ICT Construction GuiDec-19deline in Buildings

Issue date: Nov 2019

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*In case of discrepancies/contradictions of this document with Saudi Building Code, the requirement of Saudi Building Code **SHALL** supersede*

1. INTRODUCTION

This document provides minimum requirement to implement telecommunication infrastructure inside buildings. The ICT Construction Guideline in Buildings addresses architectural, electrical and mechanical requirements pertaining telecommunication services inside buildings.

Adherence to ICT Construction Guideline in Buildings is compulsory by developers, consultants and contractors.

2. DEFINITIONS

Bonding: The joining of metallic parts to form an electrically conductive path.

Cable Sheath: A covering over the optical fiber or conductor assembly that may include one or more metallic members, strength members, or jackets.

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

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

Often, the owner of the real estate is also the Developer, he is responsible for observing ICT Construction Guideline in Buildings for construction and land development works

Entrance Point: The point of emergence for telecommunications cabling through an exterior wall, a floor, or from a conduit.

Entrance Facility: An entrance to a building for both public and private network service cables including the entrance point of the building and continuing to the entrance room or space.

Equipment Room (ER): room dedicated for housing distributors and application-specific equipment

Firestop: A fire-rated material, device, or assembly of parts installed in a penetration of a fire rated barrier

Floor Distribution (FD): A floor space accommodating optional points of distribution, additional to the main point of distribution, of any common cabling infrastructure within multi-tenant buildings, also known as Horizontal Distribution Area (HDA)

Grounding: The act of creating a conducting connection, whether intentional or accidental, between an electrical circuit (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

Horizontal Distribution Area (HDA): See Floor Distribution (FD)

In-building Physical Infrastructure (IPI): A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of information within a building or campus.

Listed: Equipment included in a list published by an organization, acceptable to the authority having jurisdiction, that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Main Distribution Area (MDA): A location inside telecommunication space where the main cross-connect is located

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

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

Pathway: A facility for the placement of telecommunications cable

Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

Rack: Supporting frame equipped with side mounting rails to which equipment and hardware are mounted.

Service provider: The operator of any service that furnishes telecommunications content (transmissions) delivered over access provider facilities.

Single-dwelling Unit (SDU): means a structure that contains only one Unit.

Telecommunications Room (TR): An area used for housing the installation and termination of telecommunications equipment and cable

Underground Entry Box (UEB): A structure similar to a small maintenance hole in which it is expected that a person cannot enter to perform work.

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

3. GENERAL

3.1 SCOPE

This document addresses safety requirements of ICT construction works in buildings in terms of performance of pathways, spaces, cabling and equipment and set relations with other building utility services (Electrical, Water, Mechanical …etc).

3.2 APPLICABILITY

The requirements shall apply to:

1. Single Dwelling Units (SDUs)
2. Multi-Dwelling Units (MDUs)
3. Government Entities
4. Industrial Facilities

3.3 HEALTH AND SAFETY

Building owners shall ensure all works carried out in connection with this document and shall conform to all applicable general and site-specific Health and Safety (H&S) requirements.

4. TELECOMMUNICATION REQUIREMENTS

Section 4 provides best practices for the design and construction of telecommunications pathways, cabling and spaces, including equipment rooms (ERs), telecommunications rooms (TRs), entrance facilities (EFs), and telecommunications enclosures (TEs). This section is written in conjunction with the current best practices, codes, standards, and technology

4.1 ENTRANCE FACILITY

4.1.1 General

Where access to both wireline and wireless services is required, the entrance facilities may require adjustment in size, quantity, and location. Mechanical fixtures (e.g., piping, ductwork, pneumatic tubing) not related to the support of the entrance facility should not be installed in, pass through, or enter the telecommunications entrance facility [2]. Operators shall be contacted to establish their requirements in terms of location and diversity (if required)

It is recommended that underground telecommunications facilities not be in the same vertical plane as other utilities, such as water or power that share the same trench. Utility services should be located horizontally with respect to each other, and shall be in compliance with applicable code [2].

4.1.2 EF for SDUs

It's the responsibility of the developer to provide minimum of 2x25mm uPVC ducts, the developer shall extend the ducts from the EP location to the UD. EP location shall be provisioned at the exterior wall of the building, positioned close to the main entrance at 1.5m above AFL as shown in Figure 4.1.

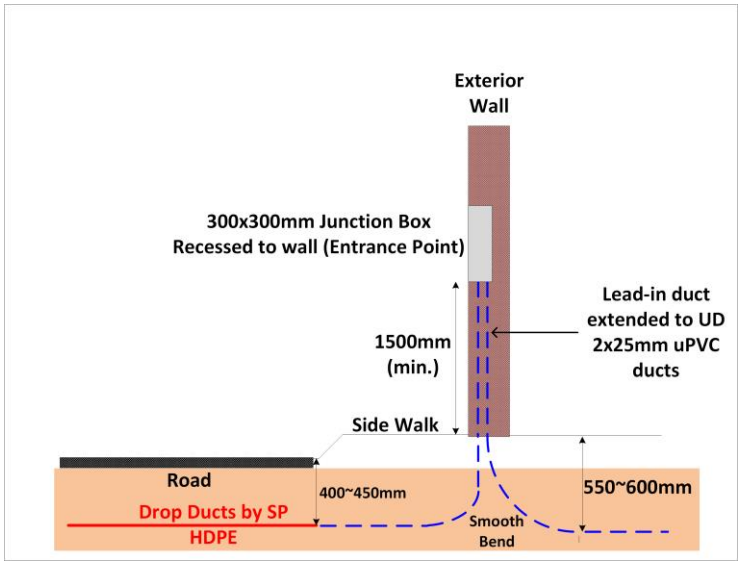

Figure 4.1 Lead-in duct details in SDU

4.1.3 EF for other building categories

The building developer shall provide underground entry box, located within plot limits. The position of the underground entry box shall be facing the building entrance facility. The size of the underground entry box shall be 600Lx600Wx800Dmm, the loading capacity shall comply with MOMRA specifications

The building developer shall install 4x50mm uPVC Lead-in ducts from the underground entry box to the SP allocated space inside the building. The open ends of the entry ducts shall be sealed in compliance with Saudi Electrical Code **SBC 401-CR (11-02, 11-06).**

In case of SP allocated space is co-located within dedicated telecom room, then lead-in ducts shall be extended minimum of ≈25 mm above the floor level and a maximum of ≈77 mm above the floor level. Lead-in ducts should be located a minimum of ≈25 mm from the wall or between adjacent sleeves to provide room for bushings, but not so far from the wall that it would be a tripping hazard or create too great a cable span from the sleeve to the backboard/tray [3].

