Feasibility Study to Connect All African Higher Education Institutions to High-speed Internet

Report 2:
Annex 1
Burkina Faso Country Case Study Report

DIGITAL DEVELOPMENT PARTNERSHIP

Administered by WORLD BANK GROUP

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Abbreviations

Term	Description
AAU	Association of African Universities
ADB	African Development Bank
AFD	Agence Française de Développement
ANPTIC	Agence Nationale de Promotion des Technologies de l'Information et de la Communication
ANVAR	National Agency for the Valuation of the Results of Research
ARCEP	Autorité de Régulation des Communications Electroniques et de la Poste
ASN	Autonomous System Number
AUC	African Union Commission
BAC	Baccalauréat
BEP	Brevet d'Études Professionnelles
BEPC	Brevet d'Études du Premier Cycle
BFIX	Burkina Faso Internet Exchange Point
BID	Banque Islamique de Développement
CAMES	African and Malagasy Higher Education (Conseil Africain et Malgache pour L'Enseignement Supérieur)
CAP	Country Action Plan
CapEx	Capital Expenditures
CEPE	Certificat d'Études Primaires Élémentaires
COVID-19	Coronavirus Disease 2019
DE4A	Digital Economy for Africa initiative
DGAP	General Directorate of Postal Activities
DGDI	Directorate-General for the Development of the Digital Industry
DGICE	General Directorate of Electronic Telecommunications Infrastructures
DGRSI	Direction Générale de la Recherche Scientifique et de innovation
DGTIC	General Directorate of ICT
DIN	Digital Industry Directorate
DNS	Domain Name System
DRCE	Directorate of Electronic Communications Regulation

Term	Description
DS4DE4A	Digital Skills for Digital Economy in Africa
ECOWAS	Economic Community for West African States
Gbps	Gigabits per second
ICT	Information and Communications Technology
IESR	Institution d'Enseignement Supérieur et de Recherche
INSD	National Institute of Statistics and Demography
ISP	Internet Service Provider
ITU	International Telecommunication Union
IXP	Internet eXchange Point
KCL	Knowledge Consulting Ltd
Mbps	Megabits per Second
MDAs	Ministries, Departments and Agencies of Government
MDENP	Ministry of Digital Economy Development and Posts
MENAPLN	Ministère de L'Education Nationale, de l'Alphabétisation et de la Promotion des Langues Nationales
MESRSI	Ministère de l'Enseignement Supérieur, de la Recherche Scientifique et de l'Innovation
NREN	National Research and Education Network
NSRC	Network Startup Resource Center
PADTIC	ICT Development Support Project
PBNT	National Telecommunications Backbone Project
PRICAO-BF	West Africa-Burkina Faso Regional Communication Infrastructure Project
PSEF	Programme sectoriel de l'éducation et de la formation - PSEF
RESINA	RESeau Informatique National de l'Administration
SDAN	Schéma Directeur d'Aménagement du Numérique
SN@DEN	Stratégie Nationale de Développement du Numérique
SNRSI	National System of Scientific Research and Innovation
UEMOA	West African Economic and Monetary Union
UV-BF	Virtual University of Burkina Faso
VAS	Value Added Services
VLP	Virtual Landing Point

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3	Ministère de l'Enseignement Supérieur, de la Recherche Scientifique et de l'Innovation	Mr Yacouba Ouattara
4	Nazi-Boni University	Mr Telesphore Tiendrebeogo
5	University of Ouagadougou II	Dr inoussa Traore
6	WACREN	Dr Boubakar Barry

Executive Summary

As part of the Digital Economy for Africa (DE4A[1]) initiative, the World Bank commissioned a feasibility study to develop an operational roadmap to connect all African higher education institutions (HEIs) to high-speed Internet. The initiative, in support of the African Union Digital Transformation Strategy for Africa (2020-2030)[2], aims to digitally enable every African individual, business, and government by 2030. Connecting universities and research institutions is crucial for expanding the opportunities for teaching, learning and innovation to foster relevant digital skills on the continent. This study has received funding from the Digital Development Partnership (DDP)[3].

This Case Study, one of four conducted to provide background information to the study, along with Côte d'Ivoire, Mozambique and Uganda, explores the connectivity challenge from a higher education[4] perspective (demand-side) as well as from the information and communication technology (ICT)-sector perspective (supply-side) in Burkina Faso.

The connectivity target is to achieve at least 2 Gbps per 1000 students by 2025 (to be provided for in the World Bank planning period ending 2023) and at least 20 Gbps per 1,000 students by 2030. Given a forecast enrolment of 221,000 higher education students in 2025, higher education institutions in Burkina Faso will need at least 442 Gbps to serve the bandwidth requirements of higher education institutions across the country. This will rise to 297,000 students and 6 Tbps of bandwidth in 2030. To put these numbers into perspective, higher education enrolment in Burkina Faso grew from 51,166 students in 2010 to 132,569 students in 2019. Despite the growth in student enrolment, the Gross Enrolment Ratio for higher education in Burkina Faso was only 7.1% in 2019, below the estimated average for sub-Saharan Africa of 9.4%, and far below the world average of 38.8% for the same year. In 2020, FasoREN was working to access an STM1 (155 Mbps) from WACREN for higher education students. This would result in a bandwidth ratio of 1.1 Mbps per 1,000 students.

As summarised in the table below, the overall total cost of connecting higher education institutions in Burkina Faso to high-speed broadband is USD 455 million over a period of five years (2021-2025). This includes the expense of providing devices to students and staff (USD 67 million), the cost of upgrading and maintaining campus networks (USD 343 million)—the major cost, core support to FasoREN (USD 10 million) and bandwidth cost for upstream connectivity with aggregation savings and upfront IRU purchases (USD 35 million). The potential savings on bandwidth cost in Burkina Faso from demand aggregation, smart procurement strategies (e.g., benchmarking regional pricing) and procuring long-term leases are estimated at 39%.

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1   *See https://www.worldbank.org/en/programs/all-africa-digital-transformation.*
2   *https://au.int/en/documents/20200518/digital-transformation-strategy-africa-2020-2030.*
3   *https://www.worldbank.org/en/programs/digital-development-partnership.*
4   *We use the term Higher Education, also known as Tertiary Education in some countries, to refer to all post-secondary education, including both public and private universities, colleges, technical training institutes, and vocational schools https://www.worldbank.org/en/topic/tertiaryeducation*

Category	Cost over 2021-25 (USD, millions)	Potential Sources of Funding
End-user devices		
Students and Staff devices	67	Government, development partners, students, institutions
Sub Total	**67**	
Upgrading campus networks		
Capex	148	Government, development partners
Opex (Cumulative)	194	Institutions, government, development partners
Sub Total	**343**	
5-year cost of connecting campuses upstream		
	With Aggregation Savings	
Using Student Enrolment & Regional Price	**35**	Development partners, institutions, students
NREN development and support costs		
FasoREN core costs and NREN development related costs	**10**	Development partners, government
Total Cost Estimate (USD, millions)	**455**	**Using cost of connecting campuses upstream based on student enrolment and regional price**

Source: KCL calculations

Burkina Faso considers the education sector as a critical player in its development priorities. The country has two major sector-wide programs designed to transform the entire education sector and translate into action the national ambition to set education and training as an integral part of the government priorities defined in its Accelerated Growth and Sustainable Development Strategy (SCADD). The first—the Education and Training Sector Plan (Plan Sectoriel de l'Education et de la Formation or PSEF, 2017-2030) focuses on primary and secondary education while the second—the National Development Action Plan for Higher Education (Plan National d'Action de Développement de l'Enseignement Supérieur or PNADES, 2014-2023) focuses on higher education.

The higher education sector in Burkina Faso comprises 18 accredited universities (10 public and 8 private) and 75 Grandes Écoles (23 public and 52 private). The Joseph Ki-Zerbo University (Former University of Ouagadougou), the Nazi-Boni University (former Polytechnic University of Bobo-Dioulasso) and the Norbert Zongo University (Former University of Koudougou) are the main public universities; and Université Catholique de l'Afrique de l'Ouest, Université Aube-Nouvelle (Ex ISIG), and the Catholic Université Saint-Thomas-d'Aquin

are the main private universities. Student enrolment in higher education in 2020 was estimated at 145,000 students, with the Joseph Ki-Zerbo University, the largest higher education institution, accounting for over 50% of total enrolment. Private sector participation in providing higher education has been improving, currently accounting for about 21% of the total enrolment.

Despite the progress, Burkina Faso still faces many challenges in expanding access to higher education, including insufficient investment to cope with a rapid increase in students' number, resulting in inadequate infrastructure and learning resources, poor quality teachers, high student-teacher ratios, outdated curricula, and teaching methodology, high failure rates and repetition, particularly in the first years of university education, low relevance of programs in relation to employment outcomes and frequent student strikes reducing lecture time and learning. Besides, the schooling of students in areas with security challenges was problematic.

Connectivity at all levels of education is still a major challenge. Joseph Ki-Zerbo University, with about 70,000 students, provides only 34 Mbps to its users. Only the academic and administrative staff at the University use the connectivity. Students have to buy their connectivity from commercial providers that have coverage around the campus.

From an education sector perspective, some of the challenges that inhibit the use of ICTs in higher education and better connectivity include:

    i. Students are not allowed to access the limited connectivity available at higher education institutions. Even in the capital city, none of the universities interviewed offers Internet access to their students. Universities provide limited connectivity to administrative staff and sometimes to academic staff and researchers.

    ii. Lack of ICT infrastructure in higher education institutions (electricity, computers, multimedia rooms, networks), particularly in rural areas, is compounded by a lack of ICT procurement strategies as well as expertise.

    iii. The nascent national research and education network, FasoREN, does not provide any services yet. Each university/institution still buys their Internet capacity directly from the ISPs, mainly Onatel, the incumbent operator.

    iv. The cost for Internet bandwidth is high and thus prohibitive. On Onatel's website, the cost of 2 Mbps per month is 2 million XOF (about USD 1,800), while the price of 20 Mbps per month is USD 10,000.

    v. Low digital literacy among teachers because current teacher training and in-service training programs do not provide ICT training.

    vi. Lack of dedicated, competent ICT human resource.

In line with the regional frameworks of ECOWAS and UEMOA, Burkina Faso has liberalised its telecommunication market and has an independent regulator— L'Autorité de Régulation des

Communications Electroniques et des Postes (ARCEP). Despite this, the market remains a duopoly between Onatel, the incumbent operator and Orange. Broadband prices remain very high, and broadband access is still restricted to the major urban centres of Bobo-Dioulasso and Ouagadougou.

Other pillars of the institutional framework supporting the development of the sector include the Ministry of Digital Economy and Posts (Ministère du Développement de l'Economie Numérique et des Postes or MDENP) in charge of ICT Policy and the National Agency for the Promotion of ICT (Agence Nationale de Promotion des Technologies de l'Information et de la Communication or ANPTIC) responsible for the development e-government in the country.

With the WARCIP Project (Additional Funding P122402), Burkina Faso invested in creating Burkina Faso Internet Exchange Point (IXP) in Bobo-Dioulasso to provide a mechanism for local providers to aggregate and exchange traffic. It has also created two Virtual Landing Points (VLPs), one in Ouagadougou and a more recent one in Bobo-Dioulasso. The country however still lacks a carrier-neutral data centre to facilitate its digital ecosystem.

From a sector perspective, some of the challenges that inhibit the use of ICTs in higher education and better connectivity include:

i.   Inadequate development and deployment of ICT infrastructure to cover the whole country, particularly rural under/unserved areas;

ii. The high tax burden on ICT services, e.g., VAT, communications tax, tax on mobile money transfers, tax on provider revenues, etc. Providers pass on these taxes to customers in the form of high prices;

iii. High wholesale and retail price for broadband services; and

iv. Inadequate numbers of qualified human resources to support ICT networks and applications.

The COVID-19 pandemic has shown that higher education needs to shift from traditional learning to blended and online learning models. While the country has made considerable progress in reforming the communication sector and developing national broadband strategies to improve high-speed connectivity, there is a need to invest more resources to improve digital technology integration in teaching, learning, and research. This will require upgrading of the campus networks, improving access to devices for students and staff and availing more bandwidth to higher education institutions.

The government and other stakeholders need to support FasoREN to become a more viable NREN that can access large volumes of bandwidth via the Virtual Landing Points (VLPs) and distribute this to members leveraging existing fibre networks. There is need to strengthen the digital ecosystem to attract investment in carrier-neutral data centres and to integrate these with the Burkina Faso Internet Exchange Point (BFIX). This study offers easily configurable tools to estimate the capital and operational costs to achieve the targeted objectives.

1.   Introduction

Burkina Faso considers the education sector a critical player in its development priorities. The higher education[5] sector, which comprised 18 accredited universities (10 public and 8 private) and 75 Grandes Écoles (23 public and 52 private) in 2020, is expected to play an important role in education and training to support the country's priority education outcomes by 2030.

Digital technologies provide opportunities for addressing the challenges facing higher education — growing demand for higher education, falling quality, the mismatch between education and employability and disconnection between research and development challenges. Higher education institutions in Burkina Faso lack adequate bandwidth to meet their research and education needs because the available broadband is expensive and insufficient to address their needs.

As part of the Digital Economy for Africa (DE4A[6]) initiative, the World Bank commissioned a study to develop an operational roadmap to connect all African HEIs to high-speed Internet. The initiative, in support of the African Union Digital Transformation Strategy for Africa (2020-2030)[7], aims to digitally enable every African individual, business, and government by 2030. Connecting universities and research institutions is crucial for expanding the opportunities for teaching, learning and innovation to foster relevant digital skills on the continent.

As part of the feasibility study, this report provides a detailed country-level assessment to connect all HEIs in Burkina Faso to high-speed Internet.

Following the Introduction in Chapter 1, the report provides a country overview in Chapter 2 to provide the national context. The connectivity gap has both a supply-side and a demand-side: Chapter 3 explores the demand-side, focusing on ICT in the education sector and the challenges impacting the use of information and communication technologies for teaching, learning, and research—creating the pull factors; and Chapter 4 examines the supply-side, the ICT sector's key components and the challenges affecting high-speed connectivity. Burkina Faso's nascent National Research and Education Network (NREN), FasoREN is the higher education response created to close the gap between the demand-side and the supply-side, and Chapter 5 presents a high-level summary of the status of this NREN as well as its achievements and limitation in delivering high-speed connectivity to HEIs. Drawing on findings from the earlier chapters, Chapter 6 discusses the cost of connecting all higher education institutions in Burkina Faso to high-speed Internet. A summary is given in Chapter 7, followed by the Appendices.

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5   *We use the term Higher Education, also known as Tertiary Education in some countries, to refer to all post-secondary education, including both public and private universities, colleges, technical training institutes, and vocational schools https://www.worldbank.org/en/topic/tertiaryeducation*

6   *See https://www.worldbank.org/en/programs/all-africa-digital-transformation.*

7   *https://au.int/en/documents/20200518/digital-transformation-strategy-africa-2020-2030.*

2. Country Overview

Burkina Faso is a landlocked, West African country. It covers an area of around 274,200 square kilometres and is part of the Sub-Saharan region. According to the United Nations projections, Burkina Faso's population was 20.9 million for 2020 and is expected to grow to 24 and 27.4 million respectively by 2025 and 2030.[8] Nearly 70% of the population lives in rural areas.

Source: UN Department of Field Support

Figure 1: Administrative Map of Burkina Faso

The two largest cities are Ouagadougou, the capital city, and Bobo-Dioulasso, shown in Figure 1, with 1.8 million and 537,728 people, respectively. Aside from these two urban centres, there are no other cities or towns with populations over 100,000. Most of the population is located in the centre and the south of the country, with a density that goes over 48 people per square kilometre in some areas. Burkina Faso is divided into 13 regions highlighted in Figure 1, which comprise 45 provinces, subdivided into 351 administrative departments. 96% of the

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higher education institutions are located around the Centre and Hauts-Bassins regions.[9]

Burkina Faso was a stable country until 2014 when a popular uprising overthrew its Head of State. A humanitarian crisis followed the political crisis, compounded by instability in neighbouring Mali with armed conflicts and waves of increasing jihadist attacks.

