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Study on common utility infrastructure sharing framework and standards for ICT infrastructure along roads and crossings in Uganda

THE REPUBLIC OF UGANDA
MINISTRY OF ICT & NATIONAL GUIDANCE

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Acknowledgement

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The research was undertaken by Technology Solutions Africa Ltd under the framework of the project and its deliverables. Technical input, feedback and guidance have been provided by ITU and the Ministry of ICT and National Guidance project team members and experts in government ministries, agencies, institutions, and across Uganda's digital ecosystem.

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Foreword

The Study on common utility infrastructure sharing framework and standards for ICT infrastructure along roads and crossings in Uganda represents a transformative step toward achieving the goals set out in the Digital Uganda Vision (DUV) and Uganda's broader national development agenda. As we seek to position Uganda as a regional leader in digital connectivity, this report underscores our commitment to fostering sustainable infrastructure development that bridges the digital divide, lowers deployment costs, and ensures equitable access to technology.

This framework and its accompanying draft standards highlight the Government of Uganda's proactive approach to addressing key challenges in ICT infrastructure deployment. By promoting infrastructure sharing and collaboration across stakeholders, we are not only reducing redundancy and cost but also enhancing environmental sustainability and urban planning. This initiative reflects our recognition that ICT is a national utility, critical to driving innovation, improving service delivery, and unlocking economic opportunities for all Ugandans.

The report's findings and recommendations provide a roadmap for aligning our ICT infrastructure development with international best practices while tailoring solutions to Uganda's unique context. By integrating feedback from stakeholders and prioritizing inclusivity, the proposed interventions will strengthen our regulatory environment, promote public-private partnerships, and streamline infrastructure planning and deployment.

As a nation, our digital future depends on coordinated efforts among all players—government, private sector, and development partners. I call on all stakeholders to work collaboratively to implement the recommendations in this report. Together, we can build a robust digital infrastructure that serves as a foundation for innovation, socio-economic growth, and improved quality of life for every Ugandan.

Hon. Dr. Chris Baryomunsi
Minister of ICT and National Guidance

Foreword

It is my pleasure to present this report under the project 'Technical Assistance and Training to Uganda on National ICT Development Strategy', a collaboration between the Government of Uganda and the International Telecommunication Union, supported by the Global Development and South-South Cooperation Fund and ITU's ICT Development Fund.

Through carefully co-crafted interventions in support of the country's vision to transform Uganda into a digitally enabled society that is innovative, productive and competitive, the project has applied a three-pronged approach focusing on the development of policy recommendations, enabling capacity development, and the implementation of pilot projects.

In recent years, Uganda has witnessed tremendous growth in its digital economy, reflecting broader trends across the Africa region and globally. The increased access to digital technologies, new opportunities that connectivity has brought, and the surge in digital services are fueling rapid advancements on how citizens engage with one another and with vital government services. These developments also bring new challenges, requiring policy-makers and regulators to rethink strategically and build enabling policy and regulatory frameworks that are future-ready and adaptable to this ever-changing landscape. Moreover, digital skills remain essential for citizens to meaningfully participate in the digital space and for professionals to fully leverage the potential of digital technologies in addressing socio-economic challenges. This has been a critical aspect of the implementation of the policy interventions within this project.

Co-created and initiated in support of Uganda's ambitious digital transformation journey, this project stands as an example of how focused and meaningful partnerships can lead to impactful change. We have witnessed the results of the policy interventions and the impact of the significant capacity development in the country. I believe the efforts will continue to impact Uganda's transformation for years to come.

I encourage ITU Member States across Africa and globally as well as development partners to join forces and invest in digital transformation for social and economic growth. The Telecommunication Development Bureau stands ready to continue supporting countries on their digital transformation journeys with impactful project implementation and partnerships that are essential for achieving universal and meaningful connectivity and digital transformation for all.

Dr. Cosmas Luckyson Zavazava
Director, Telecommunication Development Bureau
International Telecommunication Union

Foreword

The completion of the **Study on common utility infrastructure sharing framework and standards for ICT infrastructure along roads and crossings in Uganda** is a testament to the dedication and collaboration of multiple stakeholders. This report provides a detailed and practical foundation for harmonizing ICT infrastructure deployment while ensuring cost-effectiveness and sustainability.

I extend my heartfelt appreciation to the International Telecommunication Union (ITU) for their technical and financial support, which has been instrumental in shaping this initiative. The Global Development and South-South Cooperation Fund (GDSSCF) also deserves recognition for the financial contribution to this project.

Special acknowledgment goes to the technical team at the Ministry of ICT and National Guidance. Their expertise, dedication, and prior research efforts were critical in facilitating consultations, gathering data, and providing insights that enriched this report. Their commitment ensured that the recommendations and standards reflect the realities on the ground while aligning with global benchmarks.

I also wish to recognize the contributions of our stakeholders from across government ministries, local authorities, and the private sector. Their input and collaboration have ensured that the framework and draft standards address the practical realities of ICT infrastructure deployment in Uganda.

This report sets a clear path for enhancing broadband deployment, streamlining infrastructure sharing, and integrating ICT into national planning frameworks. The proposed online information portal and regulatory updates are forward-looking tools that will enable better coordination and efficiency in ICT infrastructure projects.

As we move toward implementing the recommendations, I call on all stakeholders to remain engaged and committed. Together, we can ensure that Uganda's ICT infrastructure supports its digital transformation agenda and paves the way for a more connected and inclusive future.

Dr. Amina Zawedde (PhD)
Permanent Secretary
Ministry of ICT and National Guidance
Government of Uganda

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Abbreviations

Abbreviation	Description
BDF	building distribution frame
EIA	Electronic Industries Alliance
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FTTH	fibre-to-the-home
GIS	geographic information system
HDPE	high-density polyethylene
IBS	in-building wireless solutions
ICT	information and communication technology
IPI	in-building physical infrastructure
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union Standardization Sector
KCCA	Kampala Capital City Authority
KPI	key performance indicator
MDU	multi-dwelling unit
MTR	main telecommunication room
NDP	National Development Plan (Government of Uganda)
NEMA	National Environment Management Authority
NITA–U	National Information Technology Authority – Uganda
NT	network termination point
NWSC	National Water and Sewerage Corporation
ODF	optical distribution frame
OSP	outside plant
OTDR	optical time-domain reflectometer
PPP	public–private partnership
PVC	polyvinyl chloride
RTTR	rooftop telecommunication room

(continued)

Abbreviation	Description
SDU	single-dwelling unit
TIA	Telecommunications Industry Association
UCC	Uganda Communications Commission
UDF	unit distribution frame
UEDCL	Uganda Electricity Distribution Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UNRA	Uganda National Roads Authority
USMID	Uganda Support to Municipal Infrastructure Development
UV	ultraviolet

Executive summary

This study on common utility infrastructure sharing framework and standards for ICT infrastructure along roads and crossings in Uganda is prepared under the joint Government of Uganda and ITU joint project on Technical Assistance and Training to Uganda on National ICT Strategy 2021-2024. The objective of the project is to contribute to a strengthened information and communication technology (ICT) policy and regulatory environment to enable Uganda to continue transformation into a digitally enabled society that is innovative and competitive. This work is in line with the Digital Uganda Vision and the Government of Uganda's Third National Development Plan (NDP III), Digital Transformation Roadmap 2023/24–2027/28 documents guiding the ICT sector in Uganda.

The overarching project applies a three-pronged approach supporting the Government with: (a) policy and strategy recommendations; (b) cross-cutting capacity development programmes; and (c) designing and implementing pilot projects and use cases to support the recommendations. This study consisting of on establishing a common utility infrastructure sharing framework and ICT infrastructure installation standard is one of the selected projects that fall under one of the Digital Uganda Vision pillars, Digital Infrastructure and Connectivity. The study common utility infrastructure sharing and standards for ICT infrastructure along roads, and crossings in Uganda, was awarded by the project to a local telecommunication and ICT consulting firm in Uganda, Technology Solutions Africa Limited.

The scope of work includes engaging with all utility service providers, local and urban authorities, and other government agencies, to determine the current specifications for laying ICT infrastructure along roads and crossings with the support of the Ministry of ICT and National Guidance technical teams. The background is laid out in **section 1** of this report. A situation analysis report describes the current state of existing ICT infrastructure deployments in the country, pointing out the challenges, gaps and opportunities being faced by the various stakeholders. This is presented in **sections 2** and **3** of this report. The sections also have recommendations, and proposed implementation and action plans for common utility infrastructure sharing along roads and crossings.

Part of the situation analysis study involved identification of all the key stakeholders in the public and private sectors that are involved in ICT infrastructure deployment projects, including the other utility players that can assist by sharing their existing infrastructure to support broadband expansion across the country. The stakeholders are identified in **section 4** of this report. Their roles and responsibilities are described and a collaboration plan has been proposed that could be used to promote common utility infrastructure sharing to cost-effective deployment projects countrywide, including ICT. **Section 5** presents coverage maps of national utilities along roads and crossings, **section 6** the types of roads and crossings classifications, and **section 7** types of buildings. A benchmarking study on a number of countries was undertaken to review their specifications and standards for ICT infrastructure deployments and their involvement with other utilities to share infrastructure with the support of their governments. The objective of this work was to highlight best practices, ideas for the draft standards for Uganda and their approach to common utility infrastructure sharing. The findings are presented in **section 8** of this report.

Section 9 presents the draft specifications and standards for ICT infrastructure installations. It includes specifications for fibre-optic cables, cable ducts and other accessories used in ICT installations. In addition, installation guidelines for ICT infrastructure along roads, crossings, bridges, rivers and swampy areas are included. The goal is that, after review and feedback from key stakeholders, the draft specifications and standards are finalized, adopted and shared with all stakeholders for reference.

Section 10 contains the ICT infrastructure construction guidelines for buildings. These include general requirements for ICT facilities to include in new building plans, general construction requirements for ICT facilities and documentation requirements. Specific ICT facilities requirements for single-tenant buildings and multi-tenant buildings are provided in different subsections. It is suggested that these requirements be finalized and shared with all affected line ministries and agencies, including the local government and city authorities. The goal is that these ICT requirements are always included in the architectural building plans for new public buildings being submitted to government authorities for approval going forward.

Key study recommendations are set out on ICT infrastructure sharing framework and installation standards in **section 11**. These include required updates in the regulatory and legal frameworks to support broadband deployment across the country. Amendments to existing laws are also suggested to add broadband services as a national utility, and also encourage common utility infrastructure sharing along roads, crossings, bridges and buildings, for more cost-effective deployment of ICT infrastructure across the country. In addition, suggestions for new regulations, policies and guidelines have been included to support this initiative.

Recommendations for the development of an ICT infrastructure sharing standard and a collaboration process/plan involving all government ministries/agencies and private sector players are also presented. There is an urgent need to set up a common utility infrastructure sharing steering committee with representatives from all the key ministries/agencies, the Uganda Communications Commission (UCC) and the private sector. The steering committee needs to be given a mandate to finalize the common utility infrastructure sharing framework, the specifications, standards and oversight of initial pilot infrastructure projects where there is harmonious and cost-effective sharing of infrastructure.

The creation of an online common utility infrastructure information portal is also recommended. One of the main aspects that need to be strengthened for successful co-deployment is the coordination and cooperation of organizations, including the infrastructure owner of the road transport or energy infrastructure and the telecommunication operator, as well as relevant public and private organizations involved in the co-deployment process. To promote coordination and cooperation, the development of a single information portal is suggested. It is envisaged that the portal will include information about all existing and planned engineering works that could potentially co-deploy fibre-optic cables. From the online portal, representatives of organizations, government agencies, potential investors and telecommunication operators would be able to find partners for the co-deployment of the ICT infrastructure with road transport or energy infrastructure, as well as post their information on priority areas for current investment. All interested parties would be able to exchange documents, make changes and receive information on the status of the fulfilment of certain requests, as well as access and use the methodologies and tools developed for common utility ICT infrastructure sharing. This proposed single information portal could potentially increase competitiveness and cooperation and provide access to relevant information based on equality and transparency, which in turn

would minimize duplication of effort and corruption, and identify opportunities for investment and collaboration.

It is further recommended that the Ministry of ICT and National Guidance work with the relevant government agencies to finalize and publish the Uganda ICT infrastructure specification/ standard, and share it with other ministries, departments and agencies and local governments. This document would be used by the different authorities in evaluating installation permit requests and assessing ICT infrastructure installation work by service providers and their contractors.

The creation and use of a national geographic information system (GIS) platform in Uganda – will also have many benefits. A national GIS will enable the Government of Uganda, ministries, departments and agencies, as well as private sector players, to systematically plan and execute national utility infrastructure projects more efficiently.

It is also suggested that requirements and provisions for including ICT infrastructure should be mandatory for new planned public buildings in the country. The Ministry of Lands, Housing and Urban Development and the local authorities should consider this before any new public building plans are approved for construction.

Last but not least, public awareness programmes and campaigns should be communicated to the local authorities and general public so that they are aware of the criticality of fibre-optic cable infrastructure to the economy of the country. The public needs to know that infrastructure vandalism threatens national security and reliable telecommunication services, as well as the legal consequences for causing service outages caused by intentional and unintentional fibre cuts.

Tackling these topics will establish the necessary enabling environment for common utility ICT infrastructure sharing projects in Uganda to accelerate the digital transformation of the country.

1 Introduction and background

The Government of Uganda and ITU joint Technical Assistance and Training to Uganda on National ICT Development Strategy project support the development of the ICT sector in Uganda following the Digital Uganda Vision framework, the Third National Development Plan (NDP III) and Uganda's Digital Transformation Roadmap. The project focuses on the development of policy and strategy recommendations, capacity development and the implementation of pilot projects. The ultimate goal is to contribute towards the implementation of a digitally empowered society and knowledge economy, and to transform Uganda into a digitally enabled society that is innovative, productive and competitive. The project further seeks to assist in the development of Internet connectivity in the country and the resiliency of such networks and boost related opportunities to contribute to sustainable social and economic development. The project also assists the Government of Uganda in creating an enabling ICT policy and regulatory environment and contributes to making ICT services affordable and accessible for all Ugandans.

One of the studies under the overall project sought to develop a framework and standards for common utility ICT infrastructure sharing along roads, bridges and crossings, to be adapted and used by the Government of Uganda. Technology Solutions Africa Limited was selected to do this assignment, to compile draft text for the standards for common utility infrastructure sharing with ICT infrastructure along roads, bridges and crossings. When adopted, this would facilitate quick cost-efficient deployment of ICT infrastructure by all service providers nationwide, resulting in accelerated expansion of broadband coverage and reliable services. By sharing ICT infrastructure facilities across the country, the cost of investment for each service provider would be significantly reduced.

This project contributes to achieving the first pillar of the Uganda Digital Transformation Roadmap to enhance digital infrastructure and connectivity in the country. The Ministry of ICT and National Guidance in Uganda, as the custodian of the study, is charged with providing frameworks for ICT infrastructure development that will guide the planning and roll-out of infrastructure harmoniously. The specific objectives of the Ministry in this role are summarized as follows:

- Provide a guiding framework for planning boards of local governments to issue roll-out permits to service providers who want to roll out ICT infrastructure in their areas.
- Provide frameworks to guide on installation of ICT infrastructure along roads, bridges and crossings countrywide.
- Provide a guiding framework for the incorporation of ICT infrastructure in public buildings.
- Provide a guiding framework for the elimination of duplication as well as the implementation of a dig-once policy when rolling out ICT infrastructure across the country.

The Ministry of ICT and National Guidance would like to provide the following guidelines to stakeholders involved in ICT infrastructure development:

- Standards for deployment of ICT infrastructure along transport infrastructure: These include guidelines for community roads, district roads and national roads and highways. The frameworks will cover principles of ICT infrastructure designs along the roads, provisions for maintenance of ICT infrastructure and guidelines for co-deployment with other utilities.
- Expectations for ICT infrastructure installations in public buildings: This includes an open infrastructure approach with common ICT access points, built-in ducts, maintenance points

and designated telecommunication spaces in the buildings. Cable installation guidelines should also be provided.

- Guidelines for planning committees of local governments issuing ICT infrastructure roll-out permits to service providers.
- ICT infrastructure sharing guidelines.

Currently, most of the road construction in Uganda does not plan for ICT infrastructure deployment. It is not a requirement for the road contractors to include provision for ICT infrastructure cable ducts along the roads at this time. This study sets out specifications and standards that may be followed during ICT infrastructure installations along shared common utility infrastructure. The current state of ICT infrastructure deployment alongside roads and buildings were considered to identify the challenges, gaps and opportunities. This study also reviews several benchmark studies from other countries and the standards developed for these countries. Key government ministries and agencies that have roles and mandates to facilitate ICT infrastructure sharing were also identified. The draft standards presented in this report take into account all the responsibilities of the different players to ensure that the shared facilities comply with all the laws, policies and guidelines of the Government of Uganda.

Furthermore, a collaboration plan with other ministries, departments and agencies that are responsible for deployment of other public infrastructure has been developed and the process for securing permits for service providers has been reviewed and recommendations provided for process improvement. This report also includes recommendations, implementation and action plans for common utility infrastructure sharing along roads, bridges, crossings and buildings for all stakeholders.

Why is ICT infrastructure sharing critical in the country's digital transformation journey?

The benefits of a well-coordinated ICT infrastructure sharing policy are summarized as follows:

- Easier and cheaper maintenance and operations;
- More effective physical and ICT control over the integrated infrastructure;
- Integrated infrastructure performance monitoring systems;
- Adequate protection of critical infrastructure and reducing the vulnerability of infrastructure to cyber disruptions and attacks;
- Decreased compensation costs and less land occupied;
- Public–private partnerships (PPPs) where private players take part in national development;
- Avoiding inefficient investments (for example, unnecessary parallel developments of infrastructure, where telecoms dig trenches after roads have been constructed);
- The most efficient use of existing infrastructure;
- Fewer overall detrimental environmental impacts arising from the construction and maintenance of infrastructure.

2 Current state – situation analysis report

2.1 Ministry of ICT and National Guidance engagement with key stakeholders for ICT infrastructure sharing

The Ministry of ICT and National Guidance has undertaken several consultations with other sector ministries, including Transport and Works, Land and Housing, Water and Environment, and Energy and Mineral Development. Additionally, more consultations were done with the planning committees of different cities, including the Kampala Capital City Authority (KCCA), as well as the planning committees of Entebbe, Wakiso, Masaka, Mbarara, Fort Portal, Arua, Jinja and Mbale. These were done to understand the baseline of the status of harmonized infrastructure roll-out through their respective infrastructure plans and how ICT infrastructure development may be incorporated into these plans.

During these consultations, several documents were reviewed, including NDP III implementation plans for the different local governments, laws of the different sectors and the roll-out master plan for the Ministry of Works and Transport, among others. Field visits were undertaken to different roads that had incorporated service ducts for ICT infrastructure to determine sufficiency, and as a benchmark for standards that may be adopted by other utilities.

Discussions highlighted that there is little to no coordination in infrastructure development, leading to high costs of rolling out all infrastructure due to the expenses incurred in the break and replace, high service interruptions, and congested unplanned cities due to the disorganized deployment of utility infrastructure in the road corridors. The reviews also identified insufficiency in the present regulatory and legal frameworks that barely mandate harmonization in the development of utility infrastructure. There was a wide gap for guiding frameworks from the ICT sector to other sectors and local governments for the incorporation of ICT infrastructure projects during the planning and deployment of other utilities and housing.

The Department of ICT Infrastructure Development in the Ministry of ICT and National Guidance therefore conducted a follow-up activity to consult the Ministry line agencies, UCC and the National Information Technology Authority–Uganda (NITA-U), on the development of frameworks that will guide the planning, development and deployment of ICT infrastructure alongside other utilities, as well guide local governments when issuing permits for the broadband infrastructure providers to ensure smart-looking and well-planned cities. The findings are discussed in the following sections.

2.2 Current status of ICT infrastructure deployment along transport infrastructure

In a stakeholder seminar organized by the Ministry of ICT and National Guidance technical team in March 2024, it was highlighted that no standards had been developed and published accordingly, and yet they were urgently needed, as concluded from the meetings and consultations with other sectors (3).

There is a project under the Ministry of Lands, Housing and Urban Development called Uganda Support for Municipal Infrastructure Development (USMID), supported by the World Bank International Development Agency, being implemented by the respective local governments, in which there are provisions for shared service ducts for deployment of utility infrastructure

along roads, including ICT infrastructure. This was seen as a timely opportunity for the standards to be developed for the new projects to be implemented.

Figure 1. One of the roads under the USMID project in Gulu district (13)

The challenge is that there are no shared standards to guide the sizes of the ducts and other considerations such as materials for the ducts and installation guidelines. The contractors do what is least costly and sometimes they do not even follow the provided plans. They provide no ICT facilities, since they are not mandated and enforced. Therefore, it is noted that, while some of the new road designs have ducts on the ground, most of the constructed roads do not have them.

2.3 Regulatory frameworks and recommended amendments

Concerning regulatory frameworks, the Ministry of ICT and National Guidance developed a draft ICT infrastructure policy in 2017, and some of the principles and content are still relevant. The Ministry of ICT and National Guidance should take the lead and roll out the necessary policies to support the digital transformation roadmap initiatives already under way. Benchmarking of regulatory frameworks elsewhere, including information from the International Telecommunication Union, and achievements in other countries such as Kenya, People's Republic of China, Republic of Korea, Rwanda, have highlighted how they have updated their laws.

The scope and applicability of recommended amendments should not only focus on ICT infrastructure along roads, but also on standards for the deployment of ICT infrastructure along all transport infrastructure. UCC as the national ICT regulator needs to add ICT infrastructure sharing guidelines for the service providers to follow as they deploy national broadband. The initial focus undertaken by UCC was to encourage all the private sector players to share passive infrastructure (tower masts) across the country. This has been accomplished successfully. The focus now has to be extended to encourage all service providers to share existing and new broadband infrastructure (fibre-optic and other installations) in the rural, suburban and urban areas of the country.

Some of the laws that need to be reviewed and amended are discussed below.

2.3.1 Uganda Roads Act, 2019

The Uganda Roads Act, 2019[1] relates to the "development, management and maintenance of public roads; to provide for the appointment of road authorities for the development, maintenance, control and management of different classes of public roads; to provide for toll roads and the imposition of road tolls on certain public roads; to provide for the classification of public roads; to provide for the declaration, control and protection of road reserves on public roads; to provide for access to public roads; to provide for axle load control on public roads; to provide for the creation of an environment section for the road sector; to provide for road safety; to provide for offences and penalties; and to make provision for related matters".

Section 16 of the Act covers the road reserves: Subsections 4 and 5 provide for the use of the road reserves for other developments by an authorized person. It states that the person shall remove the development and replace it as near as possible to its original state. Section 18 of the Act provides for the preparation of plans and surveys for public roads from time to time to account for deviations. While the Act provides for the use of road reserves for other developments in which ICT infrastructure would be catered for, it does not emphasize consultation with other government sectors while planning and designing the roads. This creates a challenge that needs to be resolved.

The Roads Act, 2019 will have to be amended to include specific guidance on common utility infrastructure sharing facilities along the roads and crossings.

2.3.2 Uganda National Roads Authority Act, 2006

The Uganda National Roads Authority Act, 2006[2] provides for the establishment and operation of the Uganda National Roads Authority (UNRA) to manage the provision and maintenance of the national roads network more efficiently and effectively, and to render advisory services to the Government, and for related matters.

Among the functions of the Authority, in section 6 subsection (g), the Act advises the Minister in matters relating to planning, design, construction and maintenance of roads and road reserves. It also provides for cooperation and consultation with other utility providers. The law then refers to the Roads Act for the replacement of the road reserves. Section 37 of the regulations provides for fees to be charged for the use of national roads.

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1 Available at https://ulii.org/akn/ug/act/2019/16/eng%402019-09-25.
2 Available at https://ulii.org/akn/ug/act/2006/15/eng@2006-06-08.

The Uganda National Roads Authority Act, 2006 will have to be amended to include specific guidance on common utility infrastructure sharing facilities along the roads and crossings.

2.3.3 Other national laws to be amended to encourage common utility infrastructure sharing

The Government of Uganda has to pronounce itself on the fact that broadband infrastructure should be treated as a public utility (just like water and power) to have it affordable and accessible to all by 2040. If designated as a public utility, then the telecommunication and related laws (UCC Act, Land Act, etc.) should be updated to include broadband as part of the universal service regime. These include:

- Uganda Land Act, Part 2, Article 1(w), to include "broadband" in the definition of public works (Land Act – ULII).
- The Roads Act, where the concept of "road reserve" is explained. The rules and regulations of "road reserve" must be developed in line with the amendments of the Land Act and UCC Act (Land Act – ULII).

2.3.4 Other policies and regulations in play

The purpose of the Uganda National Roads Authority (General) Regulations, 2017 – ULII regulations[3] is to provide for:

- a clear and transparent framework for the use of national roads, road reserves and ferry landing facilities;
- the installation of traffic control devices;
- the carrying out of activities on national roads;
- an up-to-date register of road reserves;
- the requirements and obligations of contractors.

The second schedule on fees for temporary use of the national road, road reserve or ferry landing facility, class three on laying of cables and pipes and erecting of poles and other infrastructure on the road reserves, provides for fees for laying of ICT infrastructure of UGX 100 000 per km per year for any of this work. This is a limiting factor in the expansion of ICT infrastructure and will have a negative effect on the price of connectivity and ICT services in Uganda. This cost needs to be revised when considering ICT infrastructure sharing along the roads.

Other policies and regulations need to be updated or developed by the various line ministries, as needed to support ICT Infrastructure national deployment initiatives.

2.4 Current status of ICT infrastructure in buildings

In general, there are no guidelines or standards for the deployment of ICT infrastructure in public buildings in Uganda. As a consequence, deployment is always an extra cost that is incurred if the occupant is interested in the service. Where the business needs it as a mandatory service, conduits are installed along the existing walls of the building. For other utilities, building plans always make provisions for their service ducts during the design and construction phase. It is

[3] Available at https://ulii.org/akn/ug/act/si/2017/44/eng@2017-08-31.

clear that ICT infrastructure in buildings has to be planned in advance during the design and construction phase.

The need to engage the planning committees that approve building permits in local governments was noted in the discussion on the development of these ICT infrastructure guidelines or standards.

A draft standard for structured cabling for government ministries, departments and agencies was developed in 2013 with a focus on local area network (LAN) installations, cable types and minimum specifications for optical fibre. These specifications were outdated and did not emphasize use of ducts in the designs.

2.5 Current state of ICT infrastructure in cities

The current deployment of ICT infrastructure in urban areas (Kampala and the other cities) needs to be addressed. Service providers are installing fibre-to-the-home (FTTH) for their clients with limited coordination and consultation. As a result, the suburbs of Kampala are littered with service provider poles, utility poles, trenches along the roads and pole-mounted microsites, all carrying fibre-optic cables. The number of daily excavations along the roads resulting in cable cuts and service outages for different operators is alarming. This is also attracting theft of and intentional vandalism to cable and accessories. There is an urgent need for service providers to develop and use an organized coordinated approach to add new broadband customers in the cities.

The Ministry of ICT and National Guidance technical team carried out field visits in nine new cities/towns – Kampala, Entebbe, Wakiso, Mbarara, Masaka, Fort Portal, Jinja, Mbale and Arua – from October to December 2023. The key stakeholders engaged included planners, economists, engineers and ICT officials. The new cities were selected because they were still in the initial stages of planning, and were better positioned to receive guidance. The purpose of the field visits was to ascertain the requirements for incorporating ICT infrastructure deployment into the ongoing roll-out strategies for water, sanitation and health (WASH) and energy infrastructure planning and management in the new cities.

The findings of the team are summarized below (2), (4).

Kampala City, Entebbe Municipality and Wakiso

District planners from Wakiso, Kampala and Entebbe Municipality were interviewed, and information from different departments was collected via questionnaires. Additionally, the planners provided information on planned and existing infrastructure projects with an ICT or broadband component. Existing and planned public infrastructure for the health, education, works and transport, energy, water and environment sectors were considered for the questionnaire. Information gathered was also used to determine whether this infrastructure (planned and existing) incorporated ICT infrastructure needs or had accounted for them in the development process. The findings from each city are summarized below.