In case of redundancy requirement, the building developer shall provide two underground entry boxes 600Lx600Wx800D separated by minimum of 20m, this shall apply for the entire route of the lead in ducts. It is recommended to have the entrance facilities at opposite sides of the building when possible

4.2 TELECOMMUNICATION SPACES

4.2.1 General

The scope of this section is the design and construction of telecommunications spaces. Telecommunications spaces are the rooms and areas where telecommunications cabling systems are terminated, cross connected, and interconnected to installed telecommunications equipment [3]. This section also impacts space allocation within the building in compliance with the international standards and best practices.

4.2.2 Telecommunication spaces for SDUs

There is no requirement to have a dedicated telecommunication space to house the UD in SDUs. The lead -in ducts shall be terminated into back box to serve the UD. A minimum of twin power sockets shall be provided adjacent to the UD within 300mm in compliance with Saudi Electrical Code **SBC 401-CR, Native of Demand (12-2.3)**

It is recommended for SDUs having multi NTs to have a dedicated recessed/wall mount rack, to house the UD and the distribution patch panel serving NTs as shown in Figure 4.2

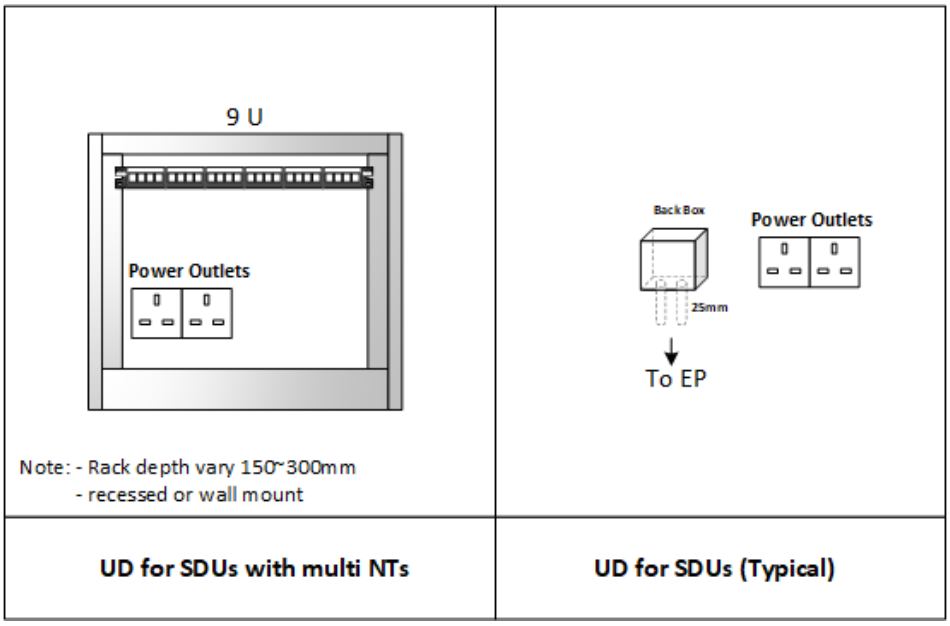

Figure 4.2 UD for SDUs

4.2.3 Telecommunication spaces for MDUs

(up to 128 units)

Allocating telecommunication space is compulsory for MDUs. A shallow room located in GF with minimum dimension of 600mm deep and 2600mm wide[1] as shown in Figure 4.3

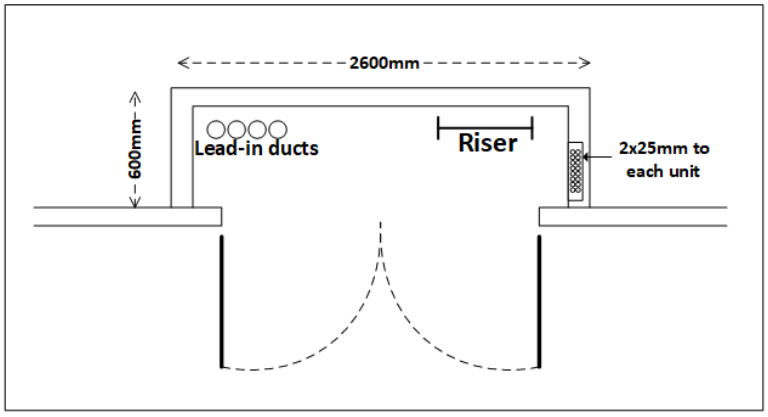

Figure 4.3 Shallow room details

Each unit shall be served by a dedicated 2x25mm, from the shallow room in GF to UD inside each unit. Daisy chain is prohibited. For UD details inside units, please refer to 4.2.2

4.2.4 Telecommunication spaces for other building categories

Providing a dedicated telecommunication room is compulsory. The telecom room shall be provisioned and sized to host SP equipment, Facility Network Equipment, MDA and HDA (optional). The size of the telecommunication room may vary according to the building size and function. Telecommunications spaces should be located in areas that are dedicated to telecommunications use. Equipment that is not related to the support of telecommunications spaces (e.g., piping, duct work, distribution of building power) should not be located in or pass through a telecommunications space[3]. Telecommunications spaces shall not be shared with building or custodial services. For example, sinks and cleaning materials (e.g., mops, buckets, solvents) shall not be located or stored in a telecommunications space [3].