Burkina Faso's literacy rate for 2018 was 41.2% of the population aged 15 years and older, a 6.6% increase from 2014.[10] The primary and secondary schools' gross enrolment rates are increasing and reached 94.5% and 41.3%, respectively, in 2019. The student population in the higher education institutions grew from 51,166 students in 2010 to 132,569 students in 2019. Despite the growth in student enrolment, the Gross Enrolment Ratio for higher education in Burkina Faso was only 7.1% in 2019, below the estimated average for sub-Saharan Africa of 9.4% and far below the world average of 38.8% for the same year.[11] Higher education student enrolment was estimated at 145,816 in 2020 and projected to reach 213,212 students in 2025 and 280,608 in 2030. This implies that the number of students entering higher education remains very low.[12]

The country has designed clear development plans for all levels of education and has put a lot of effort into developing strategies for boosting national connectivity. The Digital Development Master Plan (Schéma Directeur d'Aménagement du Numérique or SDAN), which was adopted in 2018, set out goals to extend the country's fibre backbone by 2030, as indicated in Figure 2.

Though connecting the universities and providing broadband connectivity is part of the action plans, progress is slow. FasoREN, the National Research and Education Network (NREN) has connected the Joseph Ki-Zerbo University to the West and Central African Research and Education Network (WACREN) through the AfricaConnect2 project. Burkina Faso has endorsed the AfricaConnect2 project and contributed to connecting its higher education institutions to the global research and education network. The AfricaConnect2 will bring a capacity of 155 Mbps to the largest University in Burkina Faso.

The current higher education connectivity is mainly through communication service providers. Each University buys bandwidth (less than 4 Mbps in all cases) directly from an Internet Service Provider (ISP) at a very high cost. Based on the ISP's website, 2 Mbps cost 2 million XOF (about USD 1,800) per month and 20 Mbps retail at USD 10,000.[13] Based on recommended Progressive Bandwidth Targets for African HEIs, Burkina needs about 29 Gbps in 2020 based on current student enrolment (or 0.2 Gbps per 1,000 students). Such bandwidth will be costly without the development of FasoREN that can help aggregate demand higher education institutions and negotiate for more competitive prices.

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9   *Annuaire Statistique de l'Enseignement Superieur 2017/2018*
10 *http://uis.unesco.org/en/country/bf*
11 *https://data.worldbank.org/indicator/SE.TER.ENRR?locations=BF*
12 *http://uis.unesco.org/en/country/bf*
13 *http://www.onatel.bf/ (accessed November, 2020).*
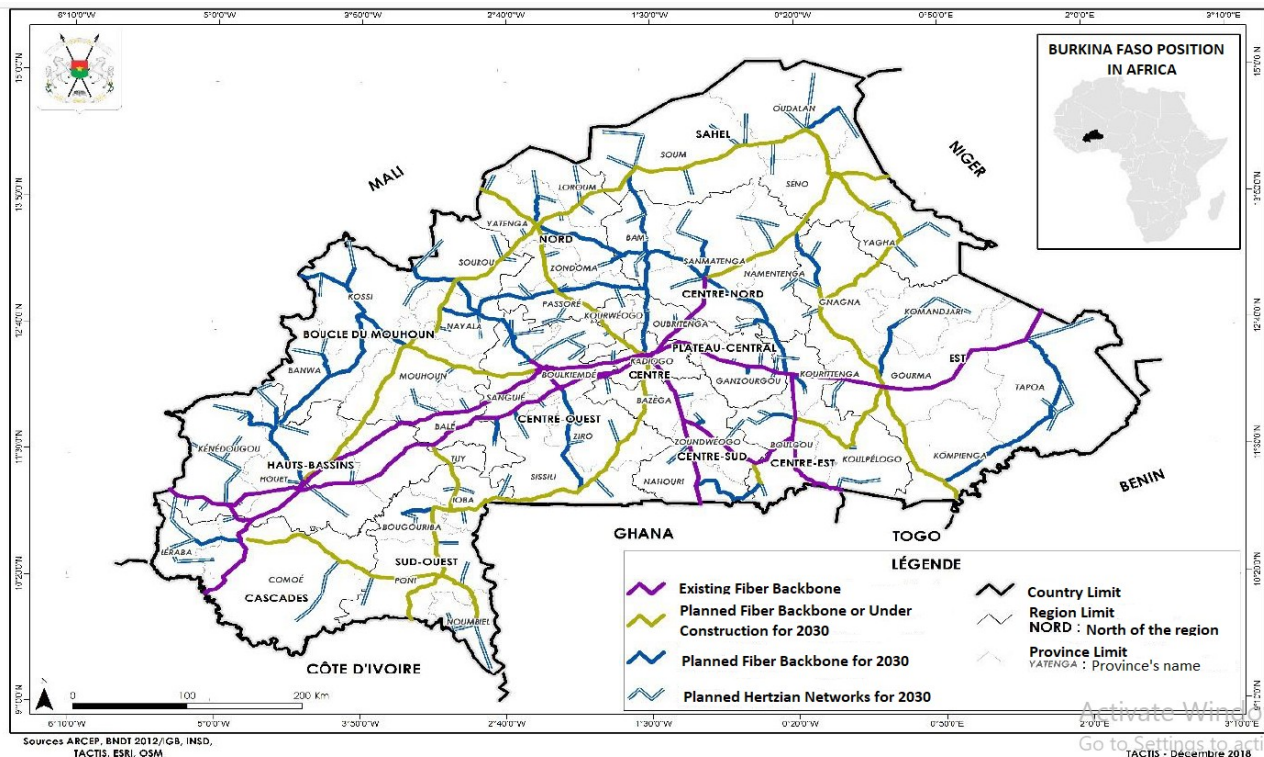
Figure 2: Existing and Planned Fibre Networks in Burkina Faso

Source: ARECEP

Burkina Faso's economy is largely based on agriculture, which employs close to 80% of the working population. Economic growth has been improving with a 4 to 6% GDP growth over the last ten years. The country faces many development challenges, particularly in terms of health and education. It ranks 144th among 157 countries in the 2020 human capital index.[14]

It is evident that Burkina Faso is an example of a country where a lot needs to be done to address the broadband gaps, as explored further in the following chapters.

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14   *World Bank, Burkina Faso Country Overview, https://www.worldbank.org/en/country/burkinafaso/overview*

3. Demand Side—the Education Sector

The higher education sector in Burkina Faso comprises public and private universities. There are 10 public universities, 8 private universities, and 23 public Grandes écoles in 2019. The Joseph Ki-Zerbo University (Former University of Ouagadougou), the Nazi-Boni University (former Polytechnic University of Bobo-Dioulasso) and the Norbert Zongo University (Former University of Koudougou) are the main public universities. The Joseph Ki-Zerbo University is the largest higher education institution, accounting for over 50% of all student enrolment, with over 70,000 students. The other universities have less than 10,000 students. The private sector's participation has been improving, currently accounting for about 21% of the total higher education enrolment in 2019. The main actors in the private higher education space include Université Catholique de l'Afrique de l'Ouest, Université Libre de Ouagadougou, and the Catholic Université Saint-Thomas-d'Aquin.

3.1 Education Sector Policy and Governance

The higher education sector falls under the Ministry of Higher Education, Scientific Research, and Innovation (Ministère de l'Enseignement Supérieur, de la Recherche Scientifique et de l'Innovation or MESRSI), which is responsible for determining the policies and direction of the higher education system in Burkina Faso. The Francophone Council for African and Malagasy Higher Education (Conseil Africain et Malgache pour l'Enseignement Supérieur or CAMES) sets standards for curriculum and faculty.

The management of TVETs, on the other hand involves multiple parties. Since 2011, the direction and management of TVETs have been assigned to the Ministry of Youth and Promotion of Youth Entrepreneurship (Ministère de la Jeunesse et de la Promotion de l'Entrepreneuriat des Jeunes or MJPEJ).[15] However, part of technical and vocational education is supervised by the Ministry of National Education and Literacy (MENA). Besides, various ministries maintain their training institutions. The MJPEJ works through several public structures, such as the National Employment Agency (Agence Nationale Pour l'Emploi or ANPE), the National Employment and Vocational Training Observatory (ONEF) and the Support Fund for Vocational Training and Apprenticeship (FAFPA). Employers' and workers' organisations participate in TVET governance through the National Certification Commission (CNC), responsible for recognizing vocational qualifications gained by graduates from various training centres.[16]

3.1.1 Key Policies and Regulations

The country developed two global programs that govern the entire education sector and

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15 https://www.jeunesse.gov.bf/accueil
16 ILO, the Skill System in Burkina Faso, https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/genericdocument/wcms_742218.pdf

translate into actions the national ambition to set education and training as an integral part of the priorities defined by the government in the Accelerated Growth and Sustainable Development Strategy (SCADD):

i. The Education and Training Sector Plan (Plan Sectoriel de l'Education et de la Formation or PSEF) — 2017-2030, which was submitted to the Global Partnership for Education, with USD 33.8 Million from AFD for the period 2018-2022. The plan sets out the main policies adopted for the development of basic[17] and secondary education. The PSEF is implemented through medium-term operational documents, the Multi-annual Action Program (PAP) 2017-2020, and its budgetary framework, which organises in detail the first implementation phase. This is led by the Ministry of National Education and Alphabetisation (Ministère de L'Education Nationale, de l'Alphabétisation et de la Promotion des Langues Nationales or MENAPLN), whose responsibilities were extended in early 2016 to all general education in preschool to secondary school, technical and vocational education, and non-formal education. For planning purposes, the monitoring and evaluation of the PSEF will be supported by adapting an Education Statistics and Management Information System (EMIS). The PSEF provides a framework for achieving priority education outcomes by 2030, emphasising adapting higher education to the needs of the economy and strengthening overall governance to ensure that resources are translated into tangible results.

ii. The National Development Action Plan for Higher Education (Plan National d'Action de Développement de l'Enseignement Supérieur or PNADES) is another policy document covering the 2014 – 2023 period. The aim is to sustainably resolve the difficulties facing higher education, and create a national education investment agency to accelerate the necessary reforms. It constitutes the reference for the programming, monitoring, and evaluation of programs and actions undertaken over 2014 – 2023.

3.1.2 Key Regulatory and Standards Institutions

The Ministry of Higher Education, Scientific Research, and Innovation (MESRSI)[18] is the key institution regulating the higher education sector. It sets the standards, provides technical guidance, monitors and evaluates higher education and research policy, and regulates the higher education and research sectors. It is composed of 10 main directorates, of which the Directorate of Higher Education and Scientific Research Information Systems directly oversees higher education and research.

Other relevant governmental agencies include:

• The High National Council for Scientific Research and Innovation (HCNRI)—hosted by the Prime Minister, with the Minister of Higher Education as secretary. This is the national body that oversees all research and technology matters across the country.

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17 *The PSEF considers formal basic education consists of pre-school education (3 years), primary education (6 years) and post-primary education (4 years). The "primary education" and "Post-primary education" constitutes compulsory basic education.*
18 *https://www.mesrsi.gov.bf/ministere/organisation*

- The National Agency for the Valuation of the Results of Research (ANVAR), under the Ministry's supervision in charge of education, is provisioned by LAW No. 038-2013/AN on scientific research and innovation. Its purpose is to translate the link between research and development into reality, promote the adaptation of imported technological innovations to the local conditions, promote intellectual property protection, and guarantee researchers and innovators' interests.

3.2 Market Size

The student population in the higher education institutions grew from 51,166 students in 2010 to 132,569 students in 2019. Despite the tremendous growth in student enrolment, the Gross Enrolment Ratio for higher education in Burkina Faso has risen from 3.5% in 2010 to 7.1% in 2019.[19] However, this is still below the sub-Saharan Africa average of 9.4% and far below the world average of 38.8% for the same year.[20] Higher education student enrolment was estimated at 145,816 in 2020 and projected to reach 213,212 students in 2025 and 280,608 in 2030. Based on the forecast of student enrolment and population in the age category 20-24, Burkina Faso's Gross Enrolment Ratio for higher education is estimated to reach 9.8% in 2025 and 11.2% in 2030.[21] While this illustrates the infrastructure and resource challenges that the country will need to address to cater to the growing numbers, the proportion of students entering higher education out of the school-age population remains very low.[22]

3.2.1   Target Institutions

Like other Francophone countries in Africa, the education system in Burkina Faso is modelled after the French national model that comprises four main stages:

- Pre-primary education (1 to 3 years);
- Primary education (6 years), leading to a certificate of primary studies;
- The first cycle of the secondary education lasts four years, leading to the first secondary school certificate, and the second cycle of the secondary school leading to the baccalauréat (BAC) and;
- Higher education, which follows the LMD (Licence-Master-Doctorate) system in a 3-2-3-year scheme.

Figure 3 illustrates Burkina Faso's education system and portrays the links and bridges between the different stages and the exit points toward employment.

Source: PSE 2016-2025 MESRSI

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19 *UNESCO country profile http://uis.unesco.org/en/country/bf*
20 *https://data.worldbank.org/indicator/SE.TER.ENRR?locations=BF*
21 *KCL calculations*
22 *http://uis.unesco.org/en/country/bf*
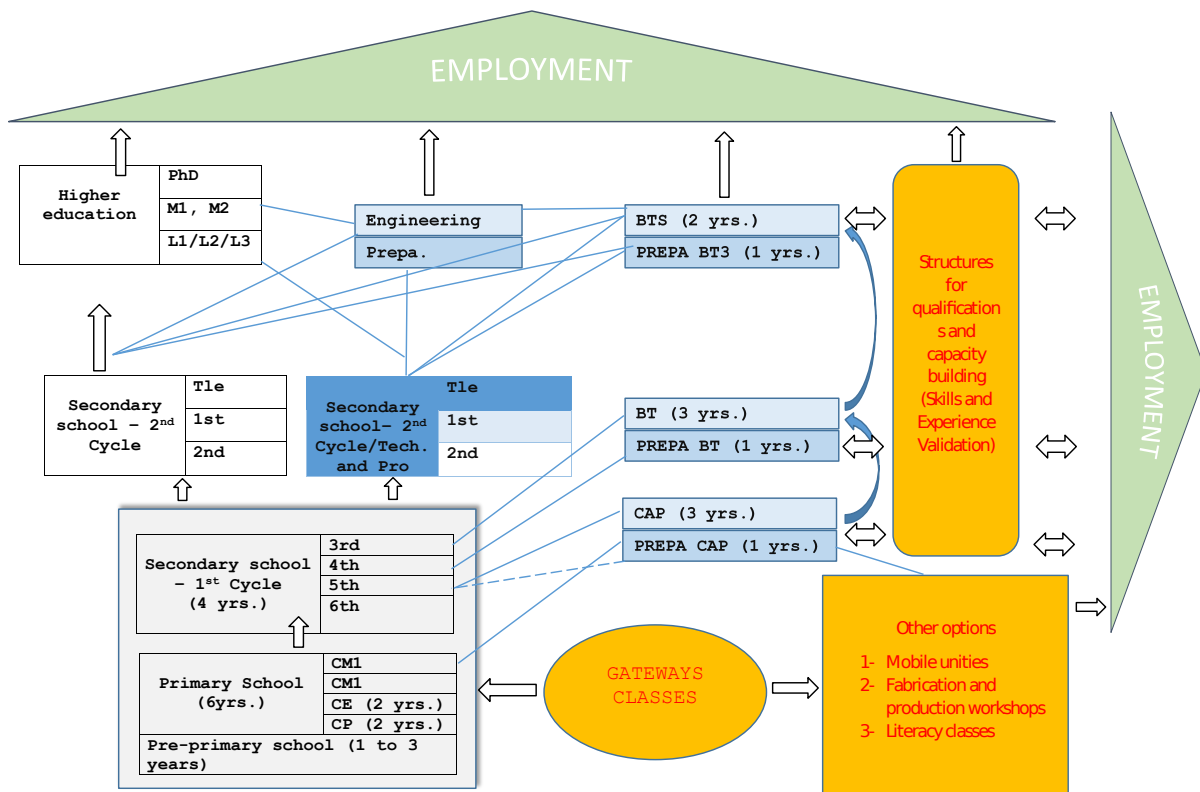
Figure 3: Burkina Faso Education System Framework

The primary and secondary education levels are under the Ministry of National Education, Literacy, and the Promotion of National Languages (Ministère de L'Education Nationale, de l'Alphabétisation et de la Promotion des Langues Nationales or MENAPLN) while higher education is under the Ministry of Higher Education, of Scientific Research and Innovation (Ministère de l'Enseignement Supérieur, de la Recherche Scientifique et de l'Innovation or MESRSI).