Kampala Capital City Authority

KCCA focuses on providing essential services through its infrastructure, such as roads, junctions, parking facilities, service centres, health centres and schools. The city plans include expanding Internet or broadband access to all these facilities. To enhance infrastructure-sharing initiatives,

KCCA has collaborated with various entities such as the Uganda Police Force, NITA–U and the Japan International Cooperation Agency to improve connectivity in the city. Challenges have arisen from utility companies digging up roads, prompting KCCA to advocate for a shared communication infrastructure group to facilitate cooperation and minimize disruptions.

Joint infrastructure planning interventions at KCCA involve engaging stakeholders and utility companies to incorporate their plans into the city development projects. However, issues have emerged, such as the lack of a communication framework, unclear responsibilities for overhead costs and the absence of guidelines on addressing cross-cutting issues. KCCA has submitted its planned projects to stakeholders and urged collaboration, but detailed neighbourhood plans are needed to guide service providers effectively. The incorporation of ICT infrastructure planning into current and future plans is crucial for aligning institutional goals with NDP III and ensuring holistic planning from all relevant stakeholders.

Incorporating ICT infrastructure planning into KCCA projects is essential for the city development, but challenges remain. The Smart City project, for example, lacks involvement from utility providers at the planning stage. KCCA aims to establish a clearer governance framework to include external stakeholders and utility providers in project implementation. While the Building Act Board has provided guidelines on ICT provisions in buildings, KCCA still needs guidance from the Ministry of ICT and National Guidance to promote ICT deployments effectively. Collaborative efforts with key stakeholders, including utility providers, will be crucial for the successful implementation of infrastructure projects and the advancement of ICT infrastructure initiatives in Kampala.

During several interviews with the KCCA Engineering Supervisor of Roads and his team, it was noted that all new KCCA roads were being built with underground service ducts. If service providers want a permit to build their own infrastructure where service ducts exist, they are encouraged to use existing ducts. Vandalism of cables is a major issue and it is the responsibility of the police force to catch and prosecute the culprits. There are issues with road reserves in Kampala City as most of them have been used or eroded over time. The existing road network has also grown naturally without compliance to engineering guidelines and standards. New roads could be built although affected landowners would need to be compensated. Successful utility infrastructure sharing would need to address issues such as the effects of high-voltage power cables on telecommunication cables in the same duct, as well as the potential impact of floods on infrastructure in the service ducts, or how damage due to vandalism and accidents would be handled.

KCCA believes that if all the stakeholders work together to share infrastructure, it would lead to a cleaner and well-laid out city. An example is a road segment between Jinja Road junction and Nakawa junction, where all the utilities share an underground service duct after all stakeholder meetings were convened to discuss a clean solution. There has not been any excavation on that segment since then. Finally, the current build-up of poles on street corners by fibre-optic service providers in Kampala is illegal according to KCCA, and a sharing solution has to be worked out between the pole owners, KCCA and UCC.

Entebbe Municipality

Entebbe Municipality is actively engaged in various infrastructure projects, with a significant focus on the USMID programme, supported by the World Bank International Development Agency. As part of this programme, new or rehabilitated roads in Entebbe are equipped with conduits,

eliminating the need for service providers to cut roads for deploying their infrastructure. The municipality internal policy emphasizes the installation of conduits on new roads to prevent damage and encourages service providers to utilize these conduits by paying a one-time annual fee.

Entebbe Municipality is proactively incorporating ICT infrastructure planning into its projects to enhance public access to services. Public facilities under construction or renovation – such as offices, taxi parks and markets – are being fitted with access points for free public Internet access. Additionally, planned works such as the rehabilitation of Kampala Road and Kiwafu Road include provisions for Internet connectivity. The municipality is open to joint infrastructure planning and sharing opportunities, particularly with non-competitive utility providers such as the National Water and Sewerage Corporation (NWSC) and Umeme, if approached with viable proposals.

Entebbe Municipality collaborates with various stakeholders for joint infrastructure planning, depending on the funding source. For instance, the municipality works with World Bank consultants and contractors from the design stage of road projects under the USMID programme, incorporating conduits for other utility service providers. Stakeholders such as the Post Office, Umeme and NWSC are involved in the planning stage to ensure efficient infrastructure sharing. Maintenance of shared infrastructure corridors by the municipality, including conduits, is essential for public service provision, funded through the Road Fund. Despite challenges related to competition among telecommunication providers, promoting cross-sector infrastructure sharing is crucial for optimizing resources and enhancing service delivery in Entebbe Municipality.

Wakiso District local government

In Wakiso District local government, there is a lack of comprehensive planning for ICT provisions and Internet connectivity in most district projects. While public utilities such as water and power are prioritized, ICT infrastructure is often overlooked due to budget constraints. Only one project, the construction of Sumbwe Seed School funded by the World Bank, includes planned ICT provisions, highlighting a broader issue of ICT not being recognized as a priority cross-cutting issue in project planning. Observations reveal a lack of fibre-optic connectivity, limited Wi-Fi access points, and insufficient infrastructure such as ducts for cables in road rehabilitation projects, indicating a significant gap in ICT integration within ongoing developments.

The Ministry of ICT and National Guidance could play a crucial role in advocating for the incorporation of ICT components into all project plans under local governments such as Wakiso District. By ensuring that ICT requirements are disseminated for various project types, the Ministry can promote the prioritization of ICT infrastructure in development projects. Addressing the current lack of ICT planning and integration in district projects is essential to enhance connectivity, improve service delivery and empower communities through access to technology. Efforts to integrate ICT considerations from the initial stages of project planning can lead to more efficient and effective implementation of infrastructure projects in Wakiso District and beyond.

Mbarara City

The city does not have an infrastructure roll-out plan in place at the moment. Infrastructure (roads and civil works) are planned for the financial year within the district development plan. There are plans to implement the NDP III as it is for every sector, but there is no linking plan for the utilities.

It was agreed that it was necessary to plan for the incorporation of ICT infrastructure into the construction of utilities such as roads during the budgeting phase. One of the challenges being experienced was the absence of official standards to be considered when planning for ICT infrastructure: for example, how to cater for persons with disabilities in buildings.

Another major challenge is that when the civil works are broken down during expansion, their strength, tension and durability are affected. There is a need for flexibility in the infrastructure plan, with standards accommodating utilities such as trenches and road reserves, to avoid breaking down civil works and denial of service, as well as the dynamics of innovation and changes in technology.

As a short-term intervention to combat the situation, a physical planning board chaired by town clerks was suggested for every district to ensure coordinated infrastructure planning among the officers.

Masaka City

The city ICT division, consisting of senior ICT officers, is not involved in city infrastructure roll-out planning, which falls under the jurisdiction of a separate physical planning committee. NWSC holds a significant role in utility discussions due to the lack of water, with water and electricity distribution planning taking precedence over ICT in road construction designs. Similar to Mbarara City, Masaka City faces service disruptions during road upgrades due to poor planning.

Suggestions included development of overall utility infrastructure guidelines by the Ministry of ICT and National Guidance for sharing with ministries, departments and agencies and local governments, along with recommendations from focus group discussions on topics such as ICT infrastructure sharing guidelines for distribution to local governments, conducting regular training for physical planning boards, and providing guidelines for issuing permits for ICT infrastructure developments with an emphasis on infrastructure sharing.

Fort Portal City

During a consultative meeting with the technical team in Fort Portal City, several key findings emerged. Concerning the roll-out of utility infrastructure, it was noted that service ducts for water and energy were being installed in ongoing road constructions, yet ICT infrastructure was notably absent from these plans. Additionally, discussions revealed that plans were in progress to accommodate water and energy infrastructure in older road developments. However, challenges arose due to the lack of a clear network plan by NWSC in Fort Portal, resulting in disputes over infrastructure costs during road construction projects. Moreover, unauthorized installation of ICT infrastructure by various operators was identified as a significant issue.

The meeting also highlighted several challenges faced by the city. These included the absence of technical personnel dedicated specifically to ICT within the city workforce and a lack of designated personnel to advocate for ICT needs within the city administration. Furthermore, the lack of coordinated planning with ICT infrastructure providers resulted in unregulated deployments, contributing to project delays and increased expenses. Despite collaborations with NWSC, high costs were imposed on city projects due to damages or relocations of infrastructure. Consequently, infrastructure relocations were causing project delays and escalating expenses, posing significant challenges to the city infrastructure development efforts.

Jinja City

During a recent consultative meeting with Jinja City technical team, significant gaps in infrastructure planning and implementation were identified. Firstly, it became evident that, despite having a physical plan for water and utilities along road corridors, the city lacked a comprehensive roll-out strategy with defined nodes. This absence of a detailed plan hindered effective infrastructure development and coordination. Additionally, roads under the USMID project – managed by the Ministry of Lands, Housing and Urban Development – featured service ducts intended to accommodate all utilities. However, service providers displayed a reluctance to share these resources, posing challenges to collaborative infrastructure deployment efforts.

Furthermore, challenges arose due to the absence of joint planning with ICT infrastructure providers, especially regarding road expansions. Walkways were utilized for service lines, yet some providers hesitated to share ducts, opting instead to acquire corridors on private land. While telecommunication operators and service providers utilized available ducts, they caused road damage during excavation where ducts were absent. These challenges were exacerbated by the limited authority over infrastructure roll-out by various ICT providers and ambiguous corridor allocations per utility. Inadequate enforcement frameworks and a lack of designated ICT officers further complicated infrastructure oversight and regulation, emphasizing the need for comprehensive planning and coordination mechanisms in Jinja City infrastructure development efforts.

Mbale City

In Mbale City, the absence of an approved infrastructure roll-out master plan prompted the formulation of a draft plan, showcasing the commitment to coordinated urban development. Notably, dedicated ducts for ICT were allocated on new roads, reflecting a proactive approach to integrating technology into infrastructure projects. These service ducts, intended for use by service providers for a fee, signify a revenue-generating opportunity for the city, with maintenance falling under its jurisdiction. Environmental sustainability was prioritized throughout project roll-outs, with environmental considerations integrated into planning to minimize ecological impact.

Despite these efforts, challenges persisted, particularly in the mapping and documentation of utility providers, hindering comprehensive infrastructure planning. Moreover, the city lacked specific cost-sharing mechanisms for shared utility implementation. However, there was an agreement with the Ministry of Works and Transport to address maintenance concerns through collaborative efforts. Comprehensive conflict resolution mechanisms and robust security protocols were established to manage disputes and safeguard infrastructure projects, underscoring Mbale City commitment to fostering cooperation and ensuring project success.

Arua City

The urban development strategy in Arua City relies on an approved physical plan, but the detailed infrastructure roll-out plan remains largely incomplete, with only 3 per cent of the work done. Recognizing the fragmented nature of the existing infrastructure, city authorities are prioritizing the integration of ICT alongside essential utilities such as water and electricity. The lack of clear guidelines and coordinated planning has led to disruptive deployments, including unplanned road cuttings by utility providers such as NWSC. This underscores the urgent need for improved communication among stakeholders to mitigate future disruptions.

Currently, while committees for physical plans are in place, there is a notable absence of a dedicated committee for ICT infrastructure in Arua City. Addressing this gap is crucial, and short-term interventions should focus on incorporating land acquisition provisions and necessary infrastructure on all new roads to facilitate future developments. Engaging utility providers from the design phase is essential to prevent potential disruptions and ensure smoother execution of projects.

The city faces numerous challenges in its infrastructure development efforts, including financial constraints, lack of collaboration among utility providers, and delayed fund releases. These challenges impede project progress and complicate implementation processes, highlighting the need for strategic planning and collaborative solutions. Additionally, complexities in integrated planning, issues with community sensitization, and public resistance further complicate the infrastructure development landscape.

Participation in World Bank projects offers both opportunities and challenges, affecting project financing and necessitating strategic planning and collaboration for resilient and efficient infrastructure development. Addressing these multifaceted challenges requires concerted efforts and proactive measures to ensure sustainable urban growth. Recommendations from meetings with city officials included the Ministry of ICT and National Guidance providing guidelines for reviewing ICT infrastructure permits, setting up infrastructure planning committees, developing and distributing ICT infrastructure guidelines, raising awareness about cross-sector infrastructure sharing, and establishing legal frameworks recognizing broadband as a public utility. Encouraging programme-based budgeting for multisectoral projects and establishing a multisectoral infrastructure body for managing cross-sector infrastructure sharing are also necessary steps.

2.6 State of collaboration with the key ministries and government agencies

Focus group discussions led by the Ministry of ICT and National Guidance with the utility Ministries of Water and Environment, Energy and Mineral Development, Lands Housing and Urban Development in Kampala were held in September–December 2023 (3). The purpose of the focus group discussions was to assess the roll-out strategies and plans for water, sanitation and health and energy infrastructure, and request that they include roll-out of ICT infrastructure.

2.6.1 Findings from meetings with the Ministry of Water and Environment

The Ministry had developed an infrastructure roll-out master plan, which was submitted to the National Planning Authority for integration into the NDP IV. Several projects, such as the Katosi project, have already been implemented, while others are ongoing across the country. These projects are mapped and documented by the implementing agencies and updated biennially. However, there is a lack of cost-sharing mechanisms for the joint implementation of utilities. The Ministry also highlighted existing agreements with the Ministry of Works and Transport for maintaining road reserves or corridors. In response to telecommunication service provider complaints about national water teams cutting fibre-optic cables, the Ministry pointed out that poor planning and demarcations led to fibre companies damaging water pipes, despite efforts to improve piping demarcations. Additionally, security measures are in place to protect projects, but vandalism remains a significant issue, managed by committees such as water user committees.

Challenges during project implementation include limited financial resources, leading to delays due to the untimely release of funds, and difficulties in integrating planning with other stakeholders. High compensation rates demanded by affected landowners and inadequate community sensitization, particularly by ICT companies running fibre projects, also posed significant hurdles. The Ministry emphasized the importance of public buy-in before commencing projects, as changes in priorities and service demand often affected project execution timelines and costs. For example, the Katosi project required larger pipes due to increased water demand, which presented challenges fitting them into existing road culverts. Public resistance varied depending on the perceived benefits of new services, with water and power projects generally more accepted than fibre and telecommunication projects.

To address these challenges, the Ministry recommended establishing clear cost-sharing mechanisms to facilitate collaboration. There was a consensus that the Ministry of Water and Environment should take ownership of major water projects, while the Ministry of Transport and Works should handle road maintenance costs, to prevent conflicts and streamline project management.

2.6.2 Findings from meetings with the Ministry of Lands, Housing and Urban Development

During consultative meetings with the technical team at the Ministry of Lands, Housing and Urban Development, several issues were discussed regarding the development of urban projects. It was noted that many projects in urban areas were being developed outside existing transport networks, and the Ministry had not yet considered incorporating ICT infrastructure provisions into these road projects. Moreover, there were no guidelines or standards in place to assist planners in integrating ICT infrastructure into their projects. However, under the USMID project, pipes were strategically placed at crossroads in 14 municipalities to help local committees identify their locations. Despite some roads having service ducts, there was a need for standardization to dictate the placement of utilities like water and power lines.

The ongoing Infrastructure Corridor project was highlighted as an initiative to guide the roll-out of utilities, including ICT. However, challenges such as lack of coordination between responsible entities and heavy charges for rights of way for public services were identified. These challenges, along with institutional arrangements, hindered the coordinated roll-out of such projects. The Ministry of Land, Housing and Urban Development is working with local physical planning committees to ensure that project requirements are implemented effectively.

To address these challenges, several recommendations were proposed. It was suggested that the Ministry of ICT and National Guidance guidelines for ICT provisions be integrated into building and infrastructure projects, aligning them with housing and land development plans. Additionally, the enforcement of these guidelines could be strengthened by having project plans approved by a multi-entity committee. The Ministry of Land, Housing and Urban Development could also play a role in enforcing these guidelines through the Physical Planning Act, which mandates the provision of utilities.

Further recommendations included the gazetting of National Physical Planning Standards and Guidelines being developed by the Uganda Bureau of Standards, which could be enforced by physical planning committees. Legal and institutional arrangements were deemed necessary to coordinate the provision of all utilities, particularly along the proposed 130 million Infrastructure Corridor project. The Ministry of Justice and Constitutional Affairs could assist in aligning these

efforts. Lastly, it was proposed that a cost-sharing mechanism for construction and maintenance be enforced through legal reforms, possibly by reviewing or amending the Land Act.

2.6.3 Findings from meetings with the Ministry of Energy and Mineral Development

Meetings with the Ministry of Energy and Mineral Development revealed various infrastructure initiatives and challenges, particularly the proliferation of poles from operators such as MTN, Lycamobile and Umeme every 15 metres along roads due to a lack of sharing arrangements. The need for enhanced ICT infrastructure in economic free zones and industrial parks, such as Wadagai, was emphasized, alongside ongoing efforts to improve broadband efficiency, by tapping into fibre networks from neighbouring countries and leveraging fibre above transmission lines. While infrastructure roll-out plans existed for projects such as the East African Crude Oil Plan and Kabalega Airport and Industrial Park, there were gaps in planning for oil exploration basin areas, compounded by intellectual property concerns that hindered the sharing of detailed plans.

In the electricity and energy sectors, strategies such as the National Electrification Strategy and grid development plans were in place, with joint planning visible in projects such as the Energy for Rural Transformation initiative. However, challenges included the lack of frameworks to manage the proliferation of poles and the installation of solar projects in agriculture and health sectors without proper guidance. To address these issues, recommendations were made for the development of a common infrastructure plan, stricter enforcement of planning regulations, and the creation of policies for utility sharing and infrastructure roll-out. Additionally, adopting a utility corridor approach, securing joint corridors and using a programme-based approach for budgeting and planning were proposed to effectively integrate ICT infrastructure into future projects.

2.6.4 Conclusions from the situation analysis of cities and government ministries, departments and agencies

Through extensive consultations and focus group discussions, coupled with field visits across various ministries and city councils, a fragmented landscape of ICT infrastructure planning and implementation has emerged. This fragmentation highlights a significant shortfall in infrastructure development efforts – a lack of cohesive planning and integration across sectors. Instances such as the Fort Portal unregulated ICT deployments, the absence of comprehensive roll-out plans in Jinja City, and conflicts between the Ministry of Water and Environment and telecommunication providers underscore the urgent need for better coordination and planning. These challenges not only highlight the uniqueness of local issues, but also reveal systematic issues, including redundant deployment, increased project costs and prolonged implementation timelines due to the absence of centralized coordination and standardized planning protocols.

Addressing these challenges extends beyond operational necessity to strategic imperatives, aligning with the National Broadband Policy vision for an inclusive and comprehensive digital Uganda. Realizing this vision hinges on overcoming silo approaches prevalent in infrastructure planning and implementation. By achieving a harmonized infrastructure development process, Uganda can optimize resource utilization, minimize project redundancies and extend equitable broadband access to all regions, including the most remote and underserved areas.

Developing an ICT infrastructure sharing standard and a collaboration process/plan involving all government ministries/agencies and the private sector is a critical first step toward achieving this goal.

2.7 Feedback and inputs from private sector ICT service providers

Meetings were held with Chief Technology Officers (CTOs) and the technical teams of leading national service providers to seek their inputs on the state of ICT infrastructure, the challenges and the concept of common utility infrastructure sharing along the roads, bridges, crossings and buildings.

Their comments, feedback, inputs and suggestions are grouped and summarized below:

1) Kampala City is congested with poles in every corner as the broadband service providers try to connect as many homes as possible to the Internet (FTTH). The poles in use include utility poles, street light poles and poles erected by broadband service providers. Each service provider is laying its own distribution cables along the roads and also using poles to connect to the different homes. This is giving the city suburbs an ugly look and maintenance of service is messy and expensive. There needs to be a framework for sharing cable facilities – service providers are willing to take the lead if the framework is established.
2) UNRA should include provision for ICT facilities along all new and upgrading road projects. Operators are willing to contribute to the investment cost. This eliminates breaking new completed roads to route ICT facilities, use of overhead poles and excavations that cause service outages. Once cables are cut, the operators must restore service in the shortest time possible for their customers. This is quite expensive.
3) Vandalism of ICT cable facilities is the number one problem for service providers. Cables, poles and other accessories are being stolen, causing serious outages that affect national security infrastructure and customers. Other fibre cut causes include rodents eating cables in the trenches, other utilities damaging the fibre and road repairs damaging existing cable infrastructure. These problems cause breach of service agreements with customers for the failure to offer 99.9 per cent reliable service. UNRA and other road owners should provide security against vandalism, and law enforcement should step up efforts to prosecute the people who vandalize the network infrastructure.
4) Operators support the use and sharing of cable ducts along the roads, as long as there is a robust framework clarifying roles and responsibilities. Who is responsible for maintaining what and what is the commitment for time to repair in case of damage to the cable ducts and cables? What colour labelling scheme will be used by the different operators? How will service outages be reported by UNRA to the service providers and who will coordinate the repair work? When manhole covers are stolen, how soon would they be replaced by UNRA? Will Uganda National Roads Authority have a network operations centre to report outages and damages in real time? What will UNRA charge for using the cable ducts and what does this include? If the price is higher than what the operator costs are today, infrastructure sharing will not be viable.
5) ICT infrastructure sharing framework should consider or include the following:
    a) Set-up of an online database that keeps track of where all the current fibre-optic deployments are (accessible to private sector players, government ministries and agencies, and local government officials): This database should include the submitted design and installation documents used for each cable link.
    b) Allowing a third-party independent company to take on the role of managing and maintaining the shared ICT infrastructure facilities to ensure quick unbiased actions in cases of service issues: Such a company would be in a better position to sign service

level agreements with each utility, with clear instructions for access management, processing permits, change management and cost-sharing models.

c) All utilities declare their quality of service targets to their customers: The ICT service providers commit very high quality of service (99.9 per cent availability), while the other utilities they share with may have less stringent key performance indicators (KPIs).

d) There is need for a common utility strategy of dealing with natural disasters such as floods and mudslides on shared infrastructure: Private sector players with ICT infrastructure investment must also be included in the recovery programme funding.

e) Public awareness programmes and campaigns to local authorities and the general public so that they are aware of the criticality of fibre-optic cable infrastructure to the economy of the country: They need to understand the law enforcement penalties for causing service outages by causing fibre cuts.

f) Private building contractors doing new construction projects must also be warned about damaging existing ICT infrastructure and understand the liabilities associated with causing service outages.

3 Identified gaps, challenges and opportunities in infrastructure sharing

This section summarizes the key findings from the situation analysis of the current state of ICT infrastructure deployments in the country, the key challenges being faced by both the public and private sector utility companies and ICT service providers. These findings have been repeated and emphasized by the different categories of stakeholders that were consulted to determine the current state of such deployments. Opportunities such as preplanned collaborative common utility infrastructure sharing that would reduce the investment cost and implementation time to accelerate ICT infrastructure deployments across the country are also noted.

3.1 Joint construction and facility sharing

Prevention of redundant investment in the same route saves construction costs stemming from repetitive road excavation and recovery. For this purpose, joint construction is a very important strategy for the future efficient deployment of broadband infrastructure. Currently, Uganda needs coordinated efforts for joint construction of broadband infrastructure of the interested parties: government organizations, telecommunication operators and public utilities. As broadband infrastructure develops in the future, the need for facility sharing will be necessary – operators share broadband infrastructure built by their competitors or public utility service providers.

There is a need to introduce a cross-cutting dig-once policy for all new transport infrastructure projects, which can harmonize the infrastructure roll-out of different sectors and cover the regulatory gaps identified.

3.2 Right-of-way issues in Uganda

For telecommunication operators or utility service providers, the acquisition of property interests to form a utility corridor that contains poles, wires, cables or pipes that will deliver services to end users is crucial. Property interests (usually strips of land) that form the utility corridor are referred to as right-of-way. Right-of-way provides rights to cross the lands of another, acquired for or devoted to building facilities, such as roads, railroads, waterways, underground ducts and poles. The concept applies to all utilities, such as ICT, electricity and water. Installation of core ICT infrastructure such as optical fibre, towers/masts line or any other utility requires the acquisition of land.

The existing laws about the acquisition of land for public works are not very straightforward, hindering the implementation of the right-of-way policy. The most relevant law is section 71 of the Land Act (1998), but the 1995 Constitution of Uganda has privileged the rights of property owners over government authority on matters of right-of-way. The absence of a clearly defined land compensation policy causes significant project delays. Uganda needs clear right-of-way concepts outlined in the relevant laws, as well as detailed rules on how to access public right-of-way.

3.3 Vandalism of deployed fibre-optic infrastructure

Vandalism of the deployment fibre-optic infrastructure is caused by the following:

- Unintended damage by excavation due to lack of knowledge of such installations: Excavation may be due to road repairs or other service providers laying their fibre in the same areas.
- Intentional activities such as crime gangs cutting rolls of fibre cable to sell it illegally to other customers: In cases of pole fibre installations, crime gangs are interested in stealing cable wires to sell as metal scrap on the local market.

Service outages caused by these vandalism acts result in costly replacement of vandalized infrastructure by the operators. There is an urgent need for public awareness campaigns about the vandalism threats to national security and reliable telecommunication services to the public. The public needs to know that those caught will be prosecuted to the full extent of the laws of Uganda, and that these incidents should be reported to the police as soon as they happen.

3.4 Lack of common utility infrastructure sharing steering committee

Previously, UCC led the efforts to create a Common Infrastructure Working Group, which included telecommunication operators, postal and broadcasting agencies, ministries, departments and agencies. They had formed a collaboration portal called SPIDER.[4] This collaboration led to the formation of the UCC enforcement unit Underground Communications Infrastructure Information Exchange Platform, a portal for collaboration between infrastructure owners and other entities to facilitate exchange of information on underground (fibre) installations. The platform served to minimize accidental destruction or damage of underground communication infrastructure during excavation activities. It facilitated timely information exchange between underground communication infrastructure owners and any entities that intend to engage in digging, excavation, construction or other civil works near communication infrastructure. But it is currently not updated and in use by the members.

There is an urgent need to expand and rejuvenate this effort and set up a Common Utility Infrastructure Sharing Steering Committee with representatives from all the key ministries/agencies, UCC and the private sector players that will include but not be limited to: Ministry of ICT and National Guidance (Chair); NITA-U; Uganda Electricity Transmission Company Limited (UETCL); Ministry of Works and Transport; UNRA; Ministry of Local Government; representatives of municipalities; KCCA; Ministry of Lands, Housing and Urban Development; UCC; the National Environment Management Authority (NEMA); and broadband service provider representatives.

This committee should meet regularly to plan and oversee national common utility infrastructure sharing projects.

3.5 No ICT infrastructure installation standards and sharing framework guidelines

The gap of unavailable standards or guidelines from the Ministry of ICT and National Guidance to other government ministries/agencies and local governments on how to plan for and oversee provision of ICT infrastructure in their areas by public/private sector players was highlighted in

[4] The SPIDER portal is available at www.ucc.co.ug/uccinfrastructure/.

almost all stakeholder meetings and interviews. It is evident that all stakeholders would like the Ministry of ICT and National Guidance technical team to take the lead in providing the necessary guidance. The work done in this study is a critical first step in this direction.

3.6 Transparency and sharing of information

Transparency will reduce costs and provide a greater incentive for late market entrants to install or share its facilities for broadband deployment. The creation and use of a geographic information system (GIS) platform in Uganda will have many benefits. It will enable the Ugandan Government to systematically plan and execute national utility projects more efficiently. In addition, it is also important that telecommunication operators and utility operators share information on the location of each other's facilities.

4 Key stakeholders to collaborate in common utility infrastructure sharing

This section covers all the key stakeholder government ministries and agencies, as well as local government authorities that must cooperate and work together to plan and construct all infrastructure projects in a cost-effective approach and shortest possible implementation time. The stakeholders listed in this section have different mandates by law, but share the same goals to achieve development targets outlined in NDP III and the soon-to-be-rolled-out NDP IV. In order to achieve common utility infrastructure sharing, a collaboration and coordination framework to roll out new infrastructure projects has been proposed. An implementation and action plan for common utility infrastructure sharing is proposed that starts with select pilot projects to work out the process details and is then used to scale up all national utility deployment projects going forward.

4.1 Identified key stakeholders

The sector ministries were identified as key implementers and coordinators of the infrastructure-sharing frameworks within their respective sectors. Some particular agencies – such as UNRA, UETCL, Uganda Electricity Distribution Company Limited (UEDCL) and National Housing Construction Company – are also stakeholders in this effort. Additionally, specific local governments such as the Kampala City Council Authority (KCCA) must be consulted and brought on board, as their operations are autonomous from the line ministries.