Telecommunications spaces [3]:

- Are frequently visited by technicians and shall be safely accessible.
- Should be kept free of any storage material or other obstructions that could prevent technicians from performing their duties or create a fire hazard.
- Locating light switches near the entrance to the telecommunications space.
- Shall have minimum of 500 Lux lighting measured 1m above finished floor
- Shall be equipped with Fire Alarm system in compliance with Saudi Electrical Code **SBC 401-CR**

Building Type	**Telecom room area m^2(minimum)**
MDU with more than 128 units	$7.2m^2$
Facility with up to 200 outlets	$15m^2$
Facility with 201 up to 800 outlets	$36m^2$
Facility with 801 up to 1600 outlets	$72m^2$
Facility with 1601 up to 2400 outlets	$108m^2$

Table 1 Telecom room dimensioning

In case the requirement exceeds 2400 outlets, the telecom room size shall be increased in increments of $1m^2$ for each 1000 outlets.

Multiple telecommunication rooms are permitted subject to fulfilling the sizing requirements in Table 1. The minimum telecommunication room size shall not be less than $7.2m^2$.

The suspended ceiling height (if used) should be 3m. The doors shall open outwards and shall have no doorsill, lockable with 1m width and 2.2m height.

4.3 PATHWAYS CONSIDERATIONS

4.3.1 General

Pathways and the pathway systems selected shall ensure cables are able to be installed and, where appropriate, fixed in accordance with the applicable minimum bend radius (during installation, during operation – static and during operation – dynamic). This may be achieved by the use of pre-fabricated curved corners, drop-outs, radius limiters or other means. Where multiple cable types (and bundled or dual/shot-gun types) are involved, the largest minimum bend radius shall apply [4].

Minimum bend radius is specified by manufacturers' instructions. If instructions do not exist the following shall apply [4]:

a) the minimum bend radius for 4-pair balanced cables shall be 8 times the cable diameter
b) the minimum bend radius for optical fiber cables and coaxial cables shall be 10 times the cable diameter
c) the minimum bend radius for other metallic information technology cables shall be 8 times the cable
diameter.

NOTE: For cables with additional protection, minimum bend radius may be greater than specified above.

Cable trays shall be planned for an initial maximum calculated fill ratio of 25%. The maximum fill ratio of any cable tray shall be 50%. The maximum depth of any cable tray shall be 150 mm [1].

Conduits shall not [4]:

a) contain more than two bends of up to 90° max between pulling points (e.g., outlets telecommunications rooms, or pull boxes);
b) be subject to cumulative changes in direction of more than 180° between pulling points. Bends within conduit shall be accessible and able to act as pulling points unless:
c) no additional cables are to be installed within the conduit, following the initial installation of cable;
d) cables are to be removed before any additional installation takes place. The inside radius of a bend in conduit shall be at least 6 times the internal conduit diameter. Bends in the conduit shall not contain any kinks or other discontinuities that may have a detrimental effect on the cable sheath during cable pulling operations.

4.3.2 Separation from other utilities

Table 2 shows the minimum separation requirements between telecom cables and power cables (sources of EMI exceeding 5 kilovolt-amperes-kVA) and other source of noise, the table also reflects the separation requirements between metallic cabling and specific electromagnetic interference source in addition to the listed requirements in **SBC 401-CR, Proximity of Communication Cables (52-8.2)**

Conditions	Separation
Unshielded power lines or electrical equipment in proximity to open or non metal pathways	≈600 mm
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	≈300 mm

Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway	≈150 mm
Electric motors and transformers	≈1220mm
Fluorescent lamps, Neon lamps, Mercury vapor lamps, High-intensity discharge lamps	≈125 mm
Frequency induction heating	≈1000mm

Table 2 Minimum separation requirement

4.3.3 Clearances

A minimum of 75 mm clear vertical space shall be available above the ceiling tiles for the cabling and pathway. A minimum of 300 mm access headroom shall be provided and maintained above a cable tray system or cable runway. Care shall be taken to ensure that other building components (e.g., air conditioning ducts) do not restrict access.

Cable trays and cable runways within the ceiling shall protrude into the room 25-75 mm, without a bend, and above the 2.4 m level. These pathway entry requirements prevent partial bend transitions through the wall

When utilizing under floor systems (raised access floor), the minimum height of the access tiles shall be 150mm from the structure slab in general office area. Regardless of the raised floor height, the minimum overhead clearance between the bottom of the raised floor and the cable tray side rails is 50mm

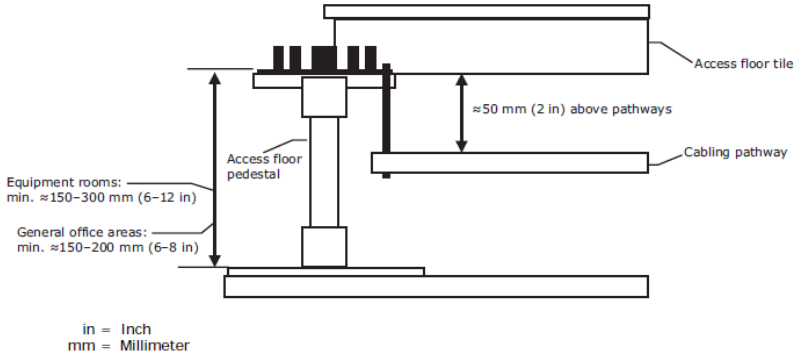

Figure courtesy of BICSI

Figure 4.4 raised access floor clearances

5. ELECTRICAL REQUIREMENT

5.1 POWER REQUIREMENTS

5.1.1 General

This section specifies the power requirements of telecommunication systems inside different building categories.

5.1.2 Power requirements for SDUs

No additional requirements, refer to section 4.2.2

5.1.3 Power requirements for MDUs (up to 128 units)

No additional requirements, for power requirements inside the units refer to section 4.2.2

5.1.4 Power requirements for other building categories

Telecommunications spaces shall be equipped to provide adequate electrical power. A minimum of two dedicated, non-switched alternating current (ac) receptacles for equipment power, each on individual branch circuits located near SP area.

A dedicated power distribution board shall be provided inside telecommunication room to serve the telecom equipment and other utilities supporting telecom systems (eg. Air condition, lighting, fire alarm...etc).

5.2 BONDING AND GROUNDING

5.2.1 General

This section specifies the generic telecommunications bonding and grounding infrastructure and its interconnection to electrical systems and telecommunications systems.