The Higher education system follows the LMD framework,[23] meaning License-Master-Doctorate (Bachelor's-Master's-Doctorate), which organises the qualifications into three different levels:

i.   1st level leads to the Grade of Licence (equivalent to the Bachelor, BAC +3)
ii.   2nd level leads to the Grade of Master (BAC +5)
iii. 3rd level leads to the Grade of Doctorate (BAC +8)

There are two different types of public and private higher education institutions:

i.   Universities
ii.   "Grandes Écoles" generically called Higher Education and Research Institutions (IESR for Institution d'Enseignement Supérieur et de Recherche), which specialise in specific fields

The MESRSI General Directorate of Scientific Research and Innovation (Direction Générale de

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23   *https://un-ci.org/etudes-et-formation/systeme-lmd.html*

la Recherche Scientifique et de innovation or DGRSI) leads research in Burkina Faso. It is organised by Law No. 038-2013/AN on the orientation of scientific research and innovation that defines researchers as anyone working on the design and creation of knowledge, products, processes, new methods, or systems based on scientific programming contributing to the resolution of problems. The law recognises two types of researchers: those linked to the universities, called lecturer-researcher, and those related to the institutes or research centres. They are supported by technical, administrative, and laboratory staff. In 2016, there were 40 research institutions, of which 25 are in the Centre Region and 6 in the Hauts-Bassins. Five of the research centres were private, and three were international.

In 2019, there were 169 higher education and research institutions providing higher Education in Burkina Faso.[24] These include 10 public universities, 8 private universities, and 23 public Grandes écoles. 71% of the higher education and research institutions were private while accounting for only 21% of the total student enrolment. The number of teachers was 2,302 with a growth rate of 5.2% from 2018 to 2019. The complete list of higher education institutions is provided in Table 15.

3.2.2   Connectivity-Related Projects

With a clear vision for how higher education can impact its development, and a clearly articulated ambition for scientific research, Burkina Faso, has embarked on many projects to improve the quality and access to high education in conjunction with several partners. Most of these large-scale projects provide significant ICT infrastructure and equipment investment, though the development of digital skills and ongoing maintenance tends to be overlooked. Some components of these projects that relate to connectivity include:

i. **World Bank Higher Education Support Project for Burkina Faso (about US$ 70 million and runs from 2019-2024).** The project aims to strengthen higher education institutions to increase access and deliver quality education in priority topic areas. The components include enhancing access to higher education by establishing the Virtual University of Burkina Faso (UV-BF), strengthening Higher Education Institutions and Supporting Innovations through the Open Digital Spaces (ENO, for Espaces Numériques Ouverts). The project has been designed to bridge a particular gap in some other initiatives. It complements the Africa Centres of Excellence (ACE I and III) programs that train students at the postgraduate level, with the target of increasing the number of students needed for the economy—especially in science, technology, engineering, and math (STEM), business, law, and finance. Burkina Faso is creating a Virtual University, which will be the biggest beneficiary in terms of connectivity since it aims to collaborate with existing higher education institutions and encourage the adoption and use of ICT to improve teaching. It plans to create 16 open digital spaces and financing the connectivity of higher education and research institutions.

ii. **AfricaConnect through the interconnection to the WACREN network.**[25] In May 2017, FasoREN, the Burkina Faso National Research and Education Network (NREN),

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24   *Governance dashboard 2019 edition, National Institute of Statistics and Demography (INSD).*
25   *https://www.africaconnect2.net/*

signed a partnership agreement with the regional West and Central African Research and Education Network (WACREN). The project was initially sized for 1 Gbps Internet connectivity for the country's Research and Education Network. The country paid its contribution of 275,000 Euros to WACREN through the support of the World Bank. The interconnection is in progress as of October 2020. The capacity has been revised to bring 1 STM (155 Mbps) to the Joseph Ki-Zerbo University core data centre.

iii. **Covid-19 Response.** In late March 2020, the UNICEF office in Burkina Faso received a Global Partnership for Education grant of US$70,000 to support the Ministry of Education in planning its response to the COVID-19 pandemic. The French Agency for Development (AFD) also provided a US$7 million COVID-19 grant to support, among others, learning continuity through educational programs on the radio; dissemination of information on hygiene practices to protect against COVID-19; creation of a toll-free call centre for guidance and information to children and parents; and school reopening.

iv. **One student, One Computer.** In April 2020, the Burkina Faso government designed a program "*One Student, One Computer,"* aimed at investing 1.9 billion XOF (about US$ 3.8 million) to provide 10,013 students with computers. That first acquisition of computing devices is part of the pilot phase of the presidential program. The government awarded the contract for the supply of computers to Horizon Informatique SA, a local supplier, by direct agreement. By promoting the use of ICT, the program aims to broaden access to higher education, reduce training costs, and improve education quality. With their computers, students will have the possibility of continuing their studies remotely without necessarily attending physical courses. In total, the Government of Burkina Faso, through the Ministry in charge of Higher Education, wants to acquire nearly 50,000 computers for students. The contribution of students wishing to obtain these computers is 40%, and the Burkinabe government will cover 60%, with support from the World Bank. 8,000 worth of computers will be distributed in 2020. The Ministry has indicated that nearly 3 billion FCFA had been mobilized to improve Internet access in public universities so that the presidential program fully achieves its objectives. The General Directorate of Higher Education supervises the program, which has since been extended to cover students from the private sector as well as teachers.[26]

3.2.3   Student Enrolment

The national statistics show that 132,569 students were enrolled in higher education in 2019, and the overall number of students has grown by an average of 12.7% over the past 5 years. Table 1 shows the trends in student enrolment, along with gross enrolment ratios for the different levels of education.

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26   *https://ordinateur.campusfaso.bf/*

Table 1: Student enrolment and forecast (with gross enrolment ratios) for different levels of education

Level	2017	2018	2019	2020	2025
Higher education	105,404 (6.0%)	117,725 (6.5%)	132,569 (7.1%)	145,816	213,212
Secondary education	1,162,297 (38.1%)	1,281,007 (40.7%)	1,342,143 (41.3%)	1,518,427	2,111,977
Primary education	3,040,802 (93.7%)	3,206,060 (96.1%)	3,232,784 (94.5%)	3,536,576	4,362,866

Source: MENAPLN, MESRSI, UNESCO UIS

For this analysis, lower levels of education are important from the perspective that they provide an indication of future enrolment for higher education. The lower education levels had 4,575,927 students in pre-primary, primary, and the two cycles of secondary education.

3.2.4   Bandwidth for Higher Education

Providing adequate bandwidth is the core challenge in Burkina Faso. Several factors contribute to connectivity gaps at the campus levels. These include the number of staff and students, the intensity of applications and services, the available bandwidth, the campus wireless, and wired networks' quality and competence in information technology and network management.

Based on the Gap Analysis Report, it is recommended that higher education institutions achieve connectivity of at least 1 Gbps for campuses that host 5000 students and staff in 2021 (see Table 11). The connectivity target is to achieve at least 2 Gbps per 1000 students by 2025 (to be provided for in the World Bank planning period ending 2023) and at least 20 Gbps per 1,000 students by 2030.

Table 2 indicates that higher education institutions in Burkina will need at least 435 Gbps by 2025 and 5.8 Tbps by 2030. Based on a recent survey, Joseph Ki-Zerbo University, the biggest University in terms of student enrolment, is only offering 34 Mbps to its nearly 70,000 students. Only the academic and administrative staff at the University currently use the provided connectivity. Students have to buy their connectivity from commercial providers with coverage around the campus. Within the framework of AfricaConnect2, FasoREN, through its partnership with WACREN, is planning to have 1 STM International Internet capacity, which is equivalent to 155 Mbps. This indicates that the bandwidth available to higher education in Burkina Faso is very far from sufficient to meet the connectivity requirements necessary for teaching, learning, and research.

Table 2: Projections for student enrolment and bandwidth requirements (2025 & 2030)

Year	Higher education enrolment (rounded to nearest hundred)	Bandwidth Estimate (Gbps)
2021	160,500	161

(1 Gbps per 1,000 students)		
2025 (2 Gbps per 1,000 students)	217,600	435
2030 (20 Gbps per 1,000 students)	289,000	5,780

3.3 Education Sector Challenges Impacting Leveraging ICT for Learning

Burkina faces much the same challenges in most African countries regarding the obstacles that inhibit the use of ICTs, particularly in higher education institutions. Some of these include:[27]

i. Even in the capital city, none of the higher education institutions interviewed provides Internet access to their students in Burkina Faso. Universities offer the limited connectivity available primarily to administrative staff and sometimes to academic staff and researchers.

ii. The student population at different education levels is growing much faster than investment in infrastructure and human resources. Indeed, the demographic dynamic has generated an expansion of access rates to primary, post-primary, and secondary education, which has led to an increase in demand for higher education, which adds new needs for education/training linked to technological advances. The higher education sector has grown by 12.2% per year for the last 5 years.[28]

iii. Lack of ICT infrastructure in higher education institutions (electricity, computers, multimedia rooms, networks), particularly in rural areas, compounded by lack of ICT procurement strategy and specialists.[29]

iv. The nascent national research and education network, FasoREN, cannot provide any services yet. Each university/institution still buys their Internet capacity directly from the ISPs, mainly Onatel, the incumbent operator. The cost for Internet bandwidth is high and thus prohibitive. On Onatel's website, the cost of 2 Mbps per month is 2 million XOF (about USD 1,800), while the price of 20 Mbps per month is USD 10,000.[30]

v. Low digital literacy among teachers because current teacher training and in-service training programs do not provide ICT training and among students, partly because secondary education does not incorporate any ICT training or use in teaching and learning.

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27   *Education/Training Sector Plan 2016-2025*
28   *Report No: PAD2751*
29   *FasoREN creation Terms of reference.*
30   *http://www.onatel.bf/ on November, 2020.*

vi. Lack of competent ICT human resources to manage the network.

vii. Lack of automated information and management systems that can support decision-making and optimal planning, and where they exist, limited usage.

4. Supply Side—the ICT Sector

Burkina Faso's communication sector is characterised by ongoing reform that has resulted in a relatively well performing mobile telephony market but still under-performing in the Internet and broadband market. The country has established an institutional framework in support of the development of the sector. The Ministry of Digital Economy and Posts (Ministère du Développement de l'Economie Numérique et des Postes or MDENP) is in charge of ICT Policy. There is an independent regulator—the Regulatory Authority for Electronic Communications and Posts (Autorité de Régulation des Communications Electroniques et de la Poste or ARCEP). The National Agency for the Promotion of ICT (Agence Nationale de Promotion des Technologies de l'Information et de la Communication or ANPTIC) is responsible for the development of e-government in the country. The slow growth in the broadband market and the high tariffs of connectivity remain the main barriers to accessibility and availability of broadband to higher education.

This Chapter examines the supply-side, looking at both the environment and the service providers, and the opportunities and challenges in delivering broadband to all the target institutions. While NRENs are part of the supply side, the FasoREN is considered in a separate chapter to evaluate how it can be supported to enable the connection of higher education institutions to high-speed broadband.

4.1 ICT Sector Policy and Regulation

Connecting higher education institutions to high-speed Internet is intimately linked to the country's ICT sector performance. Despite being landlocked and disadvantaged in several respects, Burkina Faso has, over the past three years, laid the building blocks that pave the way for the emergence of ICTs by 2030. Laying the foundation for these pillars required diagnoses, a clear vision, and precise actions to ensure the achievement of the objectives by 2030. The case of higher education institutions was also considered in these deliberations. The Government's mission to develop the ICT sector, reinforced by a presidential commitment, involve:

i. Expanding digital technology across the country;
ii. Promoting broadband access across the country;
iii. Setting up a technological hub for the development of the ICT industry;
iv. Promoting the consideration and integration of ICT in Education and research; and
v. Promoting the care and integration of ICT in the functioning of the public administration.

4.1.1 National ICT Plans and Strategies

The main digital strategy of Burkina Faso is the **National Strategy for Digital Development**

(Stratégies Nationales de Développement de l'économie numérique **[SN@DEN]**) adopted in April 2018 for the period 2018-2027. SN@DEN sets the strategy for developing the digital ecosystem composed of ICT infrastructure, services and content, access devices, the environment, and usage of ICT across different sectors. The strategy identified the country's weaknesses and challenges arising from lessons learned from the previous digital strategy plans (NICI adopted in 2000).

As a consequence of the SN@DEN, the **Digital Development Master Plan (Schéma Directeur d'Aménagement du Numérique or SDAN)**, was initiated by the Ministry in charge of ICT in 2019. The SDAN took a stock of existing infrastructure, whether built by the public or private sectors, providing a national benchmark for any new digital infrastructure construction project. SDAN's main objective is to provide the country with means and a long-term vision to cover its territory with digital networks (high-speed and very high-speed, fixed and mobile) and the universal provision of broadband services.

4.1.2 Key Policies and Regulations

The policies and regulations in Burkina Faso are developed following regional community directives and Acts (WAEMU and ECOWAS). Some key ICT sector laws, policies, and regulations that impact connectivity include:[31]

i. Law No. 061-2008 of November 27th, 2008: This lays down general regulations for networks and electronic communications services in Burkina Faso. This law's scope covers installation, upgrading layout, and operation of systems and the provision of electronic communications in Burkina Faso territory. Article 3 of Law No 061-2008/AN is dedicated to Universal Access and Service.

ii. Law No. 027-2010/AN of May 25th, 2010 amending Law N0. 061-2008/AN of November 27th, 2008: This law highlights general regulations for networks and electronic communications in Burkina Faso.

iii. Decree No2009-346/PRES/PM/MPTIC: This gives the mandate, composition, organization, and functioning of Autorité de régulation des communications électroniques et des Postes (ARCEP), the electronic communications regulatory authority.

iv. Decree No. 2010-215/PRES/PM/MEF/MPTIC: this Decree establishes the terms, requirements, and processes for licences for setting and operating fixed and mobile telephone networks and the Internet.

v. Decree No. 2010-245 PRES/PM/MPTIC/MEF: this Decree defines the procedures and conditions attached to the regimes of individual licences, general authorizations, and statements.

vi. Decree No. 2010-451/PRES/PM/MPTIC/MEF/MCPEA: this Decree deals with the general interconnection of networks and electronic communication services and access to these networks and services.

vii. Decree No. 2013-147/PRES/PM/MDENP/MEF: this Decree defines the users of radio

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31   *https://www.artci.ci/*

frequencies exempt from payment of fees or who can benefit from a reduction in fees payable.

viii. Decree No. 2011-92/PRES/PM/MPTIC/MEF: this Decree defines the procedures applicable to the management of the radio frequency spectrum

ix. Decree No. 2013-452/PRES/PM/MDENP: this Decree has the National Frequency Allocation Plan.

x. Order No. 293/MPTIC/CAB/of 08/21/2013 approving the Universal telecommunications -ICT service programs.

xi. Ordinance No. 2017-500 of August 2nd, 2017, relating to electronic exchanges between users and administrative authorities and between administrative authorities

xii. Ordinance No. 2012-293 of March 21st, 2012, relating to Telecommunications and Information and Communication Technologies.

The ICT sector regulator, ARCEP undertakes many projects that will impact the ICT sector in general and higher education institutions' connectivity. These include:

i. The National Strategy for the Development of Universal Access and Service for the period 2017 – 2021.

ii. The modernisation of *".bf" ccTLD*, both from a technical and organisational point of view. This will help the local traffic optimization and the promotion of the local brands on the net.

iii. The effective launch of accreditation in the field of electronic certification. It is ARCEP's responsibility to ensure trusted digital services. Several legislative and regulatory trust services mechanisms and frameworks have been developed, including:

    a) Law No. 045-2009 of November 10th, 2009 regulating electronic transaction services in Burkina Faso (with ARCEP as the accreditation authority for electronic certification).

    b) Decree No. 2012-1007 / PRES / PM / MTPEN / MJ / MEF defining the legal and institutional framework for electronic certification and the procedures for exercising the powers of the Regulatory Authority for Electronic Communications and Posts in matters of 'accreditation.

iv. Mobile number portability will encourage competition and bring more cost-effective services to the users.

v. The introduction of 4G in Burkina Faso will definitively improve the country's connectivity, which is limited to 3G at the moment.

vi. The Digital Terrestrial Television (DTT) project was launched in December 2017. As a follow-up, spectrum re-arrangement was needed to take advantage of the digital dividend. This is another project that the regulator is using to improve connectivity in the country. Burkina Faso's television services had migrated fully to digital by November 2019, improving TV coverage to 98%, with 35 sites throughout the country.