The key stakeholders have been identified as follows:

- Ministry of ICT and National Guidance;
- UCC;
- Ministry of Works and Transport;
- UNRA;
- Ministry of Lands, Housing and Urban Development;
- Ministry of Local Government and the district administrations;
- KCCA and other local governments (cities, municipalities and towns);
- Ministry of Energy and Mineral Development;
- Ministry of Water and Environment;
- NEMA;
- UETCL;
- UEDCL;
- NITA–U.

4.2 Roles and mandate for each stakeholder

The roles of the key stakeholder range from coordination to oversight, as shared in Table 1.

Table 1. Roles of the key stakeholder

Stakeholder	Roles and mandate
Ministry of ICT and National Guidance	Coordinator and developer of ICT guidelines and frameworks in the country
UCC	Regulator and overseer of ICT infrastructure networks and operations for all service providers
Ministry of Works and Transport	Coordinator and overseer of new transport infrastructure roll-out plans and maintenance of existing infrastructure
UNRA	Implementation and management of national road infrastructure projects, including provisions for utility corridors
Ministry of Lands, Housing and Urban Development	Oversight of land issues, national housing, and urban development planning and integration of infrastructure projects within city planning
Ministry of Local Government and district administrations	Engagement and collaboration with local governments (districts, municipalities, etc.) to align infrastructure plans with local needs and regulations
KCCA and other local governments	Responsible for Kampala City infrastructure maintenance planning and operations
Ministry of Energy and Mineral Development	Coordination of energy infrastructure projects and integration with broader infrastructure plans
Ministry of Water and Environment	Coordination of national water infrastructure projects and integration with broader infrastructure plans
NEMA	Environmental oversight and regulation to ensure all infrastructure projects comply with environmental standards
UETCL	Implementation and management of national electricity transmission infrastructure
UEDCL	Implementation and management of national electricity distribution infrastructure
NITA-U	Oversight and coordination of national ICT infrastructure projects, including standards and guidelines development

4.3 ICT facilities as a public utility (in addition to water and power)

The National Broadband Policy 2018 had called for ICT facilities to be added as a public utility (such as water, power, sanitation, etc.) so that the Government could give it the attention it deserved. Consultations on legislation for broadband development in Uganda were undertaken with support from and in collaboration with the Republic of Korea (1).

Development of the Communications and Information Bill with provisions for broadband as a public utility was done by the Ministry of ICT and National Guidance team, but it was not

submitted to Parliament. There has been weak enforcement of broadband as a public utility due to the lack of an infrastructure law and policy that cuts across all types of public utility infrastructure. This mitigation measure would include sensitization of public utility infrastructure ministries, departments and agencies to this new categorization, and require amendment of the relevant laws to make this a reality.

4.4 Proposed collaboration and coordination plan for the key stakeholders

Collaboration and coordination plan for common utility broadband infrastructure sharing: The objective of this plan is to create an efficient, cost-effective and scalable broadband infrastructure that benefits all stakeholders, including government ministries, agencies and private sector companies. Implementation of this plan involves a number of steps:

1) Establishing a governing body with a mandate to set up a collaborative sharing framework by forming a task force that includes representatives of all stakeholders: The roles and responsibilities must be well defined, clearly outlining the roles of each member in the task force.
2) Conducting a needs assessment for inventory of existing infrastructure by mapping out current broadband infrastructure and identifying gaps: A demand analysis study has to be done to assess current and future broadband needs across different regions.
3) Developing a shared utility infrastructure framework by developing infrastructure sharing memoranda of understanding that would eventually turn into legal agreements to govern the sharing of common utility infrastructure: The agreements would include mutually agreed upon cost-sharing models for equitable operational and maintenance cost distribution among stakeholders.
4) A funding strategy, which must be agreed upon by the stakeholders: Funds for these infrastructure projects can be secured from several sources:
    a) public–private partnerships (PPPs) to pool resources for infrastructure development;
    b) grants and subsidies: Secure government grants and subsidies to support initial investments;
    c) other sources (government budgets, development partner loans, etc.).
5) Implementing standardization and interoperability processes that include development and adoption of technical standards that equipment and infrastructure must comply with: There must be agreement on a regulatory compliance process that ensures all infrastructure adheres to national and international regulations.
6) Pilot common utility infrastructure sharing projects, which must be selected to test out the established processes by all stakeholders: This activity involves the team identifying regions for initial implementation to test the framework. The team must select a monitoring and evaluation team to track performance, identify issues and improve the processes as needed.
7) After the completion of the pilot projects, the team can scale up with nationwide projects by gradually expanding infrastructure sharing to other regions based on pilot results: The monitoring and evaluation team should focus on continuous process improvement by regularly updating the framework based on feedback and technological advancements.
8) A communication strategy developed and agreed upon to ensure continuous stakeholder engagement via regular meetings and mail updates to keep all parties informed: The strategy should include public awareness campaigns to educate the public and private sectors about the benefits and progress of the infrastructure projects.

Coordination mechanisms for the team include the following:

1) Regular meetings and workshops must be scheduled as follows:
    a) bi-monthly or monthly coordination meetings to ensure continuous dialogue and decision-making;
    b) annual workshop to review progress, share best practices and lessons learned, and plan future actions.
2) A digital collaboration platform must be set up to give all stakeholders visibility of all the projects. This can be accomplished by setting up an online portal that serves as a centralized platform for information sharing, document management and communication. The portal can also offer real-time monitoring tools for tracking project progress and infrastructure performance.
3) A conflict resolution framework has to be set up that includes:
    a) mediation procedures outlining clear processes for resolving disputes among stakeholders;
    b) use of neutral third-party arbitrators as impartial experts for unbiased resolution.

The monitoring and evaluation framework includes the following:

1) Key performance indicators (KPIs) must be agreed upon to measure the success of the infrastructure sharing.
2) Periodic reviews must be scheduled and conducted (quarterly and annually) to assess progress and make necessary adjustments on all projects in progress.
3) The team must publish reports regularly to maintain transparency and accountability.

4.5 Proposed implementation and action plans for the key stakeholders

Implementation and action plan for common utility infrastructure sharing: As pointed out in section 4.4 above, a number of government ministries, agencies, local governments and private sector players implementing utility infrastructure projects in a silo approach, thereby missing the opportunity to coordinate/collaborate with other stakeholders in the design and construction phase. As a result, the opportunity to share infrastructure and reduce investment cost is missed. An action plan has been proposed (Table 2) that would get all these entities cooperating and collaborating in the roll-out of infrastructure projects in the country.

This implementation and action plan ensures a systematic approach to common utility infrastructure sharing, promoting collaboration among government and private sector stakeholders. The phased approach allows for effective planning, pilot projects and scaling, supported by continuous monitoring and adaptive strategies to ensure long-term success and sustainability. The estimated timelines proposed in the table may be changed based on the consensus of the steering committee overseeing this initiative.

The objective of the action plan is to create a structured approach for implementing and managing the sharing of common utility infrastructure among various stakeholders, including government ministries and agencies, and private sector companies. The key components of the action plan are presented in Table 2.

Table 2. Key components of the action plan

Phases	Action	Stakeholder involved	Outcome	Estimated timeline
Phase 1: Planning and preparation				
1. Establish a governing body	Form a multistakeholder task force	All stakeholders	Task force charter with defined roles and responsibilities	Month 1
2. Conduct a needs assessment	Inventory existing infrastructure and perform demand analysis	Government agencies, private sector companies	Comprehensive report on current infrastructure and future needs	Months 2–3
3. Develop legal and regulatory framework	Draft and approve infrastructure sharing agreements and regulations	Government ministries, regulatory bodies	Legal agreements and regulatory framework in place	Months 3–6
Phase 2: Infrastructure development				
4. Create a funding strategy	Secure funding through PPPs, grants and subsidies	Government ministries, private sector companies	Secured funding and investment plan finalized	Months 4–6
5. Develop technical standards	Define technical standards for shared infrastructure	Technical agencies, private sector experts	Documented technical standards and interoperability guidelines	Months 6–8
6. Pilot project implementation	Select pilot regions, implement infrastructure sharing, monitor and evaluate	All stakeholders	Successful pilot projects with documented results	Months 9–12
Phase 3: Deployment and scaling				
7. Nationwide deployment	Expand infrastructure sharing to other regions based on pilot results	All stakeholders	Phased nationwide implementation of shared infrastructure	Year 2–3
8. Continuous monitoring and evaluation	Regularly track performance and compliance with standards	Regulatory bodies, independent auditors	Periodic reports and adjustments to the framework as needed	Ongoing
Phase 4: Coordination and communication mechanisms				

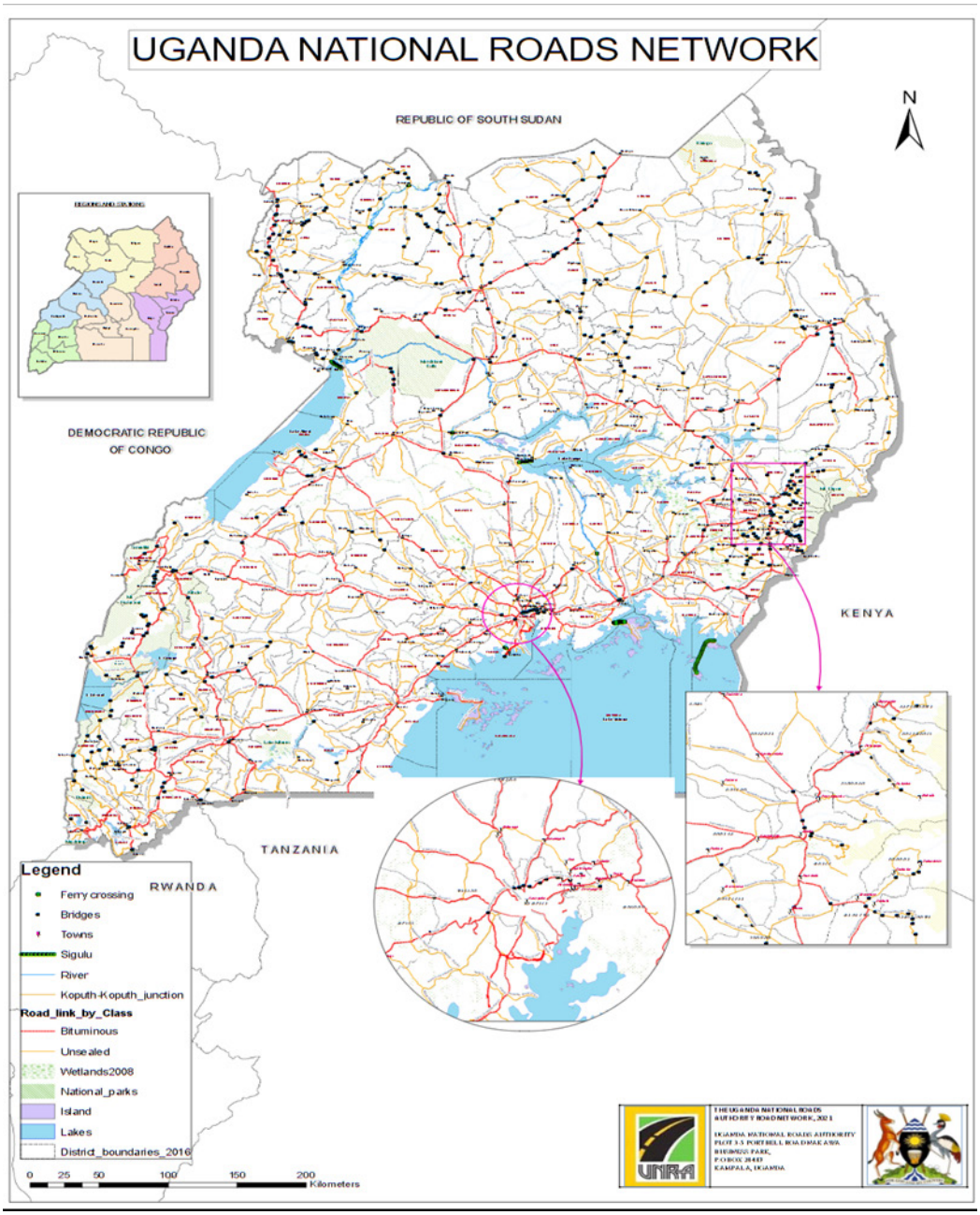
Table 2. Key components of the action plan (continued)

Phases	Action	Stakeholder involved	Outcome	Estimated timeline
9. Regular meetings and workshops	Conduct bimonthly coordination meetings and annual workshops	All stakeholders	Consistent communication and alignment among stakeholders	Ongoing
10. Digital collaboration platform	Develop and maintain an online portal for information sharing and real-time monitoring	Government agencies, private sector ICT departments	Operational digital collaboration platform	Months 6–8 (development), ongoing maintenance
11. Conflict resolution framework	Establish mediation procedures and appoint neutral third-party arbitrators	Regulatory bodies, legal experts	Clear processes for dispute resolution	Months 3–6
Phase 5: Monitoring and evaluation				
12. Define KPIs and performance metrics	Develop KPIs to measure the success of infrastructure sharing	Government agencies, private sector companies	Agreed-upon KPIs and performance metrics	Months 2–3
13. Conduct periodic reviews	Quarterly and annual reviews to assess progress and make necessary adjustments	All stakeholders	Regular updates and improvements to the implementation plan	Ongoing
14. Public reporting	Publish regular reports to maintain transparency and accountability	Government ministries, regulatory bodies	Enhanced public trust and stakeholder engagement	Ongoing

5 Coverage maps of national utilities along roads/crossings (power/water)

National infrastructure networks (including ICT) are constructed along the national transport infrastructure, as shown in the coverage maps. The main issue is that the deployments are not coordinated and there is minimal sharing of service ducts. The latest coverage maps are shown in Figures 2, 3, and 4.

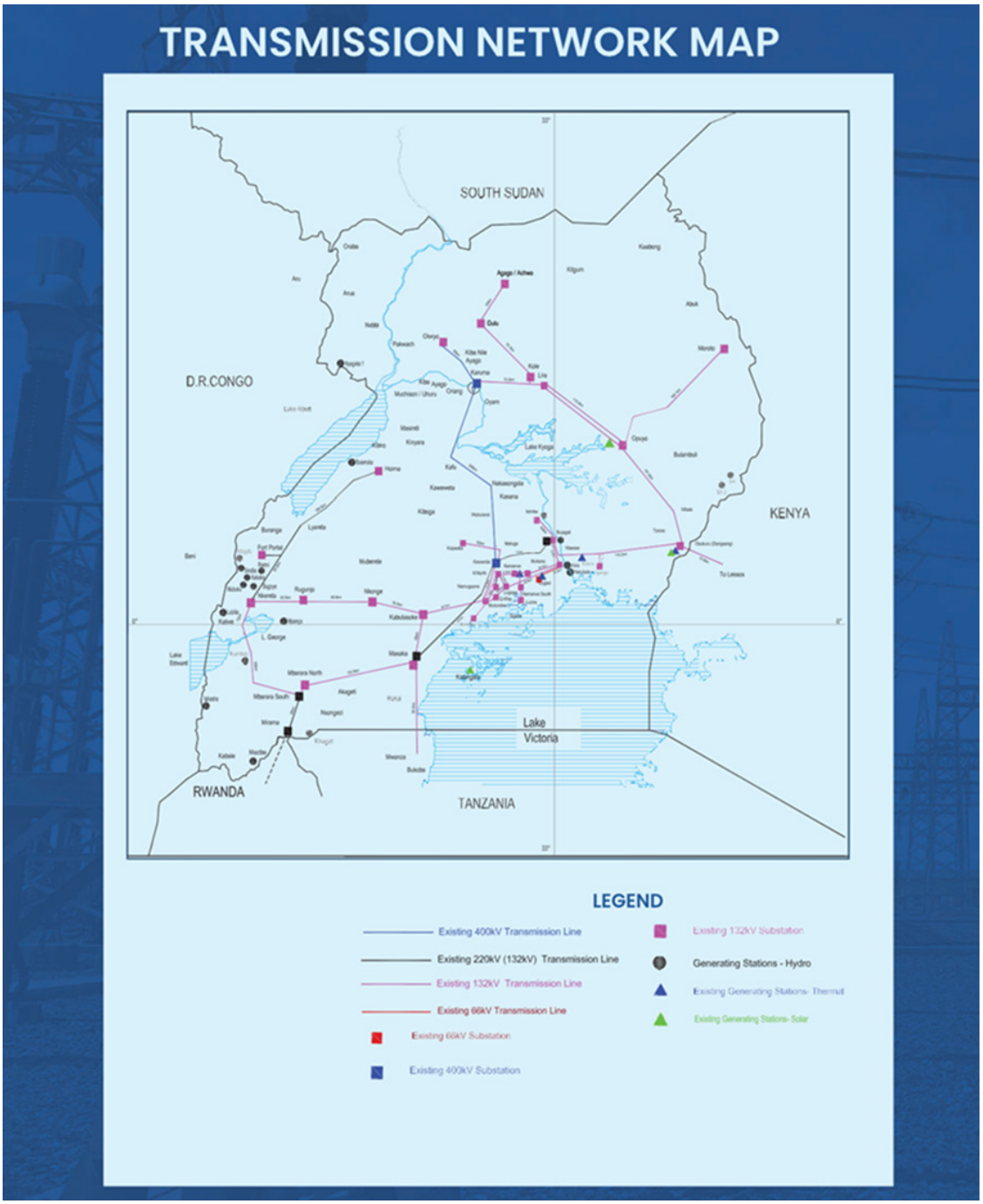
Figure 2. Map of the national roads network



Source: UNRA Corporate Plan 2024-2027

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by ITU

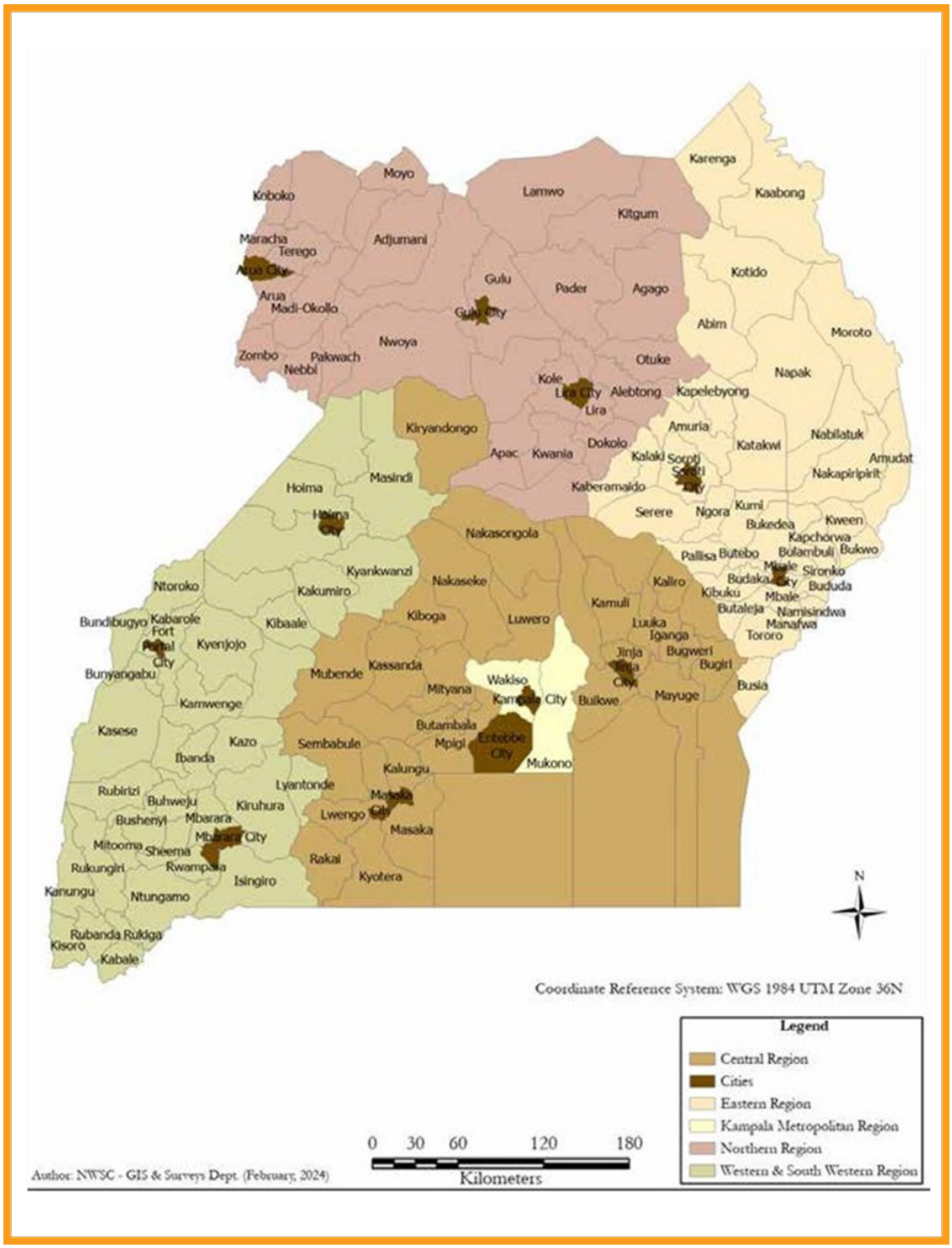
Figure 3. Uganda power transmission network map



Source: UETCL Annual Report

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by ITU

Figure 4. Uganda National Water and Sewerage Corporation coverage



Source: NWSC February 2024

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by ITU

6 Types of roads and crossings – road classifications

Before the common utility infrastructure sharing guidelines and ICT infrastructure standards along roads, bridges and crossings are presented, it is important that all stakeholders understand the types of roads that are being constructed in Uganda by the Ministry of Works and Transport, Uganda National Roads Authority and local government authorities. This background helps all the stakeholders to be on the same page as they evaluate the proposals put forward by the consultant.

According to UNRA, roads in Uganda are classified into 5 classes according to their major function in the road networks:

a) International trunk roads: These roads link international important centres and provide the connection between the national road system and those of neighbouring countries. These are carriageway roads (each with two or more lanes, with a hard shoulder, separated by a central reservation) with no obstructions, designed for high-speed traffic.

b) National trunk roads: These link provincial capitals, main centres of population and nationally important centres. Their major function is to provide mobility.

c) Primary distributor roads: These roads link provincially important centres to each other or to higher-class roads (urban/rural centres) and provide linkage between districts, local centres and development areas with higher-class roads. Their major function is to provide both mobility and access.

d) Secondary distributor roads: These roads link locally important centres to each other, to more important centres, or higher-class roads (rural/market centres) and provide linkage between locally important traffic generators and their rural hinterlands. Their major function is to provide both mobility and access.

e) Access roads: These roads link to minor centres (market/local centre) and all other motorable roads, i.e. distributing the traffic within districts. Their major function is to provide access to land adjacent to the secondary road system.

In terms of ownership responsibilities for the roads, the following responsibilities also apply:

- National highways are managed and maintained by UNRA.
- Metropolitan and city roads are managed and maintained by KCCA and other local city/ town councils.
- Inter-district roads are managed and maintained by UNRA.
- Estate and community roads are managed and maintained by local district administrations.

The Ministry of Works and Transport Department of Roads and Bridges is responsible for development and updating the General Specification for Roads and Bridge Works, containing all the technical requirements for road construction. There is a new 2024 draft General Specification that will be released before December 2024. While there are general requirements for service ducts in this document, there is a need to add specific requirements for ICT service ducts for reference. In this edition of the specification, crossings are included and required for all new road projects to facilitate utility installations.

UNRA and road planning committees of city authorities and local town councils use this general specification to prepare their Road Design Manuals for the roads under their jurisdiction.

Road Reserve Guidelines

The Government of Uganda has established Road Reserve Guidelines for all roads in the country. These guidelines are included in the Ministry of Lands, Housing and Urban Development National Physical Standards and Guidelines 2011.

Table 3. Urban road standards

Class of road	Minimum reserve width (metres)	Minimum junction spacing	Individual plot access	Tree belt
Trunk roads (arterial/ freeways including town bypasses)	60	500 m	Not permitted	Desirable
Primary distributor	40	200 m	Not permitted	Desirable
Secondary distributor	30	100 m	Not permitted	Desirable
Tertiary (local) distributor	18	–	Permitted	Desirable
Access roads:				
a) Industrial street/road	25	–	Permitted	Desirable
b) Primary residential street	15	–	Permitted	Desirable
c) Secondary residential street	8	–	Permitted	Desirable
d) Primary shopping street (heavy commercial)	20	–	Permitted	–
(e) Secondary shopping street (average commercial)	15	–	Permitted	–
f) Service lanes	5	–	Permitted	–

The Ministry of Works and Transport technical team in charge of roads/bridges pointed out that the current road reserves as previously planned are actually meant for future road expansion and not for utility infrastructure sharing. Ideally, these road reserves should be extended by at least 1 metre on each side to cater for an infrastructure sharing corridor. This would be called a utility reserve.

To achieve this, the Ministry of Lands, Housing and Urban Development would have to amend the Road Reserve Guidelines accordingly. Also in the urban areas, the no-man's land (spacing) between plots needs to be extended from 3 metres to 4 metres to provide room for infrastructure sharing space in addition to the road.

7 Types of buildings

This section gives background information and defines the different categories of buildings that this report focuses on as far as providing ICT facilities access and installation requirements.

Public buildings

Public buildings constitute privately owned structures constructed for public use and occupancy. These encompass a wide range of facilities serving various functions within the community. Examples include trade buildings such as markets and shopping complexes, office spaces utilized for business operations, residential apartments providing housing for the public, hotels offering accommodation services, and schools providing education to students. These buildings play a vital role in meeting the diverse needs of the population, serving as hubs for social interaction, commerce, education and accommodation.

Special buildings and spaces

Special buildings and spaces are characterized by their unique functions and purposes, often serving specific roles in the community or owned and operated by the Government. These structures are designed to fulfil specialized services and cater to particular needs of the public. Examples include stadiums designed for sporting events and entertainment, airports facilitating air travel and transportation, public squares serving as gathering places for events and social activities, and government buildings housing administrative offices and facilities. Additionally, special buildings encompass essential public services such as hospitals providing health care, health centres offering medical services to communities, and schools delivering education to students. These buildings and spaces are integral to the infrastructure of a region, supporting the well-being, connectivity and functionality of the community.

Private buildings

Private buildings are privately owned structures intended for private use or occupancy. These buildings serve the needs of individuals or organizations, and may include residential properties such as single-family homes, apartments and condominiums, as well as commercial properties such as privately owned businesses, warehouses and factories. Private buildings play a crucial role in providing shelter, accommodation and workspace for individuals, families and businesses, contributing to the overall functionality and development of communities.

8 Benchmarking summaries from other countries

Benchmarking with countries on ICT infrastructure standards and how common utilities co-deploy and share infrastructure was a critical part of the study. This is because the latest ICT (fibre-optic cable) installation methods vary from country to country due to stage of economic development and industrialization, government policy approach and oversight, national development goals and terrain layouts. The benchmarking research highlighted best practices, key lessons learned and infrastructure sharing approaches used in different countries. The selected countries included some developed countries with almost 100 per cent high-speed broadband coverage (such as United States of America, Republic of Korea, and People's Republic of China) and countries currently undertaking large-scale broadband access projects (such as countries in the Arab States region) and some African countries that are a little ahead of Uganda in national broadband network roll-out (such as South Africa, Kenya, Rwanda and Nigeria). A brief summary of seven case studies is presented in this section and the detailed references used are included in the references section of this report.

Common utility infrastructure sharing as a way of accelerating broadband network expansion is a concept that was adopted in the last two decades. The driver for joint development or sharing ICT facilities with other traditional utilities was mainly speed of deployment and reduction of capital investment required by both public and private sector players.

The success of this approach was noticed in the developed countries (United States, Republic of Korea, countries in the European Union, People's Republic of China) where broadband coverage quickly reached 100 per cent of the population and had remarkable impact on their economies. This section compiles the challenges, lessons learned, operational experiences and resulting opportunities of infrastructure sharing approaches and policies used in a number of countries. These findings should influence the approaches that are eventually adopted in Uganda.