5.2.2 Bonding and Grounding inside telecommunication rooms

A Telecom grounding busbar shall be provided inside telecommunication room. The minimum dimensions of the telecom grounding busbar are 6mm thick x 50mm wide and variable in length and shall be listed.
The telecommunication grounding busbar shall be referenced to the electrical distribution board inside the telecommunication room to equalize potentials between them.
Telecommunication grounding busbar shall be bonded to the nearest structural steel member, whether it is a horizontal or vertical beam, if available. This connection shall be considered only if the main electrical grounding busbar is bonded to the nearest structural steel member. Otherwise a dedicated bonding conductor shall be extended from the telecommunication grounding busbar to the main electrical grounding busbar as shown in Figure 5.1
The size of the bonding conductor shall be minimum of a 4 mm. However, a bonding conductor

that is run at distances longer than ≈30 m should be calculated for a size that meets the requirements of the applicable Saudi Electrical Code **SBC 401-CR**.

All metallic pathway sections shall be bonded in series using minimum of 2mm bonding conductors. Cable Trays shall be bonded to the grounding busbar inside telecommunication rooms using minimum of 4mm bonding conductor.

In case of utilizing subfloor pathway system (raised access floor), a supplementary bonding network (SBN) shall be designed and bonded to the grounding busbar.

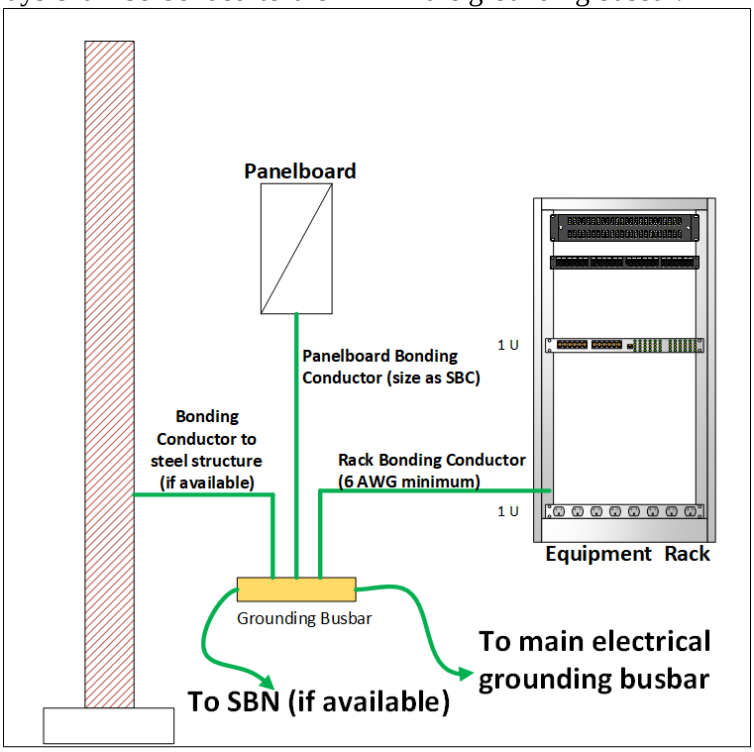

Figure 5.1 Telecommunication room grounding arrangements

5.3 POWER OVER ETHERNET REQUIREMENTS

5.3.1 General

Applications of PoE beyond 60W shall impact the bundle grouping size. The temperature rating of current carrying telecommunication cables shall be considered to minimize heat generation inside buildings. Telecommunication bundling size shall not lead to overheat containment, resulting in heat accumulation across pathways. This section sets a maximum allowable size of telecommunication bundle, to maintain temperature ratings within the specified limits of telecommunication cables

5.3.2 Power Over Ethernet (PoE) Levels

Table 3 shows different PoE levels and maximum current ratings:

Type	Maximum Current	Power at Source	Power at Device	Standard
PoE	350 mA	15.4 W	13 W	IEEE 802.3af
PoE+	600 mA	30 W	25.5 W	IEEE 802.3at
PoE++	600 mA	60 W	51 W	IEEE 802.3bt
4PPoE	960 mA	90 W	71.3 W	IEEE 802.3bt

Table 3 PoE Levels

Mated connectors shall not introduce arching when unplugged, hence compliance with PoE interconnection requirement is mandatory [7]

5.3.3 Telecommunication Bundle sizing

Telecommunication cable bundle size is limited by both Ampacity (Ampere) and Temperature rating (C°) of the used cables. Table 4 [8] shows Ampacity values for different conductor sizes, against different Temperature ratings. The matrix sets a maximum bundle size at 30 C° ambient temperature. A derating factor shall apply on the ampacity value when the bundle is subject to different ambient temperature, please refer to Table 5 [8].

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86°F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

	Number of 4-Pair Cables in a Bundle																				
	1			2–7			8–19			20–37			38–61			62–91			92–192		
AWG	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.
Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.
Informational Note: The conductor sizes in data cables in wide-spread use are typically 22–26 AWG.

Table 4 Ampacity values for different conductor sizes (source: NFPA 70 Article 725)

Table 310.15(B)(2)(a) Ambient Temperature Correction Factors Based on 30°C (86°F)

For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.				
Ambient Temperature (°C)	Temperature Rating of Conductor			Ambient Temperature (°F)
	60°C	75°C	90°C	
10 or less	1.29	1.20	1.15	50 or less
11–15	1.22	1.15	1.12	51–59
16–20	1.15	1.11	1.08	60–68
21–25	1.08	1.05	1.04	69–77
26–30	1.00	1.00	1.00	78–86
31–35	0.91	0.94	0.96	87–95
36–40	0.82	0.88	0.91	96–104
41–45	0.71	0.82	0.87	105–113
46–50	0.58	0.75	0.82	114–122
51–55	0.41	0.67	0.76	123–131
56–60	—	0.58	0.71	132–140
61–65	—	0.47	0.65	141–149
66–70	—	0.33	0.58	150–158
71–75	—	—	0.50	159–167
76–80	—	—	0.41	168–176
81–85	—	—	0.29	177–185

Table 5 De-rating factor (source: NFPA 70 Article 310)

6. MECHANICAL REQUIREMENT

6.1 ENVIRONMENTAL REQUIREMENT

6.1.1 General

This section specifies the generic environmental controls and interconnection with electrical systems within telecommunication rooms

6.1.2 Cooling

Cooling shall:

- Maintain a continuous and dedicated environmental control.
- Maintain a temperature and humidity level as recommended by ASHRAE
- Dissipate the heat generated by active devices.
- Satisfy applicably with Saudi Mechanical Code **SBC 501-CR**

6.1.3 Fire Stopping

Whenever fire-rated structures and assemblies (e.g., walls, floors, ceilings) are penetrated by conduits and/or cable trays, the integrity of the fire rated barrier shall be re-established by applying listed fire stop material in compliance with Saudi Mechanical Code **SBC 501-CR**. An example of Fire Stop application for cable trays penetrating concrete wall is shown in Figure 6.1

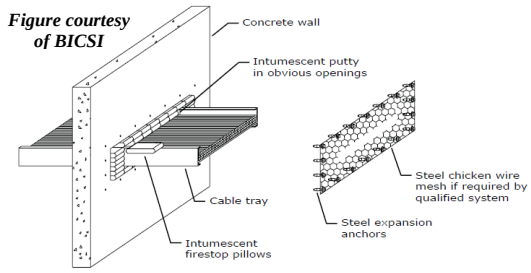

Figure 6.1 Fire Stop application (example)

6.1.4 Cable performance under fire

- Cables residing in plenum areas shall have Low Smoke Zero Halogen (LSZH) outer sheath.
- Riser cables shall be listed as being suitable for use in a vertical run in a shaft when penetrating one or more floors and shall be listed as having fire-resistant characteristics and thus be capable of preventing the carrying of fire from floor to floor [3]
- Outdoor rated cables shall be transitioned to listed cables within 15m from EF, unless the cable is contained within the slab or metallic conduit