4.1.3   Key Policy and Regulatory Institutions

There are two key institutions that oversee the ICT sector in the country.

The Ministry of Digital Economy Development and Posts (Ministère du Développement de l'Economie Numérique et des Postes or MDENP)[32] sets the standards, provides technical guidance, monitors and evaluates ICT policy, and regulates the ICT and postal sectors across the country. It is composed of central Directorates that include the General Directorate of ICT (DGTIC),[33] the General Directorate of Electronic Telecommunications Infrastructures (DGICE), the Directorate of Electronic Communications Regulation (DRCE), the Directorate-General for the Development of the Digital Industry (DGDI) and the National Agency for the Promotion of ICT (Agence Nationale de Promotion des Technologies de l'Information et de la Communication or ANPTIC)[34] that promotes ICT in government.

Finally, Regulatory Authority for Electronic Communications and Postal Services (Autorité de Régulation des Communications Electroniques et de la Poste or ARCEP)[35] is the government agency responsible for regulating the communications sector encompassing telecoms and postal services.

4.1.4   National ICT Indicators

National ICT indicators collected during the Gap Analysis phase also have a direct bearing on connectivity for higher education institutors at the country level. The most pertinent integrated into the cost model include:

  i.   Whether the country is landlocked or has access to the ocean allows direct access to submarine cables. Direct access to submarine cables reduces base bandwidth cost. Burkina Faso is landlocked.
  ii. Number of submarine cable landing stations. Landlocked countries like Burkina Faso have none, while Egypt has the most with 15. More landings improve competition amongst cable providers resulting in competitive pricing. Burkina Faso is working to attract submarine cable operators inland by creating two Virtual Landing Points (VLPs), one in Ouagadougou and a more recent one in Bobo-Dioulasso.
  iii. Internet eXchange Ladder Stage. Countries were categorised into 4 stages (see Table 3) depending on the number of IXPs and carrier-neutral data centres they have as well as the interaction between these two essential facilities.[36] Burkina Faso currently has one IXP—the Burkina Faso Internet Exchange Point (BFIX), and no carrier-neutral data centre. It is at Stage 1 of the ladder.

Table 3: Stages of the Internet Exchange Ladder

Stage	Status	Countries
Stage 0	No IXP, internet traffic exchanged overseas	Algeria, Cabo Verde, Central African Republic, Chad, Comoros, Equatorial Guinea, Eritrea, Ethiopia, Guinea-Bissau, Lesotho, Libya, Mauritania, Niger, São Tomé and

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32   *https://www.mdenp.gov.bf/ministere/organisation*
33   *DGTIC website, http://www.dgtic.gov.bf/*
34   *ANPTIC website, https://www.anptic.gov.bf/*
35   *ARCEP website, www.arcep.bf*
36   *World Bank Group, 2020. National Data Infrastructure The Role of Internet Exchange Points, Content Delivery Networks, and Data Centres (was still in draft form)*

		Príncipe, Seychelles, Sierra Leone, Somalia, South Sudan
Stage 1	Domestic internet traffic between ISPs exchanged at IXP	Benin, Botswana, Burkina Faso, Cameroon, Congo, Côte d'Ivoire, Egypt, Eswatini, Gabon, Gambia, Guinea, Liberia, Madagascar, Malawi, Mali, Namibia, Rwanda, Senegal, Sudan, Tanzania, Togo, Tunisia, Zambia, Zimbabwe
Stage 2	Diversity of participants at IXP, presence of global Content Distribution Networks (CDNs)	Angola, Burundi, Democratic Republic of Congo, Mauritius, Morocco, Mozambique, Uganda
Stage 3	IXP located alongside carrier neutral co-location data center	Djibouti, Ghana, Kenya, Nigeria, South Africa

Source: NREN Survey and Interviews with CEOs, 2020

iv. % Population within 10-km fibre coverage (reflects fibre network coverage of the country). Only 20% of Burkina Faso's population currently lives within 10-km of fibre coverage, mainly around the large urban areas. This has a direct bearing on the cost of connecting especially rural campuses.

v. Regulatory score, which reflects the maturity of regulatory environment. It is based on individual country scores from ITU Global Regulatory Outlook 2020. Burkina Faso's score was 84 out of a possible 100. A good regulatory environment leads to more competitive connectivity offerings.

4.2 Sector Operations

4.2.1   Licensing, Market Structure and Service Providers

In line with the regional frameworks of ECOWAS and WAEMU, the licensing regime for electronic communications networks and services in Burkina Faso includes an individual licence, general authorisation, and Free entry (subject to "prior declaration" to ARCEP). However, infrastructure sharing is not yet a reality, with no explicit binding requirements for licensed providers to share infrastructure with other licensees. To facilitate interconnection of the different networks and help reduce the cost of ICT services, ARCEP is working to implement the principle of open access. ARCEP works with operators to develop interconnection catalogues during an exchange. But as the SDAN study highlights, negotiating interconnection costs between different licensed operators has not been straightforward.

Although there are about 20 licensed Internet Service Providers (ISPs), less than 10 offer services on the market. Most Internet subscribers use mobile Internet services from the three mobile operators—Onatel, Orange and Telecel that share the market, as shown in Table 4. It is evident that a de-facto duopoly controls the market. Onatel and other ISPs also offer fixed Internet services, although the number of subscribers at 12,800 is much lower compared to mobile Internet subscribers (see Table 4). ARCEP has also licensed 22 Value Added Services (VAS) providers whose services range from traffic reselling to banking services, including

prepaid cards.

The connectivity costs will be impacted by the competitive environment and the licensing structure. More competition will bring the costs down.

Table 4: Licensed operators and market share (March 2020)

Operator	Population Penetration	Mobile Subscribers	Mobile Internet Users	Internet Market Share
Onatel S.A. (Incumbent)	16.1%	8,778,578	3,468,275	43.8%
Orange Burkina Faso S.A.	18.2%	8,989,189	3,919,315	49.5%
Telecel Faso S.A.	2.5%	3,003,479	531,166	6.7%
Total		**20,771,246**	**7,918,756**	**100.0%**

Source: ARCEP, 2020

4.2.2   Access to Broadband

Despite being landlocked, Burkina Faso has access to many submarine cables via terrestrial fibre from neighbouring countries including SAT-3, MainOne, WACS and ACE via Benin, Côte d'Ivoire, Ghana, Togo, and Senegal. Burkina Faso then provides onward access to other neighbouring landlocked countries like Niger and Mali by acting as an inland Point of Presence (PoP) as indicated in Figure 4.

Data from ARCEP indicates that the country had a total International Internet Bandwidth capacity of 39.9 Gbps in 2019, of which Onatel provides 51.3% and Orange delivers 41%. Africa Bandwidth Maps (ABM) estimates slightly more bandwidth at 44.2 Gbps in 2019 based on public data. It is important to note that the overall national bandwidth is very low compared to estimated bandwidth of 435 Gbps required to connect higher education institutions in 2025 (at 2 Gbps per 1,000 students) across the country.

Source: Africa Telecom Transmission Map 2020, Hamilton Research Ltd. www.africabandwidthmap.com

Figure 4: Map showing national fibre backbone in Burkina Faso

The underlying ICT infrastructure also limits broadband access in Burkina Faso in general and for higher education in particular. It is estimated that 20% of the population lives within a 10 km radius of fibre coverage,[37] and less than 26.2% of the population lives within reach of a mobile Internet network.[38] While network coverage of the population has greatly improved, with the three major operators reporting an average 3G population coverage of 73% and 4G coverage of 43%, this is focussed largely around the more profitable provincial capitals and other urban areas. When it comes to geographic area coverage, the three major operators report much lower figures—an average 3G area coverage of 49% and 4G coverage of 15%. The large disparities in terms ICT Infrastructure, particularly in rural areas, is a major challenge that Burkina seeks to address as a way to improve access and reduce the cost of services.

Figure 2 shows planned fibre roll-out to extend the national fibre backbone's reach by 2030 under the Burkina Faso Digital Development Master Plan. ARCEP projects that nearly 30% of the population now have access to the Internet,[39] which is higher than the African average of 28%, but lower than the World average of 54%.[40]

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37 *Africa Telecom Transmission Map 2020, Hamilton Research Ltd. www.africabandwidthmap.com*

38 *GSMA 2020 report*

39 *National Institute of Statistics and Demography (INSD) projects a national population of 21,510,181 inhabitants for the year 2020 in Burkina Faso. Demographic projections from 2007 to 2020 by region and province, www.insd.bf*

40 *ITU 2019. Measuring Digital Development: Facts and Figures*

Mobile cellular subscriptions continue to grow while fixed-telephone subscriptions decline, as shown in Figure 5. Mobile broadband subscriptions tally with the number of Internet users, reflecting that Internet users in Burkina Faso predominantly use mobile devices to access the Internet.

Source: ITU data 2019
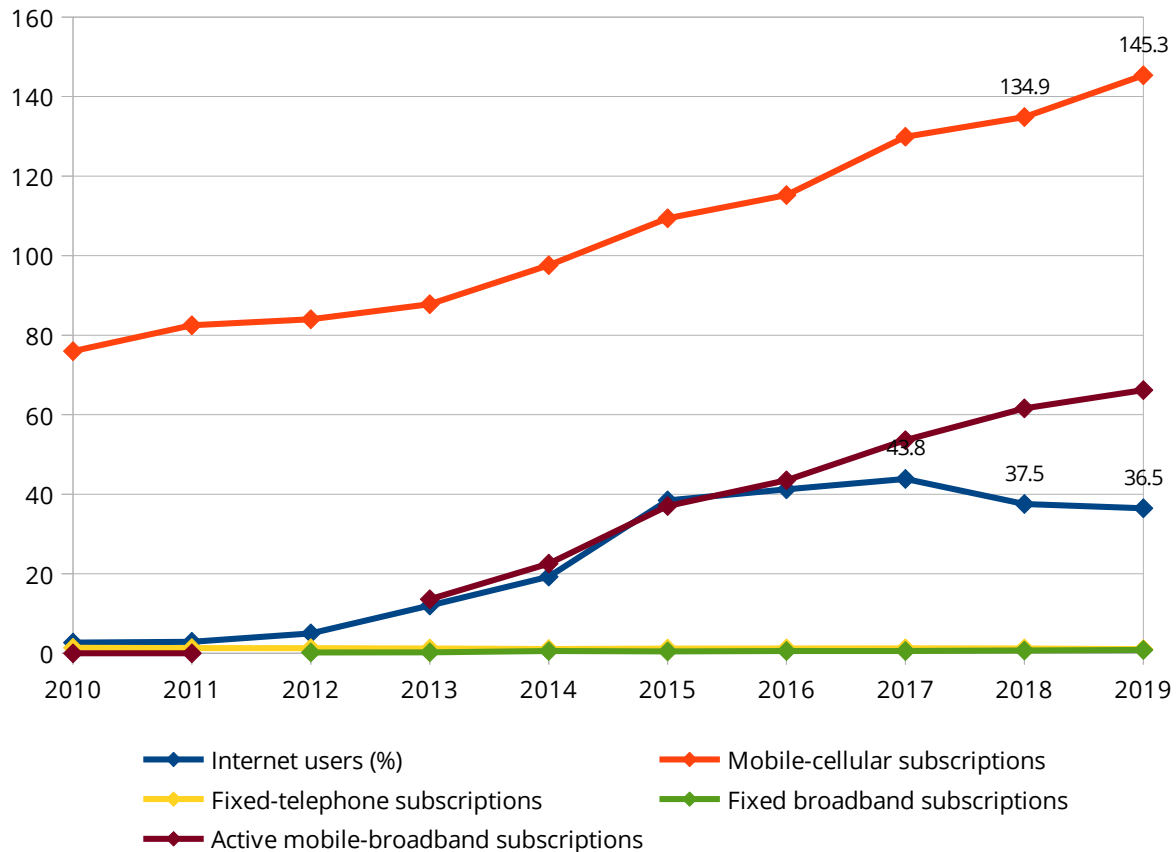
Figure 5: Trends in mobile and fixed subscriptions (per 100) 2010-2019

4.2.3   Connectivity-Related Projects

Some ongoing projects can impact or contribute to connecting higher education institutions to high-speed broadband. These include:

i. The National Budget Program *"Development of electronic communications infrastructure."* This can help ensure that there are provisions in the Government's annual budget dedicated to ICT infrastructure rollout and operations. The budget lines should also include OpEx to support NREN operational expenditure.

ii. The National Administration Network (RESINA). With the public higher education institutions under the Government's supervision, the HEI administration should lobby to benefit from the RESINA national networks. RESINA can particularly help in the rural/remote areas to connect with central repositories. Through this project, the government planned to also provide satellite coverage of isolated areas to the RESINA, with a satellite hub located in Ouaga 2000 at the headquarters of the institution, and several ground stations scattered throughout the territory, mainly in Bobo Dioulasso (6

sites), Gaoua (11 sites), Kaya (4 sites) and Tenkodogo (16 sites) in the Centre East.

iii. The ICT Development Support Project (PADTIC). The overall objective of PADTIC is to improve the availability, efficiency, and accessibility of the offer of electronic communications services throughout the national territory. One of the PADTIC objectives is to renovate the RESINA.

iv. The National Telecommunications Backbone Project (PBNT) plans to interconnect 45 provincial capitals' major urban areas by laying about 5,400 km of shared fiber optic network. AXIM Bank China financed the PBNT Phase 1, which is 2001 km long. The backbone will help facilitate the distribution of bandwidth to higher education institutions.

v. The West Africa-Burkina Faso Regional Communication Infrastructure Project (PRICAO-BF) includes several projects that will strengthen the digital ecosystem in Burkina Faso, making it easier for higher education institutions to leverage digital technologies for teaching, learning and research.

vi. The government Cloud infrastructure (G-Cloud), which the Danish International Development Agency finances, and the BKF-021, includes satellite connectivity for around 800 public offices across all regions funded by Luxembourg's Government. The cloud infrastructure can host applications and resources that support digital teaching and learning. It is worth noting that satellite bandwidth can be costly if not managed efficiently.

vii. The Virtual Landing Points (PAVs) make it easier for FasoREN or other commercial service providers to access large volumes of international capacity, which is then passed onto higher education institutions. This will help to drive down the unit cost of bandwidth.

The World Bank Group has also financed projects related to improving connectivity in the country, including:

- West Africa Regional Communications Infrastructure Project (P123093): for the period 2017 to 2022, that aims at increasing the geographical reach of broadband networks and reducing the costs of communication services in the recipient's territory and between the recipient and ECOWAS countries.
- Burkina Faso e-Government Project (P155645): 10,000,000 (US$20 million) from 2017 to 2023 for increasing the capacity for and the use of ICTs by the public administrations and agencies to provide information and public e-Services as well as foster entrepreneurship in the digital economy, with a specific focus on agriculture and rural areas.
- The WARCIP Project (Additional Funding P122402), Economic Governance and Citizen Engagement (P155121), the Higher Education Support Project (P164293), the Financial Inclusion Support Project (P164786) as well as the Unique Identification Project for Regional Integration and Inclusion in West Africa (P161329).

4.2.4 IXPs and Data Centres

In terms of the underlying infrastructure that can help the connectivity, and with the support

of the World Bank, Burkina Faso invested in creating Burkina Faso Internet Exchange Point (IXP) in Bobo-Dioulasso to provide a mechanism for local Internet traffic aggregation and exchange, improving network latency and traffic speeds.[41] BFIX connects 13 members, including all licensed telecommunication providers, ISPs and some international Internet actors such as Packet Clearing House[42]. Services offered by BFIX include public peering, Google global cache, Facebook cache, BGP Route Server, Anycast DNS from Packet Clearing House, and the support and maintenance of member equipment at the IXP.

Burkina Faso has also created two Virtual Landing Points (VLPs), one in Ouagadougou and a more recent one in Bobo-Dioulasso in September 2020 increase the amount of international capacity available within the country to over 60 Gbps.[43]

The VLPs will make it easier for licenced providers and FasoREN to access the larger volumes of international capacity necessary to meet the bandwidth requirements of HEIs envisaged under this study at more sustainable prices, while the BFIX will make it easier for FasoREN and HEIs to exchange local and some regional traffic within the country, saving on the cost by eliminating the need to pay for expensive international capacity just to exchange traffic between member institutions.