8.1 Republic of Korea (1)

Table 4. Consultation on legislation for broadband deployment in Uganda

Aspect	Details
Context	The ICT development experience and achievements of the Republic of Korea have been highly regarded globally; in particular, there is increasing interest from developing countries to use the country's approach as a benchmark. The Korea Information Society Development Institute conducted a study in Uganda in 2019 and provided policy recommendations that reflect both global trends and the experience of the Republic of Korea in the field.
Policy recommendations	Based on the experience of the Republic of Korea and the state of Uganda's broadband status, policy recommendations were made in the following areas: (a) right-of-way issues, (b) joint construction of the broadband infrastructure and sharing of telecommunication facilities, and (c) short-term and long-term plans for universal service.

Table 4. Consultation on legislation for broadband deployment in Uganda (continued)

Aspect	Details
Challenges	1. Uganda needs clear right-of-way concepts outlined in the relevant laws, as well as detailed rules concerning the access to public right-of-way. Uganda authorities must consider a fully developed section in its laws similar to the Telecommunications Business Act (TBA) of the Republic of Korea – a section devoted entirely to rules regarding installation and preservation of communication facilities. In particular, provisions with detailed guidelines on access to land and/or access to facilities (buildings) for public purposes should be included in the updated Uganda Communications Commission (UCC) Act, Roads Act and the Land Act where necessary. This report emphasizes the importance of a well-developed legal framework. 2. As is clear from the case of the Republic of Korea, the telecommunication laws are not enough to ensure access to land for public purposes such as broadband deployment. Excavating roads for network deployment, installing common ducts and poles, etc. require clear rules on access to land owned by third parties, which are addressed in other laws. Thus, jurisdictional coordination is needed and the laws should function properly to make intergovernmental coordination work. Interministerial coordination between the Ministry of ICT and National Guidance, UCC and other related ministries – such as the Ministry of Land, Housing and Urban Development; Ministry of Works and Transport; National Planning Authority; and local municipalities – is critical. One should consider the creation of an interministerial committee, where through regular meetings national utility deployment projects are planned and coordinated among the relevant ministries involved. 3. Transparency and sharing of information will reduce costs and provide greater incentive for late market entrants to install or share its facilities for broadband deployment. The experience of the Republic of Korea shows that the creation of a GIS platform in Uganda will have many benefits. In addition to a national GIS, it is also important that telecommunication operators and utility operators share information on the location of each other's facilities. In the Republic of Korea, Korea Telecom – the number one telecommunication operator – has its own GIS platform, and other operators wishing to share or install facilities with Korea Telecom facilities are granted access to the platform.
Opportunities	Use of best practices already in use in developed countries. The report discusses and compares best solutions and approached used in different countries in this sector.
Key considerations	• Well-developed legal framework to support broadband service as a utility – government leadership and enforcement; • Interministerial coordination on infrastructure projects; • Transparency and information sharing.

Source: Ministry of Science and ICT of the Republic of Korea

8.2 Kenya (8)

Table 5. Fibre-optic backbone, metro and last-mile infrastructure standard

Aspect	Details
Context	The Kenya ICT Authority has the mandate to set and enforce ICT standards and guidelines across all aspects of ICT – including systems, infrastructure, processes, human resources and technology – for the public services. The purpose of this mandate is to ensure a coherent and unified approach to acquisition, deployment, management and operation of ICTs across the public services, in order to achieve their secure, efficient, flexible, integrated and cost-effective deployment and use. The Authority standards committee developed this standard and has the mandate to enforce it across the country. Its Directorate of Programmes and Standards has the oversight role and responsibility for management, enforcement and review of this standard. The Directorate carries out quarterly audits in all the ministries, counties and agencies, and private entities, to determine compliance to this standard.
Scope and objectives	This standard sets out minimum requirements for the planning, design, deployment, operation, maintenance and management of backbone, metro and last-mile fibre-optic cable. This standard applies to all public and private entities planning, designing, developing and operating fibre-optic infrastructure within the boundaries of the Republic of Kenya.
Challenges	The National ICT Infrastructure Master Plan of 2019 identified lack of standards to guide the design, development and implementation of both backbone and last-mile fibre-optic infrastructure. Development of this standard was done to close this gap. These standards are available at the Kenya Bureau of Standards.
Opportunities	Compliance to this standard by all infrastructure players ensures sustainable cost-effective fibre infrastructure deployment in Kenya.
Key considerations	• Guidelines for planning, design and deployment of fibre infrastructure. • Guidelines for operations, maintenance and management of the infrastructure. • Worker safety, environment management, security and quality assurance guidelines.

Source: Kenya ICT Authority, 2022

8.3 Rwanda (6)

Table 6. Guidelines for fibre-optic cables underground installation

Aspect	Details
Context	These guidelines for fibre-optic cables underground installation were developed with an aim of avoiding damages to existing underground infrastructure, such as existing fibre-optic cables, sewage or water pipes, electrical cables or other telecommunication cables. They also ensure that the installation of fibre-optic cables is done in accordance with global telecommunication standards.

Table 6. Guidelines for fibre-optic cables underground installation (continued)

Aspect	Details
Scope	These guidelines apply to all fibre-optic infrastructure underground installation projects and show the most-used materials specifications for fibre-optic networks. These guidelines apply to any telecommunication operators and service providers operating within the territory of Rwanda.
Challenges	Clear installation guidelines are provided by the Authority, which enables enforcement and audits of work done by the service providers and their contractors. Resolution of any damages to existing infrastructure during new construction projects is clearly outlined by the Authority.
Opportunities	Compliance to this standard by all infrastructure players ensures coordinated high-quality broadband infrastructure deployment across the country.
Key considerations	The Government of Rwanda's strong leadership in overseeing and guiding all broadband infrastructure projects in the country for all public and private sector players is commended.

Source: Rwanda Utilities Regulatory Authority, 2013

8.4 People's Republic of China (11)

Table 7. Cross-sectoral co-deployment of ICT Infrastructure with other sectors in China

Aspect	Details
Context	The various departments of the Government of China cooperate with each other while implementing relevant national ICT strategies. These include the Ministry of Industry and Information Technology; Ministry of Housing and Urban–Rural Development; Ministry of Transport, National Development and Reform Commission; State-owned Assets, Supervision and Administration Commission; and the Ministry of Finance and Cyberspace Administration of China.
Scope	Beginning in 2003, the Chinese Government has developed the "Cyber Power" national strategy defining broadband networks as a national priority area. The activities included the Fibre to Household National Standard, 2013; Broadband China Strategy, 2013; 117 broadband demonstration cities built in 2014; 31 provinces issuing Broadband China plans, 2014, and Government guidelines to accelerate broadband 2015 the five-year plan for 2016–2021.
Challenges	• Reducing duplication of construction, reducing investment costs of all enterprises involved in construction by introducing infrastructure sharing policies; • Reducing the difficulties of coordination and speed up the construction process; • Reducing the damage and environmental impact on the city and natural landscape by enforcing sharing.
Opportunities	Multi-agency cooperation promoted intensive development in long-distance communication facilities, using the pipelines along the expressways to construct the backbone fibre-optic cable and telegraph poles to build rural fibre-optic cable networks.

Table 7. Cross-sectoral co-deployment of ICT Infrastructure with other sectors in China (continued)

Aspect	Details
Key considerations	The Chinese Government provided direct leadership on national broadband deployment country-wide by encouraging collaboration of the different public and private enterprises.

Source: Li Yanting China Academy of Information and Communications Technology, November 2018

8.5 Saudi Arabia (outside plant standards) (12)

Table 8. Technical standards for outside plant installations

Aspect	Details
Context	Provides technical standards for outside plant (OSP) infrastructure to enable operators/contractors to design, deploy and protect telecommunication network infrastructure in public and private new developments. These standards have been established with the aim of ensuring that any OSP installation in new developments is built in accordance with a common national telecommunication standard, meets international best practices and facilitates infrastructure sharing.
Scope	These standards apply to all OSP installations in new developments and provide guidance on the mostly used materials specifications for OSP networks. These standards do not change any other obligations imposed by other administrative authorities.
Challenges	The standards document covers guidelines for network design and planning to avoid the common issues associated with OSP installations. It also specifies duct standards and materials, fibre-optic standards, manhole/handhole standards, trenches, access points for buildings and safety procedures to follow when doing this work.
Opportunities	These guidelines ensure that any new public or private development projects (ICT infrastructure and new buildings) include provisions for adequate state-of-the-art ICT facilities to guarantee high-speed broadband connectivity for all.
Key considerations	Saudi Arabia infrastructure and housing projects use various contractors from Europe, the United States, China, Japan and other countries. It is imperative that all the work done follow clear national guidelines for easy maintenance and operations.

Source: Saudi Arabia Information and Communications Commission

8.6 Saudi Arabia (building ICT facilities standards) (12)

Table 9. ICT construction guidelines for buildings

Issue date: June 2022

Aspect	Details
Context	To ensure that newly constructed buildings are equipped with a "high-speed-ready ICT infrastructure" to facilitate the cost-effective installation of cabling, providing fixed and wireless broadband communications, adherence to these ICT Construction Guidelines in Buildings is compulsory for real estate developers, consultants and contractors. Given that these guidelines provide an open infrastructure to any operator, they foster competition by giving the end user the freedom to select the network provider of choice. Sharing of essential infrastructure elements such as rooms, ducts and cable trays is recommended to optimize the involved investments for all parties to guarantee an effective utilization of resources. These standards have been established to ensure that ICT facilities in new buildings are built in accordance with a common national telecommunication standard and meet international best practices.
Scope	The guidelines present the minimum architectural (such as pathways and spaces), electrical and mechanical requirements that enable a future-proof design and construction of ICT infrastructure in all types of new public and private buildings, also in relation to other utility services (electrical, water, mechanical, etc.). These requirements do not change any other obligations imposed by other administrative authorities. Installations in buildings shall strictly meet the requirements set by the relevant authorities having jurisdiction.
Challenges	These guidelines must be shared with the architects responsible for the design of the new buildings as early in the process as possible. They should be included in the building plans submitted to the authorities for approval.
Opportunities	These guidelines ensure that any new public or private development projects (ICT infrastructure and new building construction) include provisions for adequate state-of-the-art ICT facilities to guarantee high-speed broadband connectivity for all.
Key considerations	Saudi Arabia infrastructure and housing projects use various contractors from Europe, the United States, China, Japan and other countries. It is imperative that all the work done follow clear national and international guidelines for easy maintenance and operations.

Source: Doreen Gift Bujjingo, Activity report: Frameworks for ICT Infrastructure Development, Department of ICT Infrastructure Development, Ministry of ICT and National Guidance (April 2024)

8.7 Toolkit for ICT infrastructure co-deployment by ESCAP (9)

Table 10. Toolkit for ICT infrastructure co-deployment with roads and power infrastructure

Aspect	Details
Context	For telecommunication operators, laying fibre-optic cables in sparsely populated regions is not always economically viable, and the existing telephone network in many regions is not adapted to provide broadband access to the Internet. The economic cost and resources used to deploy the ICT infrastructure could be optimized through co-deployment, which is defined as the simultaneous deployment of ducts and/or fibre-optic cables during the construction of infrastructure such as new roads, highways, railways, power transmission lines and oil/gas pipelines.
Scope	This capacity-building toolkit proposes methodologies and tools for assessing and planning the economic, organizational and technical aspects of ICT infrastructure co-deployment with road transport and energy infrastructure.
Challenges	Coordination and cooperation of organizations, including the infrastructure owner of the road transport or energy infrastructure and the telecommunication operators, as well as relevant public and private organizations involved in the co-deployment process.
Opportunities	Economic benefits drive operators of different infrastructure networks to cooperate in deployment or sharing of a joint infrastructure due to potential cost savings or accelerated market entry.
Key considerations	This toolkit proposes methodologies and tools for assessing and planning the economic and organizational aspects and technical aspects of ICT infrastructure co-deployment with road transport and energy infrastructure. The tools were tested successfully in two countries in Asia and the Pacific (Kazakhstan and Kyrgyzstan).

Source: Toolkit for ICT Infrastructure Co-Deployment with Road Transport and Energy Infrastructure (United Nations Economic and Social Commission for Asia and the Pacific ESCAP)

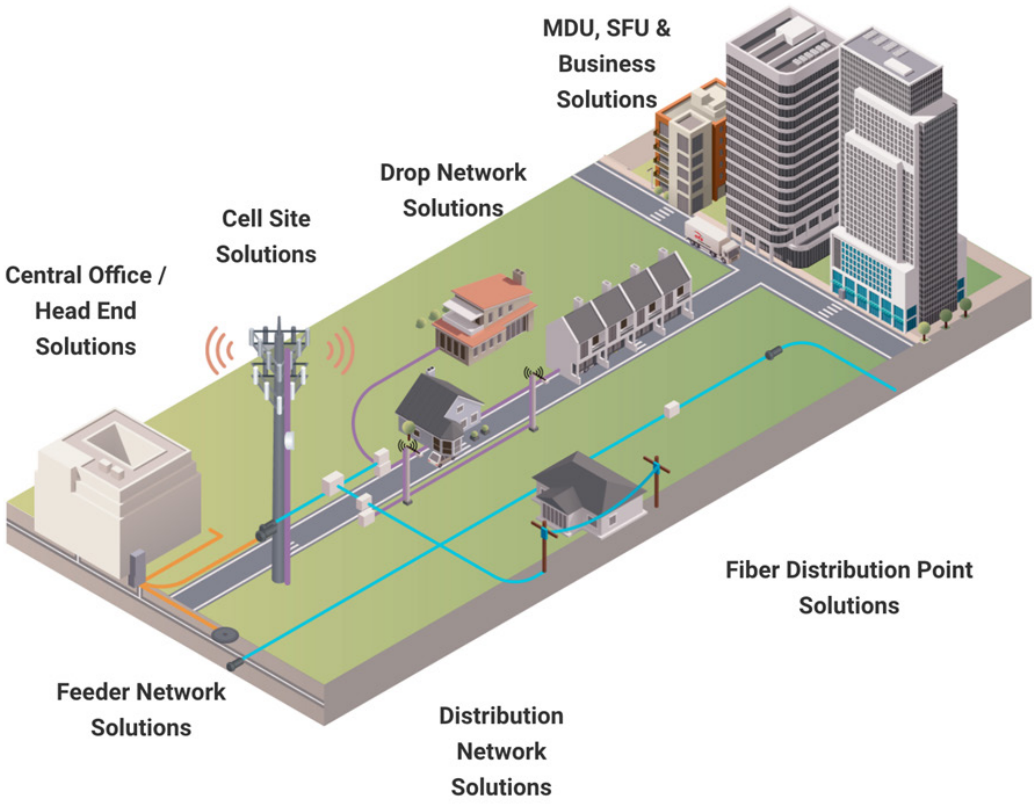
9 Draft specifications and standards for ICT infrastructure installations

This section contains the specifications for ICT infrastructure components and installation requirements (6), (7), (8). The purpose of this section is to provide a working knowledge of ICT infrastructure requirements to all stakeholders involved with broadband deployment projects in the country. It also provides the officials of key government ministries, agencies and local administrations the background information to use when deciding to issue roll-out permits to service providers or check compliance of ICT infrastructure installations in their areas of jurisdiction. The authorities should consider these ICT infrastructure requirements as additional to local codes and regulations covering construction projects in their areas.

The section starts with specifications for the different types of fibre-optic cables and fibre-optic duct specifications outlining the materials and accessories that should be used. Then the guidelines of what is required for a service provider who wants to apply for a permit to deploy ICT infrastructure are provided. This list of required documents should guide the local authorities on whether to grant a permit or not. Guidelines for ICT infrastructure installation for manholes/handholes, along the roads, road and railway crossings and bridges are also provided. A number of approaches to achieve common utility infrastructure sharing of service ducts along transport infrastructure are presented.

Figure 5 shows the different types of fibre-optic network links needed to bring broadband access to urban neighbourhoods, starting with feeder networks which get service from the backbone fibre networks not shown in the figure. This emphasizes the point that broadband networks are indeed public utilities that need to connect to each type of building for service.

Figure 5. Types of fibre-optic network links needed to bring broadband access to urban neighbourhoods



9.1 Specifications for fibre-optic network and cables

Fibre-optic cable specifications include the following:

- Optical fibre must meet the requirements of ITU-T Recommendations (ITU-T G.652 - G.657).
- Each cable must have traceability of the optical fibre back to the original fibre ID number and test parameters as provided by the fibre manufacturer.
- Each fibre must be distinguishable from other fibres in the same duct employing colour coding ink visible throughout the design life of the cable (as defined by TIA 5987C).
- Optical fibre shall have a high level of splice compatibility with optical fibre from other manufacturers.
- Performance specifications for standard single-mode optical fibre are outlined in Recommendation ITU-T G.652.
- Performance specifications for multimode optical fibre are detailed in Recommendation ITU-T G.651.
- The cables must be circular in cross-section and free from pinholes, joints, repairs and other defects.
- It is the network provider responsibility to identify and procure all the required materials for the complete fibre-optic installation work. These materials should be compliant with international standards.

Table 11. Characteristics of optical fibre

No.	Item
1	**Introduction** Fibre-optic cables are categorized into six main types based on their characteristics, as defined by the standards in the ITU-T G. series (ITU-T G.652 - G.657). The classification and standards define the various cable types to reflect their properties, as summarized below, and the ideal applications for each.
	(1) Recommendation ITU-T G.652 – Characteristics of a single-mode optical fibre and cable. (2) Recommendation ITU-T G.653 – Characteristics of a dispersion-shifted, single-mode optical fibre and cable. (3) Recommendation ITU-T G.654 – Characteristics of a cut-off shifted, single-mode optical fibre and cable. (4) Recommendation ITU-T G.655 – Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable. (5) Recommendation ITU-T G.656 – Characteristics of fibre and cable with non-zero dispersion for wideband optical transport. (6) Recommendation ITU-T G.657 – Characteristics of a bending-loss insensitive single-mode optical fibre and cable for the access network.
2	**Backbone fibre deployment** • Optical fibre used in cable manufacturing fully complies with Recommendation ITU-T G. 652. D. For detailed characteristics. • More specifically for general fibre installations • Optical fibre used in cable manufacturing fully complies with Recommendation ITU-T G.655 D. For detailed characteristics. • More specific for backbone and high-capacity long haul links with DWDM equipment • Optical fibre used in cable manufacturing fully complies with Recommendation ITU-T G. 656 D. For detailed characteristics. • More specific for backbone and high-capacity long haul links with DWDM equipment • Optical fibre used in cable manufacturing fully complies with Recommendation ITU-T G. 657 D. For detailed characteristics. • More specific for last mile installations with limited bending areas and thus small bending radius

Figure 6. High-impact strength high-density polyethylene fibre-optic duct with ultraviolet protection

General requirements

When installing fibre-optic cables, selecting the appropriate duct specifications is critical to ensure the protection, longevity and performance of the cables. Here are the key specifications and considerations for fibre-optic cable ducts:

1. Material

Common materials:

- High-density polyethylene (HDPE): Preferred for its flexibility, durability and resistance to chemicals and environmental stress.
- Polyvinyl chloride (PVC): Used for its rigidity and cost-effectiveness, suitable for indoor and protected environments.
- Metallic ducts: Such as steel or aluminium, used in high-risk areas for added mechanical protection.

2. Size and diameter

Inner diameter:

- Standard sizes: Typically range from 1/2 inch to 4 inches (12.7 mm to 101.6 mm), depending on the number of cables and installation environment.
- Multiple pathways: Consider using multiple smaller ducts within a larger conduit to facilitate cable organization, infrastructure sharing for several service providers and future upgrades.

Outer diameter:

- Conduit compatibility: Ensure the outer diameter fits within any existing conduits or pathways if retrofitting.

3. Wall thickness

Standard wall thickness:

- Schedule 40: Standard for general use, providing a balance of flexibility and strength.

- Schedule 80: Thicker walls for environments requiring extra protection, such as high-traffic or underground installations.

4. Strength and durability

Crush resistance:

- Specification: Measured in terms of pressure the duct can withstand without deformation, typically in psi (pounds per square inch).
- Application: Higher crush resistance for underground or heavy traffic areas.

Tensile strength:

- Specification: Important for pulling the duct during installation, typically measured in pounds-per-square-inch force.

5. Environmental resistance

Temperature range:

- Operating temperatures: Ensure the duct material can withstand the temperature range of the installation environment, typically from -40°C to 60°C (-40°F to 140°F).

Ultraviolet (UV) resistance:

- Outdoor use: Ducts used in outdoor installations should be UV-resistant to prevent degradation from sunlight exposure.

Chemical resistance:

- Hazardous environments: Choose materials resistant to chemicals if the ducts will be exposed to potentially corrosive substances.

6. Flexibility and bend radius

Bend radius:

- Specification: Ensure ducts maintain the minimum bend radius required for the fibre-optic cables to prevent damage during installation and use.
- Flexibility: More flexible ducts are easier to install in complex pathways.

7. Fire resistance ratings

- Plenum-rated: Suitable for spaces used for air circulation, such as drop ceilings and raised floors.
- Riser-rated: Suitable for vertical runs between floors.
- General purpose: Suitable for general indoor use.

8. Accessories and installation aids

Couplers and fittings:

- Compatibility: Ensure compatibility with the chosen duct material and size.
- Sealing: Use fittings that provide a secure, sealed connection to protect against moisture and contaminants.

Pull tapes and lubricants:

- Pull tapes: Include pre-installed pull tapes in ducts to assist with cable installation.
- Lubricants: Use appropriate lubricants to reduce friction and facilitate easier cable pulling.

9. Colour coding and markings

Colour coding:

- Identification: Use colour-coded ducts to identify different types of cables (such as data and power) or different pathways.

Markings:

- Specifications: Include markings for manufacturer, size, rating and installation instructions at regular intervals along the duct.

Example: Specifications for a standard HDPE duct for fibre optic cable installation are:

- Material: HDPE
- Inner diameter: 1.5 inches (38.1 mm)
- Outer diameter: 1.9 inches (48.3 mm)
- Wall thickness: Schedule 40
- Tensile strength: 800 pounds-per-square-inch
- Crush resistance: 200 psi
- Temperature range: -40°C to 60°C (-40°F to 140°F)
- UV resistance: UV-stabilized for outdoor use
- Colour: Orange (standard for telecommunications)
- Fire rating: Plenum-rated (CMP)
- Accessories: Include couplers, end caps and pull tapes

More details on installation and maintenance of ducts are provided in Reference (10).

Table 12. Backbone network fibre duct physical standards

Description	Specification
Conduit type	HDPE
Inner layer	Silicone with cream inner side
Colour	Owner
Labelling	Owner – yyyy= mm/yyyy (month and year of manufacture). Spacing of the labelling will be 1.0 m. The year will be changed to the right year of manufacture.
Outside diameter (mm)	40
Inside diameter (mm)	33
Standard straight length (m)	n/a

Table 12. Backbone network fibre duct physical standards (continued)

Description	Specification
Standard length coils (m)	Minimum 50
Minimum bending radius (mm), 6 metre length	n/a
Material used	Must be anti-rodent material
Minimum number of ducts to be installed	6
Minimum bending radius (mm), coils	150

The depth of duct along road reserves and across roads should be a minimum of 1.8 metres from the road surface. A minimum of six ducts are recommended for fibre and duct sharing by service providers.

Cross-section of a fibre duct installation

Figure 7. Fibre-optic underground duct installation

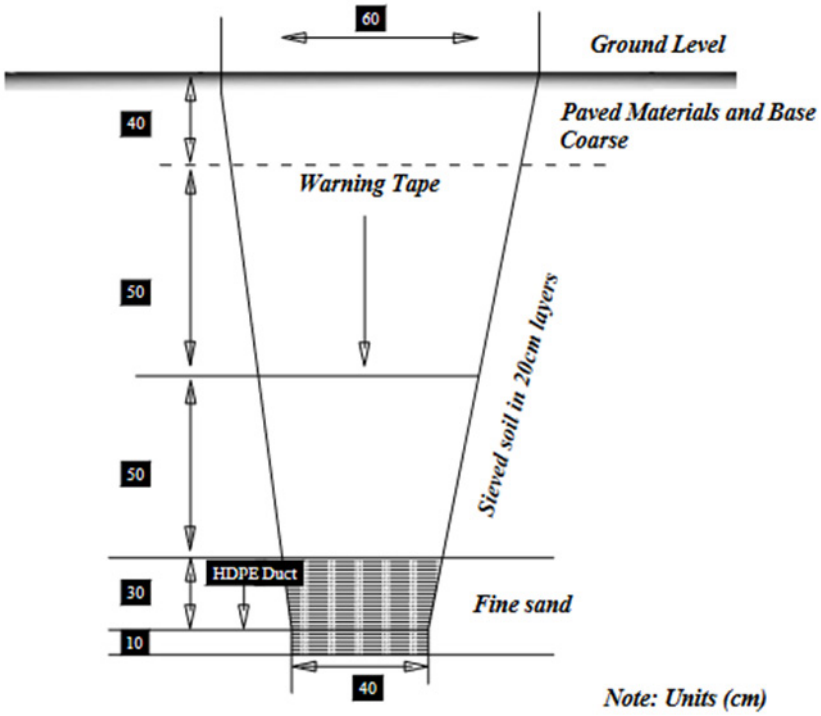


Table 13. Metro network fibre-optic duct physical standards

Description	Specification
Conduit type	Micro ducts 7-way minimum
Inner layer	Silicone with cream inner side

Table 13. Metro network fibre-optic duct physical standards (continued)

Description	Specification
Colour	Owners' colour
Labelling	Owner – yyyy = mm/yyyy (month and year of manufacture). Spacing of the labelling will be 1.0 m. The year will be changed to the right year of manufacture.
Outside diameter (mm)	14
Inside diameter (mm)	10
Standard straight length (m)	n/a
Standard length coils (m)	Minimum 50
Minimum bending radius (mm) 6m length	n/a
Minimum number to be installed once	2
Material used	Must be anti-rodent material
Minimum bending radius (mm) coils	150

A minimum of at least two pipes with a minimum of 12 cores should be installed for the access network.

Last-mile network fibre physical standards

The last-mile network shall be characterized as follows:

- Fibre-to-the-building (FTTB) – Minimum seven-way microducts from the manhole to the building and structured cable.
- Fibre-to-the-home (FTTH) – Minimum seven-way microducts.
- Fibre-to-the-site (FTTS) – Minimum four-way microducts.

All last-mile networks shall use microducts in the implementation of the network with the physical characteristics listed below.

Table 14. Last-mile network fibre-optic duct physical standards

Description	Specification
Conduit type	Microducts 7-way minimum
Inner layer	Silicone with cream inner side
Colour	Owners' colour

Table 14. Last-mile network fibre-optic duct physical standards (continued)

Description	Specification
Labelling	Owner yyyy = mm/yyyy (month and year of manufacture). Spacing of the labelling will be 1.0 m. The year will be changed to the right year of manufacture.
Outside diameter (mm)	14
Inside diameter (mm)	10
Standard straight length (m)	n/a
Standard length coils (m)	Minimum 50
Minimum bending radius (mm) 6 metre length	n/a
Minimum number of ducts to be installed	2
Material used	Must be anti-rodent material
Minimum bending radius (mm) coils	150

9.2 Installation permit application requirements

Guidelines for issuing roll permits for deployment along transport infrastructure

1) There should be a framework to guide the management of the manholes in the respective local governments. These may be benchmarked on other utilities.
2) A benchmarked manhole maintenance fee should be suggested to avoid denial of service for any interested service provider.
3) Budgeting for ICT ducts during design and planning for transport infrastructure must be mandated and included in the contracts of the subcontractors and construction personnel and may be inspected by the Ministry of ICT and National Guidance officials upon commissioning of the start and end of the road construction.
4) Terms of reference for an online permit application system for a single-window mechanism of issuing permits should be developed that will consider the role of all the required stakeholders.

Permit application requirements

These include:

1) The name of the fibre-optic network provider:

- The provider is responsible for the installation and maintenance of the cable and the signature of the applicant must appear on the permit application.
- The permit application shall list the name, address, phone number and emergency 24-hour phone number of the contact person for the fibre-optic network provider. Subcontractor information may be provided separately.