7. IPI SCENARIOS

7.1 SINGLE DWELLING UNIT

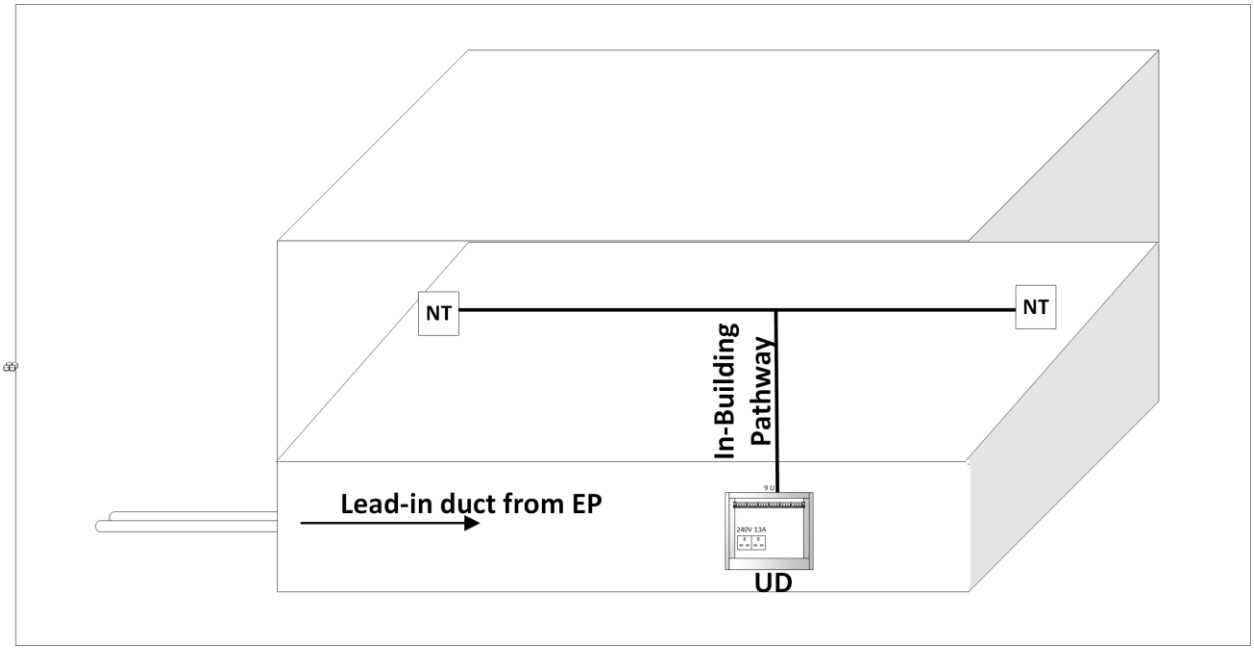

Figure 7.1 IPI for SDU

7.2 MULTI-DWELLING UNIT LESS THAN 128 UNITS

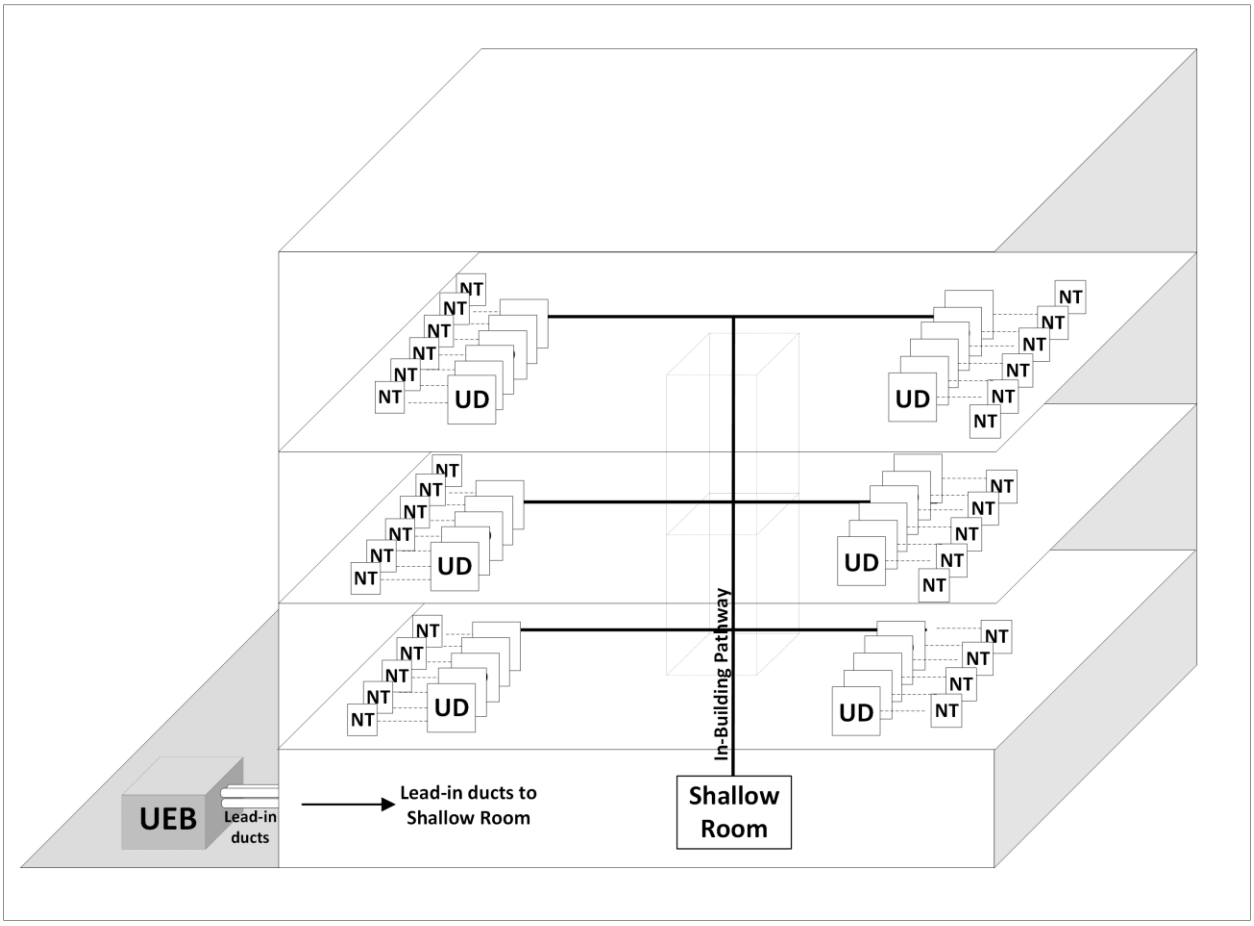

Figure 7.2 IPI for MDU less than 128 units

7.3 MULTI-DWELLING UNIT MORE THAN 128

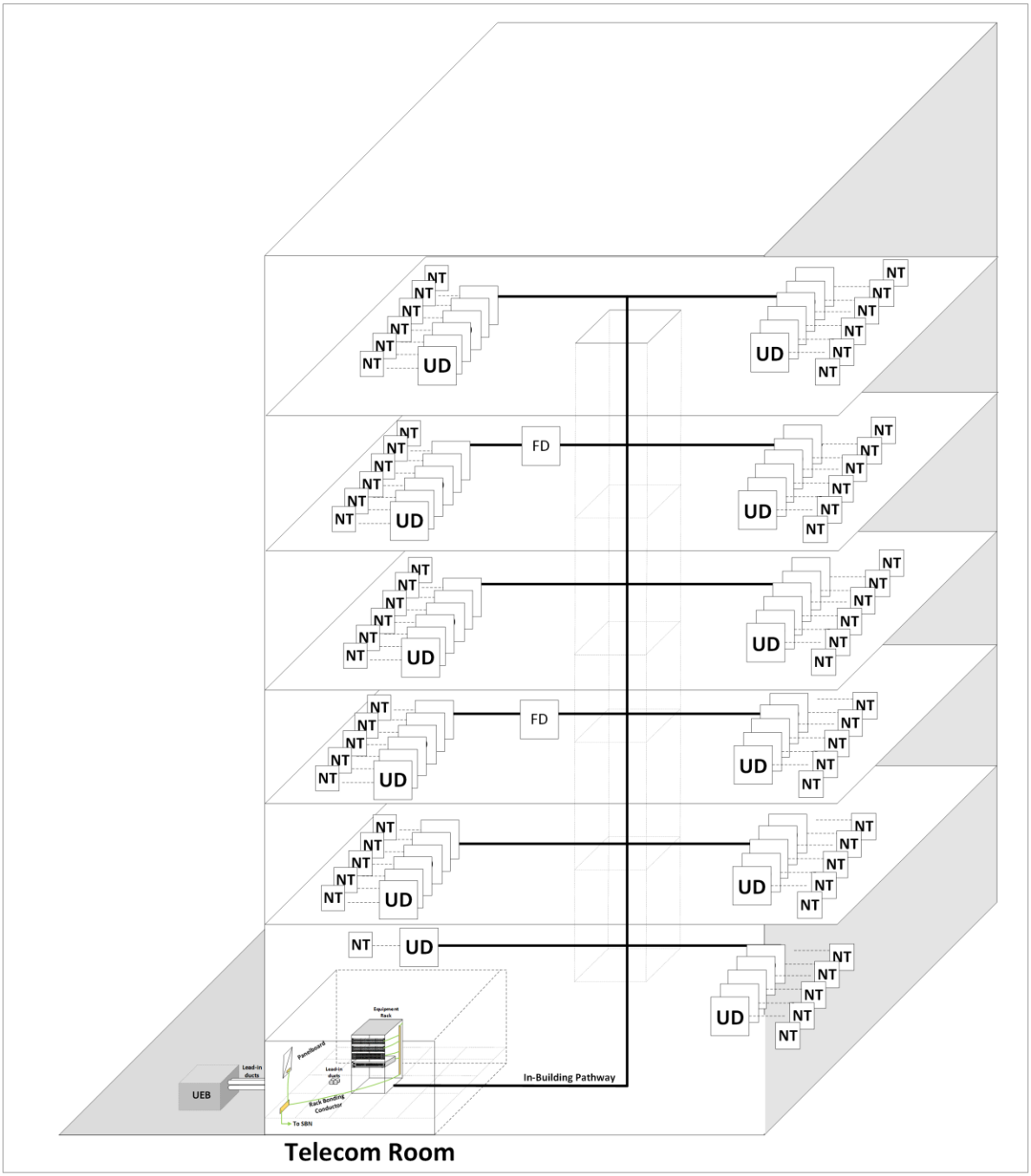

Figure 7.3 IPI for MDU more than 128 units (for telecom room details, refer to section 7.7)