Burkina Faso does not currently have a carrier-neutral data centre.

4.2.5   Cybersecurity

The ITU Global Cybersecurity Index (GCI)[44] seeks to gauge how countries are dealing with Cyber threats. Using a range of indicators, the ITU compares countries in terms of knowledge for implementing Cybercrime legislation, national Cybersecurity strategies (NCS), computer emergency response teams (CERTs), capacity to spread awareness of developed strategies, and capabilities and programmes in the field of Cybersecurity.

Higher education institutions possess large amounts of sensitive data including personal and academic information on their students and staff. As they seek to digitise their data and operations and improve connectivity, higher education institutions will increasingly become a target for hackers and cyber criminals. The challenge is to effectively manage cybersecurity while maintaining the openness of higher learning institutions that is necessary to spur cross-disciplinary collaboration and innovation.

Improved connectivity is necessary for teaching and learning as well as to exchange large amounts of research data. But improved connectivity also provides a good avenue for cybercriminals to attack higher education institutions. Therefore, institutions will need to invest in more highly skilled ICT staff, supported by better technical tools to monitor and respond to potential cybersecurity challenges. Institutions will also need to develop better usage policies and educate their students and staff on effectively operating in this new

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41 *Burkina Faso Internet Exchange Point (BFIX)* http://www.bfix.bf
42   *(it provides operational support and security to critical internet infrastructure, including internet exchange points and the core domain name system*
43 *https://www.ecofinagency.com/telecom/0809-41790-burkina-deploys-new-ixps-and-vlps*
44 *ITU Cybersecurity Index* https://www.itu.int/en/ITU-D/Cybersecurity/Pages/global-cybersecurity-index.aspx

environment. In addition, as the primary training, higher education institutions must produce a new breed of ICT professionals that will protect other sectors of the economy from similar challenges.

Although Burkina Faso's 2018 GCI score of 0.4 was lower than Cote d'Ivoire (0.46) and Uganda (0.62), the country's ranking has improved, in contrast to the other case study countries, all of which dropped: The country has moved up eleven positions from 107 to 96 out of 132 ITU member countries as indicated in Table 5. The improvement is on account of instituting better legal measures (putting in adequate regulation), improved technical measures (like setting up the national Burkina Faso Cybersecurity Center (CIRT BF)[45] and sectoral CERTs) as well as improved organisational and capacity building measures. The challenges still exist in terms of technical capacity and capacity building areas where the country needs to focus.

Table 5: Country performance in ITU Global Cybersecurity Index

Country	2017 GCI			2018 GCI		
	Score	Regional (out of 44)	World Rank (out of 193)	Score	Regional (out of 44)	World Rank (out of 193)
Burkina Faso	**0.21**	**16**	**107**	**0.4**	**14**	**96**
Cote d'Ivoire	0.42	8	73	0.46	9	86
Mozambique	0.21	17	108	0.16	26	132
Uganda	0.54	5	50	0.62	7	65

Source: ITU Global Cybersecurity Index (GCI) 2017 and 2018

4.2.6   Electrification

Table 6 compares trends in electrification between Burkina Faso and the other case study countries—Côte d'Ivoire, Mozambique and Uganda. Compared to the African average, the country has a low electrification rate, performing much worse in rural compared to urban areas. Given that the bulk of the population lives in rural areas improving broadband connectivity will be a major challenge.

Table 6: Comparison of electrification rate among case study countries

	Proportion of the population with access to electricity					Population without access (million)
	National			Urban	Rural	
	2010	2015	2019	2019	2019	2019
Africa	44%	49%	56%	81%	37%	579
Sub-Saharan Africa	33%	40%	48%	76%	29%	578
Uganda	14%	19%	29%	66%	17%	32
Côte d'Ivoire	59%	63%	76%	>99%	51%	6

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45   *https://www.cirt.bf/*

Burkina Faso	14%	19%	22%	69%	2%	16
Mozambique	16%	28%	35%	57%	22%	20

Source: IEA, World Energy Outlook-2020

4.3 Sector Challenges Impacting Broadband Connectivity

SN@DEN identified the country's weaknesses and challenges from lessons learned from the previous digital strategy plans (NICI adopted in 2000). Identified weaknesses and threats include operational challenges to implementing the strategies, insufficient coverage and low quality of telecom services, and poor electrical network quality. Other weaknesses include an inadequate appreciation of ICT skills, absence of a complete digital ecosystem to spur the development of national expertise, low availability of local digital content and low purchasing power of the population.

Threats such as political instability in the sub-regional space, Over-the-Top (OTT) services threatening telecom operators' core business leading them to restrict their investments in such services, the permeability of infrastructure to cyberattacks, fraudulent use of personal data, lack of recognition and certification of open and distance learning, and, reduction in international funding for the development were also identified as core challenges.

SN@DEN recognised that the slow deployment of optical fibre and the absence of a national telecommunications backbone had resulted in the low quality and the high cost of ICT services.

Other challenges faced by licensed ICT providers in Burkina when it comes to providing high-speed connectivity include:[46]

i. Broadband access to rural and remote areas—Although most of the higher education institutions are in the urban/suburban areas of Ouagadougou and Bobo Dioulasso, 18% are in remote rural areas. Access to broadband remains a key challenge due to limited national backbone reach and low 4G coverage.

ii. The high tax burden on ICT services, e.g., VAT, communications tax, tax on mobile money transfers, tax on provider revenues, etc. Providers pass these taxes onto customers in the form of high prices, resulting in the unintended effect of crippling the growth of the sector and the wider economy.[47]

iii. High wholesale and retail price for broadband services.

iv. Operators complain about the lack of security for their infrastructure and resulting vandalism that destroys their telecommunications infrastructure investment as a big challenge.

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46   *https://www.afriqueeconomie.net/index.php/2019/08/17/une-rencontre-sur-les-enjeux-et-defis-du-secteur-des-telecoms-a-abidjan/*
47   *https://www.afriqueeconomie.net/index.php/2019/08/17/une-rencontre-sur-les-enjeux-et-defis-du-secteur-des-telecoms-a-abidjan/*

v. Insufficient numbers of qualified human resources to support ICT networks and applications.

5.   Burkina Faso Research and Education Network (FasoREN)

Burkina Faso first created an association called the National Network for Education and Research (RENER) to promote ICT in the higher education and research sector in 1998. After some initial achievements, the association was not successful because of the lack of shared ICT infrastructure and connectivity to the Internet as envisioned by the originators. Building on the lessons learned from that experience, FasoREN was created in 2016 as a not-for-profit association with the objectives of:

   i.   Contributing to the integration of ICT in member institutions;

   ii. Contributing to innovation through ICT;

   iii. Accelerating the development of higher education and scientific research human, material, educational resources;

   iv. Mobilising technical and financial support from higher education and scientific research sector partners;

   v.   Playing the role of a sub-regional, regional and international integration vector; and

   vi. Building a modern digital national scale communication infrastructure dedicated to higher education and scientific research.

FasoREN is a member of the West and Central African Research and Education Network (WACREN), promoting collaboration between national, regional, and international research and education communities. FasoREN is also a beneficiary of the AfricaConnect2 project and the World Bank-funded WARCIP—FasoREN is currently working on a business plan to develop a fully functioning NREN that can deliver applications, services and high-speed connectivity to higher education institutions across the country.[48]

Figure 6 presents the proposed network backbone for FasoREN.

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48   *https://projects.worldbank.org/en/projects-operations/project-detail/P148062*

Source: FasoREN, 2020
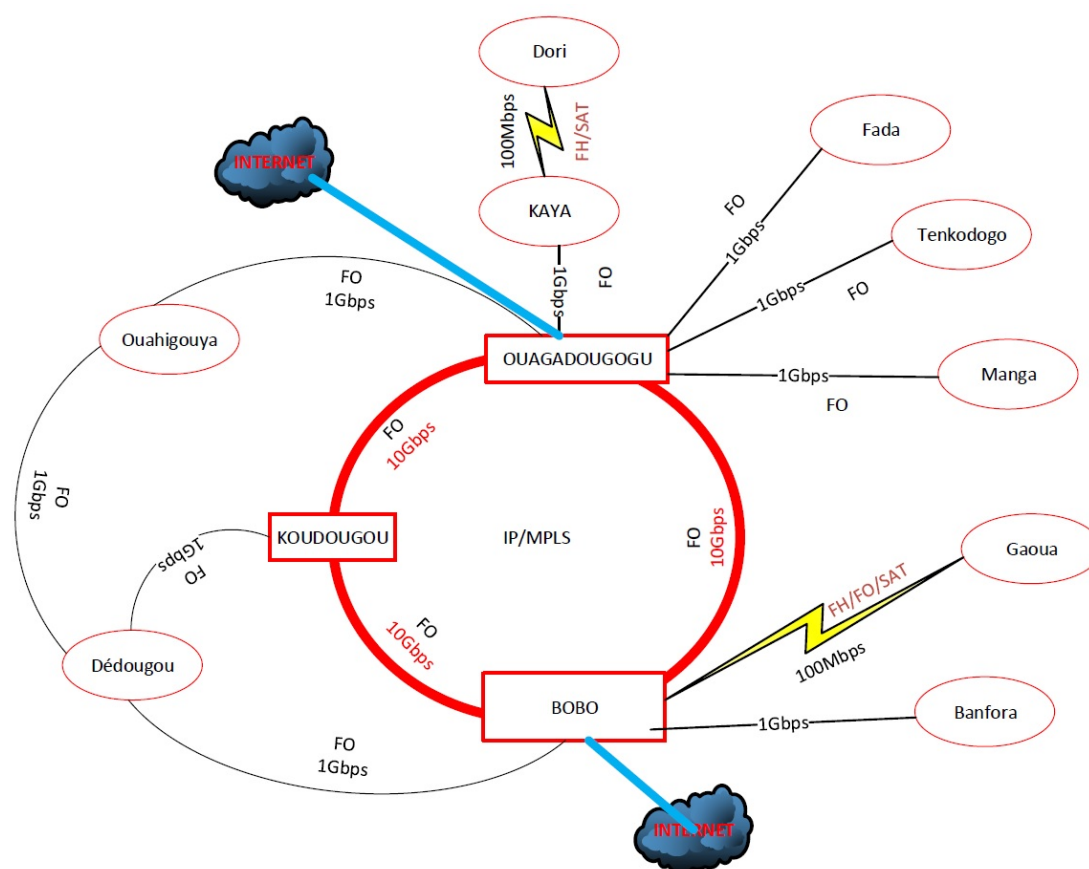
Figure 6: Proposed FasoREN network backbone

5.1 NREN Maturity

Survey results show that African countries are at different levels of NREN development or maturity based on many indicators relevant to higher education connectivity. The most pertinent ones integrated into the cost model include:

i. Presence of NREN (1 point), (scored 1 out of 1). Burkina Faso has a formal REN.

ii. NREN governance structure (1 point), (scored 0 out of 1). FasoREN is yet to implement a clear governance structure.

iii. Government recognition of NREN/NREN relationships (1 point), (scored 0 out of 1).

iv. Variety of funding sources for NREN (1 point each for membership fees, government grants and sale of bandwidth) (scored 0 out 3).

v. Whether has a network (network [virtual or physical] 1 point, national PoPs 2 points) (scored 0 out of 2). FasoREN currently lacks a network to distribute connectivity to HEIs.

vi. Whether NREN has an ASN (1 point) (scored 0 out of 1), FasoREN does not have an

ASN.[49]

vii. Whether at least one University or more has its ASN that can facilitate multi-homing (1 point) (scored 0 out of 1), no higher education institution has an ASN.

viii. Whether any ASN has networks that they peer with (1 point),[50] (scored 0 out of 1). FasoREN currently lacks an ASN to directly peer with other networks.

ix. NREN regional/global connectivity (transit in Africa 1 point, transit in Europe 2 points), (scored 0 out of 2). FasoREN as an entity does not have regional/global connectivity, although, through its partnership with WACREN, there are plans to acquire 155 Mbps of International Internet capacity.

x. Middle-ware services offered by NREN (I point each for ICT training, DNS, NOC services), (scored 0 out 3). FasoREN does not currently provide any middle-ware services to members.

xi. Advanced services offered by NREN (1 point each for identity and access management, data centre services, video conferencing, research management tools), (scored 0 out of 4). FasoREN does not currently provide any advanced services to members.

No NREN	Emerging NREN	Connected NREN	Mature NREN
- No established NREN - Varying levels of awareness about NREN need - Ongoing conversations - HEIs buy bandwidth directly from ISPs	- Formal NREN established as legal entity - Formal commitment from HEIs - Formal NREN organisational structure - Without a network	- Coherent operations of NREN - NREN has network - NREN has national PoPs to which members connect - NREN has ASN and IP resources - NREN networks peers with other networks - Offers middleware NREN services	- Regional / global connectivity to other NRENs - Offers advanced NREN services - International collaboration and access to advanced services

Figure 7: Stages of NREN development

Using a combination of Duncan Greaves' NREN Capability Maturity Model[51] and Mike Foley's levels of NREN development,[52] different African countries can be scored and organised into levels of NREN maturity. There are four broad groups summarized in Figure 7 that include:

i. No-NREN: no NREN, but varying levels of awareness about need and ongoing conversations.

ii. Emerging NREN: legal entity established, with formal organisational structure, but without a network,

iii. Connected NREN: has a network of varying coverage, may have national PoPs to connect members, has ASN and IP resources that facilitate peering with other networks and offering middle-ware services, and

iv. Mature NREN: has high-speed regional (transit in Africa)/global (transit in Europe) connectivity to other NRENs and offering advanced services.

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49 *AfriNic ASN Statistics https://stats.afrinic.net/asn/*
50 *AfriNic ASN Statistics https://stats.afrinic.net/asn/*
51 *Greaves, D. (2009). An NREN Capability Maturity Model. https://www.caseforrens.org/Resources_and_Tools/Document_Library/ Documents/NREN%20Capability%20Maturity%20Model%20(CMM).pdf*
52 *Foley, M. (2016). The Role and Status of National Research and Education Networks in Africa. World Bank.*

Table 7 depicts how the NRENs in different African countries can be categorised around these stages. It also shows the potential savings derived from demand aggregation of bandwidth requirements among higher education institutions and smart procurement strategies (e.g., benchmarking regional pricing), and procuring long-term leases. FasoREN's is categorised as an Emerging NREN.

Table 7: Classification of Connectivity in African Higher Education

State of NREN development	Countries	Actions	Contribution to Saving via aggregation
No NREN	Angola, Cape Verde, Central African Republic, Comoros, Republic of Congo, Eritrea, Equatorial Guinea, Eswatini, Gambia, Guinea-Bissau, Lesotho, Mauritius, São Tomé and Príncipe, Seychelles, South Sudan	• Ensure access to bandwidth to all higher education institutions (2 years) • NREN development (3 years) • Transition to full NREN model (5 years)	0% saving
Emerging NREN	Botswana, Burkina Faso, Burundi, Cameroon, Chad, Djibouti, Guinea, Liberia, Libya, Mali, Mauritania, Namibia, Niger, Sierra Leone, Sudan, Zimbabwe	• Strengthening NREN • Ensuring that higher education institutions are connected to adequate Internet bandwidth	30% saving
Connected NREN	Algeria, Benin, Cote d'Ivoire, DRC, Egypt, Ethiopia, Gabon, Ghana, Madagascar, Malawi, Morocco, Mozambique, Nigeria, Rwanda, Senegal, Somalia, Tanzania, Togo, Tunisia, Zambia	• Ensuring that higher education institutions are connected to adequate Internet bandwidth • Provision of advanced services • Transition to full-fledged NREN in three years	60% saving
Mature NREN	Kenya, South Africa, and Uganda	• Provision of advanced connectivity and services	90% saving

Source: NREN Survey, 2020

5.2 NREN Challenges

The FasoREN initiative is an important endeavour to aggregate the bandwidth demand of the higher education community in Burkina Faso. It will also play a major role in building the capacity of higher education institutions in the design and deployment of campus networks that enable the delivery of advanced services to students and staff. As an Emerging NREN, FasoREN faces challenges that hinder better performance. These include:

i. Higher education institutions have inadequate budgets for bandwidth. Institutions currently only provide bandwidth for staff and administration. Students buy their Internet data from commercially available merchants around the campuses.

ii. Campus networks at higher education institutions are still in a poor state. Apart from the two major campuses of the Joseph Ki-Zerbo University and Ouaga 2, there are no functional LANs on the campuses.

iii. Institutions have low levels of technical expertise among their ICT teams to manage their networks and provide the requisite services. There are no capacity building plans and, sometimes, no dedicated and trained technical resources.

iv. Awareness about the potential benefits of an NREN among higher education institutions and other stakeholders is still deficient.

v. High cost of last mile connectivity to facilitate distribution of bandwidth, especially to the higher education institutions in rural areas.