2) Cable installation design documents that should include but not be limited to the following:

- A physical pre-survey of the route for all types of installations to establish the exact cable routing, termination points, jointing locations and cutting lengths will be done before the commencement of any work or committing any materials.
- The fibre-optic power link loss shall be calculated for any fibre-optic link. The maximum length of any path between two fibre-optic repeaters must be calculated separately and depends on the total loss in all components used in the path, including fibre-optic cable, connectors, star couplers and splices. All components – such as additional connectors, star couplers and splices, along with cable attenuation – should be taken into account in calculating the loss.
- The sum of the losses in all components used in the fibre-optic path must not exceed the specified power loss budget for the chosen cable type.
- The specified power loss budget should include the loss of the two ST-type connectors connecting at the two repeater ends, and the system margin of 3 d.

3) Other installation documents required:

- One original complete copy of the plans showing the proposed work, schedule and procedures. An additional copy will be required if there is a bridge attachment, road crossing, box culvert crossing, limited access or inter-district involved.
- The route/street name/ location where the work is to be performed.
- Colour highlights to show the demanded right-of-way (red) and the existing cable (blue).
- A vicinity map or drawing showing the routes, total layout and locations of all manholes that will be included in the permit, and the surrounding area of the work.
- A legend showing the symbols used on the plans and the colour coding used to mark the plan if more than red and blue colours are used.
- A clearance distance of the minimum vertical (while crossing) and the horizontal (while in parallel) distance to the nearest affected utility and/or right-of-way object.
- Section views:
    - For any crossing which might create a potential conflict – including but not limited to cable crossings over or under large storm pipes, culverts, electrical lines, water, transmission lines and other affected utilities – an individual section view must be submitted.
    - Any proposed work in the vicinity of a bridge or box culvert must include a section showing the distance from all features of the structure.
- Labelling.
- Indicate the length and type of cable proposed for installation on each page.
- Show the distance of the proposed cable from the roadway.
- Identify the proposed cable installation method on each plan sheet such as hand, machine trenching, or directional bore.
- Drilling site information must also be submitted.
- Details of the work site and the subsoil are essential, right from the first design phase, both to reduce the number of failures and/or to limit possible damage to pre-existing services or structures.
- Existing utilities documentation are made available by local authorities and other companies.

- A list should be made of the site equipment that will be used, such as pipe and cable locators or ground penetrating radar systems.
- The drilling plan shows the infill materials (rubble, sand, etc.) that will be used.

9.3 Installation guidelines

9.3.1 Manholes/handholes installation

Each manhole/handhole constructor should use the following guidelines:

- Manholes/handholes shall be covered by a flat lid on which the size and the depth of the manhole/handhole are written.
- Manhole/handhole lids shall be labelled with the network provider name.
- Manholes/handholes must be located outside of sidewalks and roadways.
- Manholes/handholes must be located a minimum of 2 metres off the edge of the pedestrian way, and 3 metres off the roadway if there is no space reserved for the pedestrian way. In case of unavailability of the required clearance distance due to the soil or terrain condition, the special request for shorter clearance shall be sent to the local government, which will assess and provide feedback based on case specifications.
- Manholes/handholes shall not be located in the ditch line.
- Any fibre-optic joint shall be housed inside the manhole.
- The pulling of the cable shall be hand-assisted at each manhole or handhole. The cable shall not be crushed or forced around a sharp corner. Sufficient slack shall be left at each end of the cable to allow proper cable termination.
- The cable shall be marked and labelled at each manhole and all entry and end points of the fibre-optic cables.
- The area around the manhole shall be compacted. Upon final acceptance of the conduit/duct system, all manholes shall be free of debris.

Road/street labelling

Surface markers to indicate the route of the cables shall be planted by the roadsides. These markings shall be placed at intervals of 300–500 m. Visible pole markers shall indicate the fibre network provider and cable depth. It shall be placed along the trenches 30 cm below the ground surface.

9.3.2 Fibre-optic cable installation along roads

Cable installation along roads shall strictly observe the following requirements:

- Duct sharing recommendation: The fibre-optic installation contractor should install at least two pipes with a minimum of 12 cores on the access network, and four ducts for the backbone network to facilitate fibre and duct sharing. The payment of these reserved pipes and cores by a new operator will be predetermined by the authorities.
- The cables shall be laid in ducts buried to depths of not less than 80 cm or 1.5 metres in road reserves. In case the soil conditions do not allow achievement of the aforementioned minimum required depths, the special request for a smaller depth shall be sent to the local government, which will assess and provide feedback based on case specifications.
- All provisions and guidelines established by the Roads Authority and affected government agencies shall be complied with.

- Reserve at least the horizontal distance of 1 metre between the existing underground utilities and the new cable, and if not possible use tape marking to indicate the location of fibre-optic cable and inform the network provider of the existing utility five days before excavation.
- Place barriers and road signs required by current laws during excavation works.
- If the excavation must remain open or the road will be otherwise obstructed during the night or under low-visibility conditions, road signs shall be complemented by lighting devices of the colour, shape and size stipulated by police.
- Trenches should be backfilled to the original state and backfill shall be strong enough to support any kind of stress.
- Put an identification sign (marker) stated by these guidelines to illustrate your cable route.

Existing utility damages

In case of damages to any existing infrastructure, the owner will repair the damaged infrastructure and negotiate the cost with the applicant within two weeks of the declaration of the matter.

Cleaning up after installation

The following operations shall be carried out after excavating the trench:

- Remove spoils from the sides of the excavation. (Spoil must be transported to authorized disposal sites following local authority requirements.)
- Remove adjacent paving materials that were damaged as a result of excavation.
- Fulfil the cleaning conditions required by local authorities and other concerned agencies.

Guidelines for installing cables in trenches

- Fibre-optic cables laid in trenches: Trenches along road networks shall be sufficiently deep to provide appropriate fibre-optic cable protection and shall be placed at least 1.5 metres away from the edge of pedestrian walkways or storm drainages along paved roads. In case of unavailability of the required clearance distance due to the soil or terrain condition, the special request for shorter clearance shall be sent to the local government, which will assess and provide feedback based on case specifications.
- In the absence of pedestrian walkways, the cable must be located at a minimum distance of 2.5 metres off the roadway. In case of unavailability of the required clearance distance due to the soil or terrain condition, the special request for shorter clearance shall be sent to the local government, which will assess and provide feedback based on case specifications.
- Road surfaces where cable crossings have been installed shall be restored to their original state in compliance with local authorities and other concerned agencies' specifications.
- No cable installation will be permitted in a ditch line. Cable installations will be permitted along the back of the ditch line only.
- Where there are cable crossings along roads, ducting shall be of galvanized steel pipes buried deep enough (1 metre or more) for protection from vehicular or pedestrian traffic stresses. Similar galvanized steel pipe ducts shall be used at bridge crossings.

Guidelines for installing cables without trenches

Trenchless techniques are used to reduce environmental damage and social costs and provide an economic alternative to open-trench methods of installation. Trenchless or no-dig techniques used for long-section fibre-optic installation should be divided into shorter sections of the work

length, according to the characteristics of the machines and the design requirements. The trenchless techniques, after consultations with the relevant institutions, are only allowed by the authorities for road-crossing fibre-optic installation.

Any person conducting trenchless excavation shall take all reasonable steps necessary to protect and support underground utility lines. These steps shall include, but are not limited to, the following:

- The excavator should verify that all utility lines in the area are marked.
- The excavator shall ensure that bore equipment stakes are installed at a safe distance from marked utility lines.

The excavator shall ensure that sufficient clearance is maintained between the bore path and any underground utility lines during pullback:

- The excavator shall give special consideration to water, electricity and sewer systems within the area that cannot be located accurately.
- The excavator shall ensure that the drill head locating device is functioning properly and within its specifications.

9.3.3 Guidelines for installation on road crossings

Such guidelines include the following:

- All crossings are to be made perpendicular to the road.
- Road crossing machines should be used with a depth of not less than 1 m.
- Any cables should be protected with appropriate ducts along the whole crossing length.

Road crossings shall be done using directional drilling or thrust boring, and shall meet the following minimum requirements:

- Bores shall be at a depth of 1.8 metres across spur subsidiary roads, and 2 metres across the carriageway from the tarmac level.
- Bores shall exit at a depth of 1.8 m, the same level as the trench.
- Bores shall typically span to lengths of 15–20 metres but could span to a maximum of 30 metres if necessary.
- The equipment used shall drill bores spanning to a maximum length of up to 30 m.
- The drilling head shall accommodate rock drilling bits for rocky ground.
- After making a bore across the road, two 102 mm diameter galvanized pipes or two 110 mm HDPE plastic pipes (one to act as a spare for future use) shall be inserted through the bore.
- Bores shall be well-marked on both ends with marked reinforced concrete pillars.
- The operation pits shall be backfilled, unless there is a need to install a handhole in the pit location.

Road crossings for all the new roads shall be constructed during road building using concrete service ducts at intervals of 500 m. The road crossing for existing ducts shall use the physical characteristics as shown in Table 15.

Table 15. Road crossing ducts physical standards

Description	Specification
Conduit type	HDPE
Inner layer	Silicone with cream inner side
Colour	Owners colour
Labelling	Owner – yyyy = mm/yyyy (month and year of manufacture). Spacing of the labelling will be 1.0 m. The year will be changed to the right year of manufacture.
Outside diameter, Class B, C, D roads – 110 mm	Class A road – 160mm
Inside diameter, Class B, C, D roads – 100 mm	Class A road – 147mm
Standard straight length (m)	n/a
Standard length coils (m)	Minimum 50
Minimum bending radius (mm) 6 metre length	n/a
Material used	Must be anti-rodent material
Minimum number for any road crossing	2
Minimum bending radius (mm) coils	150

9.3.4 Guidelines for installation on railway crossings

Railway crossings shall be done using directional drilling or thrust boring. Any drilling or thrust boring on railway crossings shall be done following the existing government regulations. Construction of bores for railway crossings shall meet the following minimum requirements:

- Bores shall be at a depth of 1.5 metres across spur subsidiary roads and 2 metres across the railway track from the ground level.
- Bores shall exit at a depth of 1.5 m, the same level as the trench.
- Bores shall typically span to lengths of 20 m.
- The equipment used shall be able to drill bores spanning to a maximum length of up to 30 m.
- The drilling head shall be able to accommodate rock drilling bits, for rocky ground.
- After making a bore across the road, two 102 mm diameter galvanized pipes or two 110mm HDPE plastic pipes (one to act as a spare for future use) shall be inserted through the bore.
- Bores shall be well marked on both ends with marked reinforced concrete pillars.
- Conduits inside a bore shall be equipped with draw wires.
- The operation pits shall be backfilled unless there is a need to install a handhole on the pit location.

9.3.5 Guidelines for installation on river/swamp crossings

River/swamp crossings shall be done using directional drilling or thrust boring, trenching and bridge attachment. Any drilling or thrust boring on river crossings shall be done following the existing government regulations. Construction of bores for river crossings shall meet the following minimum requirements:

- The depth shall be 1.8 metres from the riverbed and across the whole river.
- Drilling bore shall start and exit at riparian land.
- Gabions stone pitching shall be used at the river slopes.
- A concrete envelope of C15 shall be installed.
- Drill bores should span to a maximum length of up to 30 m.
- The drilling head shall be able to accommodate rock drilling bits, for rocky ground.
- After making a bore across the road, two 102 mm diameter galvanized pipes or two 110 mm HDPE plastic pipes (one to act as a spare for future use) shall be inserted through the bore.
- Bores shall be well marked on both ends with marked reinforced concrete pillars.
- Conduits inside a bore shall be equipped with draw wires.
- The operation pits shall be backfilled unless there is a need to install a handhole on the pit location.

9.3.6 Guidelines for installation on bridges

Installing fibre-optic cables over bridge crossings requires careful planning and execution to ensure the cables are protected from environmental elements, physical damage and other risks. Here are the key guidelines and best practices:

1. Pre-installation planning

Survey:

- Structural assessment: Assess the structural integrity of the bridge to determine the best routing for the cables.
- Environmental conditions: Evaluate environmental factors such as temperature variations, exposure to UV light, moisture and wind loads.

Permits and approvals:

- Regulatory compliance: Obtain necessary permits and approvals from local authorities, including transportation and environmental agencies.
- Coordination: Coordinate with relevant stakeholders such as bridge maintenance authorities, utility companies and local government.

2. Design and route selection

Route planning:

- Optimal path: Choose the shortest and most direct path across the bridge while avoiding potential hazards.
- Accessibility: Ensure the route allows for easy access for maintenance and inspections.

Protection measures:

- Conduits and ducts: Use robust conduits or ducts to protect the fibre-optic cables from mechanical damage, environmental exposure and UV radiation.
- Expansion loops: Design and install expansion loops to accommodate temperature-induced expansion and contraction of the bridge and cables.

3. Cable selection and preparation

Cable type:

- Armoured cables: Select armoured fibre-optic cables for added protection against physical damage.
- Environmental ratings: Use cables rated for outdoor use, with appropriate protections against UV light, moisture and temperature variations.

Cable lengths:

- Pre-measured lengths: Ensure cables are pre-measured and cut to appropriate lengths to minimize splicing and reduce installation complexity.

4. Installation process

Securing the cable:

- Cable mounting: Secure cables to the bridge structure using appropriate mounting hardware such as brackets, clamps and hangers.
- Vibration dampening: Use vibration dampening materials to protect the cables from bridge vibrations and movements.

Conduit installation:

- Rigid conduits: Install rigid conduits along the chosen path, ensuring they are securely fastened to the bridge.
- Sealing: Seal conduit ends to prevent water ingress and protect against environmental elements.

Pulling the cable:

- Pulling techniques: Use appropriate pulling techniques to avoid exceeding the tensile strength of the fibre-optic cables.
- Bend radius: Maintain the minimum bend radius of the cables to prevent damage and ensure optimal performance.

5. Testing and verification

Initial testing:

- Continuity testing: Perform initial continuity tests to ensure there are no breaks or faults in the cables.
- Optical time-domain reflectometer (OTDR) testing: Use OTDR testing to check for signal loss, splices and other issues.

Post-installation testing:

- Final testing: Conduct comprehensive testing after installation to ensure the entire system meets performance specifications and standards.

- Documentation: Document all test results and maintain records for future reference.

6. Maintenance and monitoring

Regular inspections:

- Routine checks: Schedule regular inspections of the cables, conduits and mounting hardware to detect and address potential issues early.
- Monitoring systems: Implement monitoring systems to track the performance and integrity of the fibre-optic network.

Emergency access:

- Access points: Ensure there are accessible points along the bridge for emergency repairs and maintenance.
- Spare materials: Keep spare cables, connectors and other materials readily available for quick repairs.

Additional considerations

Safety measures:

- Worker safety: Ensure that all safety protocols are followed during installation, including the use of personal protective equipment (PPE) and fall protection systems.
- Public safety: Minimize disruptions to traffic and public use of the bridge during installation and maintenance activities.

Environmental protection:

- Pollution prevention: Implement measures to prevent pollution and protect the local environment during installation.
- Wildlife protection: Consider the impact on local wildlife and take steps to mitigate any adverse effects.

By following these guidelines and best practices, fibre-optic cable installations over bridge crossings can be executed effectively, ensuring a durable and reliable ICT network infrastructure.

9.3.7 Guidelines for common utility sharing of service ducts

Depending on the different terrains along the road sections, different approaches may be used for sharing of the service ducts along the roads:

1) Vertical duct sharing for the utilities (water, power, sewage, gas, ICT cables):

   Vertical ducts are preferred in road sections where there is restriction in road reserve space due to difficult terrains. The utility companies need to agree on the hierarchy to be used in sharing the vertical ducts to minimize outages and facilitate easy maintenance. This should be agreed upon during the road design and planning phase.

2) Horizontal duct sharing:

   If the road section has sufficient road reserve secured, the utilities may share the service duct in a horizontal approach. The order of which utility goes first (from left to right) must be agreed upon during the road design and planning phase.

3) Use of poles for common utility sharing:

   For road sections over difficult terrain such as swampy areas, the utilities may agree to share poles and run their cables/pipes aerially across the section on utility poles along the roads. The order of sharing on the poles and the distance separating each service provider cable has to be agreed upon in advance during the road design and planning phase. Similarly, a safe distance between the fibre-optic cables and the power lines and water pipes must be agreed upon in advance of installation.

4) Use of a utility corridor along highways:

   For new co-deployment infrastructure projects being planned, there is an alternate approach of designating a utility corridor alongside both sides of the road during construction (say 1-2 metres on either side). The road owner would then convene meetings with all the public and private utility companies and ICT service providers to agree on how much space is allocated for their service ducts. The utility corridor may use horizontal or vertical or both service ducts, depending on the terrain in the area.

10 ICT Infrastructure Construction Guidelines for Buildings

This section contains the ICT Infrastructure Construction Guidelines for Buildings. These include General Requirements for ICT Facilities to include in new building plans; General Construction Requirements for ICT Facilities and Documentation Requirements.

Specific ICT facilities requirements for single-tenant buildings and multi-tenant buildings are provided in different subsections. The goal is that these ICT requirements are always included in the architectural building plans for new public buildings going forward.

10.1 Definitions

Access point: Physical point located outside the building accessible by public telecommunication networks, hosting passive telecoms equipment (such as splice closures and fibre-optic distribution boxes), through which a connection between the outside plant and the in-building physical infrastructure is made. It is the demarcation point between both. The access point shall be easily accessible to public service provider networks and protected against potential damage. A lockable access point cover is preferred for this purpose.

Building distribution frame (BDF): Passive telecommunication distribution equipment between the outside plant and the in-building physical infrastructure (inside plant). The BDF allows the connection of the lead-in cables coming from the access point (outside the premises) to the cables reaching each unit.

Entrance facility: Physical area containing the lead-in ducts and cabling from the access point to the telecommunication space/room.

Floor distribution: Spaces and trunking systems accommodating points of distribution within a building floor in multi-tenant buildings, also known as horizontal distribution area.

Floor distributor: Subdividing element between the BDF and the unit distributor/network termination points located nearby or in the riser area which allows the transition from the vertical to the horizontal indoor cable for a given building floor.

FTTH/P: Fibre-to-the-home/premises.

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

In-building physical infrastructure (IPI): A collection of passive telecommunication components that together provide the basic support for the distribution of telecommunication services in a building or campus. It connects the access point with the network termination points in the building units, and includes the network termination points, distribution frames, risers, telecommunication rooms and spaces, and lead-in ducts.

Main distribution area: A location inside the telecommunication space where the main cross-connect is located.

Network termination point (NT): The point at which the IPI of a building unit terminates. A building unit may have multiple NTs.

Passive network components: These include all the non-electric physical elements – such as ducts, towers, masts, manholes and handholes, cables and closures among others – that may be used for the provision of outside plant and in-building telecommunication networks.

Outside plant (OSP): Section of a telecommunication network located outdoors. Within the ICT context, it is the outdoors section of the ICT connecting the IPI (in-building) with the public telecommunication networks.

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

Riser area: The physical location containing the vertical ducting/trunking system and distribution cabling that connects each floor with the BDF.

Telecommunication room: Space in a building used for housing the installation and termination of telecommunication equipment, cable terminations and BDF. This room is also used as a collocation area to house various equipment and cables used to distribute telecommunication, image and security services to each unit. There are three distinctive types of telecommunication rooms:

- The main telecommunication room (MTR) is of mandatory construction and always built at the ground or basement level of a building, hosting the main telecoms equipment.
- The rooftop telecommunication room (RTTR) is placed at the rooftop of a building mandatorily built when the building meets the requirements specified in this document.
- The mobile service telecoms room is a telecommunication room placed on the rooftop of a building and on different floors, mandatorily built when the building meets the requirements. It hosts mobile services and telecommunication equipment.

Telecommunication space: All dedicated rooms/areas in a building housing telecommunication equipment.

10.2 Introduction

There is an urgent need for the Government of Uganda, through its agencies, to issue ICT construction guidelines for new public buildings being constructed. Following these guidelines will be compulsory for real estate developers, consultants and contractors. The guidelines will provide an open infrastructure to any service provider bringing ICT services to the building. They will foster competition by giving the end user the freedom to select the network provider of choice. Sharing of essential infrastructure elements such as rooms, ducts and cable trays is one of the aspects in focus to optimize investment for all parties to guarantee an effective utilization of resources.

These guidelines provide the minimum architectural (such as pathways and spaces), electrical and mechanical requirements that enable a future-proof design and construction of ICT infrastructure in all types of new public and private buildings, also concerning other building utility services (electricity, water and mechanical). These standards do not change any obligations imposed by other administrative authorities. Installations in buildings shall strictly meet the requirements set by the relevant authorities having jurisdiction. All the installations shall comply with all provisions, rules and guidelines established by those authorities. The guidelines are intended to incorporate the IPI concept at the initial building planning phase, either for new construction or existing building refurbishment. The specification is developed to suit the

technical requirements of any existing/future ICT service provider with an effective utilization of the building resources.

These guidelines particularly apply to fibre-to-the-home/premises (FTTH/P) and in-building wireless solutions (IBS). The guidelines set the IPI minimum requirements for standard cases. Special buildings or developments (e.g. sports arenas, airports, hospitals or mission-critical buildings) need further interaction between the developer, the contractor and the ICT service providers, beyond these guidelines, but never in contradiction with them. The requirements shall apply to all new or under-renovation buildings, including access points easily accessible by network providers, such as:

1) Single-dwelling units (SDUs)
2) Multi-dwelling units (MDUs)
3) Government buildings
4) Industrial facilities
5) Health-care buildings
6) Commercial buildings (hotels, malls, shopping centres, etc.)
7) Transport infrastructure facilities (railway stations, airports, seaports, etc.)
8) Sports facilities (stadiums, halls, pools, parks, fields, etc.)

10.3 General requirements to include ICT facilities in new building constructions

Installing fibre-optic cables in a new public building construction involves detailed planning and adherence to specific requirements to ensure a robust, reliable and scalable network. Below are the key requirements and best practices:

1. Pre-construction planning

Needs assessment:

- Bandwidth requirements: Assess current and future bandwidth requirements for various public services.
- User and device count: Estimate the number of users and devices that will need connectivity, considering public access areas.
- Future scalability: Plan for future expansion to accommodate growing needs without significant rework.

Design and layout:

- Network topology: Determine the appropriate network topology (e.g. star or ring configuration) based on the building layout and intended use.
- Equipment locations: Identify locations for the main distribution frame (MDF) and the intermediate distribution frames (IDFs), ensuring they are centrally located for optimal cable lengths.

2. Infrastructure design

Pathways and spaces:

- Conduits and cable trays: Design conduits, cable trays and risers that support current needs and future expansions.
- Telecommunication rooms: Allocate adequate space in telecommunication rooms for racks, patch panels and other necessary equipment.
- Support and bend radius: Ensure that cable pathways comply with bend radius requirements to prevent damage to the fibre.

Environmental considerations:

- Controlled environment: Ensure that the installation environment is controlled for temperature and humidity to prevent damage to the cables.
- Interference avoidance: Plan pathways to avoid areas with potential electromagnetic interference.

3. Permits and compliance

Building codes and standards:

- Local building codes: Adhere to local building codes and regulations specific to public buildings.
- Industry standards: Follow recognized standards such as TIA/EIA-568, ISO/IEC 11801, and IEEE standards for fibre-optic installations.

Permits:

- Necessary permits: Obtain all required construction and installation permits, ensuring compliance with local regulations.

4. Cable and component selection

Cable types:

- Single-mode vs multi-mode fibre: Choose single-mode fibre for long distances and high bandwidth, and multi-mode fibre for shorter distances within the building.
- Rated cables: Use cables rated for fire resistance, UV protection (if exposed to sunlight), and other environmental factors.

Components:

- Connectors and splices: Use high-quality connectors (e.g. LC, SC) and splicing techniques like fusion splicing for low-loss connections.
- Patch panels and enclosures: Install durable patch panels and enclosures to organize and protect fibre terminations.

5. Installation process

Cable pulling and placement:

- Installation techniques: Use appropriate techniques to pull cables, ensuring you do not exceed the tensile strength of the fibre.
- Cable routing: Carefully route cables through designated pathways, avoiding sharp bends and providing adequate slack for future adjustments.

Termination and splicing:

- Clean environment: Ensure a clean environment for terminating and splicing fibres to avoid contamination.
- Splicing methods: Use fusion splicing for permanent joins to ensure minimal signal loss and high reliability.

6. Testing and certification

Testing:

- Continuity and signal loss: Use OTDR and power meters to test for continuity, signal loss.
- Clear labelling: Label all cables, connectors and patch panels clearly to facilitate maintenance and troubleshooting.
- Comprehensive documentation: Provide detailed documentation, including as-built drawings and test results, for maintenance and future upgrades, and reflectance.
- Standards compliance: Ensure all installations meet the required specifications and standards.

Documentation:

- Test results: Document all test results and keep records for future reference.
- Network schematics: Maintain detailed schematics of the network layout, including pathways and connection points.

7. Post-construction activities

Maintenance and future-proofing:

- Accessibility: Ensure that all cable pathways and termination points are accessible for maintenance and potential upgrades.
- Scalability: Design the installation with scalability in mind to accommodate future growth without significant additional work.

By adhering to these requirements and best practices, the installation of fibre-optic cables in a new public building can be completed efficiently, providing a high-performance and reliable ICT network infrastructure that meets current and future needs.

In-building IPI requirements

Figure 8 shows an IPI single-line diagram showing the physical telecommunication spaces and pathways, and the telecommunication equipment potentially installed in the telecommunication spaces.