7.4 BUILDINGS WITH OPEN SPACE OR BULK SERVICES

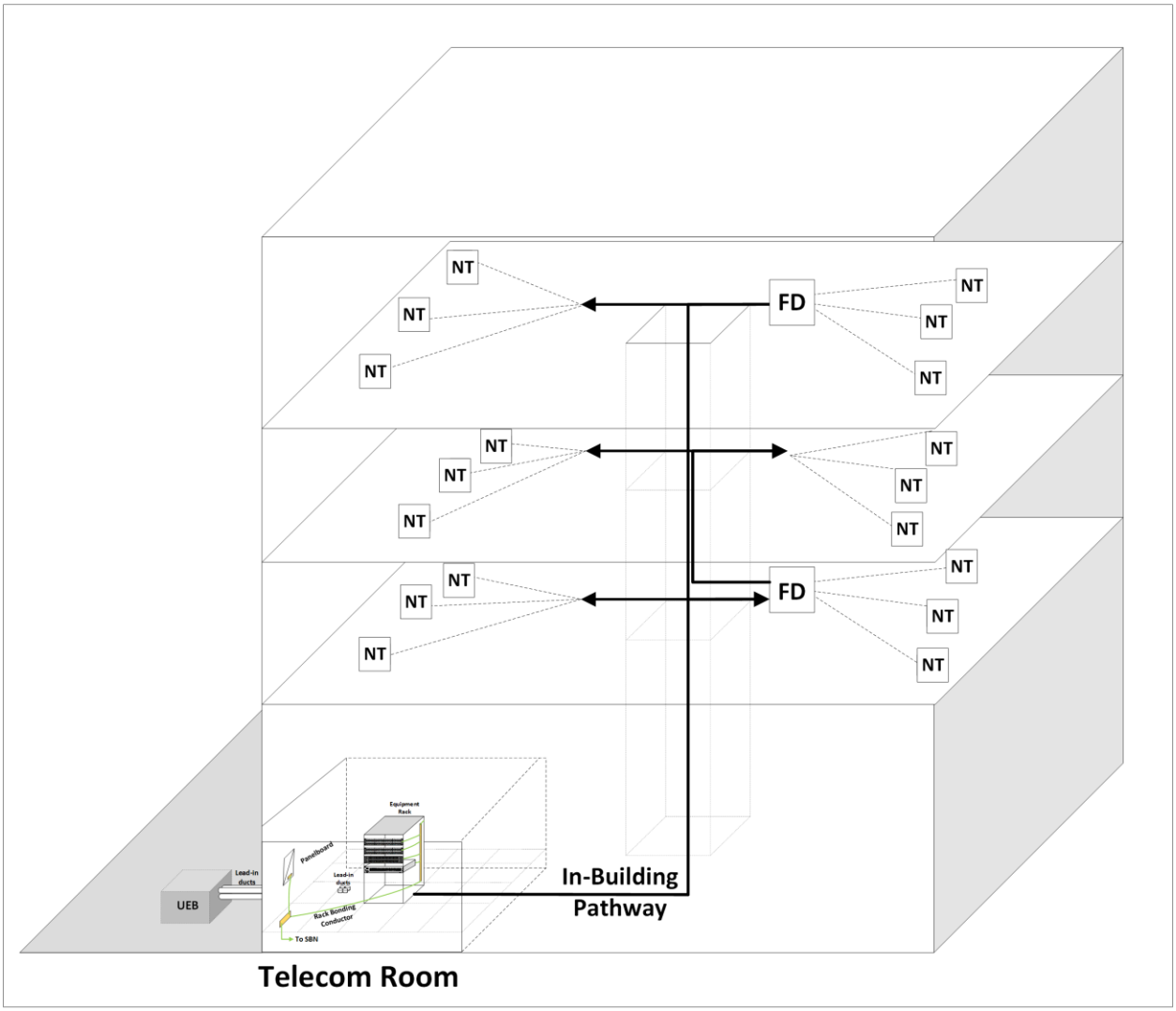

Figure 7.4 IPI for Buildings with open space/Bulk services (for telecom room details, refer to section 7.7)