6. Cost Estimates for Connecting Higher Education in Burkina Faso

Connectivity, recognized as a foundation for learning and innovation, has four major components, all of which need to be addressed to complete the value chain: end-user access devices; high quality campus networks to deliver a good broadband experience to the end-users; high-quality national networks to interconnect campuses, and regional and global networks to join national networks to the global environment.

The pricing used in the model are specific to Burkina Faso, and therefore give more accurate projections compared to the general continental averaging. A schematic diagram for connecting African higher education institutions is shown in Figure 8.

6.1 Access to Computing Devices

To compute the cost of access to computing devices for students and staff that are necessary to facilitate use of high-speed broadband delivered to higher education institutions, these assumptions were defined as part of the cost model:

Assumptions for projecting device costs for students and staff by country:

i.   Used forecast of student enrolment and staff numbers in Burkina Faso for 2021 to 2025.
ii. 80% of students are undergraduate students who spend, on average three years at the university, 20% are graduate students who spend two years at the university.
iii. One third of undergraduates in a given year are assumed to be freshers while one half of graduate students are considered to be freshers at the start of any given academic year. This results in a weighted average of 36.7% that need to acquire devices at the beginning of any academic year.
iv. Predetermined scaling down of support from different partners for student devices. Support starts at 80% of the first-year students in 2021 and reduces by 20% year-on-year: 60% in 2022, 40% in 2023, and 20% in 2024. The approach should include scaling down of support over time in order to nurture sustainability.
v.   All staff will get devices between 2021 and 2025. Staff devices are supported up to 100%, and new staff are given new devices after recruitment.
vi. Used an average figure of USD 400 per user laptop (including software) as economies of scale would reduce costs. All laptops come with a three-year warranty.
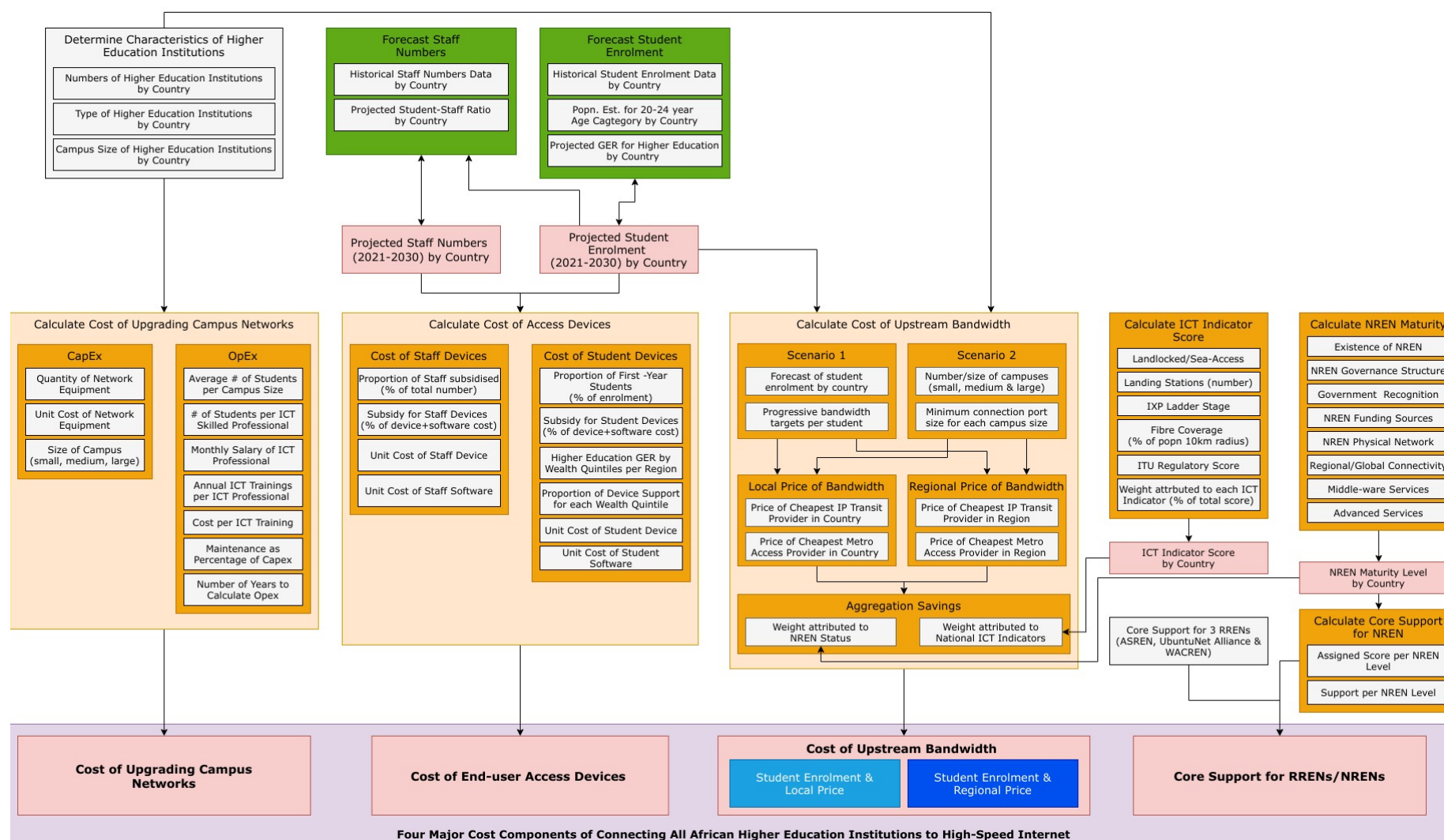
Figure 8: A schematic diagram to estimate costs for connecting higher education institutions in Africa

Burkina Faso needs USD 67 million to provide access devices for all first-year students and staff in higher education institutions between 2021 and 2025, as indicated in Table 8.

Table 8: Cost of equipping students and staff with access devices (2021 to 2025)

Year	Forecast student enrolment	Forecast staff numbers	Estimated Average cost of devices (USD, million)
2021	160,400	7,500	24.8
2022	175,600	7,910	17.2
2023	190,800	8,320	12.6
2024	206,000	8,720	11.7
2025	221,200	9,130	0.5
Total	**954,000**	**41,580**	**67**

Source: KCL calculations

6.2 Upgrading Campus Networks

Table 9 summarises the assumptions used for calculating the cost of upgrading campus networks.

Table 9: Assumptions for calculating campus network upgrade costs in Burkina Faso

Area	Assumptions
Number of buildings	A small campus has 2 medium and 3 large buildings, a medium campus has 4 medium and 6 large buildings while a large campus has 8 medium and 12 large buildings.
Length of fibre	A small campus needs a 5 km fibre network backbone, while medium and large campuses need 10 km and 20 km, respectively. Assumed a unit cost of $20 per metre of laying fibre, including civil works.
Switching centres	Small campuses have a simple network with 1 switching centre (with a core router and layer-3 switch), while medium campuses 2 switching centres (each with a core router) and one border router. A large campus has 3 switching centres (each with a core router) and two border routers, giving the network ability to support 2 independent connections. Given the poor reliability of power in many African countries, each switching centre will have a standby generator.
Data centre	A campus needs a small data centre (Tier I) with racks, centralised UPS and some servers. We budgeted 3 servers for the small campus, 9 servers for medium campus and 12 servers for the large campus. The data centre, switching centre, and Network Operations Centre (NOC) should be co-located in the same location to save on costs.
Multimedia classroom	A small campus has 1 fully integrated smart classroom with different

	technologies, including smartboards, projectors, cameras, speakers, audio equipment, lighting etc. A medium campus has 3 of these, while a large campus has 5 smart classrooms.
Support to institutional library	A Local Area Network and PCs in the main library connected to an online public access catalogue (OPAC).
Skilled staff	At least 1 ICT skilled engineer for every 450 students earns at least 1.5K per month to compete with the private sector. The staff should have access to one training opportunity per year in line with the needs of their institution.
Consulting and design support	Institutions should be able to access technical support to help the technical team implement various solutions that address their institution's needs. This can start with campus network design and span other areas, including installing and maintaining various systems and equipment.
Equipment supplies and maintenance	Institutions should be able to undertake corrective and preventive maintenance to extend the campus network's life and operation.

Table 10 summarises the CapEx and OpEx for upgrading all university and TVET campus networks in Burkina Faso. The OpEx covers five years (default period that can be modified in the model) and includes a maintenance component for the campus networks (15% for hardware and software costs). The OpEx excludes bandwidth costs that are handled in the next section. OpEx (excluding bandwidth) are higher than CapEx. Given the need for sustainability, this highlights the need for both higher education institutions and the government to budget these costs appropriately.

Table 10: Estimate for upgrading campus networks in Burkina Faso

Size of HEIs	Number of HEIs	Capex (USD, millions)	Cumulative Opex (USD, millions)	Total (USD, millions)
Institutions with less than 5000 students (small campus)	87	128	159	286
Institutions with between 5000-15000 students (medium campus)	4	11	17	27
Institutions with more than 15,000 students (large campus)	2	10	19	29
Total	**93**	**148**	**195**	**343**

Source: KCL calculations

Table 13 shows that OpEx (excluding bandwidth) and the CapEx are comparable, indicating that OpEx can be high on a long-term basis. Given the need for sustainability, this highlights the need for both higher education institutions and the government to budget these costs appropriately.

Small campuses account for 93.5% of all campuses and 83.4% of the total cost of upgrading campus networks. Given the experience of other case study countries, the small campus category can be refined into three categories—mini campus (500 students or less), micro

campus (500 to 1,500 students) and small campus (1,500 to 5,000 students), but the consulting team did not have access to sufficient data to be able to do this. This can reduce the cost of upgrading campus networks. More savings can be derived from the use of shared infrastructure like switching and data centres among micro and mini campuses that are geographically very close to each other.

6.3 Connecting Campuses Upstream

Based on the Vision and Progressive targets as provided in the Gap Analysis Report[53] and drawing on global bandwidth use, it is recommended that higher education achieve connectivity of at least 1 Gbps for campuses that host 5000 students and staff in 2021 as indicated in Table 11. The connectivity target is to achieve at least 2 Gbps per 1000 students by 2025 (to be provided for in the World Bank planning period ending 2023) and at least 20 Gbps per 1,000 students by 2030.

Table 11: Recommended progressive bandwidth targets for African HEIs

Year	Minimum bandwidth	Remarks
2021 (targeted minimum)	0.2 Gbps @1,000	Translates to 1Gbps for a campus of 5,000; and 10 Gbps for a campus of 50,000
2021-2025	2 Gbps @1,000	Translates to 10 Gbps for a campus of 5,000; and 100 Gbps for a campus of 50,000. *This should be the minimum entry level for the WBG intervention*. It should be noted that the general aspirational target of most African NRENs by 2025 or earlier is 1Gbps per 1000 students, but this is heavily influenced by current challenges and limitations.
2025-2030	20 Gbps @1,000	Translates to 100 Gbps for a campus of 5,000. Actual size for any campus to be based on the TENET approach: *"sufficient bandwidth to be able to use the prevailing applications of the day"* with port sizes twice the normal usage.

Source: KCL

6.3.1   Estimating Bandwidth Requirements and Unit Cost

Figure 9 shows two ways to determine the Unit Price (USD/Mbps/month). The unit price of bandwidth varies widely depending on the distance from fibre network, local access and transit costs, the maturity of NREN, national ICT situation and regulatory score. The Local Price comprises the cheapest cost of IP transit and the cheapest cost of local access to deliver the bandwidth in a metro area within Burkina Faso. IP transit is calculated based on 10 GigE volume or more from the cheapest provider in the country. Local metro access costs to deliver bandwidth to HEIs are calculated based on Gigabit Ethernet (GigE) circuits where available and smaller circuits in locations without big capacities, assuming that higher

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53   *See parallel Report under the same study: "A Connectivity Gap Analysis and a Review of Existing Programs"*

education institutions are located at most 15 km from a provider's PoP in a metro/urban area.
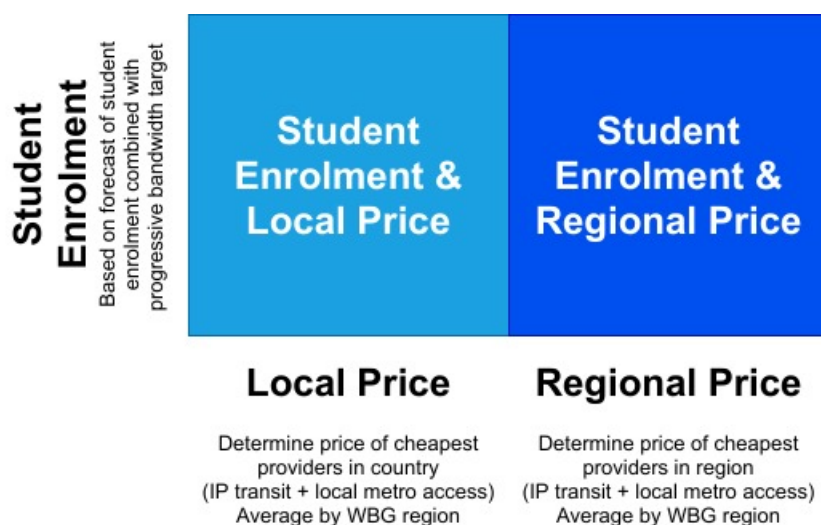
Figure 9: Matrix for determining bandwidth cost

The **Local Price (USD 52.2)** is derived by adding the respective values for IP transit and local access to deliver the bandwidth in a metro area for the cheapest provider in Burkina Faso. The **Regional Price (USD 4.3)** is derived by adding the respective values for IP transit and local access to deliver the bandwidth in a metro area for the cheapest provider in West Africa. Regional procurement approaches are useful because the large volumes attract bigger players who bring in regional pressures on pricing.

Based on this, Table 13 shows the projected bandwidth requirements for Burkina Faso higher education institutions, giving a total of 628 Gbps by 2025 and 7.6 Tbps by 2030.

6.3.2　Aggregation Savings

The Aggregation Savings calculated from Burkina Faso's NREN maturity (see section 5.1), and its performance on various national ICT indicators (see section 4.1.4) pertinent to connectivity is 39%. This reflects the cost savings that higher education institutions are expected to gain by aggregating their bandwidth demand, using smart procurement strategies (e.g., benchmarking regional pricing) and procuring long-term leases.

6.3.3　Cost of Connecting Campuses Upstream

Table 12: Projected bandwidth and cost using Student Enrolment and Local Price (2021, 2025 & 2030)

Year	Student enrolment	Projected bandwidth (Gbps)	Projected cost (USD millions) no aggregation Savings	Projected cost (USD millions) with aggregation Savings
2021	160,353	160	100	61
2025	221,154	442	139	84

2030	297,156	5,943	465	284

Source: KCL calculations

Table 13: Projected bandwidth and cost using Student Enrolment and Regional Price (2021, 2025 & 2030)

Year	Student enrolment	Projected bandwidth (Gbps)	Projected cost (USD millions) no aggregation Savings	Projected cost (USD millions) with aggregation Savings
2021	160,353	160	8	5
2025	221,154	442	11	7
2030	297,156	5,943	38	23

Source: KCL calculations

6.4 Support to FasoREN

Discussions with NREN officials in Africa indicate that they spend about 60% of their OpEx on connectivity-related expenses and the remaining 40% on human resources and related costs. Connectivity-related expenditure covers the cost of bandwidth procurement, network operations, including distribution of bandwidth and maintenance for the network infrastructure.

Given that member institutions cover connectivity-related expenses through bandwidth payments, NRENs often struggle to cover costs related to ongoing capacity building for internal staff and especially member institutions where the value of connectivity is realised. Shortage of funding also means NRENs fail to retain competent staff who are attracted by the much higher pay within the ICT private sector: this is mainly a challenge in the development and growth stage of five to ten years. It is essential to provide for such support to reap the resulting value of the NREN to the delivery of broadband.