Figure 8. IPI single-line diagram reference model

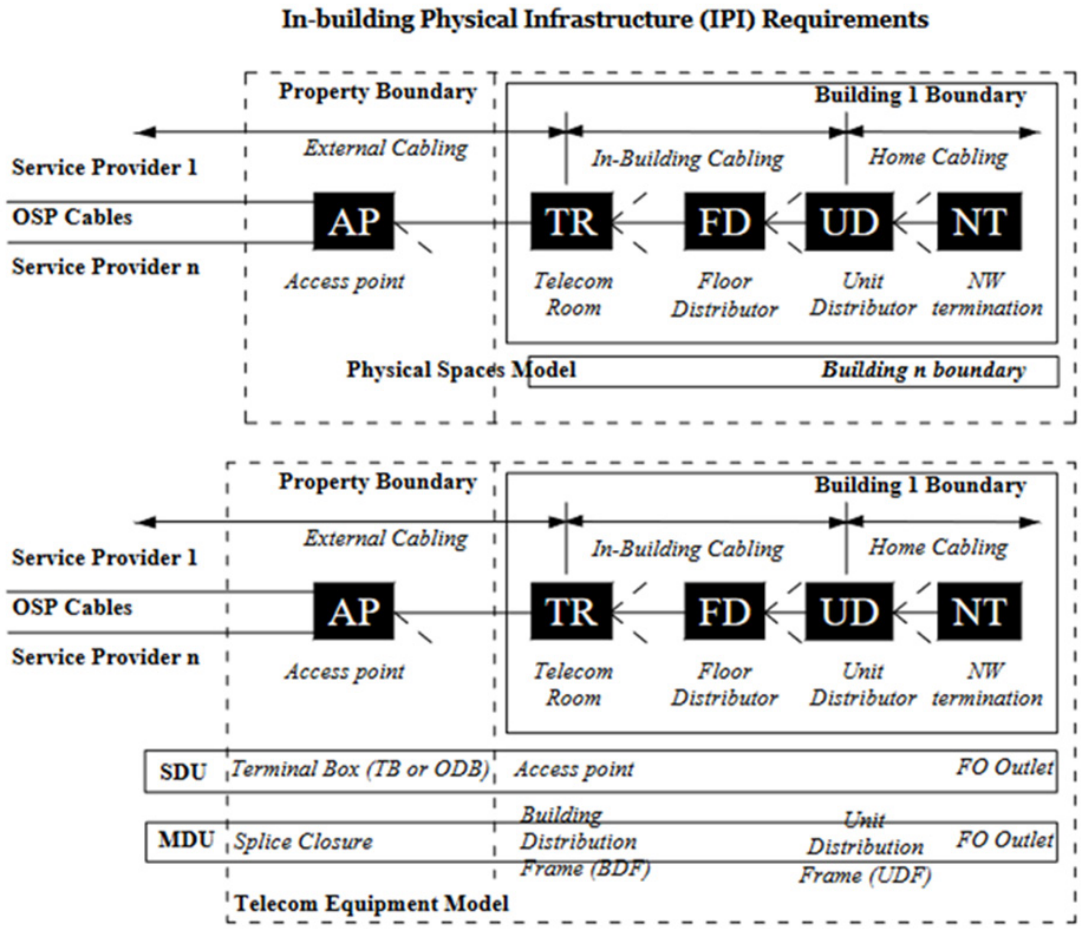


Figure 9. SDU building diagram

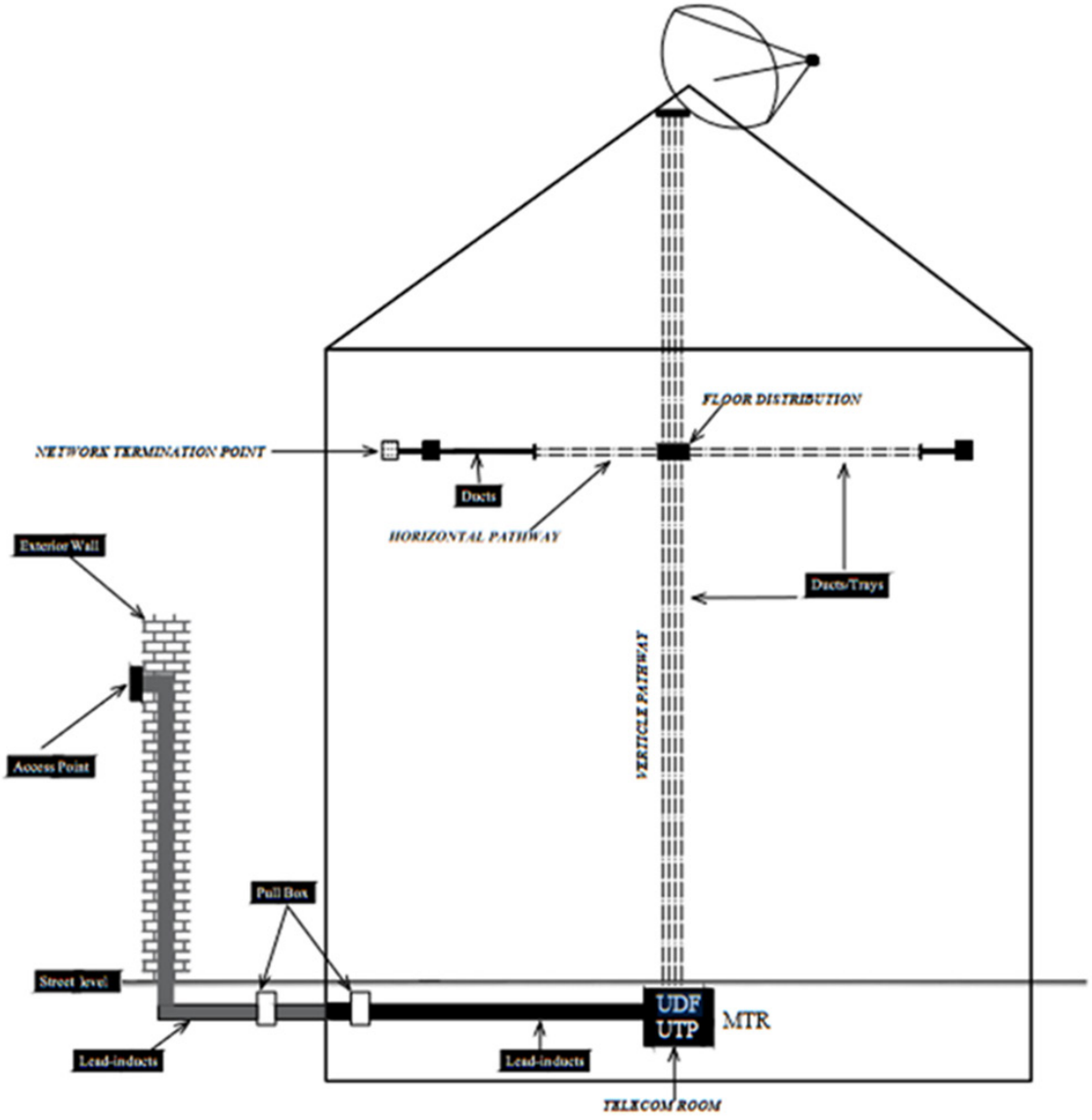
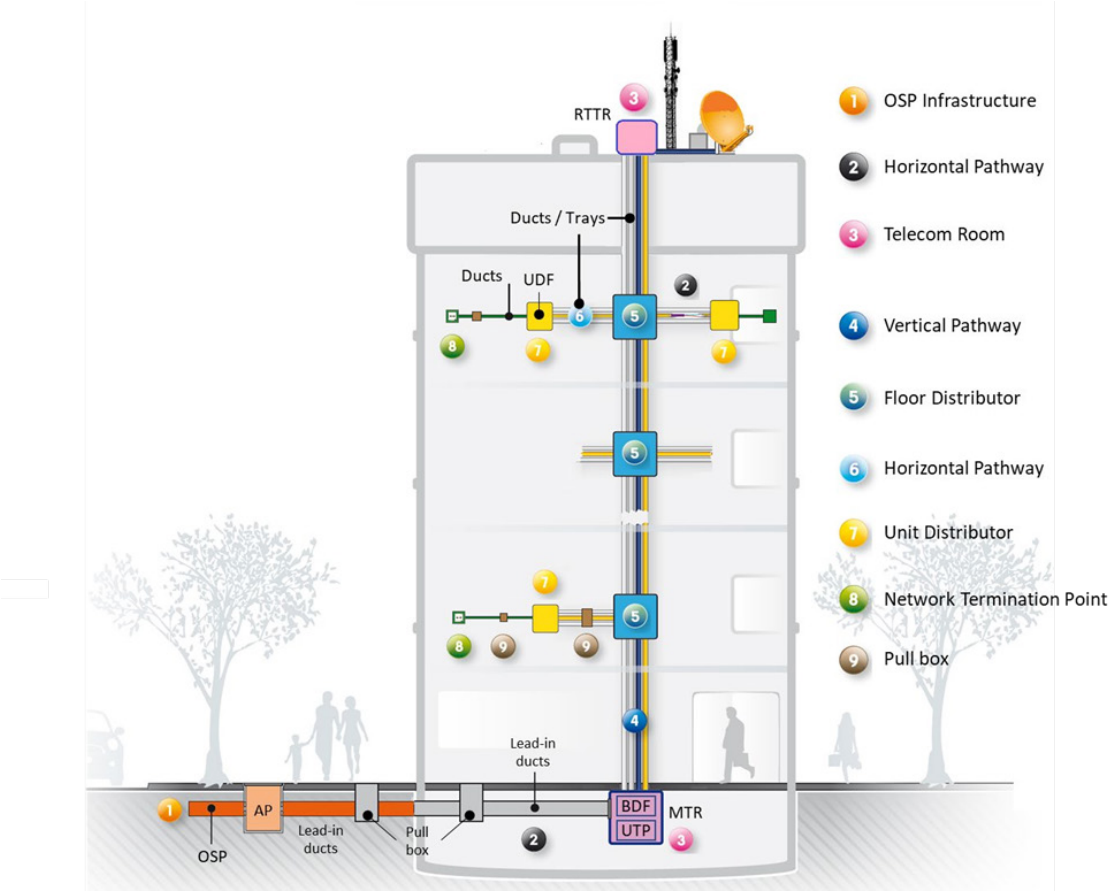


Figure 10. IPI reference model in an MDU building



Access point

In any new building project, the property owner/developer will provide at least one access point for connectivity with the ICT service providers' OSP cables. Depending on the development characteristics (size, type, structure, utilization, etc.), the access point may go from a simple wall box on an outer wall (SDU) to a dedicated 5 x 5 metre plot for the complete development of a large urban estate. All cabling structures coming from the buildings or villas will be terminated in the access point and connected to the OSP cables installed by the ICT service providers. Depending on the development requirements, more than one access point may be installed. The number and size of access points located in each project are to be agreed between the developer and the corresponding service providers based on the building(s) size, shape, total number of users, and building utilization.

Lead-in ducts

The building developer must provide lead-in ducts for main and redundant routes (if required) from the access point(s) to the telecommunication room(s). The exact number of ducts and their route will depend on whether network redundancies and multiple connections of a building are required and will be designed and implemented upon agreement between the developer and the applicable service providers and/or neutral host. Mechanical fixtures (such as piping, ductwork and pneumatic tubing) not related to the support of telecoms' entrance infrastructure should not be installed in, pass through or enter the telecommunication entrance facility.

Underground telecommunication facilities must not be in the same vertical plane as other utilities, such as water or power, that may share the same trench. Utility services must be located horizontally concerning each other and shall comply with the applicable code. The lead-in ducts shall be protected by concrete when running under permanent paved surfaces. The lead-in ducts shall be sealed at each end to prevent the ingress of any materials such as water, subsoil, gas or pests.

The location of lead-in ducts shall be marked above ground for ease of locating. Lead-in ducts shall be assigned exclusively to ICT services. The standard lead-in ducts shall be made from HDPE, unplasticized polyvinyl chloride (uPVC) or better material, following internationally recognized standards.

The lead-in ducts shall be ribbed inside and capable of accommodating optical fibre. All ducts and sub-ducts must include a draw rope made of twisted mildew and resistant polypropylene and have a minimum outside diameter of 6 mm and a minimum tensile strength of 2 400 lbs/1 000kg.

No sharp bends higher than 45° shall exist throughout the duct length, except one wide-angle, long-radius vertical bend (factory-made) at the terminating end of the duct, inside the main telecommunication room. In case a sharp bend higher than 45° is unavoidable, a cable pull-box of minimum size 600 mm (L) x 600 mm (W) x 600 mm (D) must be installed.

The quantity, location, type and actual size of the entry/pull boxes will depend on the characteristics of the development and the ducting routes from the telecommunication room to the access point. Pull boxes shall be installed for any right-angled or sharp bends in the lead-in ducts route or at any other places where cable pulling may be compromised or restricted. All lead-in duct corridors shall follow the local authorities' regulations.

Telecommunication (ICT) spaces

Telecommunication spaces are the rooms and areas inside the building where the telecommunication cabling is terminated, cross-connected, and interconnected to passive or active telecommunication equipment. It specifies the space allocation within the building in compliance with national and international standards, and best practices.

The following telecommunication space types are specified:

- telecommunication rooms (main, rooftop and indoor mobile service)
- floor distributors
- unit distributors
- network termination points.

Main t telecommunication rooms: All buildings shall be equipped with at least one main telecommunication room (MTR), which shall be provided on the ground floor or basement floor. In case multiple telecommunication rooms are equipped in the building, they shall be interconnected by separate cable trays (300 mm x 50 mm, W x H) or equivalent ducting capacity. Different types of telecommunication rooms will be required in development, depending on the characteristics of the buildings.

The telecommunication room shall meet the following requirements:

1) Telecommunication rooms must not be near any sources of heat and moisture, corrosive atmospheric or environmental conditions, high voltages, radio-frequency interference (RFI) sources or electromagnetic interference (EMI) sources.
2) Telecommunication rooms must not be directly beneath or next to wet areas such as showers, washrooms, swimming pools, garbage areas, etc.
3) If for any reason it is proposed that any part of a telecommunication room be located below any kind of water source, this must be considered at the building design stage, since the construction of a floor (attic slab) drain will be required, fitted with an automatic submersible pump to counter any risk of water ingress. In addition, sensors to detect water leakage are also to be installed inside the telecommunication room.
4) Telecommunication rooms must be clean and dry, free from sprinkler systems and windows, and provide pest-preventing measures to avoid cable damage and potential service disruption. Removable cable tray covers may be used as an additional protection measure.
5) Telecommunication rooms shall be equipped with good lighting (300 lux minimum) and have proper ventilation and air circulation.
6) Telecommunication rooms shall provide enough space for collocated equipment of at least three ICT service providers.
7) Equipment that is not related to the support of telecommunication spaces (for example, piping, duct work and distribution of building power) shall not be located in or pass through a telecommunication space.
8) Telecommunication spaces shall not be shared with building or custodial services. Sinks and cleaning materials such as mops, buckets and solvents shall not be located or stored in a telecommunication space.

Safety in telecommunication spaces

As telecommunication spaces are potentially accessible to human beings, particularly telecommunication rooms, they must comply with all municipality and national authority safety standards and regulations, including those issued by civil defence and utility companies. As a minimum set of requirements, the following shall apply:

1) All telecommunication rooms must be fitted with smoke detectors connected to the building management system; the wall mount cabinet telecommunication room for SDUs is exempted from this requirement.
2) All containment openings of telecommunication rooms must be sealed with fire-retardant material.
3) All doors of telecommunication rooms shall be fire retardant with a minimum rating of two hours and preferably made of steel, outward opening and equipped with an automatic door closing system labelled as “telecommunication room”.
4) All telecommunication spaces must be free from contaminants and pollutants.
5) Telecommunication rooms and floor distribution must be fitted with normal and emergency lighting.
6) Telecommunication spaces shall not be used as storage rooms of any type.

Electromechanical requirements

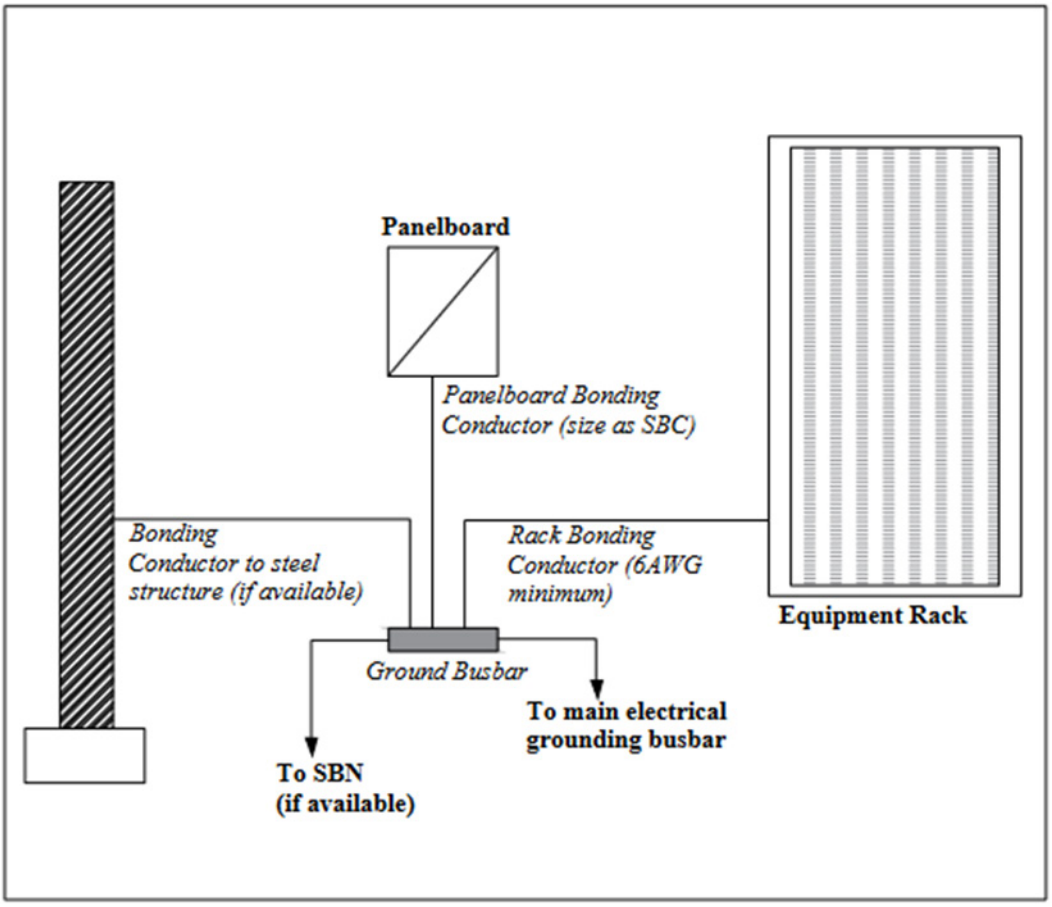
All telecommunication spaces (except the network termination points) shall be equipped to provide adequate electrical power. A minimum of two dedicated, non-switched 240 VAC

sockets for equipment power shall be installed, each one connected to an individual branch circuit. A dedicated power distribution board shall be provided inside the telecommunication room to serve all telecommunication equipment and other supporting equipment (such as air conditioning, lighting and fire alarm).

Telecommunication rooms grounding

A telecommunication grounding busbar shall be provided inside telecommunication rooms. The minimum dimensions of the telecommunication grounding busbar are 6 mm thick x 50 mm wide, variable in length and they shall be listed. The telecommunication grounding busbar shall be referenced to the electrical distribution board inside the telecommunication room to equalize potentials between them. A telecommunication grounding busbar shall be bonded to the nearest structural steel member – i.e. a horizontal or vertical beam (if available) – if the main electrical grounding busbar is bonded to the 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 11. The size of the bonding conductor shall be a minimum of 4 mm.

Figure 11. Telecommunication room grounding arrangements



10.4 General construction requirements for ICT facilities in buildings

This section covers some internal cabling, bending radius, installation, testing and documentation applicable to all IPI projects. Planning and design of the IPI, including IBS wireless requirements, shall be done by specialized personnel with adequate and specialized tools or software where

applicable. The IPI shall be future-proofed, adequately managed and maintained. All inside plant materials used for IPI construction shall be made of low smoke zero halogen (LSZH) components and be provided by renowned manufacturers who have been tested and certified by internationally accredited and recognized laboratories. The latest version of international specifications (ITU-T, ISO/IEC, etc.), shall apply in this regard.

The IPI (ducting/trunking) shall have enough capacity to provide at least four fibre connections per unit from the access point to the unit distribution frame (UDF). The building construction plans must foresee the provision of at least three services (fibre, coaxial, or twisted pair Ethernet) when dimensioning the IPI.

Cable installation

Should cables be installed at the building construction phase, the following minimum rules shall apply:

Internal cabling:

1) Cables for ICT shall be installed separately from electrical cabling. When installing ICT infrastructure in parallel to other installations, all regulations regarding health and safety, noise protection, EMI, fire protection or the security of electrical installations must be followed.
2) The internal cabling shall be based on the latest edition of the international standard ISO/IEC 11801. Fibre-optic cable shall be used. If twisted pair copper cable (UTP) is also installed, it shall at least conform to Category 6 and preferably Category 7 per ISO/IEC TR 11801.
3) Splicing of optical fibre shall be avoided. Splice attenuation shall not exceed 0.15 dB and typically be at 0.01 dB. Return loss shall not be measurable.
4) Fibre termination shall be on either SC/APC connectors (IEC 61754-4) or LC/APC connectors (IEC 61754-20) shall be used. It is recommended to coordinate with the corresponding CSP to determine the required type.
5) The cabling shall be dimensioned according to the number of units in the building and the required number of connections per unit (four fibre-optic connections), including a suitable reserve (spare) capacity of at least 10 per cent. From the UDF to inside the unit, one connection is to be terminated to each NT.
6) The cabling shall be designed to meet the projected service requirements (including IBS services) at floor level and shall have built-in flexibility to meet the growing needs of tenants.
7) All materials and cable jackets (sheaths) shall be flame-retardant, low smoke and zero halogen emissions, according to IEC 60332, IEC 60754 and IEC 61034 standards.

Bending radius:

1) The internal cabling shall consider the specified minimum bend radii for the respective cables used.
2) The bend radii are defined in Recommendation ITU-T G.657 A1/A2/B2/B3. The minimum bend radius ranges from A1 at 10 mm to B3 at 5 mm.
3) The smaller the radius, the higher the bending loss. Thus, bigger radii shall be preferred.

Testing:

1) The testing for optical fibre must conform to ISO/IEC TR 14763-3 and the relevant ITU specifications.

2) Maximum end-to-end loss between the BDF/UDF and the NTs shall be 1.5 dB @ all wavelengths (measurement according to IEC 61280-4-1, 1 reference cable method).

3) The testing for balanced cabling installations (CAT 6, etc.) must conform to IEC 61935-1 and the relevant ITU specifications.

10.5 Documentation for ICT facilities in buildings

This includes the following:

1) All building and development blueprints, e.g. original and updates, shall be managed, shared and communicated to applicable stakeholders as required – especially changes that impact the operation of the infrastructure herein and its services.

2) All infrastructure components must be clearly and uniquely labelled. Labels on components must match the label in the documentation and as-built drawings.

3) The building records shall include building location information (e.g. building and way number, address, etc.); a list of all telecommunication rooms and NTs and their locations in the building; a list of all distributors and connections; labelling of all infrastructure components; contact information; as-built drawings of IPI; and mobile wireless services indoors and outdoors.

4) All above documents must be kept in the respective telecommunication room.

5) The above documents must be updated as soon as changes to the building infrastructure have occurred and shared with applicable stakeholders.

Environmental requirements

Cooling in IPI spaces shall:

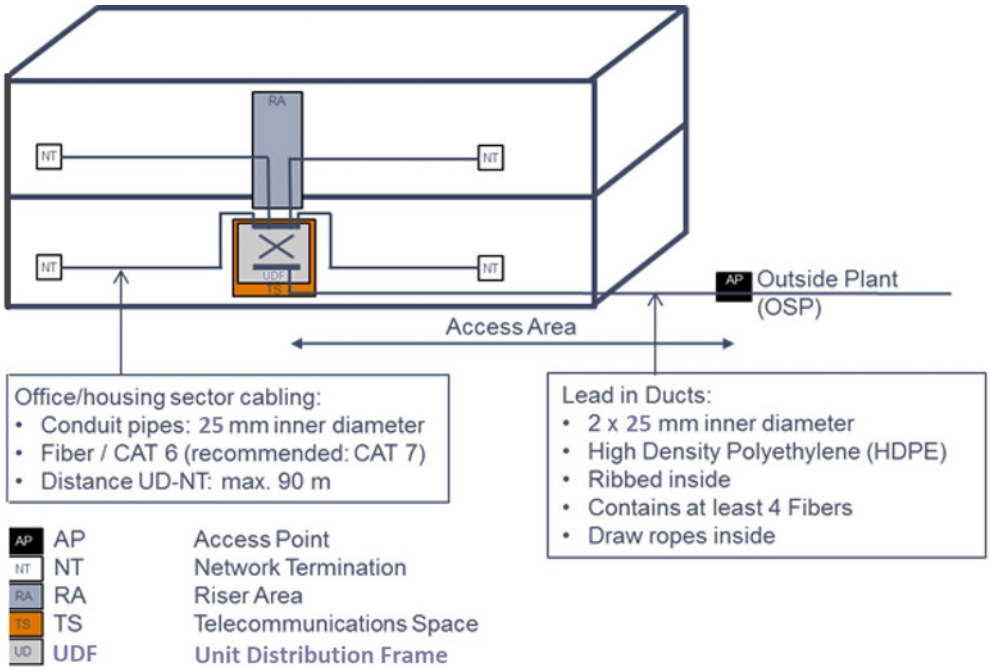
- maintain continuous and dedicated environmental control;
- maintain a temperature and humidity level as recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers;
- dissipate the heat generated by active devices.

10.6 Requirements for single-tenant buildings

Summary of complete set of requirements for single-tenant building

In addition to the general requirements described in the previous section, the requirements for adding ICT facilities for a single-dwelling unit (SDU) are summarized in Figure 12.

Figure 12. Reference configuration for single-dwelling unit in-building physical infrastructure



Access points

The access point specifications for SDUs are as follows:

1) The access point hosts the fibre-optic distribution box or similar device, to be provided by the service providers for fibre connectivity.
2) As a minimum, the access point space for SDUs shall be 30 x 30 x 12 cm (H x W x D) and shall be able to accommodate at least four fibre connections.
3) The access point location shall be provisioned at the exterior wall of the building, positioned close to the main entrance at 1.5 metres above floor level.
4) The access point can be flush mounted (integrated into the wall) or wall mounted (on the wall surface).

Figure 13. Access point with lead-in duct

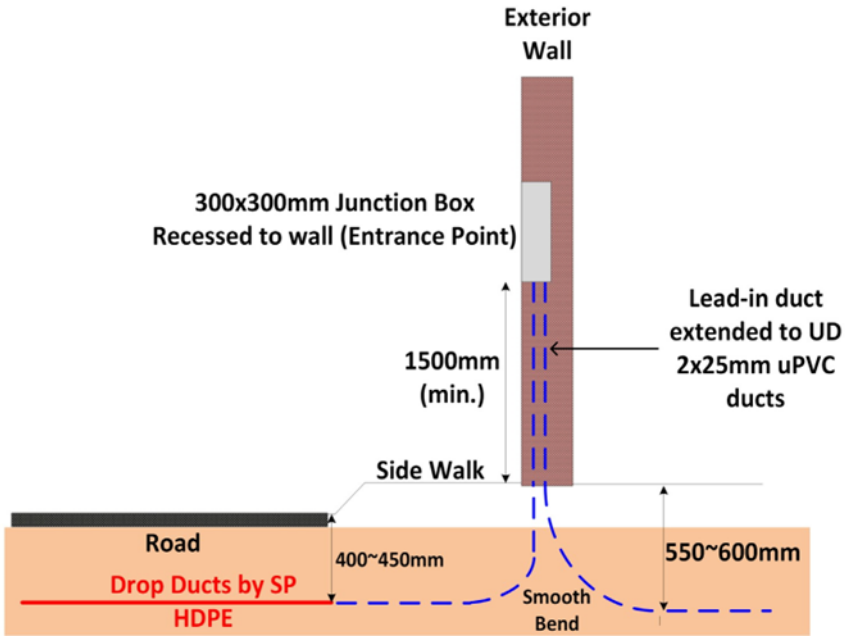
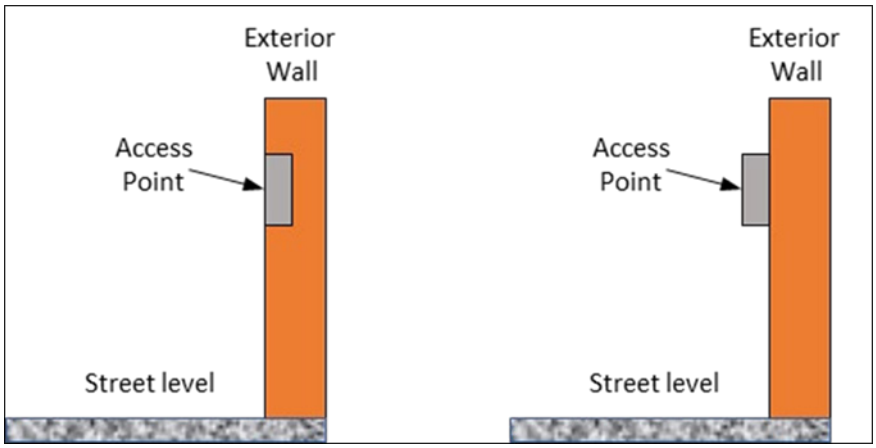


Figure 14. Access point (flush mounted and exposed)



Lead-in duct requirements for SDUs

1) Lead-in ducts shall be laid at a depth of about 550–600 mm, protected against damage, and sloping away from the building structure, considering any local municipal rules.
2) At least two (one plus one reserve) lead-in ducts shall be installed.
3) Duct systems with sub-ducts are expected to be used.
4) The inner diameter of each lead-in conduit shall be specifically defined in the project design and shall be as a minimum 25 mm.
5) The minimum thickness for 25 mm ducts shall be 2.00 mm.

Table 16. Lead-in ducts minimum requirements for SDUs

Standards: Lead-in Duct for SDUs	
Minimum dimension (inner diameter)	SDUs: 25 mm
Quantity (minimum)	SDUs: 2 (1+1 reserve)
Minimum thickness (mm)	+/-2.00 (for 25 mm ducts)

Telecommunication spaces for SDUs

SDUs have limited requirements for dedicated telecommunication spaces. As a minimum, the entrance facility, the telecommunication room and the network termination points shall be installed. For large SDU buildings, it is, however, recommended to implement all telecommunication spaces specified for MDU buildings, particularly the floor distributors. All specifications in this section apply to the complex of villas, where each villa shall meet the specified SDU requirements. The following specifications apply.

Main telecommunication room

The MTR hosts the unit distribution frame (UDF), which allows cross-connections between the outside plant cabling and the in-building cabling. For SDUs, it is allowed that the UDF is integrated with the access point.

The MTR can be a wall back box or cabinet concealed in the wall of adequate dimensions to host the UDF and meet the building cabling requirements. The Network Test System (NTS) can be directly connected from the telecommunication room through 25 mm (inner diameter) ducts.