7.5 INDUSTRIAL FACILITIES

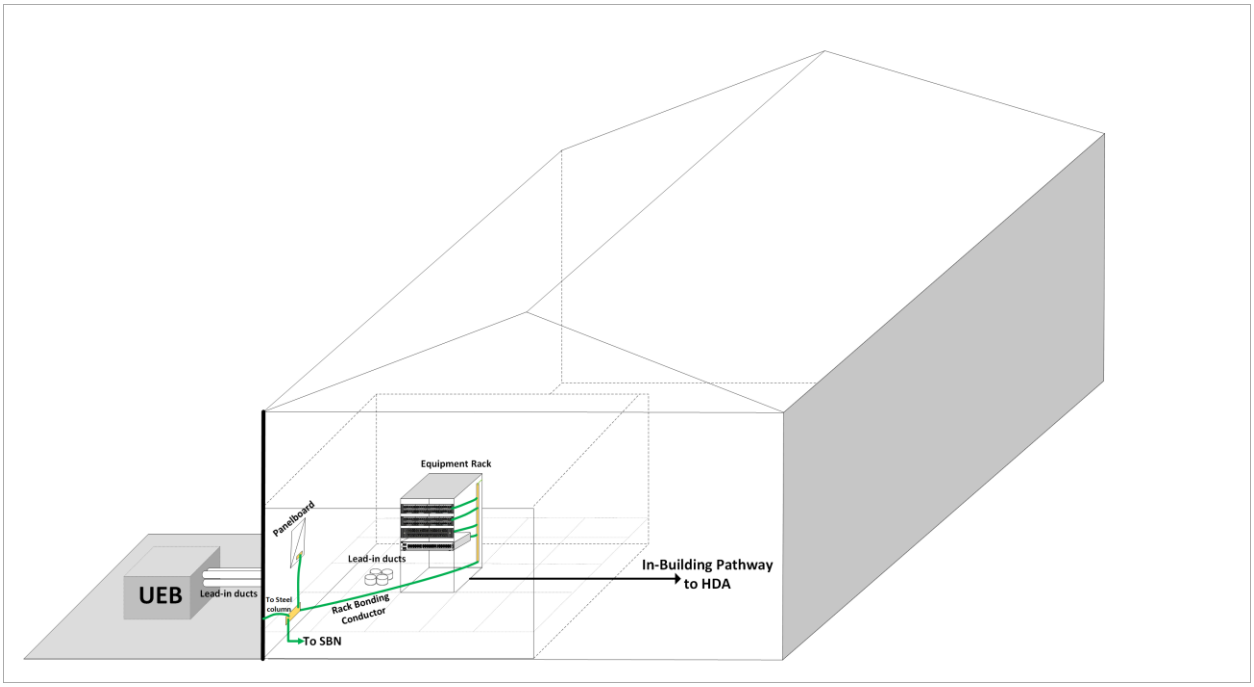

Figure 7.5 IPI for industrial facilities (for telecom room details, refer to section 7.7)

7.6 EXAMPLE OF FACILITIES WITH REDUNDANT SETUP

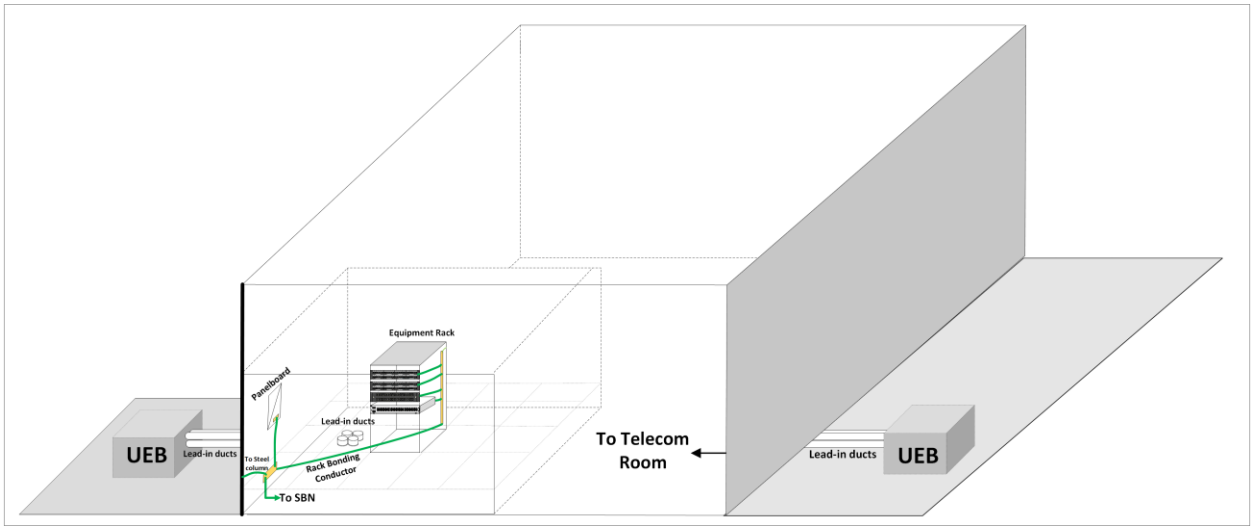

Figure 7.6 Example of redundant setup (see section 1.1.1)

7.7 TELECOMMUNICATION ROOM LAYOUT (ILLUSTRATIVE)

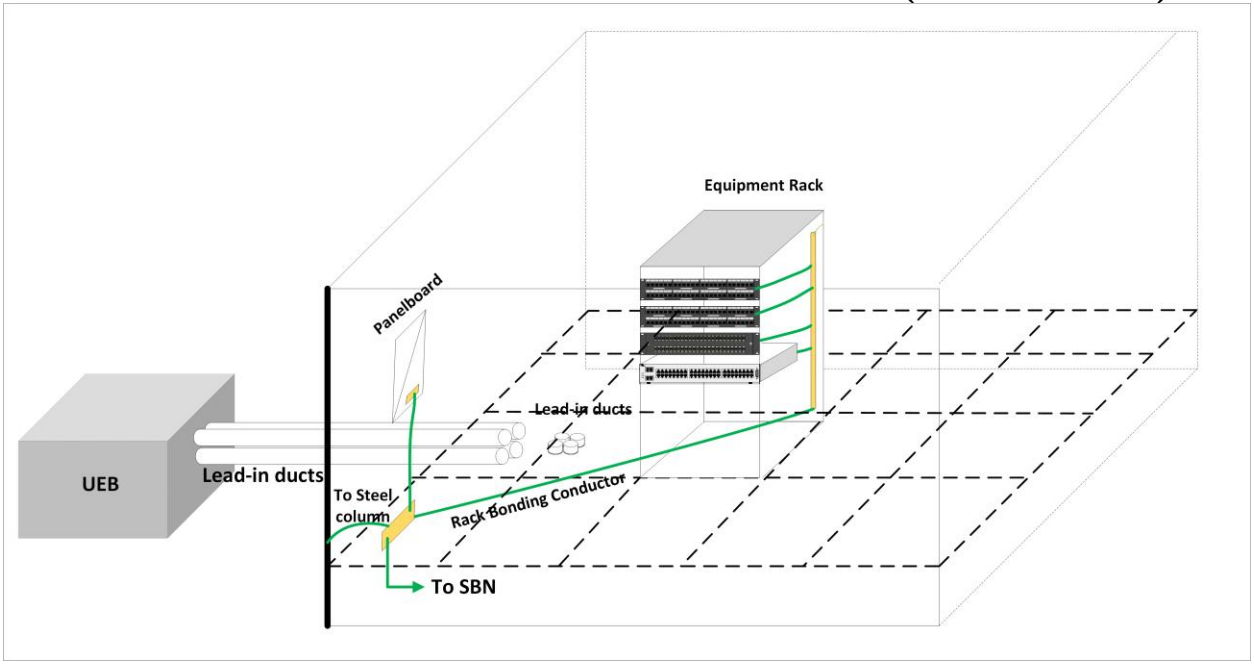

Figure 7.7 Telecommunication room layout (for details, refer to 4.2.4

8. REFERENCES

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