Based on the experience of the NRENs that have now reached maturiry, FasoREN needs a support budget of USD 2 million per year. About 40% (USD 800,000) would be spent on human resources and NREN development development-related costs and 60% (USD 1,200,000) on NREN development-related costs. This gives a requirement of USD 10 million over five years.

6.5 Cost of Connecting HEIs in Burkina Faso

Table 14 summarises the cost elements for different components that make up the total cost of connecting all higher education institutions in Burkina Faso for a period of five years (2021-2025), including the cost of equipping students and staff with access devices and designing and upgrading campus networks. The overall cost is based on aggregation savings that in turn assume an up-front investment in IRUs.

Table 14: Summary of total 5-year cost of connecting all Burkina Faso higher education institutions to high-speed Internet

Category	Cost (USD, millions)	Potential Sources of Funding
End-user devices		
Students and Staff	67	Government, development partners, students, institutions
Sub Total	**67**	
Upgrading campus networks		
Capex	148	Government, development partners
Opex	194	Institutions, government, development partners
Sub Total	**343**	
5-year cost of connecting campuses upstream		
	With Aggregation Savings	
Using Student Enrolment & Regional Price	**35**	Development partners, institutions, students
NREN development and support costs		
FasoREN core costs and NREN development related costs	**10**	Development partners, government
Total Cost Estimate (USD, millions)	**455**	**Using cost of connecting campuses upstream based on student enrolment and regional price**

Source: KCL calculations

7. Summary and Conclusion

This Case Study explores the connectivity challenge from an education-sector perspective (demand-side) as well as from the information and communications technology (ICT)-sector perspective (supply-side). This Chapter presents a summary of the key findings and recommendations.

i.   The Government of Burkina Faso has made considerable progress in reforming the communication sector, developing digital strategies and broadband plans that paved the way for improving high-speed connectivity to higher education institutions. Despite the progress, broadband prices remain very high, and broadband access is still restricted to Bobo-Dioulasso and Ouagadougou's urban centres.

ii. The connectivity target is to achieve at least 2 Gbps per 1000 students by 2025 (to be provided for in the World Bank planning period ending 2023) and at least 20 Gbps per 1,000 students by 2030. Given a forecast enrolment of 221,000 higher education students in 2025, higher education institutions in Burkina Faso will need at least 442 Gbps to serve higher education institutions' bandwidth requirements across the country. This will rise to 297,000 students and 6 Tbps in 2030.

iii. Burkina Faso currently has 18 accredited universities (10 public and 8 private) and 75 Grandes Écoles (23 public and 52 private). With a forecast of 145,000 students, enrolment in higher education is biased towards public universities, with Joseph Ki-Zerbo University accounting for about 50% of total student enrolment.

   a) Based on a recent survey, Joseph Ki-Zerbo University, with about 70,000 students, offers only 34 Mbps to its users. Only the academic and administrative staff at the University currently use the provided connectivity. Students have to buy their own connectivity from commercial providers with coverage around the campus.

   b) Based on the forecast of student enrolment and population in the age category 20-24, Burkina's Gross Enrolment Ratio for higher education is estimated to reach 9.8% in 2025 and 11.2% in 2030. While this will eclipse the estimated sub-Saharan Africa average of 9.1% in 2018, it is still far below the world average of 38.7 % at the time.

   c) Burkina Faso faces many challenges in expanding access to higher education, including insufficient investment to cope with a rapid increase in students' number, resulting in inadequate infrastructure and learning resources, poor quality teachers, high student-teacher ratios, outdated curricula, and teaching methodology, high failure rates and repetition, particularly in the first years of university education, low relevance of programs in relation to employment outcomes and student strikes reducing lecture time and learning. Besides, the schooling of students in areas with security challenges does not help.

iv. From an education sector perspective, some of the challenges that inhibit the use of ICTs in higher education and better connectivity include:

a) Students are not allowed to access the limited connectivity available at higher education institutions. Even in the capital city, none of the universities interviewed offers Internet access to their students in Burkina. The limited connectivity is made available primarily to administrative staff and sometimes for academic staff and researchers.

b) Lack of ICT infrastructure in higher education institutions (electricity, computers, multimedia rooms, networks), particularly in rural areas, compounded by lack of ICT procurement strategy and specialists.

c) The nascent national research and education network, FasoREN, cannot provide any services yet. Each university/institution still buys their Internet capacity directly from the ISPs, mainly Onatel, the incumbent operator.

d) The cost for Internet bandwidth is high and thus prohibitive. On Onatel's website, the cost of 2 Mbps per month is 2 million XOF (about USD 1,800), while the cost of 20 Mbps per month is USD 10,000.

e) Poor digital literacy among teachers because current teacher training and in-service training programs do not provide ICT training.

f) Lack of competent ICT human resources.

v. In line with the regional frameworks of ECOWAS and UEMOA, Burkina Faso has liberalised its telecommunication market and has an independent regulator—ARECEP. Despite this, the market is a duopoly between Onatel, the incumbent operator and Orange. Despite progress in reforming the communication sector, broadband prices remain very high, and broadband access is still restricted to the major urban centres of Bobo-Dioulasso and Ouagadougou.

a) Data from ARCEP indicates that the country had a total International Internet Bandwidth capacity of 40 Gbps in 2019, of which Onatel provided 51.3% and Orange delivered 41%.

b) The country has invested in creating Burkina Faso Internet Exchange Point (BFIX) in Ouagadougou and Bobo-Dioulasso under the West Africa Regional Communications Program—WARCIP APL-1B (P122402) to provide a mechanism for local Internet traffic aggregation and exchange, helping to improve network latency and traffic speeds.

c) Burkina Faso does not currently have a carrier-neutral data centre.

d) Burkina Faso moved up eleven positions from 107 to 96 out of 132 countries in the 2018 ITU Global Cybersecurity Index (GCI). The improvement is on account of instituting better cybersecurity legal measures (putting in adequate regulation),

improved technical measures (like setting up the national Burkina Faso Cybersecurity Center (CIRT BF) and sectoral CERTs) as well as enhanced organisational and capacity-building measures.

vi. From an ICT sector perspective, some of the challenges that inhibit the use of ICTs in higher education and better connectivity include:

a) Inadequate development and deployment of ICT infrastructure to cover the whole country, particularly rural under/unserved areas

b) The high tax burden on ICT services, e.g., VAT, communications tax, tax on mobile money transfers, tax on provider revenues, etc. Providers pass on these taxes to customers in the form of high prices

c) High wholesale and retail price for broadband services

d) Inadequate numbers of qualified human resources to support ICT networks and applications.

vii. Building on their experiences of creating an association called the National Network for Education and Research (RENER) in 1998, higher education institutions have now formed FasoREN, Burkina's nascent national research and education network, to aggregate their connectivity demand and ICT network infrastructure needs.

a) FasoREN can also play a critical role in building the technical capacity to improve the design of campus networks and the deployment of advanced services to foster collaboration between higher education institutions within Burkina Faso and beyond.

b) FasoREN is a member of the West and Central African Research and Education Network (WACREN), promoting collaboration between national, regional, and international research and education communities.

c) FasoREN is also a beneficiary of the AfricaConnect 2 project and is acquiring 1 STM (155 Mbps) International Internet capacity to the Joseph Ki-Zerbo University (Former University of Ouagadougou). While this will be an upgrade from the current 34 Mbps at the University, it is inadequate given the institution's bandwidth needs to support teaching, learning, and research. Therefore, the government needs to support the development of FasoREN as a platform for connecting its higher education institutions.

d) World Bank-funded WARCIP—not under Education Access and Quality Improvement Project (EAQIP)—FasoREN is currently working on a business plan to develop a fully functioning NREN that can deliver applications, services and high-speed connectivity to higher education institutions across the country.

The COVID-19 pandemic has shown that higher education needs to shift from traditional learning to blended and online learning models. While the country has made considerable

progress in reforming the communication sector and developing national broadband strategies to improve high-speed connectivity, there is a need to invest more resources to improve digital technology integration in teaching, learning, and research. This will require upgrading the campus networks, improving access to devices for students and staff and availing more bandwidth to higher education institutions.

The government and other stakeholders need to support FasoREN to become a more viable NREN that can access large volumes of bandwidth via the Virtual Landing Points (VLPs) and distribute this to members leveraging existing fibre networks. There is a need to strengthen the digital ecosystem to attract investment in carrier-neutral data centres and to integrate these with the Burkina Faso Internet Exchange Point (BFIX). The study offers easily configurable tools to estimate the capital and operational costs to achieve the targeted objectives. Actors at different levels need to appropriate the model and define the necessary financing mechanism to meet the challenge.

Appendix A: Figures and Tables
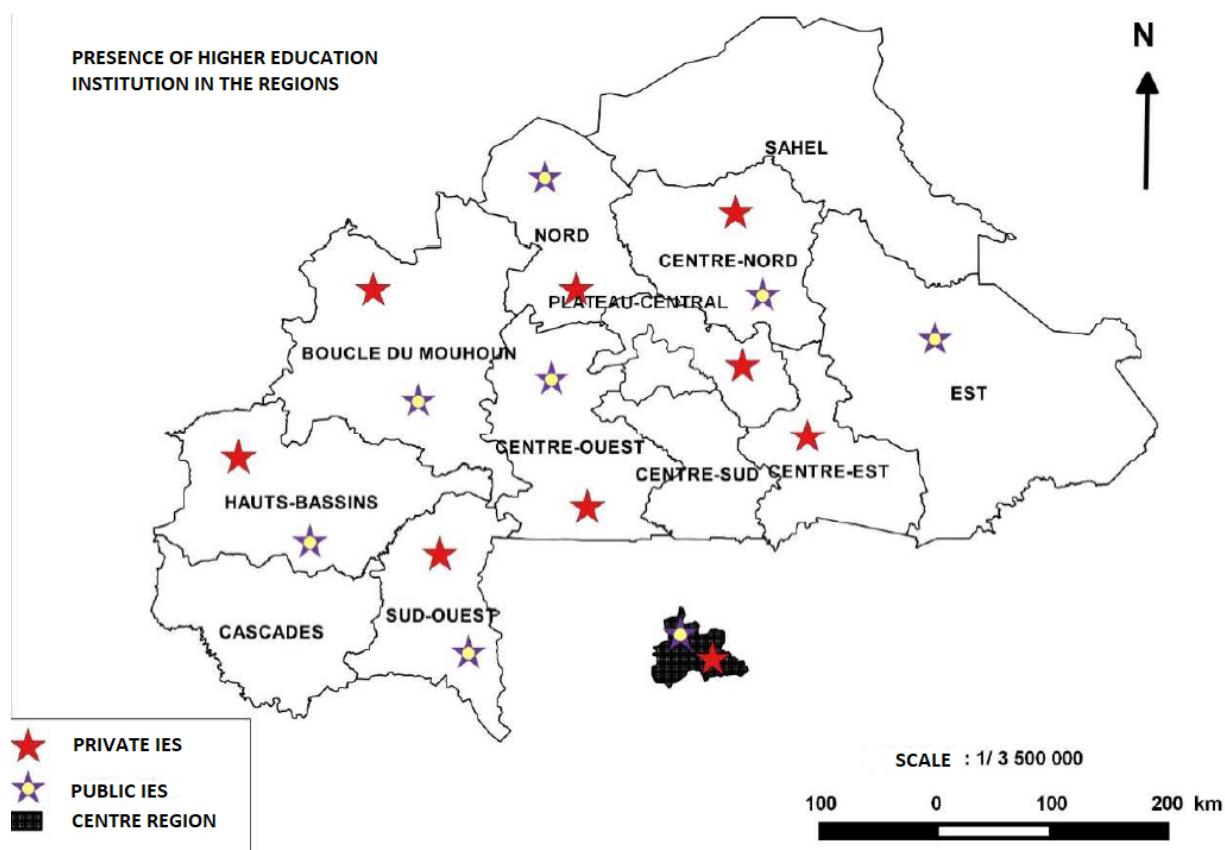
Figure 10: Presence of the Higher Education Institutions in the Regions

Source: MESRSI Statistical Directory 2017/2018
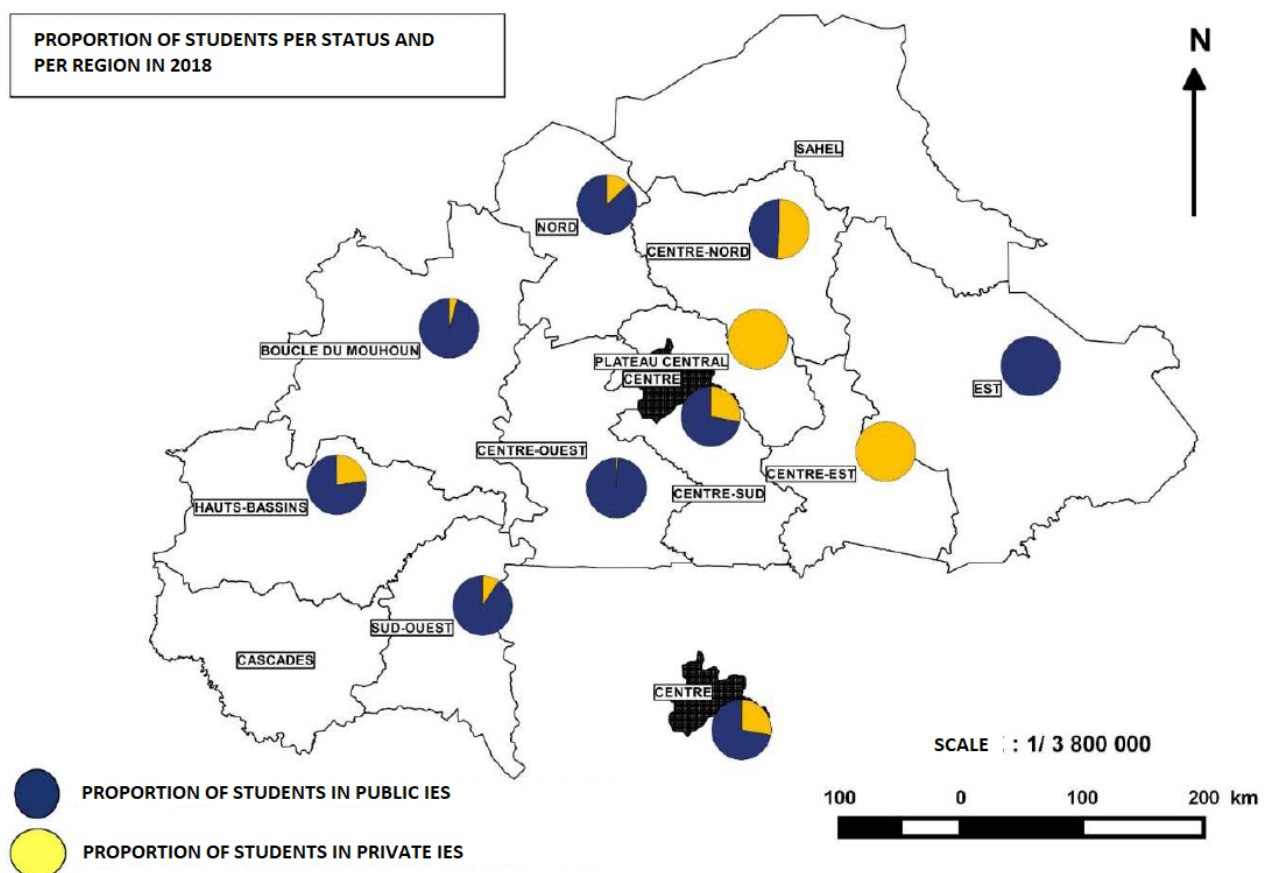
Figure 11: Proportion of Students per Status and per Region