Telecommunication room minimum requirements:

1) It shall be located where the distance to the farthest NT within the unit does not exceed 90 metres.
2) The minimum telecommunication room space shall be 600 x 600 x 300 mm (H x W x D), for collocating equipment of at least three public telecommunication networks.
3) Telecommunication rooms for SDUs can be installed together with other utilities' technical equipment in dedicated technical rooms provided that the minimum telecommunication room space is ensured.

Floor distributors

Floor distributors are not mandatory in SDU constructions; however, in the case of large SDUs equipped with floor distributors, these shall meet the following requirements:

- A floor distributor will be located on each floor of the SDU. Floor distributors shall be installed at a minimum height of 600 mm from the finished floor level.
- The space for the floor distributor shall be dry and clean.
- The floor distributors should be large enough to accommodate the three telecommunication cabling requirements (technologies) in the floor distributor. As a minimum, a flush-mount wall cabinet of 50 x 30 x 15 cm (H x W x D) shall be installed.
- The floor distributors shall be vertically connected to the telecommunication room.

Network termination points

- Each residential room (except wet rooms such as bathrooms and laundry rooms) or office room shall be equipped with at least one network termination point (NT) connected with a two-core fibre cable to the UDF.
- An electrical 240V/16A power outlet shall be made available and collocated with every installed fibre-optic NT.

Vertical pathways

The star topology is the most common one in SDU ducting systems, which does not make use of floor distributors. If this topology is used, the conduit pipes connecting the telecommunication room with the NTs shall be able to accommodate all SDU telecommunication cabling requirements, and as a minimum:

- fibre-optic cables (G657.A1/A2)
- twisted pair Ethernet cables
- coaxial cables (75 Ohm resistance).

Each of these different ICT technologies shall be installed in an independent 25 mm (inner diameter) conduit for smooth operation and maintenance; alternatively, a 1 x 50 mm (inner diameter) conduit can be installed hosting the cabling for the three services inside.

However, if a tree topology is used, all cabling between floors inside a home (vertical pathways) shall run through 3 x 50 mm inner diameter PVC conduits connecting the floor distributors.

It is recommended that all vertical conduits run straight to ease the installation of cables, which requires that the floor distributors be positioned at the same location on each floor.

Horizontal pathways

In the case of tree topology, the horizontal pathway requirements are as follows:

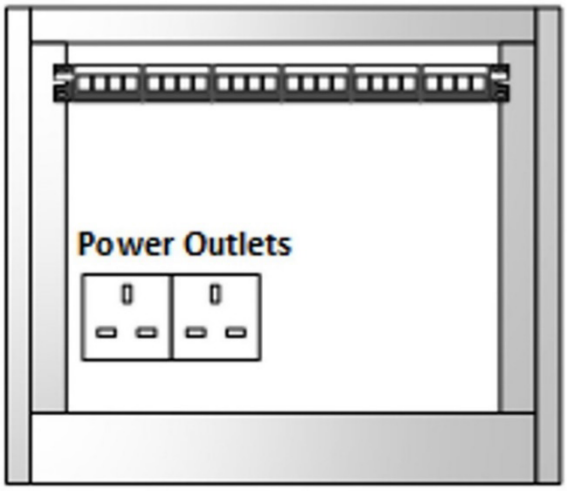
1) Each room (other than wet rooms: bathrooms, laundry rooms, etc.) on a floor shall be connected with 3 x 25 mm (inner diameter) conduits to the floor distributor (3 x NTs), each conduit being dedicated to a specific service (fibre, UTP or coaxial). Alternatively, a 1 x 50 mm (inner diameter) conduit can be installed, providing connectivity to the three different NTs, which shall be installed together (triple common socket fibre, UTP or coaxial).
2) A star topology from the floor distribution shall be used for the ducting/cabling on each floor. Looping the horizontal ducting/cabling from room to room is prohibited.
3) Intermediate PVC junction/pull boxes must be provided on individual runs that exceed 30 m. PVC junction/pull boxes must also be provided where an individual conduit run has a sharp change in direction (> 45°).
4) The conduit boxes referred to above must have the following minimum internal dimensions: 300 mm x 300 mm x 150 mm (L x W x D).

Electromechanical requirements

1) A minimum of 2 x 240 V/16A power sockets with a dedicated circuit breaker shall be provided in the telecommunication room and floor distributions in compliance with Saudi Electrical Code SBC 401-CR, Native of Demand (12-2.3).
2) All metallic parts in the telecommunication spaces must be Earth-bonded with a resistance of less than 1 ohm.

3) An electrical 240V/16A power outlet shall be made available and collocated with every installed fibre-optic NT.

Figure 15. Power outlets

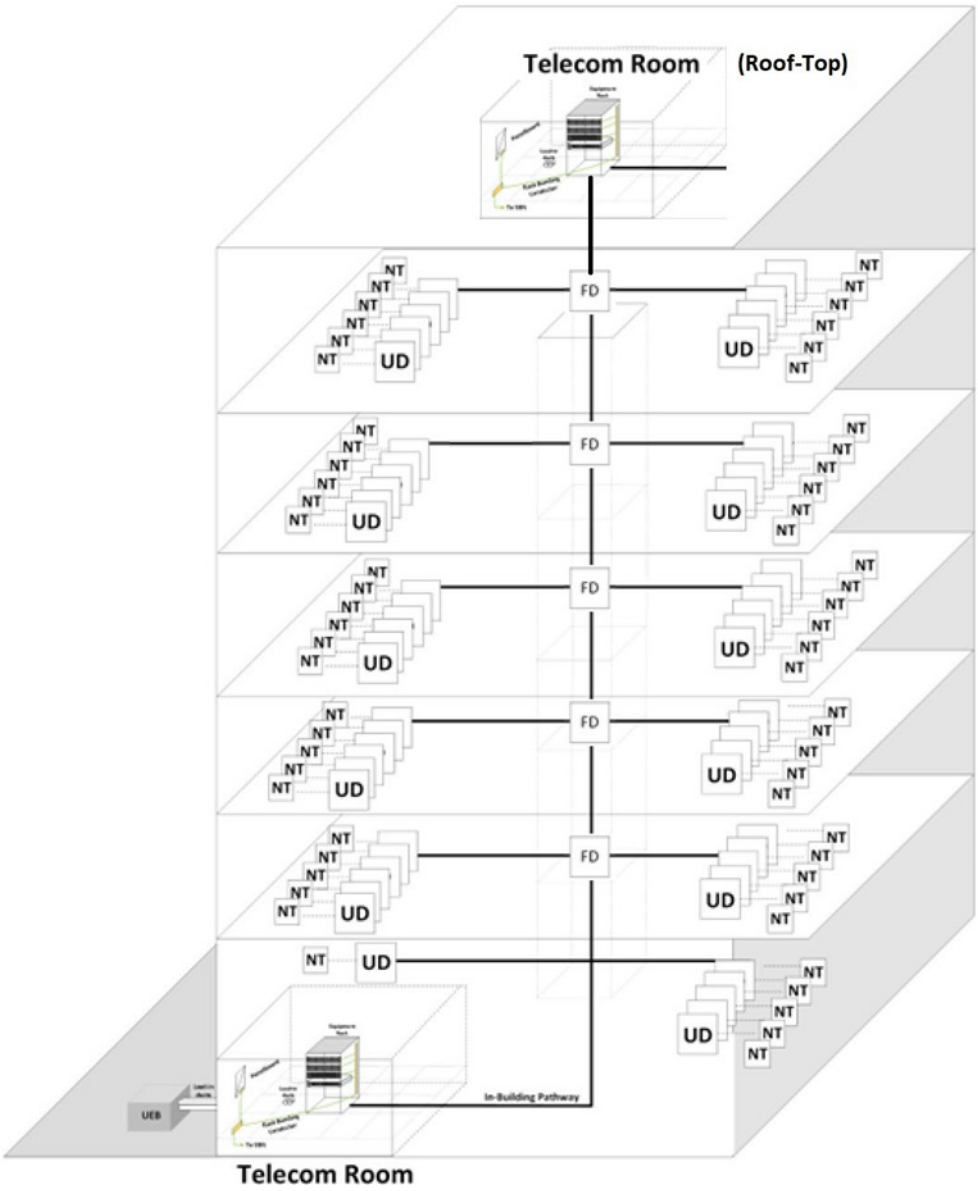


10.7 Requirements for multi-tenant buildings

Summary of complete set of requirements for multi-dwelling buildings

This section contains a summary of the complete set of requirements for multi-dwelling unit (MDU) building types in conjunction with the general requirements in section 11.2 above. The figure shows a typical configuration for MDU in-building physical infrastructure (based on ISO/IEC 11 801 and ITU Rec. L.82).

Figure 16. Generic MDU IPI configuration of a building higher than five floors



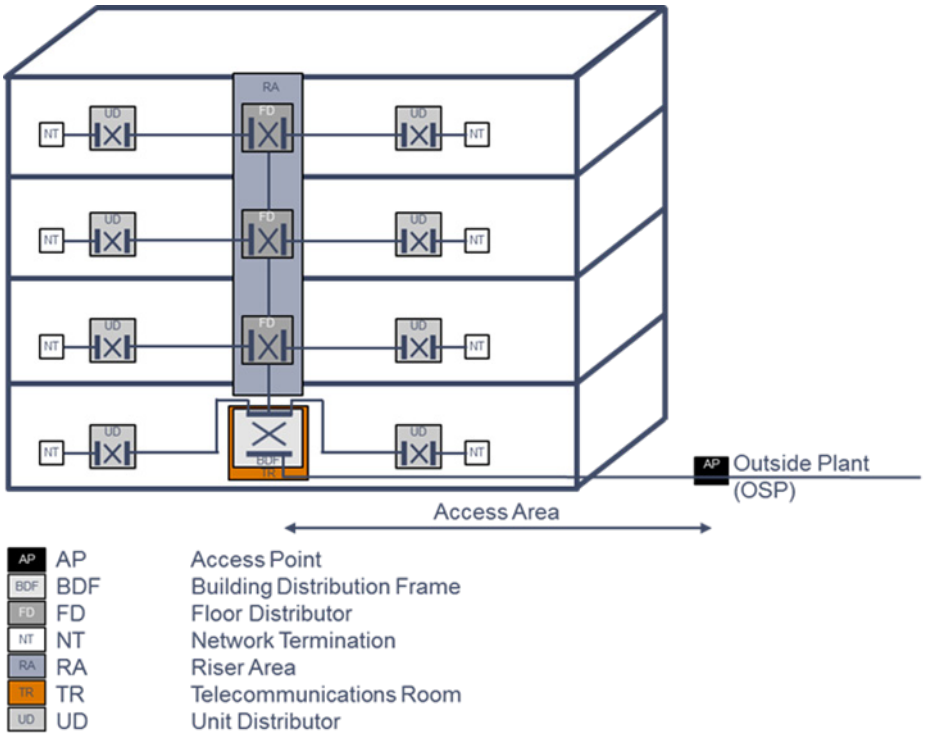
MDU topologies

There are two main IPI ducting/cabling topologies for multi-tenant buildings, depending on how the pathways are distributed in the building – the tree topology and the star topology. The star topology is not used that much in the field. The following sections detail the differences.

Tree (floor distribution) topology

The tree topology makes use of the floor distributor as a floor branch-off element and represents the reference configuration for all types of MDUs. Thus, it is the preferred topology.

Figure 17. Tree topology configuration for in-building physical infrastructure



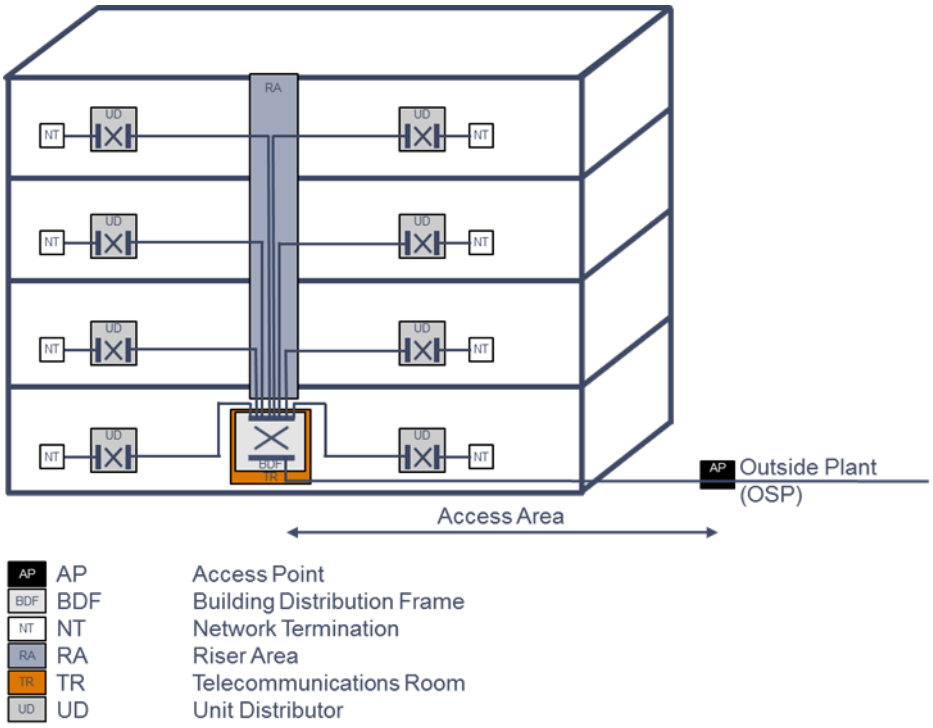
1) At least one floor distributor is installed on each floor of the building. Each unit distributor connects directly to the floor distributor that is connected to the telecommunication room.
2) The floor distributor topology shall be the only option for buildings with more than five floors. It limits cable lengths and capacity in the riser area.
3) The floor distributors allow for higher flexibility of the in-building physical infrastructure (IPI). Further, this configuration potentially reduces the length of the cables as floor distributors are interconnected.

Star topology

In the star topology, each unit distributor connects directly to the telecommunication room through the corresponding conduits system. This configuration is an option for the tree topology for small buildings, up to five floors, for it requires longer cable lengths (compared to tree topology with UDF installed in floor distribution) and considerable capacity in the riser area, but it may decrease the cost since it does not equip floor distributors.

Given that the floor distributor is eliminated, the riser area must be capable of accommodating a much larger number of conduits.

Figure 18. Star topology configuration for in-building physical infrastructure



Access points

The following requirements apply for access points of all MDU buildings:

1) The building developer shall provide underground entry boxes as access points, located within plot limits (including the sidewalk space). The number and position of these will be determined by the developer, in agreement with the corresponding service providers. In any case, they shall be facing the building entrance facilities (one or more if redundancy is required).
2) The underground entry box shall be 600 mm L x 600 mm W x 800 mm D minimum.
3) In case redundancy is required, the building developer shall provide additional access points as 600 mm L x 600 W x 800 D mm underground entry boxes separated by 20 metres as a minimum. This shall apply for the entire route of the lead-in ducts. In case of redundancy, it is recommended to have the entrance facilities on opposite sides of the building whenever possible.

Lead-in ducts in MDU buildings

The following requirements apply for lead-in ducts of all MDU buildings:

1) Lead-in ducts shall be laid at a depth of about 550–600 mm, protected against damage, and sloping away from the building structure, considering any local municipal rules.
2) At least 4 x 50 mm (inner diameter) uPVC lead-in ducts from the access point(s) to the telecommunication room(s) inside the building shall be installed.
3) Duct systems with sub-ducts are expected to be used.
4) The inner diameter of each lead-in conduit shall be specifically defined in the project design and shall be a minimum of 50 mm; (sub-)ducts shall be used.
5) The minimum thickness for 25 mm ducts shall be 3.25 mm.

Table 17. Lead-in duct requirements for MDUs

Standards: Lead-in Duct for MDUs	
Minimum dimension (inner diameter)	MDUs: 50 mm
Quantity (minimum)	MDUs: 4
Minimum thickness (mm)	+/-3.25 (for 50 mm ducts)

Telecommunication spaces

The following requirements apply for all telecommunication spaces of MDU buildings.

Main telecommunication rooms

The MTR shall be provisioned and sized according to Table 18 so that it can host the building cabling termination, service providers and neutral host equipment, facility network equipment, 1 and I (optional), covering current and future needs. The MTR hosts the building distribution frame (BDF), which allows cross-connections between the outside plant cabling and the in-building cabling.

As a minimum, MDUs shall have fibre-optic BDF/UDF with sufficient capacity to accommodate at least four connections to each unit. This optical distribution frame (ODF) shall be entirely equipped with all required fibre-optic adaptors (couplers), splice trays and pigtails dimensioned as a function of the number of building units:

- ODF minimum size = 4 x No. of units + 10 per cent spare capacity rounded up to the market available ODF size; SDUs only require 4-port ODFs.

In case multiple telecommunication rooms are equipped in the building, they shall be interconnected by separate cable trays (300 mm x 50 mm) or equivalent ducting capacity. Different types and dimensions of telecommunication rooms will be required in development depending on the characteristics of the buildings (size, function, features, etc.).

Table 18. Main telecommunication room sizing requirements

Building type	Requirements (H x W x D)
Building with 50 or fewer tenants or up to five floors or building area up to 3 000 m^2	3 x 2.6 x 0.6 metres (or as per approved project)
Building with 51 to 100 tenants or up to 10 floors or building area up to 7 000 m^2	3 x 3 x 3 metres (or as per approved project)
Building with 100 to 300 tenants or building area more than 7 000 m^2	3 x 3 x 3 metres (or as per approved project)
Building with more than 300 tenants	3 x 3 x 3 metres (or as per the approved project)
Shopping mall	3 x 3 x 3 metres (or as per approved project)
Bulk service buildings – hotels, palaces, government buildings, hospitals	3 x 3 x 3 metres (or as per approved project)
Group of warehouses and factories	3 x 2 x 2 metres (or as per approved project)

The room height measurement specified in this document is the minimum finished clearance after all given allowances for overhead cable trays and/or any other obstructions. A minimum headroom access of 300 mm is required above the trays.

It is recommended that telecommunication rooms equip a raised floor system to facilitate cable management. The minimum access clearance to telecommunication the rooms shall be 1 000 x 2 100 mm (W x H). Telecommunication rooms shall have 24/7 secured access for ICT service providers' staff, equipped with a master lock for the entrance door.

Telecommunication rooms shall be dedicated telecommunication spaces not shared with other utilities or functions (electrical or mechanical).They shall provide enough space for collocated equipment of at least three ICT service providers, with a minimum of two square metres for each provider. The final project design shall consider the size of the building and the number of units, as well as possible enhancements.

All telecommunication rooms in a building shall be vertically aligned and linked by a shared trunking system (there can be more than one vertical trunking, see Figure 19). This system must not reduce the minimum specified room space.

Figure 19. Example of building with more than one vertical trunking

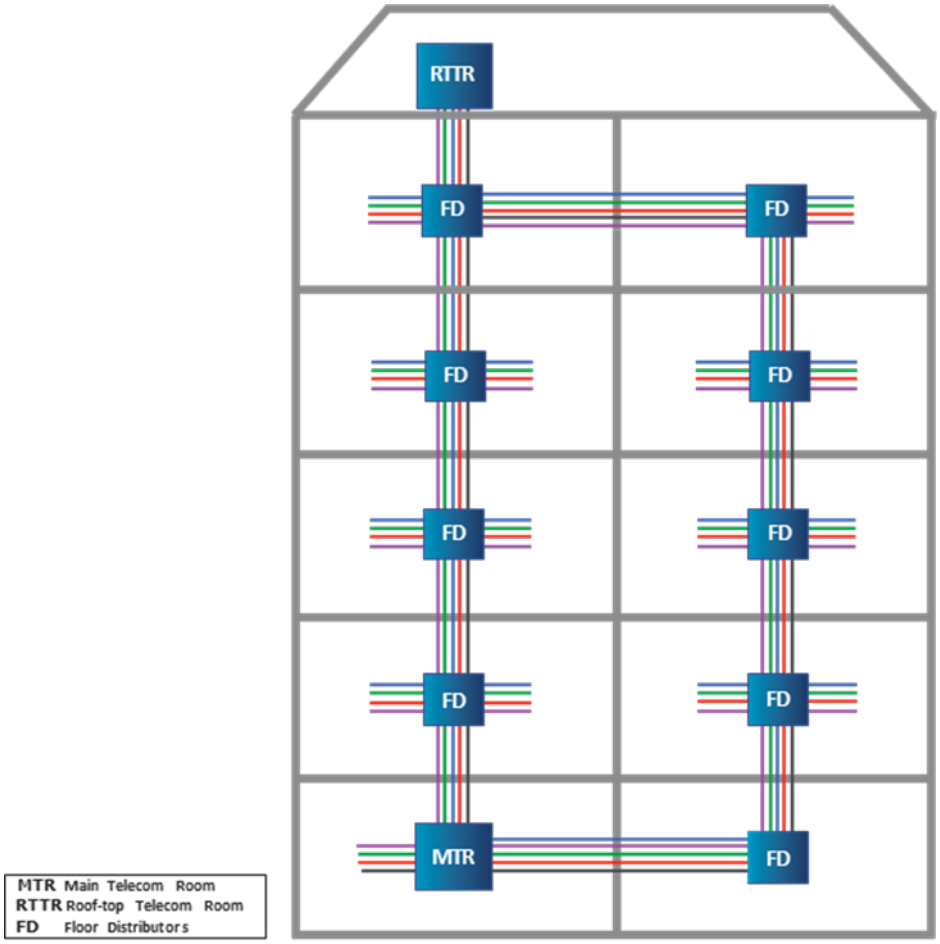
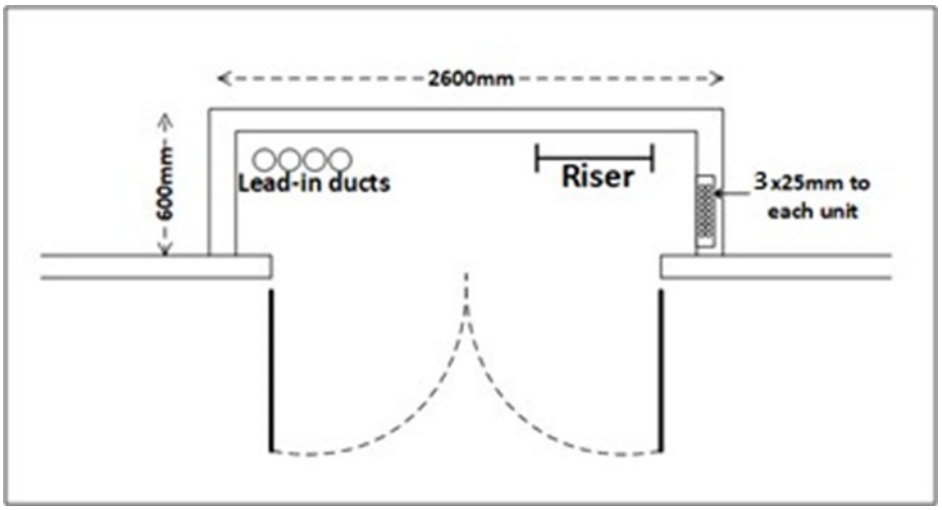


Figure 20. Shallow telecommunication room details for small MDUs



Rooftop telecommunication rooms

Rooftop telecommunication rooms host antenna-based equipment such as radio and television broadcasting (analogue or digital), line-of-sight Internet, fixed wireless access (FWA), IBS, etc. In addition to the main telecommunication room (MTR), rooftop telecommunication rooms (RTTRs) shall be provided on the roof of all multi-tenant buildings higher than five floors, including the ground level, as specified in Table 19.

Table 19. Rooftop telecommunication room sizing requirements

No. of floors	RTTR size (H x W x D)
Up to 5	Not applicable
More than 5	3 x 3 x 3 m
Shopping malls and bulk service buildings	Project requirements-based

The following considerations shall be followed for RTTR construction:

1) The RTTR shall be connected to the building riser through a vertical trunking system/cable tray of at least 300 x 50 mm.
2) Openings with compliant lead-in ducts shall be provided to the room to allow for cables to connect to external radio equipment. These openings must be 600 x 400 mm (W x H), 500 mm below the room ceiling in walls facing the building rooftop area.
3) The RTTR location varies from building to building. In any case, it must have direct access to the vertical trunking system without the need for horizontal trunking.

Space shall be reserved for wireless service equipment on the rooftop of the building. The requirements will vary, but typically comprise radio units and antennas mounted at the edge and corners of the building, or at a raised structure. The exact details must be advised by the applicable service provider(s). This is essentially subject to an agreement between the developer and applicable service providers to establish the exact details, but the above minimum requirements shall be met. All electromechanical specifications shall follow the same requirements as for the standard telecommunication rooms.

Floor distributors

Floor distributors shall be provided on all floors of multi-tenant buildings (regardless of their utilization or building type) for the routing, splicing and termination of telecommunication cables. Depending on the type of building and the number of vertical trunking systems, more than one floor distributor may be needed per floor.

The minimum floor distributor dimensions as well as the number of floor distributors to install will depend on the function and features of each building. Refer to the standard floor distributor sizes as a function of the building area and number of tenants per building in Table 20. (The height will be determined by the floor-to-ceiling distance; 3 metres is given as a reference.)

Table 20. Floor distributor sizing requirements

Building Type	Requirements (H x W x D)
Building with 50 or less tenants or up to 5 storeys or Building area up to 3 000 m^2	0.6 x 1 x 3 m (or as per approved project)
Building with 51 to 100 tenants or up to 10 storeys or Building area up to 7 000 m^2	1 x 1 x 3 m (or as per approved project)
Building with 100 to 300 tenants or building area more than 7 000 m^2	1.5 x 1.5 x 3 m (or as per approved project)
Building with more than 300 Tenants	2 x 2 x 3 m (or as per approved project)
Shopping Mall	To be determined at the building design stage
Bulk Service Buildings – Hotels, Palaces, Government Buildings, Hospitals	To be determined at the building design stage
Group of Warehouses and Factories	To be determined at the building design stage

Floor distributors shall meet the following requirements:

1) They must be provided with doors that open outwards.
2) They shall be located in vertical alignment to the riser area. The space for the floor distributor shall be dry and clean.
3) Each unit distributor on a given floor shall be connected to the floor distributor through the horizontal floor pathway. As a minimum, three services/technologies shall be considered for conduits installation: optical fibre, Ethernet and cable television.
4) A star topology shall be used for the cable ducting on each floor. Looping the horizontal cabling from unit to unit is prohibited.
5) Electromechanical requirements are specified above.

Unit distributors

A unit distributor shall be provided for each customer premises space. The unit distributor is specified to accommodate the requirements of at least two telecommunication operators at the same time.

The unit distribution frame (UDF) may be installed in the unit distributor or integrated into the floor distributor on a single frame consolidating all units' connectivity requirements of a single

floor. Either one is allowed, but not both simultaneously. (Only one patch panel/ODF is allowed at the floor/unit level.)

The minimum specifications are as follows, depending on the customer premises area:

1) Each unit (dwelling or office) shall have a unit distributor installed at a central and accessible location. The unit distributor shall connect each NT inside the unit with a ducting system. Each telecommunication service will have an individual conduit.
2) The distance between the unit distributor to the farthest NT within the unit shall not exceed 90 metres.
3) The conduit pipes and the unit distributor shall be able to handle at least the following services:
    - fibre-optic cables (G657.A1/A2)
    - twisted pair Ethernet cables
    - coaxial cables (75 Ohm resistance)
4) Different ICTs/services shall have segregated, dedicated space inside the unit distributor for smooth operation.
5) The unit distributor shall be concealed in the wall, with the cabinet front flush with the wall, and lockable front door.
6) The unit distributor shall be located in an accessible area inside the customer premises close to the entrance. The kitchen, pantry, washroom, laundry room or bedroom are prohibited for this use.
7) The unit distributor shall be installed at a height of 600 to 1 200 mm, according to site conditions (between the finished floor level and the bottom edge of the cabinet).
8) The unit distributor shall be located with adequate safe working space, lighting and ventilation around it.
9) The unit distributor shall be away from water or heat sources.
10) The unit distributor shall have available space to host a 24-port twisted pair copper cable (UTP) copper patch panel per tenant.
11) The unit distributor shall be equipped with a UDF (ODF) fitted as a minimum with 2 x SC/APC ports per NT.
12) The unit distributor shall provide cable management facilities for UTP and single-mode (SM) fibre patch cables.
13) The unit distributor shall equip sufficient cable entries to accommodate the incoming fibre-optic and UTP cables.
14) The unit distributor shall be labelled with floor/flat numbers.

