicator
41	LSA	License Service Area
42	MBBL	Model Building Bye-laws, 2016
43	MEP	Mechanical, Electrical and Plumbing
44	ML	Machine Learning
45	MoHUA	Ministry of Housing and Urban Affairs
46	MSC	Mobile Switching Centre
47	NAREDCO	National Real Estate Development Council
48	NBC	National Building Code of India, 2016
49	NOC	No Objection Certificate
50	OECD	Organization for Economic Cooperation and Development
51	OFC	Optical Fibre Cable
52	OHD	Open House Discussion
53	OLTE	Optical Line Termination Equipment
54	OPEX	Operational Expenditure
55	PRI	Panchayati Raj Institution
56	PSU	Public Sector Undertaking
57	QoS	Quality of Service
58	RAN	Radio Access Network
59	RERA	Real Estate Regulatory Authority
60	RF	Radio Frequency

61	RoW	Right of Way
62	RWA	Residents Welfare Association
63	SACFA	Standing Advisory Committee on Radio Frequency Allocation
64	SEZ	Special Economic Zone
65	TCO	Telecommunications Certification Organisation
66	TCPO	Town and Country Planning Organisation
67	TEC	Telecommunication Engineering Centre
68	TERM Cell	Telecom Enforcement and Resource Monitoring Cell
69	TIA	Telecommunications Industry Association
70	TRAI	Telecom Regulatory Authority of India
71	TSDSI	Telecommunications Standards Development Society India
72	TSP	Telecom Service Provider
73	UASL	Unified Access Service License
74	UL	Unified License
75	UL (VNO)	Unified License (Virtual Network Operator)
76	ULB	Urban Local Body
77	UT	Union Territory
78	WFH	Work From Home
79	WPC	Wireless Planning and Coordination Wing