Source: MESRSI Statistical Directory 2017/2018

Table 15: List of recognised HEIs

Institution	Abbreviation	Region	Location	Status
Institut Superieur Polytechnique Saint Augustin de Dedougou		Boucle Du Mouhoun	Dedougou	Private
Universite de Dedougou	UDDG	Boucle Du Mouhoun	Dedougou	Public
Africa Private Institute of Science and Technology	API-ST	Centre	Ouagadougou	Private
Association Internationale Ipd		Centre	Ouagadougou	Private
Institut du Developpement Equitable	IDE	Centre	Ouagadougou	Private
Centre de Recherche Panafricain en Management Pour le Developpement	CERPAMAD	Centre	Ouagadougou	Private
Centre Universitaire Polyvalent Du Burkina		Centre	Ouagadougou	Private
Ecole d'architecture et de Genie Civil de Ouagadougou	ECAGCO	Centre	Ouagadougou	Private
Ecole Superieur de Management et de Technologie Appliquee	ESMAT	Centre	Ouagadougou	Private
Ecole Superieure Africaine la Flamme de L'espoir	ESAFE	Centre	Ouagadougou	Private
Ecole Superieure de Commerce de Ouagadougou		Centre	Ouagadougou	Private
Ecole Superieure de Commerce et d'informatique de Gestion	ESCOIGES	Centre	Ouagadougou	Private
Ecole Superieure de Microfinance	ESM	Centre	Ouagadougou	Private
Ecole Superieure de Tourisme et d'Hotellerie		Centre	Ouagadougou	Private
Ecole Superieure des Techniques Avancees	ESTA	Centre	Ouagadougou	Private
Ecole Superieure des Travaux Publics de Ouaga		Centre	Ouagadougou	Private
Ecole Superieure Du Genie Rural et de l'Environnement	ESGRE	Centre	Ouagadougou	Private
Ecole Supérieure Internationale de Management	ESIM	Centre	Ouagadougou	Private
Ecole Superieure Polytechnique de la Jeunesse		Centre	Ouagadougou	Private

Ecole Superieure Polytechnique Excelle		Centre	Ouagadougou	Private
Groupe Bk-Universite		Centre	Ouagadougou	Private
Hautes Etudes Commerciales et de Developpement		Centre	Ouagadougou	Private
Institut Polytechnique Prive Shalom		Centre	Ouagadougou	Private
Institut Africain de Management	IAM	Centre	Ouagadougou	Private
Institut Africain de Sante Publique		Centre	Ouagadougou	Private
Institut Africain des Industries Culturelles	IAIC	Centre	Ouagadougou	Private
Institut Cerco Burkina		Centre	Ouagadougou	Private
Institut d'application et de Vulgarisation des Sciences	IAVS	Centre	Ouagadougou	Private
Institut de Formation et de Recherche Interdisciplinaires En		Centre	Ouagadougou	Private
Sciences de la Sante et de L'education		Centre	Ouagadougou	Private
Institut de Formation Colbert		Centre	Ouagadougou	Private
Institut de Gestion des Risques Miniers et Du Developpement	INGRID	Centre	Ouagadougou	Private
Institut de L'economie Internationale		Centre	Ouagadougou	Private
Institut des Sciences		Centre	Ouagadougou	Public
Institut des Sciences de L'entreprise et de Management	INSEM	Centre	Ouagadougou	Private
Institut des Sciences et Techniques de l'Information Documentaire	ISTID	Centre	Ouagadougou	Private
Institut des Sciences Pour l'Entreprise et la Gestion	ISEG	Centre	Ouagadougou	Private
Institut des Sciences Techniques et du Management	ISTM	Centre	Ouagadougou	Private
Institut des Technologies Modernes du Developpement	ITMD	Centre	Ouagadougou	Private
Institut Superieur Afrique Talents		Centre	Ouagadougou	Private
Institut Superieur d'application des Geosciences		Centre	Ouagadougou	Private

Institut Superieur de Developpement d'Entreprises	ISDE	Centre	Ouagadougou	Private
Institut Superieur de Droit International et des Droits de l'Homme	ISDIH	Centre	Ouagadougou	Private
Institut Superieur de Management d'innovation et de Communication		Centre	Ouagadougou	Private
Institut Superieur de Management et de Technologie		Centre	Ouagadougou	Private
Institut Supérieur de Management et d'entreprenariat		Centre	Ouagadougou	Private
Institut Superieur de Technologie et de Gestion	ISTG	Centre	Ouagadougou	Private
Institut Superieur des Sciences et Technologie Agricole	ISSTA	Centre	Ouagadougou	Private
Institut Superieur d'Etudes Spatiales et Telecommunications	ISESTEL	Centre	Ouagadougou	Private
Institut Supérieur d'innovation en Gestion et Management	IS/IGEMA	Centre	Ouagadougou	Private
Institut Superieur la Plume		Centre	Ouagadougou	Private
Institut Supérieur Polytechnique les Elites		Centre	Ouagadougou	Private
Institut Superieur Prive de Management	ISPM	Centre	Ouagadougou	Private
Institut Superieur Prive de Philosophie		Centre	Ouagadougou	Private
Institut Superieur Prive de Technologie		Centre	Ouagadougou	Private
Institut Superieur Prive des Sciences		Centre	Ouagadougou	Private
Institut Superieur Prive Polytechnique		Centre	Ouagadougou	Private
Institut Superieur de Technologies Appliquees et de Management	ISTAPEM	Centre	Ouagadougou	Private
Institut Superieuur Africain des Techniques de Gestion	ISATEG	Centre	Ouagadougou	Private
Institut Teng Tuuma Geosciences de Ouagadougou		Centre	Ouagadougou	Private
International School of Aviation		Centre	Ouagadougou	Private
Institut Superieur Al Houda		Centre	Ouagadougou	Private
Online Training Center	OTC	Centre	Ouagadougou	Private

School of Management		Centre	Ouagadougou	Private
Sup'Management-Maroc		Centre	Ouagadougou	Private
Universite Aube Nouvelle	EX ISIG	Centre	Ouagadougou	Private
Universite Libre du Burkina	ULB	Centre	Ouagadougou	Private
Universite Ouagadougou III		Centre	Ouagadougou	Private
Universite Joseph Ki-Zerbo		Centre	Ouagadougou	Public
Universite Ouagadougou II		Centre	Ouagadougou	Public
Universite Privee de Ouagadougou	UPO	Centre	Ouagadougou	Private
Universite Saint Thomas d'Aquin	USTA	Centre	Ouagadougou	Private
Apidon Academy of Science	2AS	Centre	Ouagadougou	Private
Ecole Superieure Privee en Direct		Centre	Ouagadougou	Private
Fondation 2IE		Centre	Ouagadougou	Private
Institut Superieur de Genie Electrique-Bf		Centre	Ouagadougou	Private
LQT Consulting Dakar		Centre	Ouagadougou	Private
Sup Talent Business School		Centre	Ouagadougou	Private
Universite Chretienne Logos de Ouagadou		Centre	Ouagadougou	Private
Universite Evangelique du Kadiogo	UEK	Centre	Kadiogo	Private
Institut Superieur Monseigneur Dieudonne Yougbare		Centre-Est	Koupela	Private
Ecole Superieure Polytechnique de Kaya	UCAO-UUB-BOBO	Centre-Nord	Kaya	Private
Centre Universitaire Polytechnique de Kaya		Centre-Nord	Kaya	Public
Institut Prive d'Enseignement Superieur de Koudougou	I.P.E.S_K	Centre-Ouest	Koudougou	Private
Institut Superieur de Management de Koudougou	ISMK	Centre-Ouest	Koudougou	Private

Universite Norbert Zongo	EX UK	Centre-Ouest	Koudougou	Public
Institut des Sciences et de l'Ingenierie		Est	Fada N'gourma	Private
Universite de Fada N'gourma		Est	Fada	Public
Institut Al Fourquan		Hauts-Bassins	Bobo Dioulasso	Private
Ecole Superieure des Metiers Ferroviaires	ESMF	Hauts-Bassins	Bobo Dioulasso	Private
Institut Africain de Management	IAM	Hauts-Bassins	Bobo Dioulasso	Private
Institut des Hautes Etudes Cheik Modibo Diarra	IHE-CMB	Hauts-Bassins	Bobo Dioulasso	Private
Institut des Sciences et Techniques		Hauts-Bassins	Bobo Dioulasso	Private
Institut Polytechnique Africain		Hauts-Bassins	Bobo Dioulasso	Private
Institut Superieur des Sciences Appliquees et Technologies		Hauts-Bassins	Bobo Dioulasso	Private
Universite Aube Nouvelle	EX ISIG	Hauts-Bassins	Bobo Dioulasso	Private
Universite Nazi Boni	EX UPB	Hauts-Bassins	Bobo Dioulasso	Public
Institut Sciences Campus	ISC BOBO	Hauts-Bassins	Bobo Dioulasso	Private
Institut Superieur des Filieres Professionnalisantes		Hauts-Bassins	Bobo Dioulasso	Private
Universite Catholique de l'Afrique de l'Ouest	UCAO-UUB-BOBO	Hauts-Bassins	Bobo Dioulqsso	Private
Institut Superieur de Gestion de Ouahigouya		Nord	Ouahigouya	Private
Universite de Ouahigouya		Nord	Ouahigouya	Public
Universite du Faso		Plateau Central	Ziniare	Private
Centre Universitaire Polytechnique de Gaoua		Sud-Ouest	Gaoua	Public
Institut Superieur de Management et des Techniques Appliquees de Dano		Sud-Ouest	Dano	Private

Appendix B: Profile of Joseph Ki-Zerbo University

Joseph Ki-Zerbo University (U-JKZ) is the largest public university in Burkina Faso. Originally the University of Ouagadougou, it was renamed in 2015 after Professor Joseph Ki-Zerbo.[54] With an enrolment of about 70,000 students across multiple campuses, U-JKZ accounts for about half the population of all students in higher education across the country.

The university offers diverse training programs in health science, life, and earth science, literature, arts and communication, computer science, management, human sciences, exact and applied sciences, sports science, etc. It is organised into:

i.   5 training and research units (UFR)
ii. 6 institutes and,
iii. 2 university centres (2 CU).

All areas of teaching are also the subject of research, and the University currently has 4 doctoral schools and attached research laboratories.

ICT Policies and Strategy

The Vice President leads the university ICT department in charge of Teachings and Educational Innovation (DEIP). The ICT services department, which reports to the Vice president, is supervised by a Chief Information Officer (CIO). A team of 8 staff members, 2 engineers, and 6 technicians is divided into networks and Applications/Database services. Only one developer is composing the Applications/Database team.

The ICT team interventions are limited to the administration and the teachers/researchers for the moment. The students don't have access to Internet. Recent projects have led to important investment to implement a Student Registration and Admission Management System called OKAPI.

Student Enrolment and Staff Numbers

In the school year 2019/2020, the official enrolment is as follows: 50290 students, 1160 academic staff, of whom 609 have a permanent position. There are currently 527 administrative staff. All interviewed people agreed that the actual number of people using the University should be close to 70,000. With the pace of growth, this figure will grow to 125,000 in 2025 and will more than triple in 2030.

Source: Google Maps, 2020

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54   *https://en.wikipedia.org/wiki/Joseph_Ki-Zerbo*
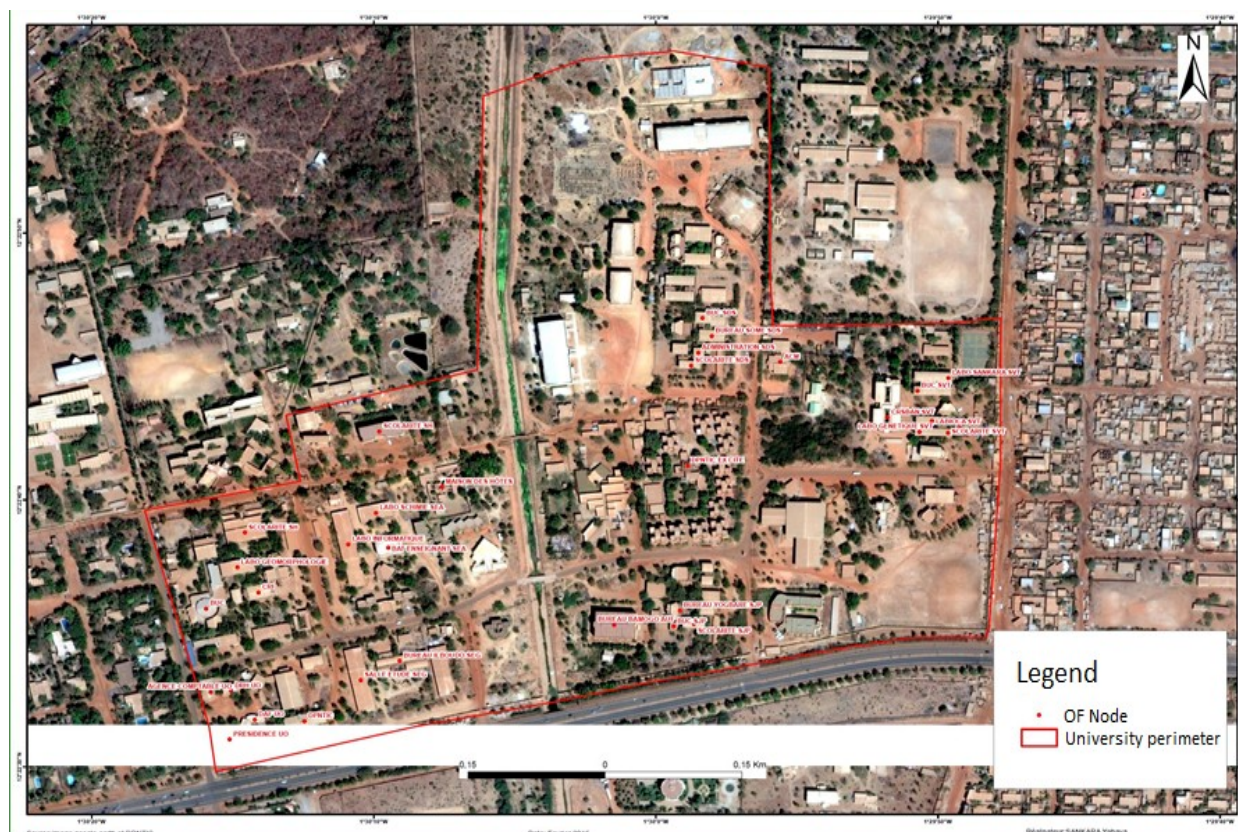
Figure 12: Satellite map of showing fibre nodes on main campus

Access to, and Cost of Connectivity

Despite the presence of multiple optical fibre nodes on the main campus (See Figure 12), the campus has a combined access to 34 Mbps of bandwidth connectivity. Of this total, 32 Mbps is delivered over fibre, while 2 Mbps is delivered over ADSL. For this amount of bandwidth, the University's Internet Service Provider charges 2 million XOF (about USD 1,800) per month for 2 Mbps connections and USD 10,000 for a 20 Mbps connection.

Only administrative and academic staff have access to the Internet (and in that order of priority). Students that need Internet access have to buy commercially available Internet over Wi-Fi and mobile networks provided by commercial service providers such as Onatel and Virtual Technologies and Solutions (VTS),[55] with its Kolibri Express Wi-Fi.

According to Internet users, many challenges hinder good connectivity at the main campus. Besides the poor and inadequate amount of bandwidth, unstable electricity that shuts down the network, the high cost of bandwidth that results in payment challenges, and the lack of adequate technical capacity to manage the campus network are some other challenges.

ICT Infrastructure

The campus network is connected to Onatel, the incumbent operator, via both fiber and ADSL. A new STM-1 fibre connection to WACREN that will boost capacity by an additional 155

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55   *https://www.vts.bf/services/internet-services*

Mbps has also been completed, but is not yet functional yet.

The campus is well meshed by Optical fibres with these links that need maintenance. The ICT infrastructure investments were 48 million CFA Francs in 2017 and 108 million CFA Francs in 2019.

The University has invested over 150 million XOF last year in infrastructure maintenance and in connecting the administration's building, on the verge of implementing the registration management platform, OKAPI. The long-term plan is to move all university registration to Campus Faso, an online platform.

1143 Laptops/Desktops are registered on the network managed by the ICT services. Offered services are messaging and access to Internet.

Maintenance is performed internally by the ICT team or externally, with associated contracts) and annual costs. The annual maintenance cost is estimated at three (3) million CFA francs. The ICT service spent thirty (30) million in 2019 and budgeted one hundred (100) million for 2020. This amount has been reduced to nine million five hundred thousand CFA francs, following COVID-19.

As the master plan is being drawn up. A network audit was recently performed by SANCFIS firm. The plan is also to build FasoRen NOC, which will serve as the new UJKZ Datacenter at the same time. The audit report is not available in November 2020.

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