The unit distributor dimensions will depend on the unit type, size and services to be provided.

Network termination points

1) Each unit (dwelling, office, commercial, etc.) shall have at least four fibre connections to the BDF (MTR). For business customers, a higher number of connections may be designed if demand is expected at the building planning phase.
2) Each residential room (except wet rooms such as bathrooms and laundry rooms) or office room shall be equipped with at least one network termination point (NT) connected with a two-core fibre cable to the UDF.

3) An electrical 240V/16A power outlet shall be made available and collocated with every installed fibre-optic NT.

Pathways

The following stipulations apply for all pathways of MDU buildings:

Vertical pathways:

Vertical risers and pathway systems shall be provided in multi-floor multi-tenant buildings to allow seamless installation of telecommunication cables from the main telecommunication room to each floor and mobile service rooms – i.e. IBS and rooftop rooms.

The riser area shall be able to accommodate at least four connections to each unit distributor. A 15 per cent reserve capacity in the riser area shall be provided for manipulation purposes.

1) Any cables that are installed in the riser area shall be easily replaceable in case of damage or fault. Cables shall be placed in cable risers, conduits, sleeves, tubes, etc.
2) The following principles shall apply:
    - Riser areas shall be accessible at all times.
    - The installations shall be done using the shortest route, and preferably as vertically as possible.
    - Riser areas shall not be located inside units or air shafts.
    - In case the riser hosts conduits, under no circumstances shall the conduit inner diameter be lower than 25 mm.

Hot-dipped galvanized cable trays shall be provided to accommodate the vertical telecommunication backbone of the building, including designated provisioning for wireless IBS cables – such as optical fibre, hybrid, twisted pair copper cable (UTP) and/or coaxial cables – which may be installed during the building construction, or at a later stage.

The vertical cable tray size shall be 450 x 50 mm (W x H, horizontal distribution raceway fitting) inside the building riser, and shall run continuously between all telecommunication rooms and floor distributors. Independent 50 mm inner diameter conduits can be installed inside the trunking systems for service segmentation.

Horizontal pathways:

Horizontal pathways are containment systems to horizontal routing cables inside the building, mostly from the floor distributor(s) to the unit distributors on the same floor.

In general, horizontal pathway systems – i.e. ceiling, perimeter and miscellaneous – must be provided from each floor distributor to all unit distributors on the same floor, with ample provisioning for the building's backbone inside the plant (cabling and equipment). The specific pathway solutions and types are dependent on the building design, characteristics and service requirements, as described below.

Horizontal pathways can use several systems (cable trays, ducts, micro-ducts, etc.), depending on the building type and shape, and the developers' choice. Ducting (conduits) shall preferably be used when:

1) The unit distributor locations are permanent.

2) The cable density is low to medium.
3) Flexibility to modify the routing is not required.

When ducting is the selected solution, the following requirements shall be met:

1) Dedicated 25 mm ducts.
2) Ducts (inner diameter) shall be installed to each unit distributor, one duct per each type of telecommunication service/technology (optical fibre, twisted pair copper cable UTP, coaxial as a minimum).

When a cable tray is the selected option, a 300 x 50 mm (W x H, horizontal distribution raceway fitting) horizontal cable tray shall be installed inside the building corridor accessible ceiling, connecting the floor distributors to the unit distributors, including the branch-off trays for each unit distributor.

Pathways separation from other utilities:

Table 21 shows the minimum separation requirements between telecommunication cables and power cables (sources of EMI exceeding 5 kilovolt-amperes-kVA) and other sources of noise. The table also reflects the separation requirements between metallic cabling and specific electromagnetic interference sources, in addition to the listed requirements in International Electrotechnical Standards Series of IEC 60364 (Electrical Installations of Buildings).

Table 21. Separation from other utilities

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	≈ 1 220 mm
Fluorescent lamps, neon lamps, mercury vapor lamps, high-intensity discharge lamps	≈ 125 mm
Frequency induction heating	≈ 1 000 mm

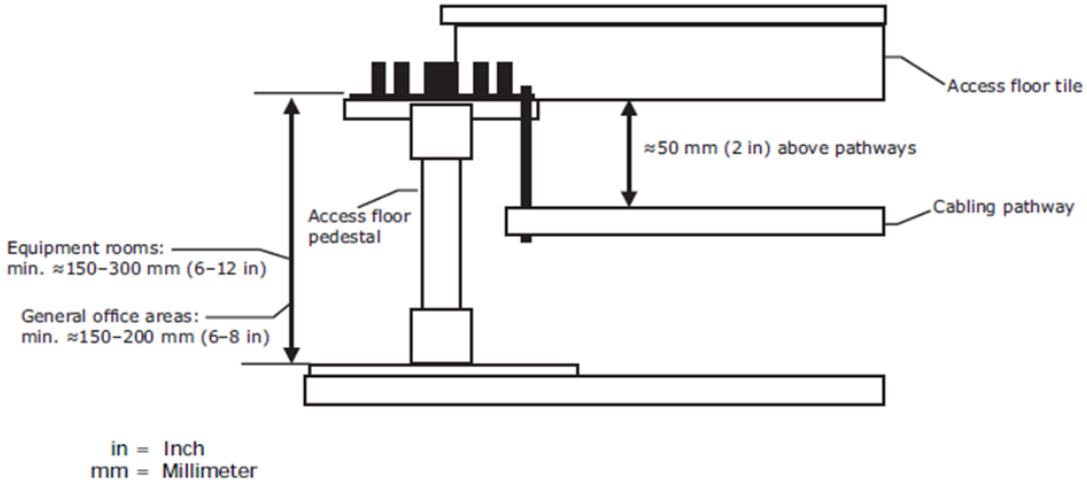
Clearances

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 (such as 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 metre 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 150 mm from the structure slab in the 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 50 mm.

Figure 21. Raised access floor clearance



Source: Building Industry Consulting Service International

Common requirements for all types of MDU buildings

All MDU buildings telecommunication rooms shall comply with the minimum following requirements:

1) Telecommunication rooms shall equip a dedicated air conditioning system (ducted split Fan Coil Units (FCU)) with duty and standby units with proper interlocking to maintain the temperature at 25° C ± 1° C and the relative humidity at 10 per cent ± 50 per cent. The air conditioning system is to be placed over the door.
2) 10 x 240V / 20A designated twin socket distributed on the telecommunication room walls with a dedicated circuit breaker.
3) 1 x AC and DC Earth bars. All metallic parts shall be Earth-bonded with resistance of less than 1 ohm.
4) 2 x 32A three pole (TP) isolator fed with dedicated feeder from essential power supply if required by tenant or communications service provider (CSP.).
5) 1 x handheld CO_2 cylinder extinguisher of minimum 10 kg capacity shall be made available inside the room.
6) Adequate lighting with a minimum of 300 Lux at table level.
7) Telecommunication rooms shall be compliant with the fire and safety requirements – i.e. smoke detectors, fire alarms, emergency lights, etc. – as per local authority standards. Water sprinklers must be avoided. As a minimum, telecommunication rooms shall equip an emergency light, a smoke detector and a fire alarm, in addition to the CO_2 fire extinguisher specified above.
8) The floor load rating of telecommunication rooms shall be no lower than 10 kilonewton (kN)/m2 (distributed load).
9) Telecommunication rooms shall equip light switches near the entrance to the telecommunication space.

10) The suspended ceiling height (if used) should be 3 m. The doors shall open outwards. All MDU buildings floor distributors shall comply with the minimum following requirements:

    A minimum of 4 x 240 V / 20A power sockets with a dedicated circuit breaker shall be provided in the floor distributors. In case high power consumption telecommunication equipment is to be hosted in the floor distributor, as identified during the planning and design phase, the power supply requirements shall be adapted to the specific requirement.

11) All MDU buildings' unit distributors shall comply with the minimum following requirements:

    The unit distributors shall be away from any electrical distribution or bus bars except those distributing power to the unit distributors: A 240 V/16A dual socket inside the unit distributor with a dedicated circuit breaker on the domestic supply is for this exclusive purpose.

Multi-unit building typologies

Multi-unit buildings may adopt a wide variety of shapes and functions, covering all population and service needs. While describing them all is not possible, this section is intended to provide a general classification and graphically illustrate some significant cases.

Horizontal developments

Buildings considered as horizontal developments are structures for residential, commercial, industrial and other utilizations that do not highly elevate from the ground level, such as:

- single dwelling units;
- industrial facilities;
- commercial buildings (malls, shopping centres, exhibition/convention centres, etc.);
- transport Infrastructure facilities (railway stations, airports, seaports, etc.);
- sports facilities (stadiums, halls, pools, parks, fields, etc.).

All these buildings shall meet the specifications and requirements established in previous sections of this document.

Vertical developments

Buildings considered vertical developments are structures for residential, commercial, industrial and other utilizations that considerably elevate from the ground level, such as, but not limited to:

- residential buildings;
- health-care buildings (hospitals, etc.);
- enterprise buildings;
- public services buildings (hotels, etc.).

Examples of the different types of MDU buildings and how the ICT facilities can be added during construction are shown below.

Figure 22. IPI for a small MDU (up to 50 units, five floors)

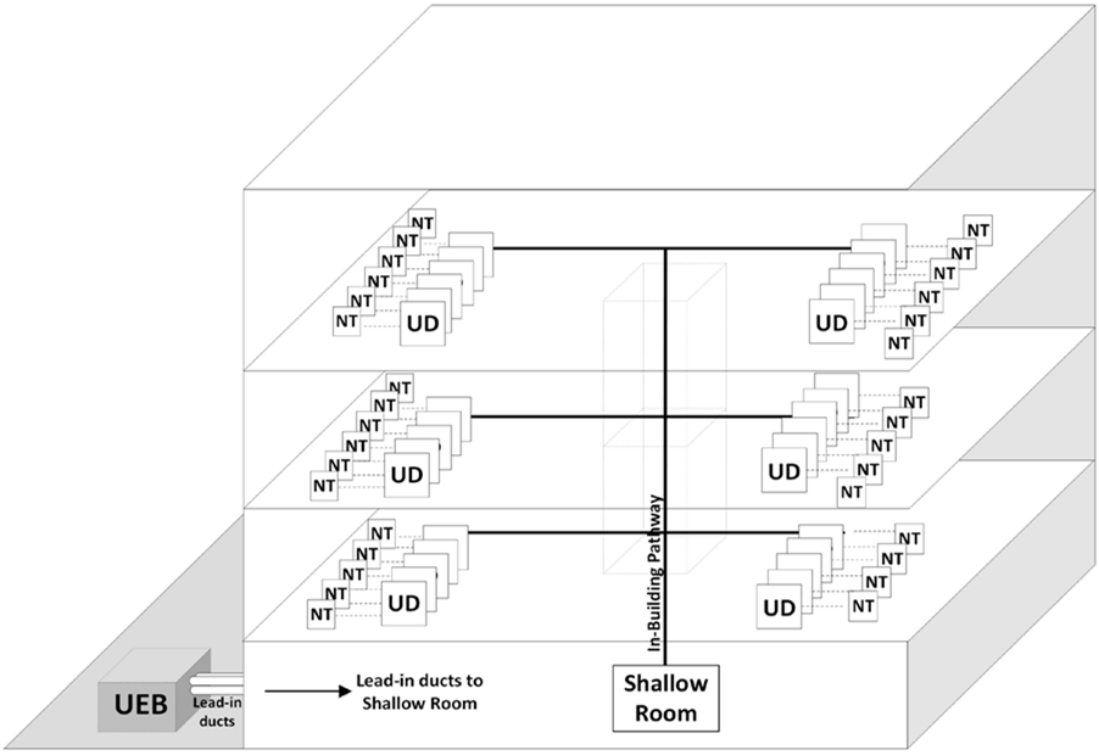


Figure 23. Example of large MDU IPI

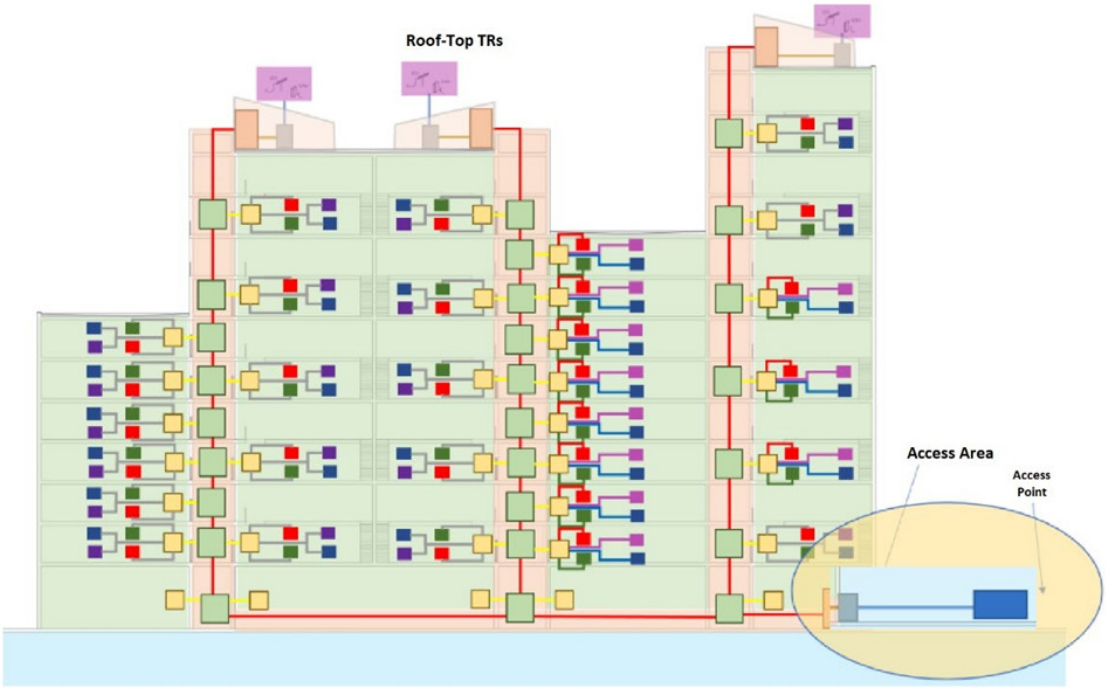


Figure 24. IPI for a high-rise MDU building

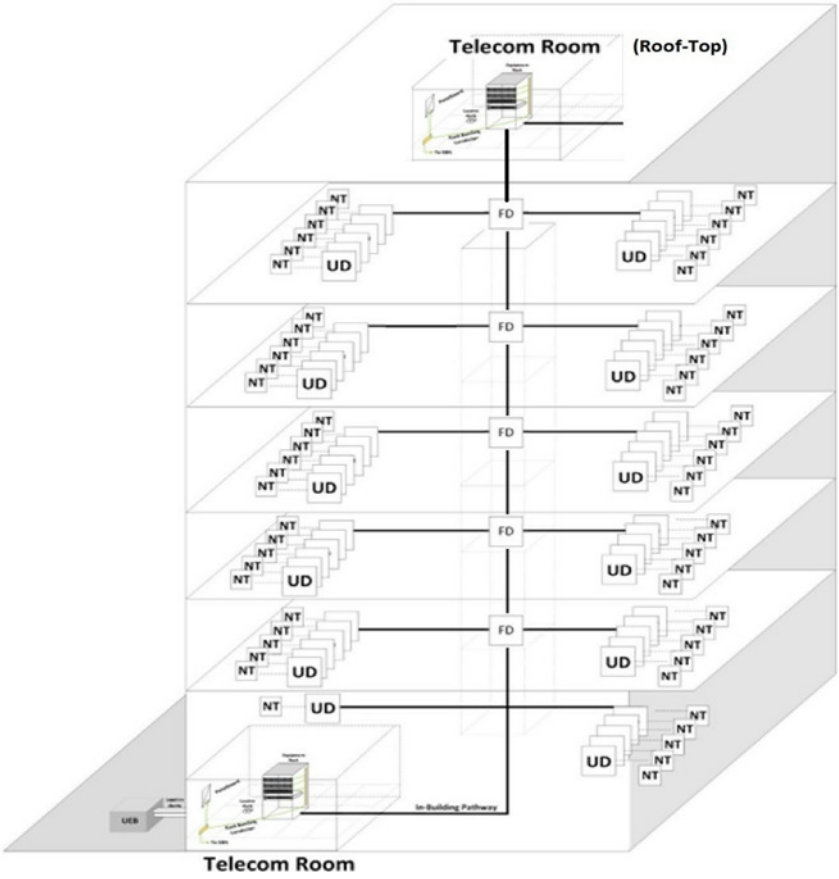
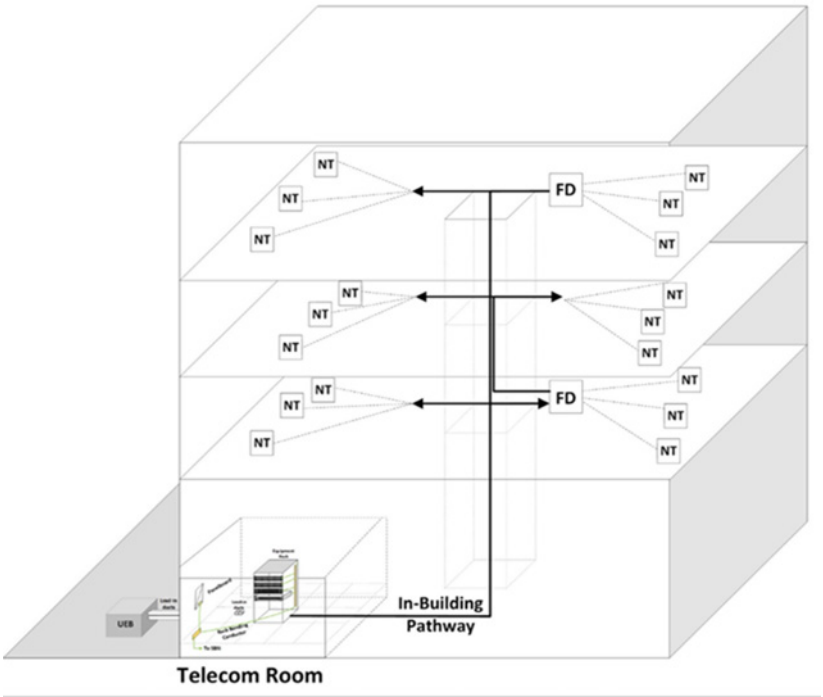


Figure 25. IPI for buildings with open space/bulk services



11 Study recommendations on ICT infrastructure sharing and standards

This study on establishing a common utility infrastructure sharing framework and ICT infrastructure installation standard contributes to implementing activities in line with the Uganda Digital Transformation Roadmap (and Digital Uganda Vision) pillars called "Digital Infrastructure and Connectivity". This study assists the government ministries and agencies to guide the public utility companies and ICT service providers to work together to accelerate the deployment of broadband networks nationwide in a cost-effective and faster implementation approach.

A situation analysis of existing ICT infrastructure deployments highlights the challenges, gaps and opportunities being faced by stakeholders in Uganda In addition, a benchmarking study of specifications and standards in other countries for infrastructure deployments was carried out to highlight best practices and ideas for draft standards for Uganda, and adopt some of their approaches to common utility infrastructure sharing.

This section sets out the key recommendations of this report for consideration and adoption, as tackling these topics will create the enabling environment needed for a common utility infrastructure sharing framework going forward.

1. Updating of regulatory and legal frameworks

The findings of this study point to a need to reinforce the regulatory framework and existing laws governing the key ministries and government agencies to support nationwide broadband deployments. Common utility infrastructure sharing between public and private utility companies and ICT service provider networks is required.

There are amendments needed in existing laws to support the common utility infrastructure initiatives in the country as presented in this report. These include but are not limited to:

- Roads Act, 2019 and UNRA Act, 2006, to include guidance on common utility infrastructure sharing along roads, crossings and bridges.
- Lands Act, 1998, to include broadband in the definition of public works and clarify on right-of-way issues.
- Roads Act, 2019, to clarify on the rules and regulations of using road reserves.
- Physical Planning Act, to add provision of ICT facilities for buildings.

The different line ministries and the regulators also need to develop new regulations, policies and guidelines to support this initiative.

2. Development of an ICT infrastructure sharing standard and a collaboration process/ plan involving all government ministries/agencies and the private sector

There is an urgent need to set up a common utility infrastructure sharing steering committee with representatives from all the key ministries/agencies, UCC and the private sector players. This is due to the finding that all public utilities, government ministries and private sector players involved with national infrastructure projects were all operating independently with little or no collaboration to save investment costs. The proposed steering committee and collaboration/ coordination process would solve this serious problem.

The members of the steering committee should include the Ministry of ICT and National Guidance (Chair); NITA–U; UETCL; Ministry of Works and Transport; UNRA; Ministry of Local Government; Representatives of Municipalities; KCCA; Ministry of Lands, Housing and Urban Development; UCC; NEMA; and broadband service provider representatives.

The committee needs to be given a mandate to finalize the common utility infrastructure sharing framework, the specifications and standards and oversight of initial pilot infrastructure projects where there is harmonious sharing.

3. Establishment of an online common utility infrastructure information portal

The situation analysis notes that there was no central depository of national infrastructure available to the public and private utility companies and ICT service providers to help them in planning their network expansion projects nationwide. Lack of this information results in all the players planning their projects individually, without any consideration of sharing existing facilities. It also leads to one player damaging existing infrastructure while digging out trenches to install their own projects.

What is needed for successful co-deployment of infrastructure is the coordination and cooperation of organizations, including the infrastructure owner of the road transport, energy infrastructure owner, water utility owner and the telecommunication operators, as well as relevant public and private organizations involved in the co-deployment process. To promote coordination and cooperation, the development of a single information portal is strongly recommended.

It is envisaged that the portal will include information about all existing and planned engineering works that could potentially co-deploy fibre-optic cables. From the portal, online representatives of organizations, government agencies, potential investors and telecommunication operators would be able to find partners for the co-deployment of the ICT infrastructure with road transport or energy infrastructure, as well as post their information on priority areas for current investment.

Using this portal, all interested parties would be able to exchange documents, make changes and receive information on the status of the fulfilment of certain requests, as well as access and use the methodologies and tools developed in this toolkit. This proposed single information portal could potentially increase competitiveness and provide access to relevant information based on equality and transparency, which in turn would minimize corruption.

4. Finalization of ICT infrastructure specification and standard

The Ministry of ICT and National Guidance is to finalize the ICT Infrastructure Specification and Standard, sharing it with other ministries, departments and agencies, and local government authorities. This was called out during discussions with officials of other government ministries, agencies and local government administrations, as recorded in the situation analysis section of this report.

5. Creation and use of a national GIS (Geographic Information System) platform in Uganda will have many benefits

A national GIS will enable the Ugandan Government to systematically plan and execute national utility infrastructure projects more efficiently. This was pointed out during the situation analysis as a missing tool that is being used in most countries to coordinate national infrastructure projects. The national GIS project has already been discussed by various stakeholders but has not yet been funded as a national priority.

6. Public awareness programmes and campaigns to local authorities and general public

Public awareness is necessary to ensure that the criticality of fibre-optic cable infrastructure to the economy of the country is well known. In addition, people need to be informed that infrastructure vandalism threatens both national security and telecommunication services and be made aware of the legal consequences for causing service outages. The government, through the Ministry of ICT and National Guidance, could also carry out public awareness programmes to support broadband network expansion across the country and solicit the support of all citizens by emphasizing the benefits to them from these projects.

It was noted during the research that the general public was not always supportive of some of the construction work being done to increase ICT broadband access, because they were not informed in advance of these projects.

7. Requirements for ICT infrastructure should be mandatory for planned new public buildings in the country

The responsible Ministry of Lands, Housing and Urban Development and the local authorities should consider this before new public building plans are approved for construction.

The Digital Transformation Roadmap 2023/2024–2027/2028 pillar of Digital Infrastructure and Connectivity calls for broadband access and connectivity for all. This is not limited to building up broadband access networks to the buildings, but includes easy access within buildings, especially government and special public buildings accessed by those who need Internet access. It is critical that the building owners include provisions for ICT facilities during the planning and construction phase, which is more cost-effective than adding ICT facilities after building completion.

References

(1) Republic of Korea, *Consultation on Legislation for Broadband Deployment in Uganda 2019,* Report by the Korea Information Society Development Institute, sponsored by the Ministry of Science and ICT.

(2) Doreen Gift Bujjingo, *Activity report: Assessment of roll-out strategies and plans of utility infrastructure (works and transport) for the coordinated roll-out of ICT infrastructure and services,* Department of ICT Infrastructure Development, Ministry of ICT and National Guidance (October 2023).

(3) Irene Karungi Sekitoleko, *Activity Report: Assessment of roll-out strategies and plans of utility infrastructure for the coordinated roll-out of ICT infrastructure and services,* Department of ICT Infrastructure Development, Ministry of ICT and National Guidance (February 2024).

(4) Doreen Gift Bujjingo, *Activity Report: Assessment of roll-out strategies and plans of utility infrastructure (for selected districts) for the coordinated roll-out of ICT infrastructure and services (Mbarara and Masaka Cities),* Department of ICT Infrastructure Development, Ministry of ICT and National Guidance (October 2023).

(5) Irene Karungi Sekitoleko, *Activity Report: Ministry of ICT and National Guidance Implementation of Cross-sector Infrastructure Sharing with Utility Providers, December,* Department of ICT Infrastructure Development, Ministry of ICT and National Guidance (2020).

(6) Rwanda Utilities Regulatory Authority (RURA), *Guidelines for Fibre Optic Cables Underground Installation* (2013).

(7) Saudi Arabia Communication Space and Technology Commission, *ICT Construction Guidelines* (June 2022).

(8) Kenya ICT Authority, *Fibre Optic-Backbone, Metro and Last Mile Infrastructure Standard,* 1st ed. (2022).

(9) United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), *Toolkit for ICT Infrastructure Co-Deployment with Road Transport and Energy Infrastructure, Part II* (March 2020).

(10) Saudi Arabia Communication, Space and Technology, *Annex A Technical Standards for Outside Plant (OSP) Installations.*

(11) Li Yanting, China Academy of Information and Communications Technology, *Cross-Sector Co-deployment of ICT Infrastructure with other Sectors in China* (November 2018). Available at www.unescap.org/sites/default/files/f_Ms%20Yanting%20Li.pdf.

(12) Doreen Gift Bujjingo, *Activity report: Frameworks for ICT Infrastructure Development,* Department of ICT Infrastructure Development, Ministry of ICT and National Guidance (April 2024).

(13) Uganda Ministry of Lands, Housing and Urban Development, *National Physical Planning Standards and Guidelines* (2011). Available at https://mlhud.go.ug/wp-content/uploads/2015/10/National-Physical-Planning-Standards-and-Guidelines_-2011.pdf.

(14) Uganda National Broadband Policy 2018 Document – section on infrastructure sharing.

(15) Uganda National Road Authority (UNRA), *Kampala-Jinja Expressway Phase ESIA Report*. Available at https://esa.afdb.org/sites/default/files/KJEXP1775_Ph1_Volume%20B%20ESIA%20Report_Rev2_corrected.pdf .

(16) NITA-U, *ESIA – Environmental and Social Impact Assessment for the Implementation of the Missing Links on the National Data Transmission Backbone Infrastructure*. Available at https://nema.go.ug/sites/default/files/ESIA_Public%20Disclosure%20Final%20Copy.pdf.

(17) ITU Publications, *Telecommunications/ICTs for rural and remote areas: Output Report on ITU-D Question 5/1 for the study period 2018-2021*. Available at www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG01.05.1-2021-PDF-E.pdf.

(18) Uganda Ministry of ICT and National Guidance, *National Broadband Baseline and Infrastructure Blueprint 2022-2032*. Available at https://ict.go.ug/wp-content/uploads/2022/01/Uganda-Broadband-Baseline-and-Infrastructure-Blueprint-Draft-2.pdf.

(19) Uganda Ministry of ICT and National Guidance, Digital Transformation Roadmap 2023/2024–2027/2028. Available at https://ict.go.ug/wp-content/uploads/2023/09/Digital-Transformation-Roadmap-2023-1.pdf .

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